123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
Air Compressor	Typical Drawing	10/06/08	1	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Air Compressor
260000	Elec-Mech Equip	09/10/13	D	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
261050	MV Motors	09/10/13	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
261200	GSU Transformer	09/10/13	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
262050	LV Motors	09/10/13	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
409413.22	CEMS	09/10/13	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
480020	Site Conditions	09/10/13	I	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
480031	Noise Control Perf	09/10/13	I	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
480032	Power Island Perf	09/10/13	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
481100	Combined Cycle PIE	09/10/13	N	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485122.11	Steam Bypass Valves	09/10/13	E	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485221	ST and TEWAC Generator	09/10/13	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485222	GTG Aeroderivative	09/10/13	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485311.10	Condensate Pumps	09/10/13	F	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485311.20	Boiler Feedwater Pumps	09/10/13	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485312	Circ Water & Aux Cooling Water Pumps	09/10/13	F	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485374.21	Compressed Air System	09/10/13	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485374.22	Fuel Gas Compressor	09/10/13	E	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485413	OTSG Spec	09/10/13	I	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485432	Surface Condenser	09/10/13	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485471	Inlet Air Chiller	09/10/13	E	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485491	Cooling Tower	09/10/13	F	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
485952	Condensate Polisher	09/10/13	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Att 24 Specs
ElectricBoiler brochure	ElectricBoiler brochure	-	11/10	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Aux Boiler Specs
ElectricBoiler Specifications	ElectricBoiler Specifications	-	11/10	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Aux Boiler Specs
ElectricBoilers Boiler Book	ElectricBoilers Boiler Book	-	11/10	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Aux Boiler Specs
CEMS	CEMS Sytem Overview (Typical layout with optional equipment)	-	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\CEMS
PASADENA CHILLER GA	Chiller Module General Arrangment	09/12/12	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Chiller
969031	One Line Diagram	-	F	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Electrical Drawings

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
Attachment 4	Attachment 4 Scheduled Major Component RTS and Delivery Dates_GE_13Dec4	-	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Equip Delivery Sched
Gas Compressor1	Machinery Arrangmenet Feed Gas Compressor System	11/20/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Gas Compressor
Att 10.1 MID-TD-0000-1	Fuel Gases for Combustion in Aeroderivative Gas Turbines Sept 2009	9/2009	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GE MID TD Specs
Att 10.2 MID-TD-0000-3	Water and Steam Purity for Injection in Aero Derivative Gas Turbines June 2010	6/2010	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GE MID TD Specs
Att 10.3 MID-TD-0000-4	Compressor Cleaning for GE Aircraft Derivative Gas Turbines June 2010	6/2010	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GE MID TD Specs
Att 10.4 MID-TD-0000-5.	Liquid Detergent for GE Aircraft Aero Derivative Gas Turbines June 2010	6/2010	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GE MID TD Specs
Att 10.5 MID-TD-0000-6	Lubricating Oil Specification for GE Aircraft Aero Derivative Gas Turbines June 2010	6/2010	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GE MID TD Specs
7253049-969014	Plan & Elevation Turbine Control Panel	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969741	Instrument Loop Diagram Hydraulic Start System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969742	Instrument Loop Diagram Ventilation & Combustion Air System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969743	Instrument Loop Diagram Mineral Lube Oil System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969744	Instrument Loop Diagram Turbine Lube Oil System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969746	Instrument Loop Diagram Fire & Gas Protection System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969750	Instrument Loop Diagram Nox Water Injections System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969751	Instrument Loop Diagram Fuel System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969753	Instrument Loop Diagram Water Wash System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969755	Instrument Loop Diagram Auxiliary Systems	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969758	Instrument Loop Diagram Sprint System	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
Pasadena CKOM -GTG Controls	LM6000 GE Aeroderivative Package	11/19/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Controls
7253049-969005	Electrical Symbols Abbreviations and Reference Data	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969006	Interconnect Plan Electrical	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969007	Interconnect Wiring Diagram Customer	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969009	Interconnect Cable Schedule	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969021	Plan & Elevation Generator Lineside Cubicle Cable Entry Top/Bottom	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969023	Plan & Elevation Generator Neutral Cubicle	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969031	One Line Diagram	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969032	Three Line Diagram Generator Metering	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969035	Schedule Motor Control Center	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969037	System Schemiatic Generator Excitation	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969041	Schematic Diagram Cicuit Breaker Control	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
7253049-969044	Schematic Dioagram Motor Control Centers	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969690	Area Classification Drawing Main Unit	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969767	Schematic Diagram DC Power Distribution	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969768	Schematic Diagram Critical Shutdown Path	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969769	Schematic Diagram Miscellaneous	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969930	Schematic Diagram Lighting & Distribution	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
7253049-969934	Schematic Diagram Communication	10/09/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
Brush_GTG_Curves	Electrical Data Sheet	10/23/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Electrical
969224	Installation Footprint Anchor Bolt and Shear Lug Location	-	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
120E4746	General Arrangement	10/18/12	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969201	General Arrangement Main Unit - LH	11/12/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969204	General Arrangement Air Filter	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969219	General Arrangement Auxiliary Skid Left Hand	11/11/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969221	General Arrangement Generator / Gearbox Mineral Lube Oil Skid	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969224	Installation Footprint Anchor Bolt and Shear Lug Location	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969293	Piping Penetrations Option LH	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
CD19671	Air Filter GE-AEP_GSX LM6000 with Chiller Coil	02/10/12	0	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
ElectricBoiler Dimensions and ratings	ElectricBoiler Dimensions and ratings	-	11-10	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
GA 69200	GA 9 Main Unit - RH	-	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
GA 969209	GA Sprint Skid	-	D	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
GA 969218	GA Auxiliary Skid Right Hand	-	H	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
GA 969221	GA Generator_Gearbox Mineral Lube Oil Skid	-	F	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
GA A0 321638800	GA Generator	07/17/12	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
Sample 00	ElectricBoiler sample drawing S-302-700kW @ 480V	06/08/10	00	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
SK-01	GE_STG_Sk1 - PWP Comments	11/15/12	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Arrangement Drawings
7253049-969232	Flow & Instrument Diagram Hydraulic Start System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969239	Flow & Instrument Diagram Ventilation & Combustion Air System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969244	Flow & Instrument Diagram Turbine Lube Oil System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969247	Flow & Instrument Diagram Turbine Hydraulic System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969248	Flow & Instrument Diagram Mineral Lube Oil System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
7253049-969254	Flow & Instrument Diagram Fire & Gas Protection System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969260	Flow & Instrument Diagram Fuel System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969262	Flow & Instrument Diagram Water Wash System	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969268	Flow & Instrument Diagram Sprint System Main Unit	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969269	Flow & Instrument Diagram Water Injection Pump	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969270	Flow & Instrument Diagram Sprint System Sprint Skid	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969272	Flow & Instrument Diagram Auxiliary Systems	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
Inlet Air Chilling_Heating Conceptual Design_R3 add pre-cooler	Inlet Air Chilling_Heating Conceptual Design_R3 add pre-cooler	10/08/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M005_(RG)_120E4746_SEP-12-2013	General Arrangement	09/12/13	G	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M101_(RB)_230F5536_AUG-23-2013	Flow Diagram Steam System	08/23/13	B	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M105 230F5512	Feedwater System	11/07/12	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M106 203D7522 sheet 2	Condenser Terminal Points On Waterboxes	08/23/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M106_(RA)_203D7522_AUG-23-2013	Condenser Terminal Points	08/23/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M107_(RB)_120E4791_AUG-23-2013	Flow Diagram Circulating Water	08/23/13	B	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M109 230F5537	Auxiliary Cooling Water System	01/28/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M112_(RA)_230F5538_AUG-23-2013	Steam Drains System	08/23/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M119 120E4734 Sheet 2	Flow Diagram Steam Turbine	08/23/13	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M119_(RC)_120E4734_AUG-23-2013	Flow Diagram Steam Turbine	08/23/13	C	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M125_(RA)_230F5539_AUG-23-2013	Condenser Air Removal System	08/23/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M190_(RD)_230F5504_AUG-23-2013	Combined Cycle system Overview Diagram	08/23/13	D	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M195 230F5496 sheet 2	Ammonia Dilution Heating Flow Diagram	02/07/13	B	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
M195_(RD)_230F5496_AUG-23-2013	Flow Diagram OSTG-1 Pressure	08/23/13	D	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\F&IDs and Flow Diagrams
7253049-969225	Lift Arrangement	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Lift and Shipping Info
7253049-969226	Shipping Data	10/16/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Lift and Shipping Info
PWP_Estimated Heaviest Lifts_Equipment Weights	PWP_Estimated Heaviest Lifts_Equipment Weights	-	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical\Lift and Shipping Info

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
7253049-000231	Flow & Equipment Symbols Mechanical	10/31/13	A	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Mechanical
Chart Only SNM Start up	Chart Only SNM Start up	04/02/12	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Performance Data
Pasadena CKOM - GT Inlet Air Conditioning	Turbine inlet Air Temperature Conditioning System	-	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\GTG\Performance Data
Attachment 12	Mechanical Completion Certificate	-	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Mechanical Completion
C12079-EI RevP	ONCE THROUGH STEAM GENERATOR ERECTION & INSTALLATION INSTRUCTIONS	09/13/13	0	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\OTSG
IST Start-Up Curve	OTSG Start-Up Curve	-	-	Attachment A3-Reference Information \A.3.A City-Supplied Power Island Equipment Info\OTSG
OTSG Erection Training - SCR-CO - Revised	OTSG INSTALLATION AND ERECTION TRAINING PRESENTATION	03/01/13	-	Attachment A3-Reference Information \A.3.A City-Supplied Power Island Equipment Info\OTSG
Pasadena CKOM - OTSG (IST)	Glenarm Repowering Project OTSG Design	11/15/13	-	Attachment A3-Reference Information \A.3.A City-Supplied Power Island Equipment Info\OTSG
Preliminary Glenarm OTSG General Arrangement	General Arrangement LM6000 PG OSTG	11/01/13	P	Attachment A3-Reference Information \A.3.A City-Supplied Power Island Equipment Info\OTSG
Typical OTSG Erection Drawings	Typical OTSG Erection Drawings	-	-	Attachment A3-Reference Information \A.3.A City-Supplied Power Island Equipment Info\OTSG
Attachment 6	Performance Guarantees	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Performance Data
Attachment 22	LM6000PG Degradation	02/01/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Performance Data
GE Guarantee Heat Balances	GE Guarantee Heat Balances	02/12/13	0	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Performance Data
Attachment 1.1	Scope of Supply GTG	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.2	Scope of Supply OTSG	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.3	Scope of Supply CEMS	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.4	Scope of Supply Mechanical and Fluid	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.5	Scope of Supply Terminal Points	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.7	Scope of Supply Engineering Design	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Attachment 1.8	Scope of Supply Commissioning and Startup	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Scope of Supply Documents
Pasadena CKOM - GE BOP Mechanical	Steam Turbine & Generator Overview	11/19/13	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\STG
STG Layout For Information Only	Steam Turbine Layout (For Information Only)	-	0	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\STG
STG_Generator Curves for Information Only	REACTIVE CAPABILITY CURVE, EFFICIENCY CURVES, SATURATION CURVES	-	0	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\STG
Attachment 23	Obligations of Site Representatives	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Technical Advisors
Attachment 5.1	Typical Site Test Measurement Procedures-Test Philosophy	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Testing Documents
Attachment 5.2	Typical Site Test Measurement Procedures-Standard Field Testing Procedure for Emission Compliance Based on US EPA, ISO and EN Methodology	10/2011	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Testing Documents

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
Attachment 5.3	Typical Site Test Measurement Procedures-SPECIFICATION FOR GAS TURBINE GENERATOR PERFORMANCE TEST MEASUREMENT (SGTGPTM) LM6000 PC / PG SAC, NATURAL GAS FUEL	-	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Testing Documents
Attachment 14.1	GTG Training Descriptions	-	2	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Training
Attachment 14.2	Training Program	2013	-	Attachment A3-Reference Information\A.3.A City-Supplied Power Island Equipment Info\Training
mitigation summary	Mitigation Summary	-	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\Air Permit
South Coast Facility Permit to Construct and Operate	South Coast Facility Permit to Construct and Operate	08/15/13	26	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\Air Permit
Title V Facility Significant Permit Revision	Title V Facility Significant Permit Revision	08/15/13	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\Air Permit
0 TOC	Environmental Impact Report-Table Of Contents	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
0 TOC_Revised	Environmental Impact Report-TOC Revised	3/2013	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
0 Executive Summary	Environmental Impact Report-Executive Summary	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
1.0 Introduction	Environmental Impact Report-Introduction	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
1.0 Introduction_Revised	Environmental Impact Report-Introduction_Revised	3/2013	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
2.0 Project Description	Environmental Impact Report-Project Description	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
2.0 Comments and Responses on DEIR_Revised	Environmental Impact Report-Comments and Responses on DEIR_Revised	3/2013	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
3.0 Environmental Setting	Environmental Impact Report-Environmental Setting	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
3.0 Corrections and Additions_Revised_Revised	Environmental Impact Report-Corrections and Additions_Revised_Revised	3/2013	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.0 Mitigation Monitoring and Reporting Program	Environmental Impact Report-Mitigation Monitoring and Reporting Program	3/2013	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.A Aesthetics	Environmental Impact Report-Aesthetics	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.B Air Quality	Environmental Impact Report-Air Quality	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.C Cultural Resources	Environmental Impact Report-Cultural Resources	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.D Greenhouse Gases	Environmental Impact Report-Greenhouse Gases	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.E Hazards	Environmental Impact Report-Hazards	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.F Land Use and Planning	Environmental Impact Report-Land Use and Planning	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.G Noise	Environmental Impact Report-Noise	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
4.H Water Supply	Environmental Impact Report-Water Supply	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
5.0 Alternatives	Environmental Impact Report-Alternatives	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
6.0 Other Environmental Considerations	Environmental Impact Report-Other Environmental Considerations	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
7.0 Persons and Organizations	Environmental Impact Report-Persons and Organizations	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
8.0 References	Environmental Impact Report-References	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix_Table_of_Contents	Environmental Impact Report-Appendix Table of Contents	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix A_Revised	Environmental Impact Report-Appendix Table of Contents_Revised	04/15/10	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-A_NOP-IS-Scoping Meeting Materials	Environmental Impact Report-NOP-IS-Scoping Meeting Materials	09/16/11	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-B_Air Quality Assessment Files	Environmental Impact Report-Air Quality Assessment Files	11/2012	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-C_Greenhouse Gas Impact Assessment	Environmental Impact Report-Greenhouse Gas Impact Assessment	06/15/12	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-D.1_Figures 1-13	Environmental Impact Report-Figures 1-13	-	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-D_Hazardous Materials	Environmental Impact Report-Hazardous Materials	07/29/11	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-E_Noise	Environmental Impact Report-Noise	01	12/2011	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
Appendix-F_Water Supply Documentation	Environmental Impact Report-Water Supply Documentation	05/23/12	2	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\EIR CEQA
GT 3&4 SWPPP (Draft)	GT 3&4 SWPPP (Draft)	01/31/03	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\SUSMP & SWPPP
PWP SUSMP	Stormwater Treatment Certification	02/03/03	-	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\SUSMP & SWPPP
Broadway Wastewater Permit Rev B	Broadway Wastewater Permit Rev B	07/31/12	B	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\Waste Water
Glenarm Wastewater Permit Rev C	Glenarm Wastewater Permit Rev C	07/18/13	C	Attachment A3-Reference Information\A.3.B City-Supplied Permitting Information\Waste Water
20001-C-004-06 4-06	GSU foundation plan	12/08/03	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural
8-2-2368	Electrical Shop Plot Plan	10/16/69	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2369	Electrical Shop Plan & Elevations	12/08/60	3	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2370	Electrical Shop Mezzanine Floor Plan & Details	09/21/60	3	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2371	Electrical Shop Floor Plan Anchor Bolt Setting Plan	06/21/20	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2372	Electrical Shop Partial Deck Plan & Longitudinal Sect.	03/03/60	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2373	Electrical Shop Basement Plan Sections & Details	02/17/69	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2374	Electrical Shop North & Partial East Elevations & Roof Slab Over Room B1	06/21/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2375	Electrical Shop Foundation Plan for New Deck Slab Basement Ramp & Room B1 Floor Slab	02/17/69	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
8-2-2376	Electrical Shop Reinforcing Details for Beams, Girders, Floor Slab & Ramp	06/21/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2381	Electrical Shop Architectural Floor Plan & Room Elevations	02/17/69	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2382	Electrical Shop Architectural Room Elevations	09/16/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2383	Electrical Shop Miscellaneous Architectural Details	09/20/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-2384	Electrical Construction Shop Electrical Layout	09/15/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Architectural and Structural\Pump Building Existing
8-2-49	Circ Pipe Tunnels Demo 2	08/02/49	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
8-2-49B	Circ Pipe Tunnels Demo 3	08/02/49	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
8-2-49C	Circ Pipe Tunnels Demo 4	04/27/49	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
8-2-1337	Overall Tunnel Demo 1	01/02/58	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
8-2-1355	Stack Foundation Demo 5	11/01/56	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
8-2-1670	Plot Plan Crane Rail Demo 6	02/26/62	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
SKM-1	Existing Tunnels and Proposed Equipment Overlay	06/12/13	B	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Demolition Scope
2-2-1562	Underground Fair Oaks ave.	04/22/03	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
8-2-547	Receiving Stations and Dispatching Center Electrical Plot Plan	01/30/95	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
8-2-575	Powerhouse to Receiving Station Section A Interconnecting Tunnel Ground System	10/14/48	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
8-2-1341	General Arrangement of Existing Structures and Foundations	03/27/58	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
20001E004-01	Overall conduit routing plan & sect	04/10/03	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
20001E004-02	Overall conduit routing plan & sect	12/08/03	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
20001E004-03	Overall conduit routing plan & sect	12/08/03	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
20001E004-05	Conduit ductbank sect & misc sect	12/08/03	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
20001E004-13 004-13	Conduit ductbank details-GSU hv lines	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
8-2-6643, 6507, 6606, 6510, 6603, 6613 & 6602	Existing Trench and Sanitary Sewer East of Glenarm Building	-	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
Storm Drain and Conduit Trench Drawing	Storm Drain and Conduit Trench Drawing	04/10/03	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
V-228	UG Vault Standards	06/27/07	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Electrical
8-2-300	Fountain Drawing	09/02/38		Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001-071R0	Waste Water F & ID	11/08/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001-090	Flow & Instrument Diagram Ammonia System	05/19/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001M001	Overall Site Plan GT 3 & 4	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
20001P001-02	Key plan above ground and trenches	12/08/03	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001P026-01	29% NH3 tank area above ground piping	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001P026-02	29% NH3 tank area above ground piping	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
20001-P-011-01	Piping and Plan Details Existing OWS	11/18/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
Existing Oil-Water Separator	Existing Oil-Water Separator Manufacturer's Information	01/23/03	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Mechanical
Glenarm Parcel Map	Glenarm Parcel Map	08/09/04	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Survey Info
Glenarm Parcel Plan	Glenarm Parcel Plan	09/28/04	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Survey Info
Pasadena Glenarm Facility	Pasadena Glenarm Facility	-	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Survey Info
8-2-1002	General Location Plan	03/29/73	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Arrangement Dwgs Existing or Past
8-2-1477	Piping Arrangement	11/25/60	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Arrangement Dwgs Existing or Past
8-2-1669	Gas Equipment Building Miscellaneous Sections & Details	02/26/62	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Arrangement Dwgs Existing or Past
8-2-1670	Gas Equipment Building Plot Plan Paving & Yard Details	02/26/62	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Arrangement Dwgs Existing or Past
Site Water Utility Information	Site Water Utility Information	-	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Arrangement Dwgs Existing or Past
8-2-1355	Sootblowing Stack & Precipitator Support Foundations	11/05/56	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001c002-01	Civil Key Plan Paving / Grading & U.G. Sewer PDF	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001c002-01	Civil Key Plan Paving / Grading & U.G. Sewer CAD	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001c002-03	Area 2 paving grading sewer	12/23/03	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001c002-04	Area 3 paving grading sewer	12/23/03	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001c006-04	Oily Water Separator foundation sections and details	03/06/03	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
20001-c003-05	Civil Sections & Details	01/24/03	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
8-2-6643, 6507, 6606, 6510, 6608, 6613 & 6602	Existing Trench and Sanitary Sewer East of Glenarm Building	6/1987	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Civil
8-2-49	Circ Pipe Tunnels	02/06/31	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
8-2-49B	Circ Pipe Tunnels	08/14/31	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
8-2-49C	Circ Pipe Tunnels	08/05/31	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
8-2-49D	Circ Pipe Tunnels	05/22/31	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
8-2-598	Circ Pipe Tunnels	10/03/50	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
8-2-949	Broadway to Glenarm Pipe Tunnel	12/22/65	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
8-2-1337	Station Service Plot Plan	01/02/58	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P006-03	West end culvert piping	11/18/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P006-04	West end culvert piping	05/19/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P027-01	Pipe trench between culvert & NH3 tanks	12/16/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P028-01	Demin Water Pump 158A & Pipe Trench	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P028-02	East end culvert & trench piping details	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
20001P00601	Ammonia truck unloading and culvert piping	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Mechanical Tunnels
33W	Location of power plant water services	08/29/40	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
3716	Utility Drawings in Public ROW - Fair Oaks Ave - Glenarm to State St	03/27/87	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001-274-M	Oil Water Separator Flo Trend Systems	01/16/03	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001E011-04	Cathodic protection pipe pit area	02/24/03	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P001-01	Key plan underground piping A	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P003-01	GT 3&4 equipment drains underground	12/08/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P004-01	GT3 area underground piping	12/17/03	1	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P005-01	GT4 area underground piping	12/17/03	2	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P009-01	NH3 tank area underground piping	12/16/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001P011-01	Oily water separator pit piping	11/18/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
20001-P-011-01	Piping Plan & Details Oily Water Separator Pit	11/18/02	0	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
Glenarm Plant Fire Protection Drawing	Glenarm Plant Fire Protection Drawing	06/30/03	3	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
GT1 GT2 UG GAS DWG	Piping Area III	04/30/75	4	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
k350 OWS flow diagram	k350 oil water separator flow diagram	10/11/02	A	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities
Storm Drain and Conduit Trench Drawing	Storm Drain and Conduit Trench Drawing	04/10/03	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Existing PWP Dwgs\Underground\Underground Utilities

123374 Pasadena OE

Attachment A3-Reference Informationerence Documents

December 11, 2013

Document No./ Filename	Document Title	Current Rev. Date	Current Rev. No.	Location
3626-04-02	GT-5 FIRSTPCRCorrectionEnvironmental Investigation	07/29/11	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR
3626-04-02	GT-5 Environmental Investigation - 1 of 4 txt only	07/29/11	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR\Enviro
3626-03	Geophysical Investigation	04/15/10	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR\Geotech
3626-04-01	GT5 Geotechnical Investigation	08/01/11	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR\Geotech
11195Hydrologue_ThermalResistivity_01	Soil Thermal Resistivity Tests	09/16/11	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR\Soil Resistivity
geovisionthermal Resistivity	Soil Thermal Resistivity Tests	08/10/11	-	Attachment A3-Reference Information\A.3.C Existing Site and Reference Drawings\Geotech Report and GPR\Soil Resistivity
Attachment 1.6 Scope of Supply DOR	Attachment 1.6 Scope of Supply DOR	-	-	Attachment A3-Reference Information\A.3.D Division of Responsibility
Completion Turnover Start-Up	GLENARM REPOWERING PROJECT SCOPE OF RESPONSIBILITY MATRIX	10/11/13	A	Attachment A3-Reference Information\A.3.D Division of Responsibility

On-Site Training Course Description for

"Aero Package Operations / Familiarization"

A. Summary

A comprehensive training program is conducted for a selected number of customer's engineers, operations and maintenance personnel. The training will be conducted at the customer's job site. The customer's personnel assigned for training must have prior general knowledge of power plant systems operation. The Buyer shall designate a training coordinator for the project who is familiar with overall plant design and system operations. This person schedules and coordinates job site training, as well as integrates individual systems training into the overall plant operation. There is also the option to have GE provide the Training Coordinator at an additional charge. If the Buyer chooses this option, please notify the Seller 60 days in advanced before the training program begins.

B. Training Material and Related Conditions (On-Site Training)

1. Classes run daily (five days/week) and are limited to six (6) hours. The actual class time, a.m. and p.m. hours, is dictated by the availability of the equipment and the students per the normal work schedule. Each class time period should be agreed to by the customer's management and GE's instructor(s) at the beginning of the program. The six (6) hour class limitation will allow ample time for the instructor(s) to prepare the next session's work plan.
2. A maximum of fifteen (15) students per class can be accommodated.
3. English-speaking instructor(s) will be furnished for the course duration.
4. Each student will be furnished a suitable bound course instruction and reference handbook in English; shipment costs have been included in the firm price quoted herein. Any materials furnished are exclusively for the use of the customer's personnel. This material is not for resale or to be distributed to third parties, nor is it to be copied or reproduced without GE's prior written permission.
5. Any audio or video recording of GE's lecture material is prohibited unless GE grants permission in writing in advance of the training program.
6. The instructor(s) will retain all visual aids.
7. The power plant equipment should preferably be operable and available to support this course of study.

C. Training Schedule

1. After the contract has been finalized, training will be conducted during a mutually–agreeable time.

D. Course Description

1. This site-specific course is designed to enable, supervisors, operations, and maintenance personnel to operate GE designed Aeroderivative gas turbine generator units. The course develops a background in gas turbine generator support systems, and operations, which will enable participants to analyze operating problems and take the necessary corrective action. It will also detail the design and construction of the gas turbine, and generator.
2. Emphasis is placed on the detailed description of the gas turbine - generator major components, the functions of their auxiliary systems, and the operator's responsibilities with regard to systems operations, and operational data acquisition, and evaluation of anomalies thru the use of classroom instruction, and class exercises.
3. If the course is held at the customer's location it will include site visits to familiarize personnel with the physical layout of the gas turbine - generator, and the location of the various system components,

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and provide personnel the opportunity to correlate the system piping schematics to the respective system hardware.

4. Operators are instructed in how to interpret fault annunciation and how to determine if the annunciated fault can be remedied by operator action or with the assistance of instrumentation and/or maintenance personnel.

5. The course focuses on the starting, loading, and specific operator checks of the various turbine support and auxiliary systems to ensure reliable operation of the gas turbine - generator unit, and the effect that operation has on major mechanical maintenance.

E. Content

The typical Gas Turbine-Generator Operation course covers the following areas:

1. **Introduction**

   A. Instructor background
   B. Student background and expectations
   C. Course schedule

2. **Gas Turbine**

   A. Gas Turbine Basics

      1. Principles of Operation
      2. Axial Compressors
      3. Gas Turbine Combustors
      4. Turbine Section
      5. Air/Exhaust Gas Flow Characteristics
      6. Gas Turbine Configurations

   B. Details of Construction

      1. Engine Overview
      2. Stations and Orientation
      3. Shaft and Bearing Configuration
      4. LP Compressor Section (as applicable)
      5. Fixed vs. Variable Inlet Guide Vane Assembly
      6. Frame/Support Members
      7. Variable Bypass Valve Assembly (as applicable)
      8. HP Compressor Assembly
      9. Variable Stator Vane Assembly
      10. Combustor Assembly
      11. HP Turbine Assembly
      12. LP Turbine Assembly
      13. Auxiliary Gear Box
      14. Engine Airflow
      15. Turbine Instrumentation
      16. Key Performance Features and Operating Parameters

   C. Gas turbine support systems, description, function, and operating limits (As applicable)

      1. Inlet and exhaust, and control air
      2. Inlet cooling
      3. Inter cooling
      4. Lube oil (SLO/MLO)
      5. Variable Geometry Hydraulic and control oil
      6. Fuel system(s)

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7. Water injection
8. Ventilation and Combustion air
9. Fire protection
10. Anti-Icing
11. Starting means
12. Water wash
13. Power augmentation (steam)
14. Performance monitoring
15. Vibration Monitoring

3. **Reduction Gear (As applicable)**

   A. System Description

   B. Lubrication System

4. **Clutch (As applicable)**

   A. System Description

   B. Lubrication System

5. **Generator**

   A. Overview

      1. Machine theory
      2. Generator construction
      3. Generator arrangement
      4. Generator Instruments

   B. Operation

      1. VAR's
      2. Power factor
      3. Synchronization
      4. Online operation
      5. Offline operation

   C. Support systems, description, function, and operating limits (as applicable)

      1. Lube oil
      2. Inlet air filtration
      3. Coolers
      4. Generator Protection

   D. Excitation

      1. Equipment description
      2. Operation
      3. Alarms, trips

6. **Control System**

   A. Overview

      1. Control panel arrangement
      2. Basic control functions and operating sequences
      3. Basic protection function

   B. Operator responsibilities

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1. Data taking and evaluation
2. Operating limits
3. Required operator action on various annunciation indications

C. Gas turbine-generator operating modes

1. Operator screens (HMI or I)
2. Startup
3. Loading
4. Shutdown
5. Cooldown
6. Trip management

7. **Unit documentation**

A. Operation and Maintenance Manuals

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On-Site Training Course Description for

"Aero Gas Turbine Package System Maintenance"

A. Summary

A comprehensive training program is conducted for a selected number of customer's engineers, operations and maintenance personnel. The training will be conducted at the customer's job site. The customer's personnel assigned for training must have prior general knowledge of power plant systems operation. The Buyer shall designate a training coordinator for the project who is familiar with overall plant design and system operations. This person schedules and coordinates job site training, as well as integrates individual systems training into the overall plant operation. There is also the option to have GE provide the Training Coordinator at an additional charge. If the Buyer chooses this option, please notify the Seller 60 days in advanced before the training program begins.

B. Training Material and Related Conditions (On-Site Training)

1. Classes run daily (five days/week) and are limited to six (6) hours. The actual class time, a.m. and p.m. hours, is dictated by the availability of the equipment and the students per the normal work schedule. Each class time period should be agreed to by the customer's management and GE's instructor(s) at the beginning of the program. The six (6) hour class limitation will allow ample time for the instructor(s) to prepare the next session's work plan.
2. A maximum of fifteen (15) students per class can be accommodated.
3. English-speaking instructor(s) will be furnished for the course duration.
4. Each student will be furnished a suitable bound course instruction and reference handbook in English; shipment costs have been included in the firm price quoted herein. Any materials furnished are exclusively for the use of the customer's personnel. This material is not for resale or to be distributed to third parties, nor is it to be copied or reproduced without GE's prior written permission.
5. Any audio or video recording of GE's lecture material is prohibited unless GE grants permission in writing in advance of the training program.
6. The instructor(s) will retain all visual aids.
7. The power plant equipment should preferably be operable and available to support this course of study.

C. Training Schedule

1. After the contract has been finalized, training will be conducted during a mutually–agreeable time.

D. Course Description

1. This site-specific course is designed to introduce operations and maintenance personnel to the routine preventative maintenance procedures of the Aeroderivative gas turbine package support systems, and to the major mechanical maintenance required to attain high levels of availability, and reliability from the Aeroderivative gas turbine package. This course will also cover Borescope procedure introduction, troubleshooting, and a summary of the disassembly inspections required for major gas turbine generator mechanical maintenance. Operating and maintenance personnel should attend this course together to develop a working relationship regarding the maintenance requirements of the unit, and how unit operation may affect these requirements.
2. The training will include detailed descriptions of the Aeroderivative gas turbine generator package and support systems. This will include a functional description of the systems as well as the routine preventative maintenance requirements. The training will also detail the Level 1 maintenance work packages with an overview of the Hot and Cold Level 2 maintenance inspections. The course DOES

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NOT include repair procedures for gas turbine components. If the course is held at the customer's location it will include site visits to familiarize personnel with the physical layout of the gas turbine generator, and the location of the various system components, and to allow personnel to correlate the system piping schematics to the system hardware

E. Content

The typical Aeroderivative Gas Turbine-Generator Package Systems Maintenance course covers the following topics:

1. **Introduction**

   A. Instructor background
   B. Student background and expectations
   C. Course schedule

2. **Gas Turbine Overview**

   A. Gas Turbine Basics

      1. Principles of Operation
      2. Axial Compressors
      3. Gas Turbine Combustors
      4. Turbine Section
      5. Air/Exhaust Gas Flow Characteristics
      6. Gas Turbine Configurations

   B. Details of Construction

      1. Engine Overview
      2. Stations and Orientation
      3. Shaft and Bearing Configuration
      4. LP Compressor Section (as applicable)
      5. Fixed vs. Variable Inlet Guide Vane Assembly
      6. Frame/Support Members
      7. Variable Bypass Valve Assembly (as applicable)
      8. HP Compressor Assembly
      9. Variable Stator Vane Assembly
      10. Combustor Assembly
      11. HP Turbine Assembly
      12. LP Turbine Assembly
      13. Auxiliary Gear Box
      14. Engine Airflow
      15. Turbine Instrumentation
      16. Key Performance Features and Operating Parameters

3. **Maintenance Administration**

   A. Maintenance Management
   B. Maintenance Information
   C. Operator Event Logs
   D. Equipment Logs
   E. Equipment History Logs
   F. General Maintenance Concepts
   G. Standard Practices
   H. Maintenance Work Package Development
   I. Scheduling Work
   J. Maintenance and Repair Responsibilities

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4. **Equipment Testing**
   - A. Cleanliness
   - B. Characteristics of Metal
   - C. Preservation and De-Preservation of Gas Turbine Engines
   - D. Special Tools
   - E. Engine Trending and Analysis and Performance Data Recording
   - F. Vibration Analysis
   - G. Ultrasound and Infrared Thermal Imaging
   - H. Oil Analysis
   - I. Bearing Maintenance
   - J. Single Point Maintenance
   - K. Calibration

5. **Gas Turbine Support Systems, description and maintenance requirements (As applicable)**
   - A. Inlet and exhaust, and control air
   - B. Inlet cooling
   - C. Intercooling
   - D. Lube oil (SLO/MLO)
   - E. Variable Geometry Hydraulic and control oil
   - F. Fuel system(s)
   - G. Water injection
   - H. Ventilation and Combustion air
   - I. Fire protection
   - J. Anti-Icing
   - K. Starting means
   - L. Water wash
   - M. Power augmentation (steam)
   - N. Performance monitoring
   - O. Vibration Monitoring

6. **Major Gas Turbine Mechanical Maintenance (As applicable)**
   - A. Level 1 Maintenance Packages
   - B. Level 2 Hot/Cold Maintenance Brief

7. **Reduction Gear (As applicable)**
   - A. Maintenance Requirements
   - B. Lubrication System

8. **Clutch (As applicable)**
   - A. Maintenance Requirements
   - B. Lubrication System

9. **Generator**
   - A. Overview
     1. Generator construction
     2. Generator arrangement and load gear (if applicable)
     3. Lift Arrangements
     4. Support systems, description and maintenance requirements (As applicable)
        - a. Lube oil
        - b. Cooling air inlet
        - c. Lift/Jacking oil

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d. Coolers
e. High Voltage Bushings and Connections (Line and Neutral)

5. Major Mechanical Maintenance (As applicable)
   a. Generator Rotor Removal Brief
   b. Turbine Generator Alignment
6. Generator Electrical Maintenance (As applicable)
   a. Periodic Inspections
   b. PMG Checks
   c. Megger Checks

10. **Borescope Basic Introduction**
    A. Required equipment
    B. Functional use
11. **Trouble-Shooting Basics**
12. **Unit Documentation**
    A. Operation and Maintenance Manuals
    B. Illustrated Parts Breakdown
    C. Specific LM GEK Manual's
    D. Product Bulletins
    E. Maintenance Video's
    F. Critical Parts Life Management
    G. Name Plate Data

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On-Site Training Course Description for

"Aeroderivative Control Systems Operation, Maintenance & Troubleshooting (LM6K MicroNet)"

A. Summary

A comprehensive training program is conducted for a selected number of customer's engineers, operations and maintenance personnel. The training will be conducted at the customer's job site. The customer's personnel assigned for training must have prior general knowledge of power plant systems operation. The Buyer shall designate a training coordinator for the project who is familiar with overall plant design and system operations. This person schedules and coordinates job site training, as well as integrates individual systems training into the overall plant operation. There is also the option to have GE provide the Training Coordinator at an additional charge. If the Buyer chooses this option, please notify the Seller 60 days in advanced before the training program begins.

B. Training Material and Related Conditions (On-Site Training)

1. Classes run daily (five days/week) and are limited to six (6) hours. The actual class time, a.m. and p.m. hours, is dictated by the availability of the equipment and the students per the normal work schedule. Each class time period should be agreed to by the customer's management and GE's instructor(s) at the beginning of the program. The six (6) hour class limitation will allow ample time for the instructor(s) to prepare the next session's work plan.
2. A maximum of fifteen (15) students per class can be accommodated.
3. English-speaking instructor(s) will be furnished for the course duration.
4. Each student will be furnished a suitable bound course instruction and reference handbook in English; shipment costs have been included in the firm price quoted herein. Any materials furnished are exclusively for the use of the customer's personnel. This material is not for resale or to be distributed to third parties, nor is it to be copied or reproduced without GE's prior written permission.
5. Any audio or video recording of GE's lecture material is prohibited unless GE grants permission in writing in advance of the training program.
6. The instructor(s) will retain all visual aids.
7. The power plant equipment should preferably be operable and available to support this course of study.

C. Training Schedule

1. After the contract has been finalized, training will be conducted during a mutually–agreeable time.

D. Course Description

1. This site-specific course is designed to introduce operations and maintenance personnel to the routine preventative maintenance procedures of the Aeroderivative gas turbine package support systems, and to the major electrical and control system maintenance required to attain high levels of availability, and reliability from the Aeroderivative gas turbine package. This course will also cover functional sensor & actuator description, troubleshooting, and a summary of calibration and inspections required for major gas turbine generator package electrical and control system maintenance. Operating and maintenance personnel should attend this course together to develop a working relationship regarding the maintenance requirements of the unit, and how unit operation may affect these requirements.
2. The training will include detailed descriptions of the Aeroderivative gas turbine generator package and support systems from a control system perspective. This will include a functional description of

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the systems as well as the routine preventative maintenance requirements. The course DOES NOT include repair procedures for gas turbine components. If the course is held at the customer's location it will include site visits to familiarize personnel with the physical layout of the gas turbine generator package, and the location of the various system components, and to allow personnel to correlate the system electrical schematics and wiring diagrams to the system hardware.

E. Content

The typical Aeroderivative Control Systems Operation, Maintenance & Troubleshooting course for the LM6000 GTG Package with the MicroNet style control system covers the following topics:

1. **Introduction**
   - A. Instructor background
   - B. Student background and expectations
   - C. Course schedule
2. **Control Basics**
   - A. Introduction to Closed-Loop Control
   - B. Governing Control Fundamentals
   - C. Sequencing Control
   - D. System Protection
3. **System Overview**
   - A. System Block Diagram
   - B. Major Control System Components
   - C. Package Documentation
4. **Instrumentation – Theory of Operation and Practical Troubleshooting**
   - A. Sensors
   - B. Magnetic Pick-Ups
   - C. Thermocouples
   - D. RTDs
   - E. LVDTs
   - F. Servo Actuators
   - G. Electrically Actuated Valves
   - H. Pressure Transmitters
   - I. Fire Detectors
   - J. Gas Detectors
   - K. Vibration Pick-Up Devices
5. **Engine (Core) and Package Controller (Outer Ring)**
   - A. Woodward MicroNet Overview and Architecture
   - B. Woodward MicroNet Hardware
   - C. Woodward MicroNet Software Interface Tools
     1. Graphical Application Programming Software (GAP)
     2. Control Assistant Software
     3. App Manager Software
   - D. Woodward MicroNet Maintenance
   - E. Woodward MicroNet System Back-Up
6. **Vibration Monitoring System**
   - A. Bently Nevada 3500 Overview and Architecture
   - B. Bently Nevada 3500 Hardware
   - C. Bently Nevada 3500 Interface Tools

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a. 3500 Rack Interface Software

D. Bently Nevada 3500 Maintenance

E. Bently Nevada 3500 System Back-U

7. **Fire & Gas Detection System**

A. Fire & Gas Detection System Overview and Architecture
B. Fire & Gas Detection System Hardware
C. Fire & Gas Detection System Maintenance
D. Fire & Gas Detection System Back-Up

8. **Generator Excitation Controller**

A. Brush A30 AVR Overview and Architecture
B. Brush A30 AVR System Hardware
C. Brush A30 AVR System Interface Tools
1. Brush A30 HMI Software
D. Brush A30 AVR System Maintenance
E. Brush A30 AVR System Back-Up

9. **Generator Protection System**

A. IGPS Overview and Architecture
B. IGPS System Hardware
C. IGPS System Interface Tools
D. IPScom Communication Software
E. IGPS System Maintenance
F. IGPS System Back-Up

10. **Package Application Control**

A. Review of Systems and HMI Navigation
B. Start-Up and Shutdown Sequences
C. Operation Modes
D. Individual System Sequencing
E. Turbine Control
F. Generator Control, Protection, & Switching

11. **Integrated System Topics**

A. Power Up
B. Communication Interfaces
C. HMI housekeeping

12. **Summation**

A. Review
B. Questions and Answers

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Attachment 14.2 Training Services

Training Services

A comprehensive training program is conducted for a selected number of City's engineers, operations and maintenance personnel. The training will be conducted at the City's job site.

The City's personnel assigned for training must have general knowledge of combined cycle power plant systems operation, as well as a fundamental knowledge of plant start-up, normal operations, shutdown and abnormal operations, including safe, efficient power plant operations. In addition to operator training described herein, more specific training can be offered as optional packages in detailed areas such as controls and maintenance.

A Contractor training coordinator will be designated for the project who is knowledgeable with overall plant design and system operations. This person schedule and coordinate job site training, as well as integrate individual systems training into the overall program.

Training packages for equipment provided by Others are the responsibility of Others. A comprehensive training program can be coordinated in a combined session.

The training programs will cover the areas specified below and detailed on the following pages:

Training Material and Related Conditions (On-Site Training)

- Classes run daily (five days/week) and are limited to six (6) hours. The actual class time, a.m. and p.m. hours, is dictated by the availability of the equipment and the students per the normal work schedule. Each class time period should be agreed to by the customer's management and Contractor's instructor(s) at the beginning of the program. The six (6) hour class limitation will allow ample time for the instructor(s) to prepare the next session's work plan.
- A maximum of twenty-five (25) students per class can be accommodated.
- English-speaking instructor(s) will be furnished for the course duration.
- Each student will be furnished a suitable bound course instruction and reference handbook in English; shipment costs have been included in the firm price quoted herein. Any materials furnished are exclusively for the use of the customer's personnel. This material is not for resale or to be distributed to third parties, nor is it to be copied or reproduced without Contractor's prior written permission.
- Any audio or video recording of Contractor's lecture material is prohibited.

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- The instructor(s) will retain all visual aids.
- The power plant equipment should preferably be operable and available to support this course of study.
- Contractor shall be responsible for the instructors' travel and living expenses during the training period.
- City will be responsible to provide a classroom facility suitable for instructing for fifteen (15) students, including LCD projector, and white board.
- Training will be done at the customer site location or other agreed suitable location.

Typical Course Content (Refer to GTG Training Descriptions)

Gas Turbine Generator Courses

Aero Package Operations / Familiarization

Aero Gas Turbine Package System Maintenance

Aeroderivative Control Systems Operation, Maintenance & Troubleshooting (LM6K MicroNet)

Basic Steam Turbine Generator Familiarization Course (2 days)

- Steam Turbine Basics
  - Principles of Operation
  - Steam turbine fundamentals
  - Steam Flow Characteristics
- Major Equipment
  - Turbine casing
  - Turbine rotating parts
  - Nozzle & Diaphragms
  - Shaft packings, bearings and standards
  - Emergency stop valve & Governor valve
  - Gear box & Turning gear
- Steam turbine support systems, description, function, and operating limits (As applicable)
  - Steam system
  - Oil system
  - Condensing & Vacuum system
  - Oil unit system

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- Generator Basics
  - Generator fundamentals
  - Generator construction
  - Auxiliary systems
- Control System
  - Basic control functions
  - Governor control
  - HMI interface
  - Basic protection functions and devices
  - Supervisory instrumentation
  - Excitation & Synchronizing fundamentals
  - Excitation & synchronizing system and components
  - Digital generator protection

Operation and Maintenance Manuals and documentation

OTSG Familiarization Course (2 days)

- Overview & General Description of OTSG
  - General Arrangement Description
  - P & ID Overview
  - System Description
  - Description of Main Components
  - Auxiliary Component Description
- Description of OTSG Controls
  - Description of Feedwater Control
  - Description of OTSG Protection
  - Description of Attemperator Control
- Description of OTSG Commissioning Procedure
  - OTSG Hydrostatic Test Procedure
  - Recommended OTSG Cleaning Procedure
- Description of OTSG Operation Procedure
  - Precautions before OTSG Start-up
  - Start-up Procedure
  - Shutdown Procedure
  - Emergency Operation Procedure
- Inspection and Maintenance Procedure
  - Inspection Procedure
  - Maintenance Procedure

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Cooling Tower Familiarization Course (1 day)

- Cooling Tower Design and Construction
- Heat transfer sections
- Fans and Motors
- Ductwork
- Air removal Equipment
- Condensate Storage Tank
- Drain Pot and Drain pumps
- Instrumentation
- Cooling Tower Operation
  - Startup
  - Shutdown
  - Normal Operation
  - Abnormal Operation

Plant Control System (PCS) Operation Course (Optional - not included)

CEMS Course (2 days)

The continuous emission monitoring system course covers the following areas:

- Operate each of the devices at the operator workstation
- System Fundamentals
- Analysis and Analyzer Fundamentals
- System Components
- Recognize and take action on alarms
- Operate the CEMS to control process
- Use trend and trend attribute displays
- Archiving Information
- Reporting
- Operator Troubleshooting – Failed Major Components

Condensate Polisher System (2 days)

- System Fundamentals
- Operation of Equipment
- System Components
- Troubleshooting
- Equipment Maintenance

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Combined Cycle Operations Course (5 days)

The typical Combined Cycle Operations course covers the following areas:

- Thermodynamic Review
- Systems Review and Operation
  - Gas Turbine
  - Steam Turbine
  - Steam Systems
  - Air Systems
  - Electrical Systems
  - Circulating and Cooling Water Systems
  - OTSG Operations
  - Condensate and Feed water
  - Water Treatment and Make up
  - Basic Chemistry
  - Electrical Systems
- Operating Philosophy
  - Location of Control
  - Load Control
  - Closed Loop Control
  - Pump Motor Control
  - Steam Turbine Equipment Protection
  - Automatic Sequencing
- General Operator Responsibilities
  - General Plant Safety
  - Operational Precautions
- Plant Start-up
  - Start up (integrated plant)
  - Start up of one GT and ST
  - Simple Cycle Operations
- Operations
  - Load Changes
  - Load Rejections
  - Casualty and Plant Upsets
- Shutdown
  - Combined Cycle Shutdown
  - Emergency Shutdown
  - Shutdown to Wet Lay-up
  - Shutdown to Dry Lay-up

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- Gas Turbine Trips
  - Trip Prevention
  - BOP Trips
  - Operator Errors

Course Duration

Training is given in consecutive days, six (6) hours per day, exclusive of weekends and holidays. Due to changes in course curriculum and training, material final course duration may be different than the approximate durations listed. Any Customer requested modifications to the standard training curriculum will be evaluated and may be considered as custom training, beyond the scope of this standard offering.

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REF. NO.	QTY.	DESCRIPTION	TAG NUMBER	MANUFACTURER/PART NUMBER	EST. WEIGHT (EA.)
1	2	AIR COMPRESSOR	CPR-500A/B		5,950 LBS/2699 kg
2	2	DESICCANT AIR DRYER	AD-0505A/B		1115 LBS/506 kg
3	1	400 GALLON WET VESSEL	TK-0503A		882 LBS/400 kg
4	1	400 GALLON DRY VESSEL	TK-0510B		882 LBS/400 kg
5	1	STRUCTURAL SKID		DANMAR/F0161C-SKD-01	9500 LBS/4309 kg
				EST. PACKAGE WT.: 28000 LBS/12700 kgs.	

NOZZLE SCHEDULE			
TAG	SIZE	RATING	SERVICE DESCRIPTION
N1	2"	150# RFWN	INSTRUMENT AIR DISCHARGE
N2	2"	150# RFWN	SKID DRAIN
N3	2"	150# RFWN	FUTURE CONNECTION

⊗ INDICATES CENTER OF GRAVITY

STRUCTURAL NOTES:

[1] **SEISMIC ZONE DATA:**
CTG EQUIPMENT_____US SEISMIC CATEGORY A

BOP EQUIPMENT_____CATEGORY III OCCUPANCY w/ SEISMIC ACCELERATION AS PER ASCE 7/05

[2] SEISMIC ZONE DATA REFERENCED FROM:
UTILITY ENGINEERING/PROJECT SPECIFICATION INFORMATION
PROJECT SPECIFICATION #A013296-001G000101
Pg. 3; SEISMIC ZONE DATA
DATED: 11/09/2007

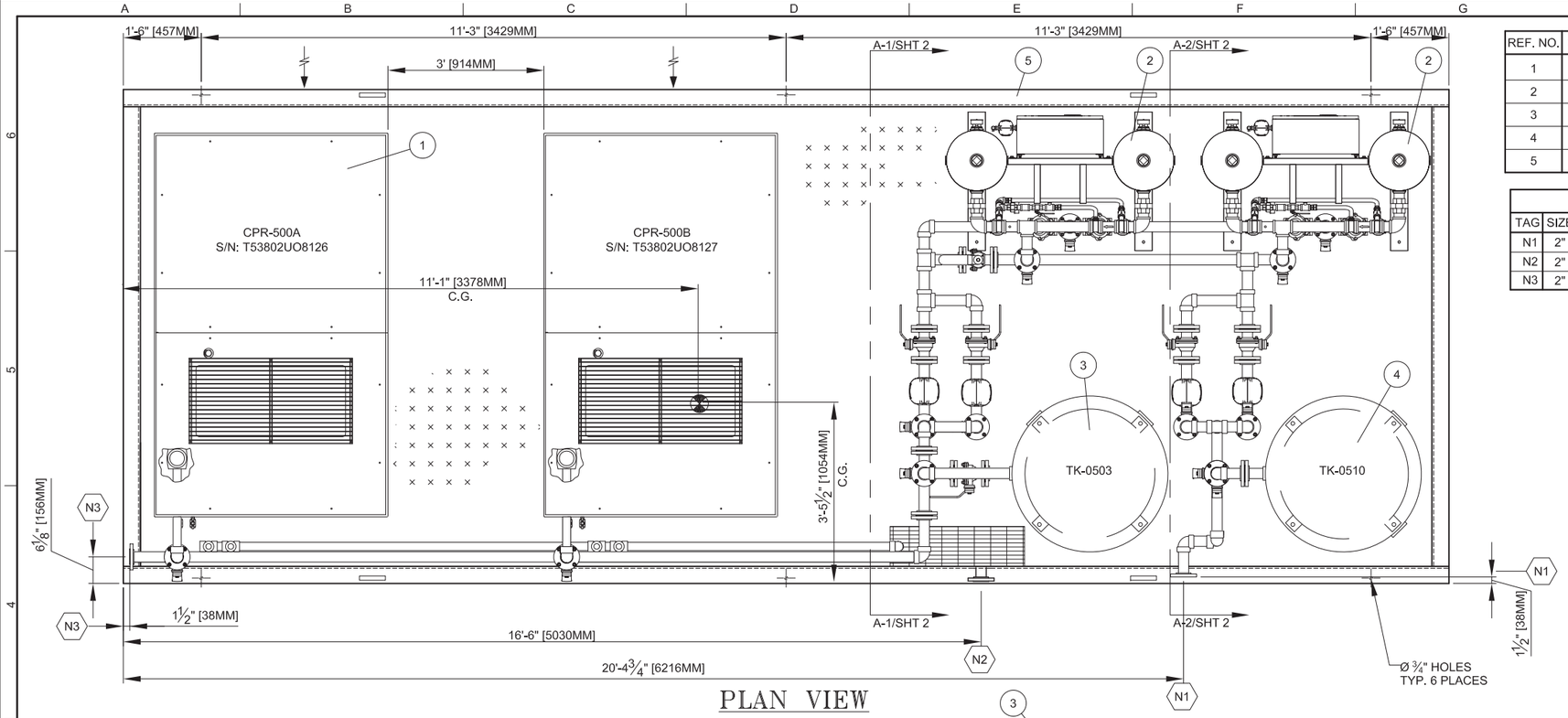
[3] SKID LOADS: Typical

LIFT: FY = 28000 LBF

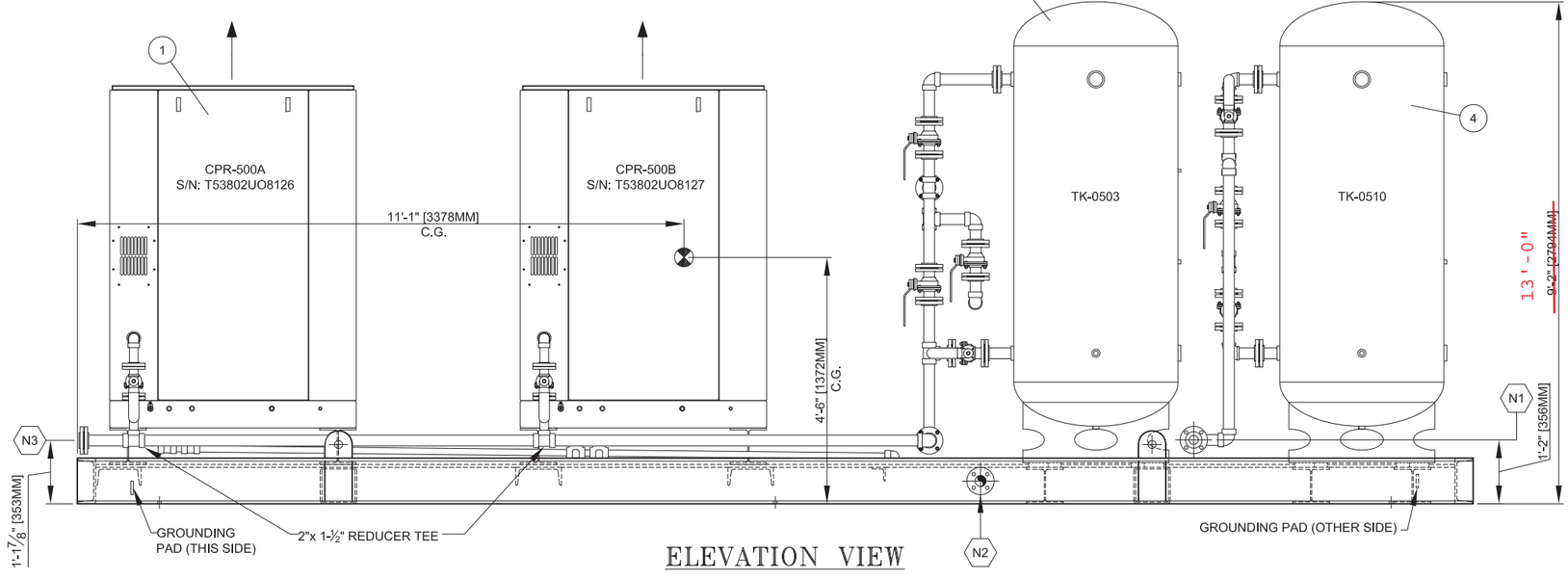
OPERATING: FY = 28000 LBF

SEISMIC: FY = 29000 LBF
V = 1000 LBF (SHEAR)
M = 3000 FT*LBF (OVERTURNING MOMENT)

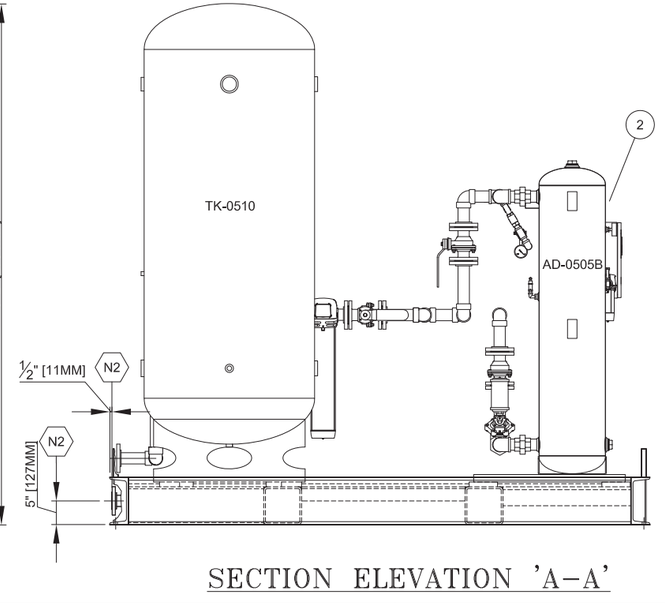
WIND: FY = 28000 LBF
V = 7500 LBF (SHEAR)
M = 37000 FT*LBF (OVERTURNING MOMENT)



PLAN VIEW



ELEVATION VIEW



SECTION ELEVATION 'A–A'

SUPPLIER DOCUMENT INFO. (to be completed by Danmar)	
Issued For:	
☐ Information	Purchase Order No.
☐ Approval	Material Requisition No.
☐ Final (No Cert.Required)	Supplier Reference No.
☐ Certified	Document No.
☐ As Built	Document Title:
	Tag No(s).

ENGINEERING REVIEW STATUS (to be completed by client)	
Acceptance of this document by does not relieve the Supplier of responsibility for accuracy of dimensions and strict compliance with the Purchase Order.	
☐ Mfg. may proceed	☐ Mfg. may proceed as noted
☐ Information only	☐ Not applicable to this project
☐ Void	☐ Not correct, revise and resubmit
Date Recv'd: / Seq/Rev:	☐ Mfg. may proceed; Review not required

No.	REVISION DESCRIPTION	DATE	BY	CHKD.	APPV.
A	INITIAL DRAWING	04/08/08	RMF	TA	TA
B	ADDED COMPRESSOR DATA PLATE/STRUCTURAL NOTES	07/09/08	JG	JG	KA
C	ADDED CENTER OF GRAVITY	07/18/08	JG	JG	KA
0	GENERAL PIPING/FILTER CORRECTIONS / I.F.C.	09/11/08	JG	SS	KA
1	CORRECTIONS PER CUSTOMER SPECIFICATION	10/06/08	JG	JG	JG

DANMAR INDUSTRIES, INC.
2303 OIL CENTER COURT, HOUSTON, TX 77073
(ph) 281-230-1000 (fax) 281-230-1010 www.danmarind.com

PURCHASER:
PROJECT: 12
ITEM TAG #: N
DANMAR PRO.
SCALE: 3/8"
DWG.#: F0

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PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 260000

Electrical-Mechanical Equipment

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 260000
Electrical-Mechanical Equipment

Prepared for: *PASADENA WATER & POWER*
Prepared by: *BLAKE TURNER, P.E.*

REVISION HISTORY		
DATE	REVISED BY	REVISION
06/29/2011	B. TURNER	A
09/14/2011	S. HARRIS	B
02/02/2012	B. HRITSCO	C
09/10/2013		D - CONTRACT VERSION

SECTION 260000
ELECTRICAL-MECHANICAL EQUIPMENT

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 REFERENCES 1
1.3 DEFINITIONS 1
1.4 SUBMITTALS 1

PART 2 - PRODUCTS 2

2.1 GENERAL 2
2.2 COMPONENTS 2
2.3 SOURCE QUALITY CONTROL 11

PART 3 - EXECUTION - NOT USED 12

PART 4 - SUPPLEMENTS 12

SECTION 260000
ELECTRICAL-MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. Specification outlines electrical requirements for Contractor supplied mechanical packages that are not primarily electrical but, due to need for single Contractor responsibility, includes electrical and instrumentation work associated with mechanical package.
2. See Mechanical Equipment Specification for more detailed requirements.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Factory Mutual (FM).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. Insulated Cable Engineers Association (ICEA).
5. Jurisdiction In Charge (JIC).
6. National Electrical Code (NEC).
7. National Electrical Manufacturers Association (NEMA).
8. Occupational Safety and Health Administration (OSHA).
9. United Laboratories (UL).

1.3 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.4 SUBMITTALS

A. Drawings:

1. Complete customer drawing deliverables for electrical items being furnished.

2. Installation and Commissioning Manual, Operation and Maintenance Manual, General Arrangement drawings included in customer drawing deliverables and anchor bolt location drawings, and conduit interface points.
3. Electrical schematics, wiring diagrams, and other electrical documentation.
4. List of power sources to be furnished for each package. Data shall include volts, phases, maximum and normal KW and KVA. For LM6000 GTG, refer to One line diagram drawing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical material and equipment shall be listed or labeled by Underwriters' Laboratories, Factory Mutual, or equivalent testing laboratory for service in which it is used, and shall bear label or listing. Material and equipment not available with such label or listing shall be built in accordance with latest published standards of UL, FM, or equivalent testing laboratory.

B. Electrical equipment supplied for installation in hazardous areas shall meet requirements specified in NEC for Hazardous Area Installation.

C. Furnish prepiped and prewired, as much as practical, packaged equipment for all components necessary for complete and proper operation.

D. Equipment to be located outdoors shall be capable of operating at rated capacity at ambient temperature specified in Mechanical Equipment Specification and the General Technical Specification while exposed to sun and weather without auxiliary cooling equipment.

E. When specified in Mechanical Equipment Specification package system provide electrical heat tracing.

2.2 COMPONENTS

A. Power Source:

1. Nominal ratings of power sources available to supply packaged equipment are as follows:
   a. 480 volts, 3-phase, 3-wire, 60 Hertz (40,000 amps sym. interrupting rating minimum). Voltage variation plus or minus 10 percent with occasional momentary dips to 80 percent. Frequency will normally be within plus or minus 1 percent, but unusual fluctuation of plus or minus 1.66 percent may occur during unusual utility system conditions.
   b. 208Y/120 volts, 3-phase, 4-wire, 60 Hertz unregulated (10,000 amps sym. interrupting rating, minimum). Same voltage and frequency variation as above.
   c. 120 volts, 1-phase, 2-wire, 60 Hertz, regulated (UPS). Voltage variation plus or minus 2 percent, frequency plus or minus 0.85 percent. UPS has an automatic transfer to another regulated 120 VAC. This service is available for limited use only.

2. 125V DC (105V to 140V range): Except for instruments and controls that operate from separate sources of power, provide single power feeder for each package at one of the voltages; 480V or 208Y/120V, indicated above. Where power is to be utilized at more than one voltage level, supply transformation means in control panel.

B. Motors: In accordance with Specifications listed in supplements and in general compliance with the following:

1. Motors 1/2 HP through 200 HP: 460V, 3 Phase, 60 Hertz.
2. Motors less than 1/2 HP: 115V, single phase, 60 Hertz.
3. Select motors for critical service may be required to be 125V DC.
4. Furnish 120V AC motors with motor starters and contactors.

C. 480-Volt Motor Starters:

1. Provide motor starters in accordance with the following:

a. Combination motor starters for local mounting.
b. Full voltage, magnetic, combination circuit breaker type with individual control transformer, and 3 thermal overload relays. Interrupting rating shall be 25,000 amperes symmetrical.
c. Reversing and two-speed motor starters shall be electrically and mechanically interlocked to prevent simultaneously energizing both contactors.
d. Starter thermal overload relay shall be ambient temperature compensated, manually reset, bimetallic type, adjustable between 85 percent and 115 percent of their nominal trip rating.
e. Control Transformer:

1) Furnish fused 480-volt to 120-volt with each starter.
2) Secondary shall be grounded and fused.
3) Minimum of 20 percent capacity in excess of continuous volt ampere requirements of holding coil, with indicating lights.
4) Capable of operation with inrush current 20 percent greater than required by holding coil, and indicating lights and 50W additional capacity.

f. Control fuses shall be accessible for replacement without removing control device assemblies or disconnecting wires or cables. Primary fuses are required on control power transformers larger than 50 VA.
g. AC controls shall be suitable for operation on 120 volts. In the event that some starters require 480-volt coil, furnish interposing relay between control circuit and starter coil circuit. Starters, size 4 and larger shall include interposing relay.
h. DC controls shall be suitable for operation on 125V DC.
i. At least 2 NO and 2 NC spare auxiliary interlock contacts in addition to seal-in-contact shall be furnished on each contactor for Buyer's exclusive use. In the event that this exceeds number which can be mounted on starter, furnish auxiliary relays to obtain specified spare auxiliary switch contacts.

2. Variable Frequency Drives (VFD) shall be furnished when required by Mechanical Equipment Specification or recommended by equipment Contractor.

D. Control Circuits (For LM6000 GTG, 24 VDC and 125 VDC battery power supply systems (including battery banks and chargers) are BOP Contractor's scope of supply per DOR file provided.):

1. 120 volt AC, 60 Hertz, grounded neutral.
2. If voltages other than 120 volt AC are required for control devices or instruments, furnish necessary transformers or devices to produce such voltages.
3. In special cases where 125V DC or 120V AC critical power (UPS) is required advise Buyer/General Manager. Provide sufficient data (amps, operation duration, etc) to assist General Manager in system sizing.
4. Provide separate control transformer and distribution panel for 120-volt AC control circuits.
5. Voltage to ground on any instrument device for control and/or indication shall not exceed 120 volts.
6. Control circuits for motors shall contain only those components necessary for control of individual motor.
7. Redundant control circuits shall not allow single component failure to disable both circuits.

E. External Connections: Devices requiring external connections shall be routed to terminals in junction terminal box or control panel or on devices directly, for LM6000 GTG, refer to Interconnect cable schedule drawing 969009. All external feeders/cabling (in BOP scope of supply) will be via armored cable. Provide separate terminal boxes for the following:

1. 120-volt AC control circuits wired to a separate control terminal box (CTB).
2. 120-volt AC power circuits, including heat trace.
3. Control circuits and power circuits may be routed together to common junction box provided separate terminal blocks are used for each type of circuit.
4. Thermocouple and RTD circuits shall be wired to separate thermocouple terminal box (TTB).
5. DC analog, and digital signal or measurement circuits may occupy same instrumentation terminal box (ITB), but shall be terminated on separate terminal blocks.
6. Thermocouple and RTD, and analog and digital signals may be routed to common junction box provided separate terminal blocks for each type of circuit are used.
7. Shields shall be wired to separate terminal points.

F. Enclosures And Miscellaneous Material (For LM6000 GTG, Contractor's standard enclosures and materials for electrical equipment are provided for the project.):

1. Constructed of heavy gauge metal to assure rigidity and durability.
2. Hot-dipped galvanized steel or stainless steel with no paint or sheet steel with Contractor's standard paint and coding, epoxy-resin coated or corrosive-resistant aluminum with less than 0.4 percent copper.
3. Miscellaneous material such as channel, angle, Unistrut, hanger rods, clamps, angle clips shall be hot-dip galvanized steel. In highly corrosive areas, use special finishes or material suitable for environment.
4. Hardware:

    a. Bolts, nuts, screws, washers shall be hot-dip galvanized steel or stainless steel or other.
    b. Cadmium plating or electro-galvanizing is not acceptable.
    c. Hardware shall be heavy-duty industrial quality.

d. Items such as Korn Clamps, speed clips, scissors clips, flange clips, set screw couplings are not acceptable.

5. Outdoor junction boxes, terminal boxes, enclosures for relays, and enclosures for controls shall be properly sealed against entrance of dust and moisture and shall be equipped with breathers and drains.
6. Install space heaters or heat exchangers where required to avoid corrosion due to condensation.
7. Relay, PLC, and control cabinets shall be key lockable.
8. Enclosures for electrical equipment shall be suitable for environment in which they will be located as stated in the Mechanical Equipment Specification and General Technical Requirements and shall be as follows:

Enclosures		
Description	**Enclosure Type**	**Special**
Outdoor – General	NEMA 4 (IP54 or better for GTG)	None
Indoor – General	NEMA 12 (IP43 for GTG)	None
Class I Division I Locations	NEMA 7 (N/A for GTG)	None
Class II Division I Locations	NEMA 9 (N/A for GTG)	None

G. Control Equipment And Devices:

1. Contractor approved manufacturers and equipment types shall be provided for the Electrical Equipment and Material.
2. Control relays shall be rated 600 volts. Relay coils shall be 120 volt, 60 Hertz or, 125V DC or 24 DC (when DC is specified for specific relays). Contacts shall be rated 10 amps, minimum, continuous at rated contact voltage. When approved by Buyer, 5A rating will be acceptable. Contacts shall have both inductive and resistive interrupting ratings suitable for their service.
3. Devices such as pushbuttons, relays, terminal blocks, and the like shall be of heavy-duty, oil tight construction as per LM6000 GTG standard. Contacts for use in low energy circuits shall be gold plated or gold flashed or silver alloy type.
4. Where motors are controlled with automatic devices, control stations suitable for "Hand-Off-Automatic" operation shall be provided. Motor controls shall be grouped together in control panel where possible.
5. Controls shall be mounted on supports (racks) that will not transmit vibration to control device.
6. Where nonhazardous dust is present, use hermetically sealed contacts, if available.

H. Heating Elements:

1. Metal clad with thermal enclosures to prevent exposure of live parts.
2. 1800 Watt Rating: 120 volt, single phase.
3. Over 1800 Watt Rating: 208 volt, single phase, or 480 volt, 3 phase.

I. Wire and Cable:

Contractor provides the following types of wire in LM6000 GTG:

• Panel

Type ETFE Multi-core, 600 volt insulation, 18, 14, 12 and 10 AWG

• Skid

Type CLX, XHHW, 600 volt insulation, 14 and 16 AWG, Belden Special. Instrumentation wiring is single to multi-core with individual and overall shielding.

• Turbine/Generator Enclosure: Power, control and instrumentation: XHHW equivalent, 600 volt insulation, SS braided armor, 10, 12, 14, 16 AWG.

Instrumentation wiring is single to multi-core with individual and overall shielding.

Contractor furnishes appropriately sized copper conductors with white insulation. The ground wires are green/yellow. Other color coded insulation is not supplied.

Contractor installs a shrink-on, tubular plastic sleeve with printed terminal number identification on each end of each conductor. "Double tagging", identifying the opposite end of the wire, is not furnished.

Contractor furnishes appropriately sized copper conductors with white insulation. The ground wires are green/yellow. Other color coded insulation is not supplied

1. Types:

    a. Stranded, tinned copper.
    b. 0-600 Volt Cable, Power Service: Type XHHW, No. 12 AWG, minimum, rated for 600 volts.
    c. 120 Volt Conductor for Motor Control Circuits, Emergency Shutdown (ESD), Interlocks: 600 volt, Type XHHW, No. 14 AWG, minimum.
    d. 0-600 Volt Conductor, Lighting Service: Type THW or XHHW, No. 12 AWG, minimum.
    e. Wiring to instrument devices shall be twisted pairs and shielded.
    f. Electronic Instrument Wire:

        1) Twisted pair or triad.
        2) No. 16 AWG 7-strand copper conductor with No. 18 AWG 7-stranded tinned copper drain wire.
        3) 90 degrees C PVC primary insulation.

    g. Individual Pair Thermocouple Extension Wire:

        1) Material compatible with thermocouple and color-coded per ANSI standards.
        2) Twisted pair.
        3) No. 16 AWG solid alloy conductor.
        4) 105 degrees C PVC primary insulation.
        5) Aluminum 100 percent overall shield, 80°C PVC jacket.

    h. Control Panel Wiring (internal):

1) Single conductor.
2) No. 14 AWG, minimum.
3) 600 volt stranded, tinned copper.
4) 90 degrees C rated Type SIS or XHHW insulation.

i. Wire and cable shall have flame retardant insulation, certified as meeting requirements of UL-FR-1 Flame Test.

j. Maximum number of single-conductor wires per conduit shall be limited to 15 in 1-inch conduit, including 3 spare wires, and limited to 25 in 1-1/2-inch conduit, including 5 spare wires.

k. The following two groups of wiring when used with GENERAL MANAGER's plant control system shall be separated from each other and from all other wiring:

1) Thermocouples and RTDS.
2) 4-20 mA analog and digital contacts.

l. Small single conductor wires or small OD single or multiple pair shielded wire shall not be run in same conduit with larger OD multi-conductor cables.

2. Circuit/Wire Identification:

a. Each circuit/wire shall be identified at each end and in junction, terminal, and pull boxes with proper identifying number. Identifying labels shall be firmly attached and shall be permanently non-weathering type.

b. Individual wire shall have same assigned number at each end and at each location where it is terminated.

c. Wire Color Coding:

1) AC Power Single Phase:

a) Line: Black.
b) Neutral: White.

2) DC Circuits (Power and Control):

a) Positive Leads and Busses: Red.
b) Negative Leads and Busses: Black.

3) Thermocouple Wiring: Per ANSI Standards.
4) Insulated Grounding Conductors: Green.
5) Combination Starter Terminal Number:

a) Hot: Black.
b) Ground, X2: White.
c) Coil-Hot, 3: Red.
d) Coil-Neutral, 6: Orange.

6) Annunciation (AC or DC):

a) Signal: Orange.
b) Common: Black.

7) DC Circuits (Instruments):

a) Positive: Black.
b) Negative: White.

d. Where it is necessary to terminate 120 volt (nominal) or higher voltage circuits in control panels, terminal boxes, or other enclosures containing lower voltage conductors, isolate higher voltage conductors with insulating cover or barrier and identified with label showing voltage and service.

J. Terminal Box and Control Panel Wiring Details:

For LM6000, standard terminal box and control panel wiring are provided. Due to various configurations, percentage of spare spaces is not guaranteed.

1. Terminate control wiring on screw type terminals using T&B Stakon insulated spade lugs.
2. Terminals shall be sized to current carrying requirements of conductor.
3. Splicing of circuits is not permitted.
4. Power terminations shall be made using insulated ring tongue or lugs on bolt type terminals.
5. Provide 10 percent, minimum, spare terminals in terminal boxes and control panels.
6. Size terminal and junction boxes per Article 370 of NEC for maximum number of terminations in box (including 10 percent spares mentioned above) and based on 2 No. 14 AWG wires per terminal. This includes internal panel wiring plus terminal allowance for external wiring normally required.
7. Wire and cable shall be neatly dressed with nylon ties and shall be free from nicks or cuts in copper conductor or insulation. Plastic wire duct or Panduit may also be used as alternate to nylon ties.
8. Control panel wiring shall be done in a neat and professional manner and shall be laced or secured in wire ways. Wiring shall be collected and gathered wherever intermixed. Self-adhesive "stick-on" wire tie bases are used where is required.
9. Thermocouple extension wiring connections to terminal blocks shall be made with thermocouple terminal blocks manufactured by Sprecher Schuh, model V7, Weidmuller, Phoenix Contact, or Contractor approved equal. Both wires shall be twisted together on one terminal.
10. Where ambient or surface temperatures require use of high-temperature insulated wire, junction box shall be provided outside high temperature zone where high-temperature wire shall be connected to standard insulated wire via terminal blocks.
11. Shields of circuits shall be made continuous by connecting drain wires on terminal point.

K. Miscellaneous Wiring Details (LM6000 GTG standard wiring is per NEC NFPA 70) :

1. Wire nuts shall not be used.
2. Splices in junction boxes (only when necessary) or at lighting fixtures shall be made with self-insulated crimp type connectors. These connections shall be waterproofed with heat shrink sleeves to prevent entrance of moisture into connector.
3. Components requiring field-soldered connections for installation or replacement shall not be used.

4. When dressing individual shielded multi-pair or triad cable at termination points, heat shrink sleeves shall be installed on stripped pairs or triads to prevent unraveling of wrapped coverings.
5. Special care shall be exercised to isolate shields from ground, except at common grounding point and to keep positive and negative signal leads close together and twisted. Wire shields to separate terminal points.
6. Wiring for AC and DC power or control circuits shall be kept segregated and shall not be mixed in same conduit or in conductors of multi-conductor cables.
7. Instrument wiring shall be in separate conduits from power wiring.
8. No open wiring or exposed live parts shall be allowed. Live parts or equipment subject to arcing shall be guarded by grounded metal enclosure.
9. Devices requiring periodic operator adjustment, i.e., timers, overloads, resets shall be accessible without having to open/enter areas containing exposed live parts.
10. Relays, fuses, and other devices shall not be installed in wire raceways, junction boxes, pull boxes, or other enclosures intended for routing and connecting wires.
11. Splices or taps shall be avoided in power, control, and shielded wires between termination points. Wire shall not be spliced in conduit under any condition.
12. A single contact of a relay or sequence timer shall not be used to control more than one motor.

L. Conduit Systems (For LM6000 GTG, Contractor's standard copper free aluminum conduit system is provided):

1. Furnish and install complete conduit system required for equipment package. Conduit system shall include, but not be limited to: conduit, conduit fittings, condulets, pull boxes, junction and terminal boxes, braces, hangers, brackets, supports, cover plates, drains, and bonding jumpers.
2. Run electrical circuits in hot-dipped galvanized steel rigid metal conduit with hot-dipped galvanized threads bearing label of metal listed by Underwriters' Laboratories.
3. Install level, plumb, and in a neat and workmanlike manner.
4. Installed either parallel with or perpendicular to structural members and grouped wherever possible.
5. Supported at spacing not to exceed the following:

    a. 3/4-Inch Through 1-Inch Conduit: 10 feet.
    b. 1-1/2-Inch Conduit: 14 feet.
    c. 2-Inch Conduit: 16 feet.
    d. 3-Inches and Above Conduit: 20 feet.

6. Conduit and pull fittings shall not be located in inaccessible places where difficulty would be experienced in wire pulling.
7. Conduit and conduit fittings shall not be welded to any pipe or structure.
8. Conduit shall not be installed within 6 inches of insulated hot lines. Line shall be considered as "hot" line when operating at temperature of 225 degree F or more.
9. Conduit used for wiring between instrumentation and junction box shall be 3/4-inch, minimum, except where 1/2-inch NPT instrument conduit is required. In such cases, 1/2-inch conduit is acceptable.

10. Conduit Fittings:

    a. C-H Form 8 with cast covers and solid neoprene gaskets.

b. Sizing of condulet bodies and boxes to accommodate splices shall be per the NEC.
c. 1-1/4-inch conduit size shall not be used.
d. Use mogul fittings, C-H type BUB, PBD, where needed for cable pulling ease.
e. Hot-dipped galvanized malleable iron or ferrous alloy.

11. Conduit Bends:

    a. Make with approved conduit bending machine or hickey. Use of pipe tool, vise, or heat for bending shall not be permitted.
    b. Radius of conduit bends shall be not less than specified in NEC or minimum conductor bending radius, whichever is greater.

12. Terminate conduit in threaded hubs or bushings designed to prevent damage to wire during pulling operation. Grounding lugs shall be provided on all conduit termination hubs and bushings.
13. Conduit Connections:

    a. Entrance into sheet metal boxes shall be made with threaded, insulated, watertight "Myers" type hubs with grounding lock-nuts.
    b. Make on side or bottom of enclosures.
    c. Top connections shall not be permitted, except in indoor applications.
    d. Unions shall be provided in conduits connecting individual device enclosures to allow easy removal.

14. There shall be no conduit in final installation that is in any way crushed, deformed, or otherwise damaged. Conduit ends shall be cut square, properly reamed, and free of any burrs or sharp edges. Joints shall be made up wrench tight with at least five full threads engaged. Threads shall be coated with Crouse-Hinds STL compound.
15. Excessive threading shall be avoided.
16. Use of running threads shall not be permitted.
17. Marks and breaks in galvanized coating of conduit, boxes, and fittings shall be touched up with zinc-rich coating. Coat threaded conduit ends that are not galvanized with a zinc-rich compound prior to application of STL compound.
18. Threaded fittings and threaded parts of enclosures shall be treated with Crouse-Hinds STL compound before being made up. Ground joints of fittings and enclosures shall receive a light coat of STL compound. Before final make-up of all enclosures, threads and joints shall be thoroughly cleaned and STL reapplied.
19. Flexible Liquid-Tight Metallic Conduit:

    a. Type UA, at devices subject to vibration, movement for belt adjustments, operational inspection and maintenance facility.
    b. Terminate at both ends using insulated, threaded, watertight connectors or hubs, Appleton type "STB" with external grounding lugs.

20. Flexible conduit connections to motors with belt drives shall be long enough and installed in such a manner as to facilitate belt tightening or replacement without distorting flexible conduit.
21. Conduit shall be installed in such a manner as to prevent collection of trapped condensation and arranged so as to be free of traps.

M. Grounding and Bonding (Contractor's standard GTG package Grounding and Bonding system is provided. Refer to Contractor's Wiring Diagram Earthing and Bonding 86990 for detail.):

1. Electrical circuits, exposed noncurrent carrying metal parts of electrical equipment, and metal structures shall be grounded in accordance with provisions of NEC.
2. Neutrals of each transformer shall be solidly grounded only at transformer. Insulated neutral bus at distribution panel shall be connected to transformer ground with insulated wire.
3. Grounding cables and wires shall be insulated to prevent corrosion.
4. Skid-mounted packaged systems shall include threaded stud connectors at each end of skid, diagonally opposite each other, sized appropriately to accept and connect No. 2/0 AWG stranded copper ground taps.
5. Electrical equipment rated 600 volts or less which is solidly mounted on metallic switch rack will be considered adequately grounded providing switch rack is solidly grounded.
6. Liquid-tight flexible metal conduit containing power circuits shall have an external bonding jumper.
7. Provide copper ground bus with necessary mechanical lugs in control and panel enclosures. This bus shall be grounded to skid steel.
8. Cases of instruments, relays, and meters in control panel shall be grounded effectively to panel frame.
9. Motors shall be grounded through conduit system and equipment grounding conductor run with phase conductors.
10. Bond together conduits entering sheet metal enclosure to provide ground continuity of conduit system.
11. Provide appropriate threaded stud connectors at medium-voltage motor bases for attachment to plant ground system.

N. Equipment Tag Numbers (Contractor's standard GTG package equipment tag numbers are provided. Refer to Nameplate Schedule 969013 drawing for detail.) :

1. Provide firmly attached nameplate for each item of electrical equipment and each control station.
2. Three-ply laminated phenolic plate engraved to show equipment device number, function and service; black-white-black and engraved through black lamination.
3. Lettering: 3/16 inch, minimum.
4. Nameplates for emergency equipment or for warning shall be red-white-red, engraved through red lamination.
5. Nameplates shall be attached with stainless steel screws.

2.3 SOURCE QUALITY CONTROL

A. Testing: (Contractor's standard GTG static testing is provided. Please refer to LM6000 STATIC TEST PROCEDURE for details.)

1. Electrical equipment furnished shall be assembled, wired, and static tested at factory.
2. Factory tests shall include, but not be limited to:

   a. DC high voltage test, where applicable.
   b. Complete functional test of components.
   c. Conductors in raceways shall be meggered before terminating.

3. Perform continuity test on electrical circuits to verify devices are installed and connected in accordance with Drawings and Specifications.

PART 3 - EXECUTION - NOT USED

PART 4 - SUPPLEMENTS

The supplements listed below, following "END OF SECTION," are a part of this Specification:

1. Electrical Equipment and Material List.

END OF SECTION 260000

SUPPLEMENT A ELECTRICAL EQUIPMENT AND MATERIAL LIST

A. Electrical items required for the package shall be from Contractor approved vendors.
   1. Circuit Breakers (Westinghouse, GE, Sq D, Siemens)
   2. Control Fuses For all applications (Bussman) (self-indicating when available)
   3. Enclosures (See Section 3.0) Control panel, operators panel (Hoffman or equal)
   4. Junction boxes (Hoffman, Killark, Crouse Hinds or equal)
   5. Control Devices

      a. Push Buttons, Oil-tight: Cutler Hammer, Allen Bradley.
      b. 120 Volt Manual Motor Starters:

         1) Crouse-Hinds Type EFS - Indoor.
         2) Crouse-Hinds Type OFC - Outdoor.

      c. Momentary contacts shall be rocker-arm type.

   6. Relays, Nontime Delay:

      a. AC:

         1) Industrial control type.
         2) Allen Bradley, Bulletin 700 Type P; Cutler Hammer, Type M-600; Westinghouse, Type AR; GE, Type CR.

      b. DC: Allen-Bradley, Bulletin 700, Type N; Westinghouse, Type ARD.

   7. Relay, Time Delay:

      a. Pneumatic Time Delay Relay:

         1) Industrial grade.
         2) Temperature compensation with plug-in headers.
         3) Agastat, Series 7000.

      b. Solid State Timing Relay:

         1) Industrial grade.
         2) Temperature compensation with plug-in headers.
         3) Agastat, Series 9000.

   8. Sequence Timers: ATC, Series 2400 Motor Driven Contact Type.
   9. 120-Volt Receptacle:

      a. NEMA grounded type.
      b. Specification grade.
      c. Hubbell.

   10. Panelboards: G.E., Westinghouse or Square D.
   11. Conduit Seals: Drain Type; Crouse-Hinds, Type EYS.
   12. Conduit, Flexible: Anaconda, Sealtite.
   13. Conduit Fittings, Condulets:

a. Crouse-Hinds Form 8, or BUB, LBD.
b. With cast covers and solid neoprene gaskets.
c. Appleton.

14. Flexible Conduit Fittings:

a. Insulated bushings.
b. External grounding lugs.
c. Appleton, OZ, Crouse-Hinds.

15. Transformers, Dry Type, 3-Phase: Westinghouse, Type EPT, 3 phase or equal.
16. Heater Wiring: Rockbestos Firezone 101 Aircraft Wire.
17. Wire Markers: Brady, all temperature.
18. Portable Cord: Heavy-duty type "SO" portable cord Okonite. Connector: C-H, type CGB.
19. Terminal Blocks: Phoenix Contact DIN Rail mount or equivalent Weidmuller terminal blocks.
20. Wire Lugs: Compression Ring Type, T&B Sta-kon.
21. Ground Lugs: Mechanical Type, Burndy.
22. 480-Volt Motor Starters Contactors: Allen-Bradley, G.E., Square D, Cutler Hammer, W

PASADENA WATER & POWER

Glenarm Repowering Project
GT-5 Combined Cycle Installation)

Section 261050
Medium Voltage Motors

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 261050
Medium Voltage Motors

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: STEVE HARRIS

REVISION HISTORY		
DATE	REVISED BY	REVISION
6/29/2011	B. TURNER	A
9/14/2011	S. HARRIS	B
9/10/2013		C – CONTRACT VERSION

SECTION 261050
MEDIUM VOLTAGE MOTORS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 GENERAL **1**
1.2 BID DATA **1**
1.3 DESIGN DATA **1**
1.4 DESIGN OPERATING CONDITIONS **1**
1.5 EQUIPMENT AND SERVICES TO BE PROVIDED BY THE VENDOR **1**
1.6 EQUIPMENT TO BE PROVIDED BY OTHERS **1**
1.7 CODES AND STANDARDS **1**
1.8 DEFINITIONS **2**
1.9 DOCUMENTATION **2**
1.10 SPARE PARTS **2**
1.11 TECHNICAL DIRECTION OF INSTALLATION **2**
1.12 GUARANTEES **3**

PART 2 - PRODUCTS 3

2.1 GENERAL REQUIREMENTS **3**
2.2 SPECIAL TOOLS AND DEVICES **5**
2.3 TESTS **5**
2.4 NOISE EMISSIONS **5**
2.5 SHOP ASSEMBLY AND SHIPMENT **5**
2.6 CLEANING, FINISHING, AND PAINTING **5**

PART 3 - EXECUTION 6

SECTION 261050
MEDIUM VOLTAGE MOTORS

PART 1 - GENERAL

1.1 GENERAL

A. This specification is for the design and supply of various sized 4000 Volt motors, defined herein. The electric motor is supplied to drive equipment specified separately per the mechanical equipment package specification.

B. If the bidder can offer alternatives that have more attractive costs and schedule these alternatives can be offered. The bidder shall clearly identify exceptions to the equipment identified herein.

1.2 BID DATA

A. Contractor shall submit with bid detailed description of its offering. The Contractor will provide the information required on the attached data sheet for each motor provided.

1.3 DESIGN DATA

A. Refer to Mechanical Equipment Specification

1.4 DESIGN OPERATING CONDITIONS

A. Refer to Mechanical Equipment Specification

1.5 EQUIPMENT AND SERVICES TO BE PROVIDED BY THE VENDOR

A. Major equipment to be furnished shall consist of: 4000 Volt motors in addition to the equipment specified under the Mechanical Equipment Specification.

1.6 EQUIPMENT TO BE PROVIDED BY OTHERS

A. Material receiving unloading and storage

1.7 CODES AND STANDARDS

A. All equipment covered by this Specification shall be designed, manufactured, installed and tested in accordance with currently approved or accepted provisions of the following Codes, Standards and Regulations as stated herein where applicable.

American National Standards Assn.	ANSI
Institute of Electrical and Electronics Engineers	IEEE
National Electric Manufacturers Assn.	NEMA
National Fire Protection Assn.	NFPA

Occupational Safety and Health Administration	OSHA
Underwriters Laboratories	UL

B. Including but not limited to:

ANSI/IEEE C37	
ANSI/IEEE C57	
Energy Conservation Standards	10CFR431.42
NEMA MG-1	
National Electrical Code	NEC
National Electric Safety Code	NESC
Uniform Building Code	UBC

1.8 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.9 DOCUMENTATION

A. Documentation shall be submitted as indicated on that attached Vendor Data sheet Table. Documentation delivery is critical to the execution of this project. Timely submittals are required.

B. In addition to other design drawings and data, Contractor shall provide a complete listing of interface connections indicating, as a minimum, description, reference drawing, size and pressure rating, design pressures and temperature, and maximum operating pressures, temperatures, and flow rates. The Contractor shall also provide allowable loads for all connections during the design phase.

1.10 SPARE PARTS

A. The Contractor shall furnish a recommended spare parts list with prices within 180 days of issuance of a Purchase Order.

1.11 TECHNICAL DIRECTION OF INSTALLATION

A. The Contractor shall quote its standard daily rates for installation and startup assistance.

1.12 GUARANTEES

A. Refer to Specification 481100 Combined Cycle Power Island Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. This specification is applicable to motors that are above NEMA frame sizes. (i.e. larger than 150 Hp at 900 rpm and 200 Hp at 1200 or 1800 rpm and all motors above 575 Volts.)

B. The motor shall be a squirrel cage induction motor having copper stator windings and rotors that are copper, brass, bronze, or aluminum. The motor shall be designed for Class B insulation temperature rise but insulated throughout with Class F or higher insulation.

C. The motor shall start and accelerate the driven equipment to rated speed with a variation in voltage of plus or minus 10% at rated frequency, a variation in frequency of plus or minus 5% with rated voltage, or a combined variation of 10% if the variation in frequency does not exceed 5%. The starting current shall not exceed 6.3 times full load current (1.0 service factor loading). The full load power factor shall be 0.85 or higher. The motor efficiency shall be at least 95% as measured using IEEE Standard 112.

D. Bearings

1. Where possible motors rated at or below 500 Hp at 3600 or 1800 rpm, 350 Hp at 1200 rpm, or 250 Hp at lower speeds be supplied with anti-friction ball or roller bearings. The minimum L_{10} life shall be 100,000 hours for direct coupled service and 40,000 hours for belt drive or chain drive service. The bearings shall be re-greasable and designed so that they may be safely lubricated while the motor is in service. The bearings shall be covered or sealed to prevent the entrance of foreign material.
2. Sleeve bearings shall be of the oil ring type. Oil rings shall be of a one piece design. Insulation shall be provided to prevent circulation of stray or shaft currents through the bearings, bearing temperature detector connections, or oil piping connections. Both ends of the shaft shall be marked to show when the rotor is at the magnetic center position and the limits of end float with a permanent reference point on the bearing housing or shaft seal.

E. Vertical Motor Thrust: Vertical motors shall have plate type upthrust and downthrust bearings and lower guide bearings.

F. Current Transformers: Relay accuracy current transformers with 5 Amp secondaries shall be furnished and mounted in the motor lead terminal box on all motors rated 2500 Hp or greater. The CTs shall be wired to a shorting type terminal strip that will accept ring tongue terminals for 10AWG wire. This terminal strip shall be installed in a terminal box separate from the motor lead terminal box.

G. Enclosure: All enclosure parts shall be made of cast iron, cast steel, sheet steel, or steel plate. Aluminum is not acceptable.

H. Nameplate: The following additional information shall be shown on the nameplate or an auxiliary nameplate or Motor datasheet.

1. Efficiency and Full Load Power Factor
2. Locked Rotor Power Factor
3. Serial Number and Date of Manufacture
4. Starting limitations, if any
5. Insulation system class
6. Design altitude and maximum ambient temperature.
7. Recommended type of bearing lubricant.

I. Soleplate: A soleplate shall be provided. There shall be sufficient open space around the motor feet that the feet and soleplate can be drilled for dowel pins.

J. Space Heaters: All motors shall have space heaters. Heat requirements of up to 720 Watts shall be met by using 240 Volt heaters on a 120 Volt circuit and increasing the rating of the heaters to compensate for the lower voltage. Requirement of over 1200 Watts shall be met by using 277 Volt heaters energized at either 208 or 240 volts as shown on the returned approval drawings. The heaters shall be adequate to prevent condensation at any temperature down to the lowest ambient temperature shown in the detailed requirements and shall not cause the motor to overheat if turned on at maximum motor load at the highest ambient temperature. The heaters shall be accessible without disassembling or removing any parts of the motor or moving the motor. The heaters shall be mounted so they do not damage any components or the motor finish.

K. Surge Capacitors: Surge capacitors shall be installed on all motors rated 2500 Hp or more.

L. Temperature Detectors: All motors with sleeve bearings shall have ungrounded platinum bearing RTDs installed and wired to terminal strips in a separate junction box. All motors rated 1000 Hp or more shall have two ungrounded platinum RTDs installed on each stator winding with leads installed and wired out to terminals in the same junction box as the bearing thermocouples. The terminal strips shall have space for individually terminating the RTD ground lead.

M. Terminal Box:

1. The minimum size for the motor lead terminal box on 2300 Volt and 4000 Volt motors through 1250 Hp is 2000 cubic inches. Motors of these voltages from 1250 through 6000 Hp shall have 5600 cubic inch boxes. The terminal box shall be split diagonally and the joint shall be gasketed. The terminal box shall be rotatable in 90° increments so that the conduit can enter from any direction. The terminal box shall not interfere with the base, soleplate, or any other box or device in any position to which it may be turned. A terminal connected to the motor frame shall be provided in the motor lead terminal box for connection to the grounding conductor. The motor leads shall have NEMA space 2-hole lugs for connection to the power cable. Where supplied the surge capacitors and current transformers shall be mounted in the motor lead terminal box.
2. Separate terminal boxes shall be provided for the current transformer and RTD leads, and for the motor heater leads.

N. The motors shall be supplied by

1. General Electric

2. Reliance
3. Siemens
4. TECO-Westinghouse
5. U.S. Motors

2.2 SPECIAL TOOLS AND DEVICES

A. One (1) complete set of special tools and lifting devices, including any metric wrenches required for operation and maintenance of the equipment furnished under this Specification, shall be furnished with the equipment in a separate container clearly identified with the name of the equipment and the Buyer's contract number. These tools and devices shall be in a new and unused condition on delivery.

2.3 TESTS

A. The systems shall be factory tested in accordance with the codes specified herein. Customer may observe testing.

2.4 NOISE EMISSIONS

A. Refer to the Combined Cycle Power Island Noise Control Performance Specification.

2.5 SHOP ASSEMBLY AND SHIPMENT

A. Equipment shall be shipped in the fewest practical number of shop fabricated and assembled sections. As applicable, all component parts of machinery or equipment shall have been formed, machined, welded, stress relieved, tested for defects, balanced, fitted and assembled in the fabricator's shops, then disassembled as necessary for shipment.

B. All items shall be identified to facilitate handling and field installation.

C. Large components or shipping containers shall be fitted with suitable skids where and as required to facilitate handling and for shipping protection. As applicable, all components shall be boxed, capped, plugged or otherwise suitably prepared in a manner that will prevent loss and protect them against dirt, rust, weather, and entrance of foreign matter or other damage during transit, pre-erection storage and field handling. Shipping protection shall be adequate for up to 3 month's outdoor field storage.

D. As a minimum, each container shall be permanently marked with an identification number, a list of its contents and the Buyer's purchase order number.

2.6 CLEANING, FINISHING, AND PAINTING

A. All surfaces, except interior surfaces of any pressure parts, shall be thoroughly cleaned of all mill scale, grease, weld spatter, slag, and other foreign matter in accordance with Contractor's standard practice. All non stainless steel equipment shall be painted in accordance with the manufacturer’s standard.

PART 3 - EXECUTION

Not Applicable

END OF SECTION 261050

	INDUCTION MOTOR DATA SHEET ☐ INQUIRY ☐ PROPOSAL ☐ STUDY ☐ PROJECT	ITEM NUMBER	PAGE OF
PROJECT: GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)			BY / DATE
REVISIONS	A / B / C / D		
SERVICE:	MANUFACTURER	NO. REQ'D	SOURCE OF QUOTE

CONDITIONS OF SERVICE AND CONSTRUCTION FEATURES

NAMEPLATE HP	Eff. ☐ Std. ☐ High	SYN SPED RPM
VOLTS: 4000V PHASE	HZ	NEMA DESIGN
SERVICE FACTOR ☐ 1.0 ☐ 1.15		TEMPERATURE RISE °C

MULTISPEED: ☐ NOT APPLICABLE
☐ SINGLE WINDING ☐ TWO WINDING
☐ VARIABLE TORQUE ☐ CONSTANT HORSEPOWER
☐ CONSTANT TORQUE ☐

LOCATION: ALTITUDE 750 FT AMBIENT TEMPERATURE: 40AVE/50MAX °C

AREA CLASSIFICATION CLASS DIV. GROUP

AUTO IGNITION TEMP.: °C OPERATING ATMOSPHERE:

ENCLOSURE: ☐ OPEN-DRIP PROOF ☐ TEFC ☐ TENV
☒ WEATHER PROTECTED (WP II) ☐ MILL & CHEM RESISTANT
☐ FORCED VENTILATED ☐ TEAAC
☐ DUST-IGN. PROOF ☐
☐ EXPLOSION PROOF W/ "T" CODE MARKING **{NOTE 4}**

STARTING CONDITIONS:
☐ LOADED ☐ UNLOADED
☒ FULL VOLTAGE ☐ REDUCED VOLTAGE
MINIMUM STARTING VOLTAGE % OF RATED 80

INSULATION CLASS:
TYPE ☐ MFR.'S STANDARD ☐ ENCAPSULATED ☐ VPI

ROTATION FACING END OPPOSITE DRIVE:
☐ CLOCKWISE ☐ COUNTERCLOCKWISE ☐ REVERSIBLE

BEARINGS: ☐ ANTI FRICTION ☐ SPLIT SLEEVE ☐ GREASE LUBRICATED ☐ OIL LUBRICATED

MOUNTING: ☐ HORIZONTAL ☐ VERTICAL SOLID SHAFT ☐ VERTICAL HOLLOW SHAFT

DRIVE SYSTEM: ☐ DIRECT COUPLED ☐ GEAR UNIT ☐ V BELTS ☐ CHAIN

☐ HALF COUPLING PRESSED ON BY MOTOR SUPPLIER

ACCESSORY EQUIPMENT

☐ BASEPLATE ☐ SOLE PLATE FURNISHED BY:
☐ COUPLING FURNISHED BY:
☐ SPACE HEATER 120 VOLTS 1 PHASE
☐ AIR FILTERS ☐ GUARD SCREENS
☐ STATOR WINDING TEMPERATURE DETECTORS
☐ 120 OHM RTD, 2 PER PHASE, WIRED TO JUNCTION BOX
☐ THERMOSTAT, 1 PER MOTOR, WIRED TO JUNCTION BOX
☐ DRAIN/BREATHER
☐ CTS FOR DIFFERENTIAL PROTECTION, RATIO
☐ BEARING TEMPERATURE DETECTORS
☐ 120 OHM RTD, 1 PER BEARING, WIRED TO JUNCTION BOX
☐ THERMOCOUPLE, 1 PER BEARING, WIRED TO JUNCTION BOX
☐ BEARING OIL SUMP HEATERS
☐ BEARING VIBRATION DETECTORS
☐ SURGE CAPACITOR MDT. IN TERMINAL BOX
☐ MOTOR CONTROLLER BY MOTOR SUPPLIER

DATA SUPPLIED BY MOTOR MANUFACTURER OR VENDOR

FRAME NO.	MOTOR TEMPERATURE RISE: °C			
LOAD	1/2	¾	FL	S.F.
EFFICIENCY (%)				
CURRENT (AMPS)				
POWER FACTOR (%)				
KW LOSSES				

LOCKED-ROTOR TORQUE
BREAKDOWN TORQUE
PULL-UP TORQUE
LOCKED-ROTOR CURRENT
LR KVA CODE LETTER
LOCKED-ROTOR WITHSTAND TIME SEC.(COLD) SEC.(HOT)
SUCCESSIVE STARTING LIMITATIONS
FULL LOAD SPEED RPM
FAN ROTATION: ☐ UNIDIRECTIONAL ☐ REVERSIBLE
LOAD WK^2 LB-FT^2
ROTOR WK^2 LB-FT^2
LOAD CAPABILITY WK^2 LB-FT^2
SPACE HEATER WATTS
MOTOR NET WEIGHT LBS.
MAX. ERECTION WEIGHT LBS.
MAX. OVERALL: L W H

TERMINAL BOX:
☐ SIZED FOR MOTOR LEADS ONLY
☐ OVERSIZED FOR MOTOR LEADS WITH STRESS CONES
☐ GROUND LUG MOUNTED INSIDE SIZE AWG
☐ SEPARATE AUXILIARY
☐ SEPARATE EXTERNAL GROUND PAD OR STUD (50 HP AND ABOVE)

ADDITIONAL SPECIFICATION REQUIRMENTS OR REMARKS:

(1) THE CONTRACTOR SHALL COMPLETE ALL BLANK ITEMS ON DATA
(2) CONTRACTOR TO ADD ADDITIONAL PERTINENT DATA BELOW THESE NOTES.
(3) SPACE HEATERS ARE REQUIRED ON ALL MOTORS
(4) SEE MECHANICAL EQUIPMENT SPECIFICATION AND/OR EQUIPMENT DATA SHEET FOR ADDITIONAL INFORMATION. SELECT PROPER ENCLOSURE ACCORDINGLY.

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PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 261200

Generator Step-up Transformer

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 261200
Generator Step-up Transformers

Prepared for: *PASADENA WATER & POWER*
Prepared by: *BLAKE TURNER, P.E.*

REVISION HISTORY		
DATE	PREPARED BY	REVISION
05/19/2011	B. Turner	A
09/14/2011	B. Turner	B
02/02/2012	C. Hayward	C
05/04/2012	C. Hayward	D
06/15/2012	G. Harwood	E
10/04/2012	C. Hayward	F
09/10/2013		G – CONTRACT VERSION

SECTION 261200
GENERATOR STEP-UP TRANSFORMER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SCOPE 1
1.2 CODES AND STANDARDS 1
1.3 REFERENCES 1
1.4 DEFINITIONS 1
1.5 SUBMITTALS FOR REVIEW 2
1.6 SUBMITTALS FOR INFORMATION 2
1.7 PROJECT CLOSEOUT SUBMITTALS 2
1.8 DELIVERY, STORAGE, AND HANDLING 2
1.9 MAINTENANCE MATERIALS 3

PART 2 - PRODUCTS 3

2.1 LIQUID-FILLED POWER TRANSFORMER – GENERAL 3
2.2 COOLING CLASS AND TEMPERATURE RISE 3
2.3 SERVICE CONDITIONS 3
2.4 RATINGS 3
2.5 DESIGN FEATURES & CONSTRUCTION 4
2.6 AUXILIARY EQUIPMENT & ACCESSORIES 9
2.7 INSULATING LIQUID 11
2.8 SOURCE QUALITY CONTROL 12

PART 3 - EXECUTION 12

APPENDIX A – DATA SHEET 14

APPENDIX B - VENDOR DATA COMMITMENTS 17

SECTION 261200
GENERATOR STEP-UP TRANSFORMER

PART 1 - GENERAL

1.1 SCOPE

A. Oil-immersed, ONAN/ONAF/ONAF three winding transformer for Generator Step-up Power application. Quantity required – one (1)

B. Final design requirements shall be coordinated with Power Island Contractor to accommodate actual generators' ratings.

1.2 CODES AND STANDARDS

A. Transformer shall conform to the applicable standards of IEEE, NEMA, and ANSI. All materials and devices shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Administration" standards.

B. The transformer shall be designed, fabricated, and tested in accordance with the latest revision of ANSI C57 series and this specification.

C. Transformer and associated equipment shall comply with NERC requirements for Aurora Vulnerability Mitigation.

D. In case of conflict between the requirements of the various parts of these documents, the requirements of the different parts shall govern, to the extent of such conflict, in the following sequence: Mandatory governmental regulations, code, and standards; this specification; the referenced industry codes and standards.

1.3 REFERENCES

A. IEEE C57.12.00-Latest Edition – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers. (ANSI)

B. IEEE C57.116-Latest Edition – Guide for Transformers Directly Connected to Generators

C. IEEE C57.12.90-Latest Edition – Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short–Circuit Testing of Distribution and Power Transformers. (ANSI)

D. IEEE C57.109-Latest Edition– Guide for Liquid Immersed Transformer Through-Fault-Current Duration. (ANSI)

E. NFPA 70 – Latest edition of the National Electrical Code.

F. IEEE 693 – Recommended Practice for Seismic Design of Substations

1.4 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.5 SUBMITTALS FOR REVIEW

A. Vendor Documentation requirements shall be provided in accordance with attached Vendor Data Commitments and shall be considered as part of this technical specification.

B. Approval drawings shall include the following Refer to Attachment 11 – Drawing Schedule:

C. Drawing Requirements:

1. Each drawing title block shall include the PO number, date, revision number, revision description and project name.

1.6 SUBMITTALS FOR INFORMATION Refer to Attachment 11 – Drawing Schedule

1.7 PROJECT CLOSEOUT SUBMITTALS

A. The manufacturer shall provide the General Manager with electronic media of all drawings, manuals, and instruction books. All drawings shall be submitted as .dwg files compatible with AutoCAD 2000.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Transformer shall be delivered DDP to the rail siding at the site, freight allowed as indicated in applicable purchase order. Project site is 72E Glenarm, Pasadena, California

B. Transformer shall be shipped in an upright position (no split tank designs). Transformer shall be shipped sealed at -40F Dew Point with pressure gauge showing positive dry air pressure on depressed railroad car.

C. The transformer oil shall be shipped separately. The manufacturer shall furnish the oil by bulk shipment in truck trailers (no returnable drums) to the construction site at the time designated by the BOP Contractor.

D. The manufacturer shall mount and ship an impact recorder on the rail car or truck transporting the transformer and shall mount and ship an impact recorder on the transformer. The impact recorders shall be mounted at the factory to provide a permanent record of the magnitude of axial, transverse, and vertical forces to which the transformer was subjected while in transit. The recorder mounted on the transformer shall be removed once the transformer is set and aligned on its foundation. General Manager will remove and retain charts and return recorders to manufacturer.

1.9 MAINTENANCE MATERIALS

A. Special tools are not required.

B. The manufacturer shall furnish one (1) complete extra set of gaskets for all items removed for shipment and all items that are normally removed for inspection during installation or maintenance.

PART 2 - PRODUCTS

2.1 LIQUID-FILLED POWER TRANSFORMER – GENERAL

A. This part describes the design and construction of three phase, three-winding, pad mounted, oil immersed power transformer, outdoor locations for use in generator step-up application.

B. Equipment Tag Identification: Generator Step-up Transformer

2.2 COOLING CLASS AND TEMPERATURE RISE

A. Transformer shall be rated ONAN/ONAF/ONAF with 65° C rise above ambient conditions noted in the Section 480020 Site Conditions. Winding and hot spot temperature rise shall be per ANSI Standards.

B. The manufacturer shall install forced cooling equipment on transformer.

2.3 SERVICE CONDITIONS

A. Reference Section 480020 Site Conditions for Project environmental requirements.

2.4 RATINGS

A. Generator Step-up Transformer

1. Capacity: The transformer shall be designed to deliver the full capacity listed below at the site elevation. Transformer nameplate shall indicate site elevation.

   a. H: 57/76/95 MVA @ 65° C rise, Class ONAN/ONAF/ONAF
   b. X: 45/60/75 MVA @ 65° C rise, Class ONAN/ONAF/ONAF
   c. Y: 12/16/20 MVA @ 65° C rise, Class ONAN/ONAF/ONAF

2. High Voltage Winding: 34.5 kV 3-phase, 60 Hz, Grounded Wye connected.
3. High Voltage Taps: Two (2) 2.5% full capacity taps above nominal rated voltage; two (2) 2.5% full capacity taps below nominal rated voltage, arranged for de-energized operation.
4. Low Voltage Winding X: 13800 Volt delta (delta must be closed inside main tank).
5. Low Voltage Winding Y: 13800 Volt delta (delta must be closed inside main tank).
6. Vector Relationship: Standard phase displacement, i.e. high voltage (H1 to neutral) leading the low voltage (X1 & Y1 to neutral) by 30 degrees.
7. Voltage Classifications

   a. 13.8 kV windings – External :110 kV BIL @ 3300 ft. elevation
      Internal: 110 kV BIL

b. 34.5 kV winding – External:200 kV BIL@ 3300 ft. elevation
Internal: 200 kV BIL

8. Impedance: The positive sequence impedance shall be as indicated in the data sheets. Impedance tolerance shall be ± 10% per IEEE C57.12.00-2010, Section 9.2. The negative sequence shall be equal to the positive sequence impedance. The zero sequence impedance shall be equal to or less than the positive sequence impedance.

9. Sound Levels: NEMA TR-1

2.5 DESIGN FEATURES & CONSTRUCTION

A. Short Circuit & Overvoltage Capacity

1. Transformer shall be capable of withstanding, without damage, the mechanical and thermal stresses caused by short circuits limited only by the transformer impedance on the external terminals of any winding or windings, with 100% rated voltage maintained across the terminals of any other winding connected to an energy source. These constraints shall be subject to the following provisions:

a. The magnitude of the RMS symmetrical current in any winding of the transformer does not exceed twenty-five (25) times the base current of the winding.
b. The duration of the short circuit shall be in accordance with the latest edition IEEE C57.109, "Guide for Liquid Immersed Transformer Through-Fault-Current Duration".

2. The transformer shall be designed to be self-protecting from all through faults, three-phase, single line-to-ground, double line-to-ground, and line-to-line on any one set of terminals at a time.
3. The transformer shall be capable of operating above rated voltage or below rated frequency as required in the latest edition of IEEE C57.12.00- 4.1.6.1.

B. High Voltage Bushings [Bushings are offered in accordance with ANSI C57.19.01-1991]

1. Phase Bushings

a. High Voltage bushings shall be side wall mounted (Segment 3) with draw through leads, oil filled, porcelain clad, sky gray glaze (ANSI-70 color), with liquid level indicators, 34.5 kV class, 200 kV BIL at 3300 feet, 1800 amp, ANSI transformer type for side wall mounting. Micafil and Lapp PRC bushings are NOT ACCEPTABLE. One spare high voltage bushing shall be provided for the Project.
b. High bushing voltage bushing shall be supplied with caps having a stud with 1.5" – 12 thread-UNF-2A threaded section, with a minimum 2.0" useable thread length.
c. Bushings shall be furnished with NEMA four hole (four 9/16" holes on 1-3/4" centers), flat pad terminals for vertical take-off suitable of EHV service.
d. Each high voltage bushing shall have three (3) bushing current transformers, 2000:5 MR, C800. Ratios are subject to change.

1) The continuous thermal rating factor for the CTs shall be 2.0.

2. High Voltage Termination Compartment

a. Tank wall mounted bushings shall be enclosed in an oil-filled compartment mounted on the side of the transformer. The bottom of the compartment will be at least 84 inches above ground.

b. The compartment shall have gasketed front and top covers equipped with handles. The covers shall be large to permit works that include the installation of cable terminators and the connections between bushings and terminators. The front cover shall be hinged.
c. A total of twelve terminators shall be installed.
d. Flexible connections between bushings and terminators shall be supplied for later installation at delivery site. Do not install the connectors.
e. Nitrogen for oil preservation shall be fed with a separate control valve rated for full vacuum.

3. Neutral Bushing

a. The high voltage neutral bushing shall be top mounted (Segment 2), 25kV class, 150kV BIL 1800 amp and be equipped with a 1200/5-ampere, multi-ratio (5-terminal), C800 accuracy class current transformer. Bushing porcelain color shall be ANSI 70 gray.
b. Bushings shall be furnished with NEMA four hole (four 9/16" holes on 1-3/4" centers), flat pad, single tank terminals for vertical take-off.

C. Low Voltage Bushings (X Winding) [Bushings are offered in accordance with ANSI C57.19.01-1991]

1. Phase Bushings

a. Low voltage phase bushings shall be wall mounted (Segment 1), oil filled, porcelain clad, 15 kV class, 110 kV BIL. One spare low voltage bushing shall be provided for the Project.
b. Transformer low voltage terminals shall be furnished with enclosure flanges for connection to the customer's non-segregated phase bus duct. The low voltage bushings shall be rated for connection to bus operating at 105°C.
c. Bushings shall be furnished with NEMA four hole (four 9/16" holes on 1-3/4" centers), flat pad, terminals for horizontal take-off and shall have the same current rating as the bushing.
d. Each low voltage bushing shall have two (2) bushing current transformers, 4000:5 MR, C800.

1) The continuous thermal rating factor for the CTs shall be 2.0.

D. Low Voltage Bushings (Y Winding) [Bushings are offered in accordance with ANSI C57.19.01-1991]

1. Phase Bushings

a. Low voltage phase bushings shall be wall mounted (Segment 1), oil filled, porcelain clad, 15 kV class, 110 kV BIL. One spare low voltage bushing shall be provided for the Project.
b. Transformer low voltage terminals shall be furnished with enclosure flanges for connection to the customer's non-segregated phase bus duct. The low voltage bushings shall be rated for connection to bus operating at 105°C.
c. Bushings shall be furnished with NEMA four hole (four 9/16" holes on 1-3/4" centers), flat pad, terminals for horizontal take-off and shall have the same current rating as the bushing.
d. Each low voltage bushing shall have two (2) bushing current transformers, 1200:5 MR, C800.

1) The continuous thermal rating factor for the CTs shall be 2.0.

E. Transformer Grounding

1. Tank Ground: The manufacturer shall furnish four (4) copper faced steel grounding pads welded to the transformer base at each corner. These pads shall be NEMA drilled and tapped; i.e., two (2) ½" x 13 UNC threaded holes on 1-3/4" centers.
2. Core Ground: The core ground shall be brought through the tank wall using a 5 kV bushing of appropriate ampacity. The core ground bushing and intentional ground connection shall be enclosed in a covered housing. The H-0 bushing ground connection shall be made to a NEMA drilled and tapped, copper faced, steel ground pad located near the bushing. Manufacturer shall furnish a permanently installed ¼" x 3" copper ground bus or cable of appropriate ampacity. This bus or cable shall be installed from a grounding pad (two (2) ½" x 13 UNC threaded holes on 1-3/4" centers) on the transformer cover adjacent to the neutral grounding bushing, down the side of the tank to another identical ground pad located 6 (six) inches from the bottom of the transformer base. The bottom pad shall be drilled identical to the upper ground pad.

F. Core and Coils

1. Core and Coils shall be braced to withstand short-circuit forces limited only by the transformer impedance without damage or displacement of the coil on the core, and to withstand normal moving and handling without the use of special shipping braces.
2. Transformer coils shall be copper. The coils shall be insulated from the core and from each other with sufficient insulation to withstand the standard impulse and low frequency tests for transformer of the designed voltage class.

G. Oil Preservation System

1. The oil preservation system shall be automatic, positive pressure, inert-gas type ("Atmoseal" (COPS) will be accepted as an alternate.) All alarm contacts shall be wired to the main control cabinet.
2. Inert-gas type systems shall have a ratio of gas expansion volume to oil volume of at least 10%. The gas control cabinet shall be mounted at eyelevel on either end of the main tank, and shall include a gas-sampling valve for connection to a portable analyzer. Two standard gas storage bottles shall be supplied with the transformer.
3. The serial number of these bottles shall appear on the invoice for the transformer.
4. All tanks and enclosures subject to operating pressures of the oil preservation system shall be designed to withstand 125 percent of the maximum operating pressures, positive or negative. In addition, transformer shall be designed with sufficient bracing and strength to permit full vacuum filling with insulating liquid.
5. The nitrogen cylinder shall be equipped with two wire loop pressure transducer with a 4 to 20 ma DC output signal for input to the Qualitrol 509-ITM transformer monitor. Nitrogen cylinder and all associated equipment shall be enclosed in a weatherproof cabinet mounted on the transformer and at ground level. Nitrogen cylinder fittings shall use SAE threads for nitrogen bottles.
6. The preservation system shall have necessary pressure-vacuum bleeder, pressure-vacuum gauge, gas sample devices and gas pressure alarms for the transformer and a low-pressure alarm for the gas cylinder. Waukesha Inert Air Systems with rigid pigtail shall be provided. Waukesha data sheets shall be attached.

H. Cooling Equipment

1. Integrally mounted equipment shall be furnished to provide the cooling capacity necessary to maintain the transformer rating. Temperature control shall be provided by an assembly of devices arranged and designed to automatically vary the transformer cooling capacity in steps proportional to transformer load and temperature.

2. Cooling Fan Motors

   a. 480 volt, 3-phase, 60 Hz.
   b. All fan motors shall be totally enclosed, non-ventilated, with sealed, pre-lubricated ball bearings, and rated for all-weather outdoor operation.
   c. The motors furnished shall be designed, manufactured and routine tested shall operate in accordance with the latest applicable OSHA, NEMA, IEEE, and ANSI standards. In addition, the motors shall comply with any applicable standards and tests that may be specified herein.
   d. All motors shall operate successfully at their specified rating at the ambient temperature and altitude specified in the service conditions. The motors shall be high efficiency type.
   e. The continuous horsepower nameplate rating shall be greater than or equal to the maximum brake horsepower required by the driven equipment when the driven equipment is operating at the maximum load conditions. Service factor rating shall not be used to meet this requirement.
   f. Insulation for all motors shall equal or exceed the requirement for Class B insulation, unless otherwise approved by the General Manager.
   g. Integral horsepower motors shall have a NEMA Design B torque characteristic unless otherwise required by driven equipment.
   h. Fan guards shall be provided in accordance with latest OSHA safeguard requirements.

3. Controls

   a. The transformer cooling equipment control system shall utilize control contacts furnished in the Electronic Temperature Monitor (ETM). ETM shall be Qualitrol Corporation Model 509-ITM. This relay shall be equipped with 100 ohm platinum probe and shall be housed in a NEMA 3R (vented) UV resistant, corrosion proof fiberglass housing. The H.V. and L.V. hot-spot CT secondary outputs shall be wired into the ETM. A two pole shorting type test switch shall be provided in the hot-spot CTs secondary leads to facilitate testing.
   b. An additional top-oil temperature thermometer (Bourden Tube probe style) shall be provided with the contacts wired for parallel T.O. alarms to the ETM. This thermometer shall be mounted at eye level on the transformer.
   c. The ETM shall be set up for manually alternating the cooling fan operation sequence. Manual control switches shall be provided in the control cabinet to allow testing and maintenance of the cooling fans

4. Transformer cooling equipment shall be designed and arranged to allow individual radiators to be removed from the transformer without removing the transformer from service or draining oil from any other transformer component.
5. Manually operated shutoff valves shall be provided, as required, for cooling equipment removal. All shutoff valves shall be bolted-flange mounted, and shall have provisions for padlocking in the opening or closed position.
6. Each removable radiator shall have a top and bottom shut-off valve to allow the radiator to be removed without draining oil from any other part. Each removable radiator shall be equipped with a bottom drain plug and a top vent plug.

I. Mechanical Construction

1. All tanks, bases, radiators, covers, junction boxes when required, and any other attached compartments shall be fabricated from steel of sufficient strength to withstand normal service stresses without distortion or damage to any part. The base shall be extra heavy, suitable for rolling or skidding in any direction.

2. The transformer tank shall have the centerline and center of gravity permanently marked on all four (4) sides.
3. Two (2) manholes, a minimum of 24" in diameter in the cover for access.
4. The cover shall be domed to shed water and aid in gas collection for the gas detection relay.
5. All joints in transformer tanks, radiators, bases, etc., shall be made gas-tight and oil-tight by welding, except that the connections between oil coolers and tanks shall be provided with gasketed, bolt secured flanges.
6. Transformer shall be equipped with lifting lugs, jack bosses located not less than 15 inches above the base, pulling eyes, skids, and jacking pads to accommodate rollers such as manufactured by Hillman.
7. Four ¼ inch diameter by ¾ inch mounting studs, for customer owned impact recorders, welded to the side of the wall of the transformer tank, accessible from ground level, with vertical spacing of 9-5/8 inches and a horizontal spacing of 8-3/8 inches.
8. The tank finish shall be ANSI sky gray #70 (Munsell No. 5 OBG 7.0/0.4). The tank top (cover) shall be painted with an extra coating of paint including a non-skid medium, A grit or approved "Safety Walk" material. The interior of the transformer shall be painted white or ANSI sky gray #70.
9. The top of the transformer shall be equipped with a removal or collapsible fall protection system. When the removal system is selected, storage for the system shall be provided on top of the transformer. When the collapsible system is selected, provisions shall be provided to secure the system so that it does not vibrate during normal transformer operation. The fall protection system shall meet the requirements of current OSHA regulations.
10. The de-energized tap changer shall be located above the core and coil assembly. The operating handle shall be brought out through the side of the tank where an operator can access from grade.

J. Wiring

1. All control wiring, including CT circuits, shall be terminated with ring tongue (non-insulated) lugs.
2. Control, current transformer, auxiliary power, and alarm circuit wiring shall be 600 volt, standard copper conductor with TA, SIS or other approved insulation. All wiring shall be capable of passing the ICEA Flame Resisting Test, ICEA S-61-402, and Section 6.5. Hinge-type wiring shall be used in all connections to swinging panels. Minimum wire size for bushing current transformer secondary wires shall be #10 AWG. Minimum wire size for control, alarm & monitor wiring shall be #14 AWG.
3. All CT secondary leads shall be brought down to short-circuiting type terminal blocks located in the control cabinet (one 6-point block per CT, PENN-UNION #6006SCS or equal). Each CT shall be wired to a separate terminal block. CT polarity shall be connected to terminal #1 of each block. Terminal #6 shall be grounded.
4. To facilitate connection of the customer's field wiring, all control components, alarm contacts, cooling equipment, and accessories shall be wired to 12-point, barrier type, strap-screw terminal blocks. Terminals shall be labeled with white terminal identification marking strips. Terminal blocks shall be mounted on the sides or back wall of the transformer control cabinet, and shall be easily accessible with normal tools. Terminal block points and associated wiring shall be grouped and separated as to low voltage power, low voltage and instrumentation, low-level signal and current transformer. All terminal blocks shall have at least 20 percent spare positions for use by General Manager.
5. All metallic wiring raceways, electrical enclosures, wire ways, conduit bodies, and fittings shall be corrosion resistant (galvanized, enameled, or otherwise properly coated, inside and out.) Cut threads on conduit shall be properly re-coated to prevent oxidation.

6. All electrical wiring between permanently mounted accessories and the control cabinet shall be enclosed in a rigid steel conduit securely fastened to the transformer tank in a manner to prevent mechanical damage or vibration. All conduit joints and fittings shall be dust tight and watertight.
7. All electrical wiring between the control cabinet and the motors shall be enclosed in conduit, routed on and secured to the tank, up to close proximity points near each motor. All interconnecting cabling between the conduit end and the motors shall be flexible with a sunlight resistant jacket.

K. Seismic Withstand Requirements

1. The transformer shall be qualified according to the requirements of IEEE Std 693. The transformer shall meet the requirements of the high seismic qualification level, with supports and anchorage designed for PGA = 0.60g. Frequency modifying devices shall not be allowed.
2. Manufacturer shall submit along with drawings for approval to the City a statement attesting to compliance with the seismic requirements of this Specification. This statement of compliance shall be signed by a duly authorized representative of Manufacturer and a registered professional engineer.

2.6 AUXILIARY EQUIPMENT & ACCESSORIES

A. The transformer shall be equipped with a high voltage, no-load tap changer with external operating mechanism located on the side of the transformer tank. The tap changer handle shall have provisions for padlocking in any position, and shall provide visible indication of the tap position without unlocking.

B. A single, weatherproof control cabinet shall be provided for all customer conduit and cable connections. The cabinet shall be accessible from ground level, and shall be sized large enough to house all forced air-cooling equipment control components.

1. The control cabinet shall be supplied with thermostatically controlled space heaters to prevent condensation. Space heaters shall be rated 240 VAC, but shall be sized for a normal operating voltage of 120 VAC. Space heater circuits shall be individually protected with molded case circuit breakers.
2. Control power transformers (CPT's) shall be provided within the control cabinet to supply control equipment and space heaters. CPT's shall be protected against overload with molded case circuit breakers. Each auxiliary equipment branch circuit shall be protected by an individual molded case circuit breaker properly coordinated with the CPT breakers.
3. The control cabinet shall be provided with a 120 VAC, duplex grounding receptacle, wired to a 20 amp, molded case circuit breaker. The circuit breaker line side shall be wired to a control cabinet terminal block. The customer will supply one 120 VAC, 60Hz, 20-amp branch circuit to power the receptacle.
4. The control voltage for the sudden pressure relay, and any associated equipment shall be 125 VDC.
5. The control cabinet shall be equipped with a "Loss of DC Alarm Voltage" alarm relay, with alarm contacts wired to a terminal block in the cabinet.
6. All control relays shall have enclosed, dust tight contacts.

C. An automatic, voltage seeking transfer switch shall be provided to supply power to the transformer auxiliary equipment. The customer will supply two (2) sources of nominal 480 volt, 3-phase, 60 Hz power to feed this switch. The automatic transfer equipment shall be of sufficient capacity to transfer the total cooling equipment, control circuit and space heater load from the normal source voltage. Voltage fail-

ure relays shall be installed in order to monitor normal and emergency source voltages. Each relay shall provide a contact closure on loss of voltage. The contacts shall be wired to a terminal block in the control cabinet.

D. Transformer sudden pressure fault relay shall be provided with contacts wired to terminal blocks in the control cabinets. When the sudden pressure relay is activated it shall generate two (2) contact closures that will be maintained until manually reset by a switch located at the transformer control cabinet. One contact closure will be for alarm the other will be for use in high speed transformer protective relaying. Qualitrol Model Number 900–009-01.

E. Tank pressure relief devices shall be supplied for each oil-filled compartment. Each device shall be equipped with an alarm contact and a manual reset, mechanically operated semaphore to indicate that the relief device has operated. Alarm contacts shall be wired to a terminal block in the control cabinet. Qualitrol Model Number 910-011-06.

F. The main tank shall have one Magnetic oil-level indicator to monitor liquid level conditions. The indicator shall include a Potentiometer with a range of 0 to 15000 ohms for input to the Qualitrol 509-ITM transformer monitor. The high voltage termination compartment shall have one Magnetic oil-level indicator to monitor liquid level conditions. All indicators shall show the maximum, minimum and 25 degrees C levels on the gauge faceplate.

G. A main tank top oil temperature indicator/switch shall be located at eye level. Alarm contacts shall be wired to a terminal block in the control cabinet.

1. Dial type thermometers for indicating liquid and winding temperatures shall be mounted in wells as indicated in C57.12.00.
2. For mounting heights of 96 inches or less above the elevation of the transformer base, the face of the thermometer shall be mounted in a vertical plane. For mounting heights greater than 96", the face shall be at an angle of 30 degrees from the vertical plane.
3. The thermometer shall have a dark face dial with light markings, a light colored indicating hand, and an orange-red maximum indicating hand with provision for resetting.
4. The diameter of the dial (inside bezel) shall be 4-1/2 inches +/- 1 inch. 9.5 The dial markings shall cover a range of O degrees C to 160 degrees C.
5. The words "LIQUID TEMPERATURE" or “WINDING TEMPERATURE” shall be on the dial or on a suitable nameplate mounted adjacent to the thermometer.
6. A 10 ohm, copper RTD mounted in a well will be required for liquid temperature input to the Qualitrol Model # 509-ITM monitoring system.

H. The transformer shall be equipped with the Electronic Temperature Monitor (ETM). See paragraph 2.5-H-3-a. , located at eye level. The ETM shall be equipped with (minimum) 4 temperature inputs and 6 outputs.

I. The transformer shall be equipped with an alarm annunciator panel (Rochester or equivalent).

J. Transformer shall be equipped with the following valves and fitting:

1. Drain valve with sampling device.
2. Lower filter press valve with malleable iron (non-galvanized, typ.) pipe plug.
3. 1-1/2” IPS upper filter press valve with malleable iron pipe plug.
4. One 3-inch NPT female threaded opening in the top of the main tank located diametrically opposite to the filter pressure inlet. The pipe opening is to be used for vacuum oil filling and is to be furnished with an extra heavy capped nipple to close the opening.

5. One ½" NPT pipe coupling to be located in the tank wall at the top-oil level for General Manager's use in future installation of an online gas monitor.
6. One ½" NPT pipe coupling to be installed in the tank wall at a position six (6) inches above the bottom of the transformer tank and in the same vertical plane as item 5.

2.7 INSULATING LIQUID

A. Insulating oil shall meet all the requirements defined by ANSI/ASTM D3487-79. It shall be chemically stable, free from acidity or other corrosive ingredients, and shall contain a suitable oxidation inhibitor. Transformer nameplate shall state that the oil is inhibited. The oil shall contain less than 10-ppm water when tested in accordance with the procedures of ASTM D1533 (Karl Fischer method). The dielectric strength of the oil shall be at least 30 kV when tested in accordance with the procedures of ASTM D877, or ASTM D1816 using a 0.040-inch gap.

B. The oil shall have the following characteristics:

1.	Viscosity: (ASTM D-88)	Not less than 12 seconds, nor greater than 66 seconds Saybolt at 40°C.
2.	Flash Point: (ASTM D-92)	Not less than 145°C.
3.	Moisture Content: (ASTM D-1533)	Not higher than 15.
4.	Pour Point:	Not higher than minus 45°C.
5.	Neutralization Number: (ASTM D-974)	Not more than .03 milligram of potassium hydroxide required to neutralize 1 gram of oil.
6.	Mineral Acids: (ASTM D-878)	The oil shall show absence of Sulfur or chlorides and sulfates.
7.	Free and Corrosive: (ASTM D-1275)	The oil shall not contain free Sulfur: corrosive sulfur compounds.
8.	Interfacial Tension: (ASTM D-971)	40 Dynes/CM at 25°C.
9.	Dielectric Strength: (ASTM D-877)	Not less than 30 kV.
10.	Color: (ASTM D-1500)	Very light, 0.5 maximum.
11.	Power Factor, 60Hz: (ASTM D-924)	0.05 percent maximum at 25°C.
12.	Specific Gravity: (ASTM D-1298)	0.91 maximum at 15°C.
13.	Oxidation Stability: (ASTM D-2440)	0.15 percent maximum sludge after 72 hours; 0.5 mg of KOH maximum total acid after 72 hours.
14.	Aniline Point: (ASTM D-611)	Not higher than 75°C.
15.	Steam Emulsion: (ASTM 1935)	Not higher than 30 seconds.
16.	Inhibitor:	2,6 Ditertiary – Butyl –Paracresol – 0.2% by weight.
17.	Charge Density:	Less than 200 micro Coulombs/M^3.

C. The Contractor shall certify the oil delivered with this equipment, and any oil used in production or testing of this equipment, is classified as "PCB-free" (polychlorinated biphenyl) with contamination of less than 1 ppm (parts per million) per EPA publication 40 CFR Part 761. The General Manager will not

accept delivery of the equipment until such certification is received. Demurrage incurred due to lack of this certification will be paid by the Contractor. The Contractor is also responsible to provide the same certification as listed above for any oil supplied by sub-Contractor. The Contractor is also responsible to certify that all tankers used in the delivery of the oil are "PCB-free".

2.8 SOURCE QUALITY CONTROL

A. Transformer shall be tested in accordance with latest editions of IEEE C57.12.00 and IEEE C57.12.90. The General Manager will witness the testing of the transformer. The manufacturer shall provide a minimum of 20 days notification prior to the testing of the transformer.

B. The following tests shall be performed and certified by the manufacturer:

1. Resistance measurements on all windings. The test report shall indicate how windings were connected, either series or parallel.
2. Ratio tests on the rated voltage connection and on all tap connections.
3. Polarity and phase relation test on the rated voltage connections.
4. No load loss and exciting current at rated frequency and voltage and at maximum raise and lower tap position.
5. No load loss and exciting current at rated frequency at 90% rated voltage (0.9 p.u.)
6. No load loss and exciting current at rated frequency at 110% rated voltage (1.10 p.u.).
7. Impedance volts at rated current and at maximum raise and lower tap positions.
8. Load loss at rated current and at maximum raise and lower tap positions.
9. Temperature rise test with top-oil, winding & hot spot temperature rises reported at the transformer self-cooled kVA rating, the ONAF-1 rating & the ONAF-2 rating at rated current on each cooling stage. The temperature rises shall be corrected to 3300' elevation on the final test report. The winding hottest spot temperature and any metallic part temperature shall not exceed 110°C with operation at a constant 40°C ambient air temperature (maximum temperature in any 24hr. period 50°C). In addition, winding rise and oil rise exponents (M&N exponents) shall be reported for ALL cooling stages.
10. Applied potential test.
11. Induced potential test. With RIV reported in both pC & MicroV (5 minute intervals)
12. Lightning Impulse Test
13. Switching Impulse Test

C. The certified test report shall indicate all impedance values; positive, negative and zero sequence. Photos of the core and coil assembly shall also be included with the test report.

D. Copies of all factory power factor test or equivalents shall be furnished with certified test reports.

E. All test required by regulatory agencies shall be witnessed by an Agency Inspector unless specifically waived, in writing, by the Agency. All items tested for regulatory compliance shall be pre-tested prior to scheduling the Agency Inspector.

PART 3 - EXECUTION

A. Vendor to provide optional pricing for field assembly, vacuum oil filling, and field tests. If vendor does not offer this, vendor to include pricing for supervision of field assembly, vacuum oil filling, and field tests.

END OF SECTION 261200

APPENDIX A – DATA SHEET Data to be furnished during project execution

Project: **Glenarm Repowering Project (GT-5 Combined Cycle Installation)** Project Number: 123374
Equipment Number: GSU
Service/Application: Generator Step-up

1. TRANSFORMER	**Unit**	**REQUIRED**	**Vendor**
Quantity	Ea	1	
Type		Oil-Filled, Outdoor, Station Type, Power Transformer	
Continuous Rating (H)	MVA	57/76/95 at 65° C	
Continuous Rating (X)	MVA	45/60/75 at 65° C	
Continuous Rating (Y)	MVA	12/16/20 at 65° C	
Cooling Class		ONAN/ONAF/ONAF	
Temperature Rise	°C	65°	
Voltage, HV-LV	KV	34.5 – 13.8	
HV Configuration		Wye	
LV Configuration		Delta	
Phases		3	
Frequency	Hz	60	
Insulation Liquid		Mineral Oil (or equivalent)	
Optional Price		FR3 dielectric fluid	
Taps Available	%	(2) 2.5% above and (2) 2.5% below rated voltage	
Tap Changer Type		De-Energized	
BIL, High Voltage @ 3300 ft.	KV	200	
BIL, High Voltage Neutral @ 3300 ft.	KV	150	
BIL, Low Voltage @ 3300 ft.	KV	110	
HV Bushings		Side Wall Mount	
LV Bushings		Side Wall Mount	
Neutral Grounding		Solid	
Efficiency	%		
Load Losses @ OA Rating	KW		
No Load Losses	KW		
Auxiliary Losses	KW		
Percent Impedance Voltage			
H-X	%Z	12.66% @ 57 MVA	To be finalized during project execution
H-Y	%Z	47.5% @ 57 MVA	To be finalized during project execution

SECTION 261200
GENERATOR STEP-UP TRANSFORMER

Project: **Glenarm Repowering Project (GT-5 Combined Cycle Installation)** Project Number: 123374
Equipment Number: GSU
Service/Application: Generator Step-up

1. TRANSFORMER	**Unit**	**REQUIRED**	**Vendor**
X-Y	%Z	31.5% - 55.95% @ 57 MVA	To be finalized during project execution
Max. Audible Noise, 0A Rating	dB.A	Per NEMA TR-1	
Winding Material HV/LV		Copper/Copper	
Coil Construction (Layer-wound, Cylindrical, Rectangular)			
Ambient Temperature	^{o}C	Reference Section 480020	
Site Elevation	ft	Reference Section 480020	
2. INSTRUMENT TRANSFORMERS			
HV Neutral Bushing CT		1200:5 MR C800	
High Voltage Bushing H CT 3 per phase		2000:5 MR C800	
Low Voltage Bushing X CT 2 per phase		4000:5 MR C800	
Low Voltage Bushing Y CT 2 per phase		1200:5 MR C800	
3. PHYSICAL DATA			
Dimensions (Approximate)			
1. Height	In		
2. Width	In		
3. Depth	In		
4. Height over Cover	In		
5. Untanking Height (Plus Slings)	In		
Weights (Approximate)			
1. Core and Coils	Lb		
2. Tank and Fittings	Lb		
3. Bushings	Lb		
4. Oil	Lb		
5. Total Weight	Lb		
6. Shipping Weight	Lb		
Oil Volume	gallons		
4. ACCESSORIES			
ANSI C57.12.10 Standard	Std	Yes	
No Load Tap-Changer		Yes	
Liquid-Level Indicator		Yes	
Liquid-Temperature Indicator		Yes	

SECTION 261200
GENERATOR STEP-UP TRANSFORMER

Project: **Glenarm Repowering Project (GT-5 Combined Cycle Installation)** Project Number: 123374
Equipment Number: GSU
Service/Application: Generator Step-up

1. TRANSFORMER	**Unit**	**REQUIRED**	**Vendor**
Winding-Temperature Indicator		Yes	
Pressure-Relief Device		Yes	
Rapid Pressure Rise Relay		Yes	
Pressure-Vacuum Gage		Yes	
Pressure-Vacuum Bleeder		Yes	
Drain and Filter Valves		Yes	
Bushings		Yes	
Lifting, Moving, and Jacking Facilities		Yes	
Nameplate		Yes	
Ground Pads		Yes	
Polarity, Angular Displacement, and Terminal Markings		Yes	
Oil Preservation		Yes	
Tanks		Yes	
Auxiliary Cooling Equipment		Yes	
Controls for Auxiliary Cooling Equipment		Yes	
Fans for Auxiliary Cooling Equipment		Yes	
Removable Radiators and Isolation Valves		Yes	
5. COMMERCIAL			
Warranty	M		
Drawings after Order	Wk		
Approval	Wk		
Shipment after Approval	Wk		

APPENDIX B - VENDOR DATA COMMITMENTS Refer to Attachment 11 – Drawing Schedule

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 262050
Low Voltage Motors

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

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B

Section 262050
Low Voltage Motors

Prepared for: *PASADENA WATER & POWER*
Prepared by: *BLAKE TURNER, P.E.*

REVISION HISTORY		
DATE	REVISED BY	REVISION
6/29/2011	B. TURNER	A
9/14/2011	S. HARRIS	B
9/10/2013		C – CONTRACT VERSION

1.1 TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SCOPE 1
1.2 ACCEPTABLE MANUFACTURERS 1
1.3 STANDARDS 1
1.4 DEFINITIONS 2
1.5 SUBMITTALS 2

PART 2 - PRODUCTS 2

2.1 SCOPE 2
2.2 PERFORMANCE 2
2.3 VOLTAGE AND FREQUENCY 3
2.4 SIZING AND CAPACITY 3
2.5 MOTOR TORQUE 3
2.6 MOTOR STARTING 3
2.7 MATERIALS 4
2.8 MAINTAINABILITY 4
2.9 DESIGN AND CONSTRUCTION 4
2.10 MOTOR FRAME 5
2.11 SLIDING BASES 6
2.12 STATOR ASSEMBLY 6
2.13 ROTOR AND SHAFT ASSEMBLIES 6
2.14 WINDING INSULATION AND TEMPERATURE RISE 6
2.15 BEARINGS 7
2.16 VERTICAL MOTOR BEARINGS 7
2.17 LUBRICATION SYSTEM 8
2.18 MOTOR FANS 8
2.19 SPACE HEATERS 8
2.20 MOTOR TERMINAL BOX 9
2.21 MOTOR BALANCE AND VIBRATION 9
2.22 IDENTIFICATION AND TAGGING 10
2.23 DOCUMENTATION REQUIREMENTS 10
2.24 INSPECTION AND TESTING 10

PART 3 - EXECUTION (NOT USED) 11

PART 4 - ATTACHMENTS 11

4.1 MOTOR DATA SHEET 11

SECTION 262050
LOW VOLTAGE MOTORS

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the minimum technical requirements for the design, manufacture, and testing of low voltage electric motors less than or equal to 300 horsepower. For a specific electric motor, this specification shall be used in conjunction with the data sheets for that electric motor.

1.2 ACCEPTABLE MANUFACTURERS

A. Toshiba

B. Reliance

C. Westinghouse TECO

D. General Electric

E. Baldor

F. Or Contractor-approved equivalent

1.3 STANDARDS

A. The Vendor shall consider the most recent issue of the applicable codes and standards issued by the association and approval bodies listed. American standards are listed for reference and should be followed as much as possible. Refer to the list of codes and standards in Attachment 1 for GTG that Contractor considers the applicable sections of the US and ISO Codes and Standards to be the most relevant standards for gas turbine equipment.

B. If there is, or seems to be, a conflict between this specification and a referenced document, the matter shall be referred to the General Manager in writing.

C. The following is a list of applicable codes and standards, associations and approval bodies:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Institute of Electrical and Electronics Engineers (IEEE)
5. International Electrotechnical Commission (IEC-34)
6. National Electrical Manufacturers Association (NEMA) MG1, “Motors and Generators”
7. National Fire Protection Association (NFPA) 70, “National Electrical Code”
8. Underwriters Laboratories (UL) 1004, “Motors, Electric”
9. United States Department of Labor - Occupational Safety and Health Administration (OSHA)

1.4 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.5 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

PART 2 - PRODUCTS

2.1 SCOPE

A. The electric motor required is a squirrel-cage, induction motor conforming to the requirements of NEMA MG 1. The electric motor is either supplied separately or as a component of an equipment package. All motors provided shall be consistent with equipment requirements in regards to electrical hazardous classification. LM6000 standard design motors are provided in Contractor's scope of supply in accordance to Contractor's Low Voltage Motor specification.

2.2 PERFORMANCE

A. The electric motor shall be designed for a nominal 25-year operating life.

B. The electric motor shall have a service factor as shown on the Data Sheet. A service factor of 1.0 at 1000 meters at 50°C low voltage motors are provided in GTG scope of supply

C. The electric motor shall be capable of supplying the horsepower obtained by multiplying the rated horsepower of the motor by the service factor with rated voltage and frequency applied. Motor NEMA Code Letter G or better shall be provided. The maximum motor temperature rise shall not exceed the temperature rise listed in NEMA MG 1 for a Class B insulated motor with a service factor of 1.15 (A service factor of 1.0 at 1000 meters at 50°C without exceeding NEMA standard temperature constraints for class B operation low voltage motors are provided in GTG scope of supply), when supplying the rated horsepower without infringing upon the service factor. In GTG package, for motors 15 horsepower or larger: code letter "G" is used; For Motors 3 to less than 15 horsepower: code letter "H" is used.

2.3 VOLTAGE AND FREQUENCY

A. Motors shall run successfully at the rated load and frequency with a supply voltage variation that does not exceed plus or minus 10% of the rated voltage.

B. Motors shall run successfully at the rated load and voltage with a supply frequency variation that does not exceed plus or minus 5% of the rated frequency.

C. Motors shall run successfully at the rated load with a combined variation of supply voltage and frequency that is not more than plus or minus 10% (sum of absolute values) of the rated voltage and the rated frequency provided that the 5% frequency variation is not exceeded.

D. Motors rated at 100 horsepower (HP), and above shall be capable of starting and accelerating to running speed with a load that has a torque characteristic and inertia value not exceeding that listed in NEMA MG 1, Motors and Generators, with the voltage and frequency variations specified above and maximum voltage dip of 20%, at starting. For motors in GTG, Each motor shall be capable of number of starts per NEMA MG-1 part 12.54, with additional requirement of (4) cold or (4) hot starts per hour minimum. These starts shall be permitted to be in quick succession less than 25 seconds.

E. Motors shall be capable of operating with the power supply characteristics as shown on Data Sheet.

2.4 SIZING AND CAPACITY

A. The motor nameplate horsepower shall cover the full range of the driven equipment load plus 15%. The motor shall be sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Rating shall include allowance for altitude de-rated and peak ambient temperature as required by site conditions. Motors provided within GTG scope shall have horsepower rating based on continuous operation at 1.0 load service factor at 1000 meters at 50 °C ambient without exceeding NEMA standard temperature constraints for class B operation.

2.5 MOTOR TORQUE

A. Motor torque characteristics shall conform with a standard NEMA design letter designation and shall be appropriate for the mechanical load served. Motors provided within GTG scope shall be designed to NEMA “A” or “B” torque/speed characteristics with normal starting torque and starting current for full voltage starting unless specified otherwise by Contractor.

B. The locked-rotor, breakdown, and pull-up torque (at the rated voltage and frequency) shall meet the requirements of NEMA MG 1.

2.6 MOTOR STARTING

A. Motors shall be capable of making the number of starts shown on the Data Sheet.

B. These restart requirements apply only when the moment of inertia (Wk^2) of the load, the load torque during acceleration, the applied voltage, and the method of starting, are the requirements

for which the motor is designed. No additional starts shall be made until conditions effecting operation have been investigated and the motor examined for evidence of overheating.

C. For three-phase, integral-horsepower, squirrel-cage induction motors, the locked-rotor currents at the rated motor voltage shall not exceed standard NEMA values for the required horsepower and specified insulation and temperature rise classes.

2.7 MATERIALS

A. All materials used for the motor shall be appropriate for the site conditions and the associated process mechanical equipment for which it is used. Motor materials provided within GTG scope are as below: Motor frame, end shields, inner bearing caps, fan covers, and terminal boxes shall be of cast iron. Rotor shall be of cast aluminum or copper bar as appropriate based on motor size and slip characteristics. Armature and fields shall be wound with Copper wire.

2.8 MAINTAINABILITY

A. The electric motor shall not require any maintenance other than routine cleaning of the exterior surfaces and periodic lubrication.

2.9 DESIGN AND CONSTRUCTION

A. The electric motor shall be a heavy-duty type using cast iron construction.

B. Electric Motors over 75 pounds shall be furnished with lifting eyes. The lifting eyes shall be arranged so that the lifting slings do not become entangled in any apparatus mounted on the motor. For Motors provided in GTG scope, Lifting means should be provided based on horizontal or vertical orientation of motor on motor data sheet. Shouldered eyebolts may be used but eyebolt receptacle shall be blind thread holes. Lifting eyes shall be in accordance with ASTM A 489, "Standard Specification for Carbon Steel Lifting Eyes".

C. Motor efficiency shall be provided in accordance with Premium Efficiency requirements for motors 50HP and larger. Motor efficiency shall be provided in accordance with Standard Efficiency requirements for motors smaller than 50HP. For motors provided in GTG scope of supply, All motors shall be NEMA Premium® Efficiency, or equivalent, continuous rated, single-speed, polyphase, squirrel-cage induction motor of 2, 4, or 6 pole design meeting the performance requirements of Design A or B per NEMA MG-1 part 1 unless specified otherwise on the motor data sheets in this specification. Motors shall have nominal full load efficiency not less than shown in NEMA MG-1 part 12. Motor efficiency shall be determined in accordance with method B in 6.4 of IEEE STD 112.

Low voltage motors (i.e. < 1kV) supplied under this specification shall have a CEMEP (European Committee of Manufacturers of Electrical Machines & Power Electronics) efficiency rating of IE3 preferred per IEC 60034-30. IE2 shall be permitted where IE3 is cost or design prohibitive. Mandatory introduction of minimum efficiency class IE2 will start on 16 of June 2011. Further measures will regulate the use of variable speed drives for electric speed control and of motors efficiency class IE3. The data sheet shall indicate if IE3 efficiency is mandatory for low

voltage motors. Motors specified for continuous operation shall be the high efficiency type, operating at high power factor and optimal low line current under normal conditions.

For 60 Hz motors: All 60 Hz motors shall have additional requirement to meet Conformance to (EPCA) Energy Policy and Conservation Act, as amended, 42 U.S.C. 6291-6316 and 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart B-Electric Motors: Test Procedures, Labeling, and Certification Requirements;" shall be a requirement of this specification.

D. All vertical motors coupled to vertical turbine pumps shall be equipped with spark-resistant non-reversing ratchets. . Spark-resistant non-reversing ratchets will be attached between the pump and the motor on all GTG Turbine Lube Oil and Generator Lube Oil systems.

E. Case drip shields shall be provided for all vertical motors.

F. The vertical centrifugal and in-line pump motors shall be designed to withstand up-or-down thrust loads that may occur during pump startup or operation.

G. The electric motor shall be designed for full voltage across the line starting.

2.10 MOTOR FRAME

A. All motor enclosures shall be totally enclosed; fan-cooled (TEFC) for all locations, except motors that are 3 horsepower or less. These motors may be totally enclosed non-ventilated (TENC). All sealing parts shall be machined in high accuracy in order to minimize breathing

B. The motor frame, end brackets, fan covers, drip shields (if required), and bearing housing shall be corrosion-resistant with the motor supporting feet case as in integral part of the frame. Motor materials provided within GTG scope are as below: Motor frame, end shields, inner bearing caps, fan covers, and terminal boxes shall be of cast iron. Rotor shall be of cast aluminum or copper bar as appropriate based on motor size and slip characteristics. Armature and fields shall be wound with Copper wire.

C. Motors shall be provided with stainless steel drains and plugs. The drain holes shall be located at the low point of the motor as mounted. Drain plugs provided within GTG scope shall be of brass material. Totally enclosed vertical motor housings shall have at least one drain hole with a plug provided at each end as applicable for TEFC motors. Motors intended for horizontal use shall have at least one drain hole at each end with plugs provided.

D. Motor frames shall be drilled and tapped for a ¾ inch bolt for ground connection. On horizontal frames, the hole shall be located in the right rear motor foot (as viewed from the coupling end). On vertical frames, the hole shall be drilled in the junction box side (as viewed from the flange end). Motors provided within GTG scope shall have in addition an external stud on the motor frame. Grounding means for field wiring shall be in accordance with MG-1 part 4.20.

E. If multiple motors are provided, motor frames should be standardized to the minimum number of different frame sizes and associated mounting dimensions to allow for easy interchangeability.

2.11 SLIDING BASES (not used in GTG motors)

A. When sliding bases are required, Vendor shall provide complete dimensional drawings.

B. Base shall be fabricated from heavy steel in a single-unit construction using two adjusting bolts. The heavy-duty base shall be capable of supporting the heaviest weight and largest overhung load for its motor rating without bending, flexing, or vibrating.

C. A permanent means for identifying proper motor frames for which it is suitable shall be provided.

2.12 STATOR ASSEMBLY

A. The stator assembly shall consist of high-grade material consistent with the specified operating efficiency. The stator assembly shall be kept in alignment and held under compression by through bolts and end rings.

B. Stator insulation shall either be vacuum pressure impregnation (VPI) or multiple dips and bakes of insulating varnish. Tropicalization shall consist of additional dips and bakes of insulating varnish and either the use of special insulating materials or varnish treatment to prevent the growth of fungus and the ingress of moisture. Stator insulation materials provided in GTG scope shall be non-hygroscopic and shall be non-nutritive and/or employ appropriate fungicidal and bactericidal agents to render the motors suitable for installation and use in tropical environments

2.13 ROTOR AND SHAFT ASSEMBLIES

A. The motor shaft shall be machined corrosion resistant steel and capable of transmitting the torque produced by the motor.

B. The rotor cage may be of fabricated aluminum, or integrally die-cast aluminum. Rotors shall be epoxy- or Glyptol-coated.

C. The rotor shall be balanced in accordance with Section 2.21 herein.

D. The rotor assembly for horizontal motors shall be removable through either bell end of the motor without requiring removal of the stator assembly.

E. The rotor assembly for vertical motors shall be preferably removable from the top of the motor without requiring dismantling or removal of the motor.

2.14 WINDING INSULATION AND TEMPERATURE RISE

A. The motor windings shall be either random or form-wound coils with Class F insulation. The windings and winding terminals shall be completely insulated for an ungrounded system.

B. The temperature rise, measured by resistance of the motor windings for an ambient temperature of 40°C, shall not exceed the Class B Temperature Rise, when the motor is operated at the rat-

ed nameplate horsepower, voltage, frequency and without infringing upon the service factor. Winding insulation provided within GTG scope shall be class F type minimum with class H preferred with temperature rise due to resistance limited to class B as per NEMA MG-1 Part 1, IEEE Standard 1, or IEC 60034-1 table 7 and IEC 60085 Class B rise shall be defined as 70 °C given a motor rated for Ta = 50 °C at 1.0 SF or 80 °C with Class B rise for motors rated for Ta = 40 °C) at 1.15 SF per NEMA MG-1 12.43 (Ta= ambient temperature).

2.15 BEARINGS

A. Grease-lubricated ball bearings shall be supplied unless otherwise specified. Ball bearings shall be vacuum-degassed steel, motor quality. For vertical type motors in GTG scope, motor guide and thrust bearings shall be either ball or roller bearing type

B. The bearing and bearing housing shall be constructed and provided with slingers and seals to prevent dirt or moisture from entering the motor. Interior bearing caps shall be provided to prevent lubricant from entering the motor.

C. The bearing supports shall be integrally case as a part of the motor end bell. The end bell shall be rabbited to the stator assembly to ensure proper bearing alignment and air gap spacing.

D. The bearings shall be designed so as not to be damaged by axial rotor movement during motor startup or shutdown.

E. Double shielded bearings using high temperature greases shall be provided on motors for air cooler fan (fin fan) applications. Motors in GTG scope shall use single shielded bearings.

F. The bearings shall be of the anti-friction type and shall have a minimum rated life of 40,000 hours (AFBMA L-10, Life), in accordance with AFBMA Standard 4, Tolerance Definitions and Gauging Practices for Ball and Roller Bearings. Motors in GTG scope, Integral horsepower motor bearings shall be fully re-greaseable and sized to provide a L10 life of 26,280 hours hours under minimum V belt sheave sizes for max belt loading conditions. Bearings shall be capable of an L10 life of up to 130,000 hours when the motor is direct connected under appropriate conditions as defined by the manufacturer. Bearings shall be in compliance with ISO 281.

G. Where horizontal motors are mounted in vertical position with V-belt drive (such as in air-cooler drives), the bearing on the shaft extension end shall be sized to accommodate the radial load caused by the belt drive with the bearing life specified in Section F above.

2.16 VERTICAL MOTOR BEARINGS

A. Bearings for motors driving vertical pumps, including in-line pumps, shall be designed to carry 200% of the maximum thrust (up or down) which the pump may develop during starting or stopping or while operating at any capacity on the rated performance curve. Minimum continuous up-thrust capacity shall be equal to 30% of down-thrust at rated capacity. Bearing life shall comply with the requirement of 2.15 Section F above. Thrust bearings for in-line pump motors shall be at the upper end of the motor. Motors in GTG scope, when specified for vertical operation, motors shall be equipped with anti-friction bearings selected to meet the requirements of the internal thrust load. For vertical type motors, motor guide and thrust bearings

shall be either ball or roller bearing type. Plate and split sleeve bearings, where required by the radial and thrust load conditions, shall have prior approval of Contractor before being applied.

2.17 LUBRICATION SYSTEM

A. The motor's grease lubrication system shall be capable of operating at least 8,000 hours without requiring addition of grease or a complete change of grease. Life of the lubricant and requirement may vary due to different loads and running conditions.

B. The motor's grease lubrication system shall be provided with readily accessible grease inlet and outlet plugs in the bearing housings to enable re-greasing while the motor is in-service.

2.18 MOTOR FANS

A. All motors shall be air-cooled and equipped with an externally-mounted, non-sparking fan and fan housing.

B. Fans shall be bi-directional.

2.19 SPACE HEATERS

A. Space heaters shall be furnished for all motors sizes defined in these specifications. Space heaters shall be sized as required to maintain the motor internal temperature above the dew point when the motor is idle. Motor space heaters shall not cause winding temperatures to exceed rated limiting values or cause thermal protective device over-temperature indication when the motor is not energized. Space (anti-condensation) heaters shall be provided on motors (5) horsepower and larger in GTG scope.

B. Low surface-temperature space heaters shall be mounted inside the motor frame of motor to be mounted outside.

C. The sheath temperature at 110% of rated voltage, when operating in a 40°C ambient temperature, shall not exceed 200°C. In GTG scope, Space heater shall avoid raising the motor insulation temperature in excess of 130 °C.

D. The space heaters shall be designed to be operated at 120/230 volts, single-phase and shall be suitable for NEC Class I areas.

E. The space heaters shall maintain the temperature inside the motor at 5°C above the ambient temperature.

F. The space heater power leads for motors rated at or below 150 HP shall be routed to the main terminal box. Motors larger than 150 HP shall have a separated terminal box for the space heater leads. Motors in GTG, The termination of motor anti-condensation heaters in the main terminal box of low voltage (i.e. < 1kV) motors shall not be permitted. AC motor space heater leads shall be provided in separate terminal box with terminal lugs as a minimum, terminal blocks preferred. If NEMA frames size 143-286 cannot accommodate separate terminal box, a conduit elbow may be added off main terminal box with auxiliary junction box added to conduit elbow.

2.20 MOTOR TERMINAL BOX

A. Motors shall be equipped with a corrosion resistant terminal box.

B. Terminal box sizing shall allow for the bending radius and stiffness of motor supply cables and for terminating a grounding conductor. Terminal box size selection shall be one size larger than listed in NEMA MG 1. Motor feeders will be armored cable supplied by BOP Contractor. In GTG scope, Motor terminal boxes shall be sized and designed such that the total volume of all conductors per sizing from the data sheet does not exceed 25% of the total volume of the terminal box and in accordance with NFPA 70 Article 430.12 and in accordance with NEMA MG-1 Part 4.

C. A grounding lug shall be provided inside the motor housing conduit box to accommodate an incoming ground conductor.

D. Motor leads shall have brass or stainless steel ferrules embossed with the appropriate lead number or leads shall be imprinted with the lead number. In GTG scope, Motor winding leads, heater leads, and auxiliary leads provided at terminal boxes shall comply with NEMA standards. All leads shall have pre-crimped-on terminal lugs provided in junction boxes for termination of interconnect leads.

E. Terminal boxes shall be fitted with neoprene gaskets. In GTG scope, All terminal boxes shall be IP55 minimum per NEMA MG-1 part 6 or per IEC 60529

F. Terminal boxes shall be rotatable in 90° intervals to permit connection at any one of the four sides.

G. A motor lead seal and separator gasket shall be provided between the motor frame and terminal box on all motors. In GTG scope, Motor ingress protection shall be IP55 minimum per NEMA MG-1 part 6 or IEC 60034-5. All terminal boxes shall be IP55 minimum per NEMA MG-1 part 6 or per IEC 60529.

H. Terminal boxes with threaded conduit entrances or hubs shall be provided on all motors.

I. Motor lead insulation shall be oil resistant.

2.21 MOTOR BALANCE AND VIBRATION

A. Motor Balance: All motors shall be dynamically balanced. Balance shall be achieved by drilling out parent metal in such a manner that the structural strength of the rotor is not weakened. Chiseling or sawing is not acceptable. The use of solder or similar deposit materials to achieve balance is not acceptable. An acceptable balancing method is to use balance washers that are securely pinned in place.

B. Vibration Measurement.

1. The method of measuring vibration shall meet the requirements of NEMA MG 1.

2. With the motor running at the rated speed or any operating speed, with the shaft axis in normal position, and with the half-key in the key way, the vibration in any plane shall not exceed NEMA Standard.

2.22 IDENTIFICATION AND TAGGING

A. An embossed, stainless steel nameplate shall be securely attached with stainless steel screws or pins on the electric motor. The nameplate shall contain standard information in accordance with NEMA MG 1. The following additional information shall be provided on the same or separated nameplate:

1. Year of Manufacture
2. Type of Bearing Lubricant and Specification Number
3. Arrow Indicating Direction of Rotation, if unidirectional

B. The covers of motor terminal boxes shall be provided with a nameplate labeled, ISOLATE MAIN AND HEATER CIRCUITS BEFORE REMOVING COVER.

2.23 DOCUMENTATION REQUIREMENTS (for LM6000 GTG, refer to O&M manual, Bill of Material at the end of F&ID, and package factory test report)

A. Detailed operating and maintenance instructions for the equipment supplied.

B. Complete list of all instruments and accessories supplied, listing manufacturer, model number and operating ranges.

C. Complete documentation of all inspections and tests performed, including all logs, curves, and certificates. The documentation also shall note any replacement of equipment or components that failed during testing.

D. As-built drawings, including schematics showing mechanical, structural, instrumentation controls, and electrical details.

2.24 INSPECTION AND TESTING (Motor manufacturer's standard inspection and test procedure shall be used for LM6000 GTG).

A. No-load running current and power measurements.

B. High Potential Tests in accordance with NEMA MG 1.

C. Vibration Test in accordance with NEMA MG 1.

D. Locked-rotor current measurement.

E. Machine Noise Level Test in accordance with IEEE 85, Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery.

F. Heat Run Test.

G. Percent slip measurement.

H. Breakdown torque calculation.

I. Pull-out torque measurement.

J. Starting torque measurement.

K. Efficiency and power factor measurements for 1/2, 3/4, and full-rated loads in accordance with IEEE 112, Test Method B.

L. Winding resistance measurement.

PART 3 - EXECUTION (Not Used)

PART 4 - ATTACHMENTS

4.1 MOTOR DATA SHEET

A. Motor Data Sheet shall be completed for each unique drive for the equipment provided during project execution.

MOTOR DATA SHEET
(Provide a completed data sheet for each type of equipment during project execution)
Equipment Name: **Tag No.:**

DESCRIPTION	UNITS	SPEC DATA	VENDOR DATA
Motor Manufacturer and Catalog No			
System Voltage	Volts	480	
Operating Frequency	Hz	60	
Terminal Voltage (Motor Nameplate Voltage)	Volts	460	
Number of Phases	Qty	3	
RPM @ Rated Load	RPM		
Rated Shaft Output	Hp		
Driven Load (maximum)	Hp		
Rated Power Factor @:			
100% Full Load	%		
75% Full Load	%		
50% Full Load	%		
Efficiency @:			
100% Full Load	%		
75% Full Load	%		
50% Full Load	%		
Full Load Current @:			
100% Full Load	A		
75% Full Load	A		
50% Full Load	A		
Locked Rotor Current	A		
NEMA Code			
Service Factor	%	1.15	
Maximum Ambient Temperature	°F	See Environmental	
Site Altitude	Ft	See Environmental	
Insulation Class		F	
Temperature Rise of Insulation Class		B	
Hot Spot Temperature Rise	°F		
Duty Type		Continuous	
No. of Speeds			
No. of Poles			
Motor Starting Method		Full Voltage	
Motor Rated for Use With a VFD	Yes/No		
Minimum System Voltage During Motor Start	%V	80%	
Maximum Overcurrent Protection	A		
Sound Level @ Full Load (1 meter distance)	dBa	85 max.	
Bearing Type (Ball or Roller)	Per Specification		
Bearing Estimated Life Expectancy	Hrs		

DESCRIPTION	UNITS	SPEC DATA	VENDOR DATA
Motor Space Heater*:*	Yes/No	Yes	
Wattage	W		
Voltage (Rated 240V, but connected 120V)	V	120/240	
The Following Data is Required for Motors Rated 60 Hp and Larger			
Permissible Starts per Hour:			
With Motor at Rated Ambient	Qty		
With Motor at Rated Total Temp.	Qty		
Locked Rotor Time:			
Cold	Sec		
Hot	Sec		
Acceleration Time, Full Load:			
@ 100% Full Voltage	Sec		
@ 80% Full Voltage	Sec		
Maximum kVAR for PF Correction	kVAR		
Non-reversing Ratchets	Yes/No		
RTD sensors ***(100Hp and Larger)***	Yes/No	Yes	
RTD Type			
Number of RTD Sensors	Qty		
Stator RTD Temperature To Trip	°F		

END OF SECTION 262050

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Continuous Emissions Monitoring System
Section 409413.22

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

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Section 409413.22
Continuous Emissions Monitoring System

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *DAVE THOMAS*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/18/2011	D. Thomas	A
06/23/2011	D. Thomas	B
09/09/2011	D. Thomas	C
05/04/2012	T. McAuliffe	D
06/15/2012	B. Hritsco	E
10/04/2012	G. Harwood	F
11/7/2012	G. Harwood	G
9/10/2013		H – Contract Version

SECTION 409413.22
CONTINUOUS EMISSION MONITORING SYSTEM

TABLE OF CONTENTS

PART 1 - GENERAL **1**

1.1 SUMMARY OF WORK 1
1.2 RELATED SPECIFICATIONS 3
1.3 APPLICABLE CODES, STANDARDS, AND REGULATIONS 3
1.4 MARKINGS, NAMEPLATES, SHIPMENT 4
1.5 INFORMATION SUPPLIED WITH BID ERROR! BOOKMARK NOT DEFINED.4
1.6 GUARANTEE AND WARRANTY 4

PART 2 - PRODUCTS **5**

2.1 TECHNICAL REQUIREMENTS 5
2.2 TOOLS 11

PART 3 - EXECUTION **11**

3.1 TRAINING, SUPERVISION 11
3.2 TESTS, INSPECTIONS, REPORTS 12

APPENDIX A – INFORMATION, DRAWING REQUIREMENTS FROM CONTRACTOR **14**

APPENDIX B – PROJECT SPECIFIC DATA **15**

APPENDIX C – PERFORMANCE DATA **17**

APPENDIX D – PAPERLESS CHART RECORDER – SCAQMD REQUIREMENTS **21**

SECTION 409413.22
CONTINUOUS EMISSION MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Work Included: The work shall consist of the equipment and services required for furnishing one (1) engineered, designed, assembled, certifiable, tested (factory testing accepted before shipping) and delivered fully extractive, continuous emission monitoring system (CEMS) for use on plant gas turbine generator (GTG) Emissions Control Module (ECM) stack complete with all accessories necessary to meet the requirements specified in Appendix C.

1. Probe (s), sample lines, analyzers, cabinets, sample conditioning system and enclosures as specified in Appendix C2.
2. Microprocessor based Emissions Analysis Control Units.
3. Microprocessor based data acquisition and report generating system including the capability to graph trends from the collected data in color and a printer to be located in the CEMS enclosure with the CEMS monitor. A remote CEMS HMI is required to monitor CEMS unit to be located in the control room. The CEMS microprocessor shall communicate with the remote monitoring unit via a direct fiber link from the microprocessor to the remote workstation.
4. NEMA 4 stainless steel enclosure(s) required for equipment located on the stack for operating in ambient conditions specified in the site data.
5. Associated hardware such as bolts, washers, nuts, mounting plates, gaskets, junction boxes, interconnecting cables and tubing for equipment at the stack location, sample tubing to the environmental enclosure, power distribution panel, fittings, air regulators, eductors, valves, solenoids, blowers, compressors, receivers, manifolds, required to assemble a completely operable and certifiable system.
6. Power supplies, filters, disconnects, transformers conditioning equipment required by equipment design to interface with existing 480 VAC, 60HZ, three phase power source. A 120V UPS power source will be brought to the CEMS shelter by others.
7. Operation and maintenance manuals.
8. CEMS Plan, CEMS Test Protocol, Quality Assurance and Quality Control Plan and Preliminary Monitoring Plan. Contractor shall complete and submit to General Manager: Process Flow Diagrams, Stack Diagram, CEMs Flow Schematic Diagrams, Monitored parameter Equations/Calculations, Computer Programming Logic Description, and other technical information required on SCAQMD Form ST 220 (CEMS Certification Application). General Manager will submit & pay for completed Form ST 220 to SCAQMD.
9. Special tools and devices required for operation, maintenance, and calibration.
10. Drawings for installation, wiring including electrical load data on equipment, internal and external wiring, System Flow Diagrams, General Arrangement, Elevation Drawings, and piping of equipment.
11. Commissioning and checkout aid and I&C technician training.
12. Guaranteed certification by a third party testing organization in accordance with applicable 40 CFR 60, 75 &98, South Coast AQMD Rule 218 &218.1 and South Coast AQMD Regulation 2012. Third party test organization to be approved by General Manager. Guaranteed certification of the system shall be quoted as a separate lump sum item.
13. Insulated sample tubing as specified in Appendix C2. Separate price per foot for additional length, if required shall be provided. Tube bundle shall include instrument air

and power if required at probe. Sample tubing shall be field trimmable for length on one end.

14. The CEMS system shall be required to provide totally isolated 4 to 20 mA signals and dry output contacts to and from the plant control system as specified in Appendix C4. CEMS system shall also be able to interface with plant control system via a serial link.
15. Calibration gases and enclosure to house bottles and regulators attached to outside wall of CEMS enclosure.
16. All analyzers/probe instruments shall have permanent S.S. tags attached with S.S. wire marked with the tag number, General Manager's P.O. number, and service. General Manager shall assign tag numbers.
17. An ISA style data sheet shall be provided for each instrument furnished under this specification. This data sheet shall list as a minimum the following:

    a. Tag Number
    b. Service
    c. Process Fluid
    d. Process Span
    e. Calibration
    f. Any Sizing Data
    g. Set Point
    h. Contact Rating
    i. Enclosure NEMA Rating
    j. Manufacturer
    k. Model Number
    l. Serial Number

18. A calibration sheet shall be provided for each instrument provided under this specification. This calibration sheet shall have as a minimum the following:

    a. Tag Number
    b. Service
    c. Signature & Date of Calibrator

19. Each analog instrument shall be calibrated at 0%, 25%, 50%, 75%, and 100% of span showing input and actual reading.
20. Each digital instrument shall show desired and actual setpoint.
21. The CEMS buildings shall be provided with smoke detectors that adhere to the following general requirements.

    a. Comply with UL 268; operating at 24-V dc, nominal.
    b. Detectors shall be two-wire type.
    c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
    d. Integral Visual-Indicating Light: LED type indicating detector has operating and power-on status.
    e. Integral audible alarm.
    f. Dry contacts for connection to an external fire alarm system

22. Contractor Responsibility. The Contractor shall submit and propose to provide all necessary hardware and system software components capable of meeting all functional

system requirements in this specification including the air permit requirements in the Authority to Construct / Final Decision. The Contractor shall assume full responsibility for choosing proper equipment adequate to perform all specified tasks reliably. The Contractor shall fully understand the job to be done, and it shall be his responsibility to resolve any questions or uncertainties arising from this specification prior to the issuance of a purchase order. The Contractor's proposal shall be evaluated against criteria developed to ensure successful installation, certification, and operation of the system.

23. CEMS building shall include electrical HVAC systems to maintain a controlled environment in the CEMS building to prevent electrical equipment failure due to excessive heat or condensation.
24. RTU capable of producing a printout of the stored data in color.
25. Electronic recorder that receives data independent of the RTU and serves as an independent tool for verifying data archived in the RTU or sent to the SCAQMD central NOx station.
26. Pollutant analyzers shall have a dual range so that an analyzer will be capable of monitoring both controlled emission and uncontrolled emission concentration.
27. Each span gas shall meet 40 CFR 60 & 75, SCAQMD Regulation XX, Rule 218 &218.1 and other applicable regulations.
28. A sample conditioning system.
29. Paperless Chart Recorder. Recorder shall be tamper-proof type, installed independently of the analyzer, and shall collect data for two years minimum. See Appendix D for detailed SCAQMD requirements.

B. Work Not Included

1. Stack platforms and access.
2. Receiving, unloading and storage
3. Oil-free instrument grade air at 125 psig
4. Equipment mounting, installation and interconnection of Contractor supplied cable/tubing.
5. Stack stub-outs for sample ports as specified in Appendix B2.

1.2 RELATED SPECIFICATIONS

1. 260000 Electrical Specification for Mechanical Equipment
2. 262050 Low Voltage Motors
3. 480020 Site Conditions
4. 481100 Combined Cycle Power Island
5. 485413 Once Through Steam Generator

1.3 APPLICABLE CODES, STANDARDS, AND REGULATIONS

A. The stack monitoring system is being purchased to satisfy the requirements contained in the applicable federal, State of California, and SCAQMD Authority to Construct / Final Decision.

B. The following listed Standards and Codes, in effect, as of the date of the contract, shall govern design and selections of equipment and material supplied. If there is any conflict between the requirements of these documents, or a conflict between any of them and these specifications,

then that requirement which the General Manager considers most appropriate shall take precedence.

1. ANSI American National Standards Institute
2. ASME American Society of Mechanical Engineers
3. EPA Environmental Protection Agency
4. IEEE Institute of Electrical and Electronics Engineers
5. ISA Instrument Society of America
6. NEC National Electrical Code
7. NEMA National Electrical Manufacturers Association
8. NFPA National Fire Protection Association
9. OSHA Occupation Safety and Health Administration
10. CAL/OSHA California Occupational Safety and Health Administration
11. UL Underwriters Laboratories
12. EPA Region IX
13. ARB California Air Resources Board
14. SCAQMD South Coast Air Quality Management District
15. All applicable local, state, county or municipal codes, laws, and ordinances.

1.4 MARKINGS, NAMEPLATES, SHIPMENT

A. If analyzer cabinets are used in lieu of open racks, interior of cabinets shall be cleaned primed and painted white. Exterior of the control cabinet shall be cleaned, primed, and painted per manufacturer's standard. Exterior of CEMS enclosure shall be painted according to the paint specification in C2. All other equipment to be per manufacturer's standard.

B. Equipment shall be shipped as completely assembled as practicable in the least number of factory fabricated and assembled sections.

C. All equipment and components shall be identified and/or match marked to assist field assembly and erection. All items shipped shall be accompanied by instructions for storing and protecting.

D. All spare parts and special tools, whether specified herein or ordered later, shall be in packages or boxes separate from equipment shipments. Spare parts and special tools, which are too large for packaging, shall be identified with permanent metal tags securely attached.

1.5 GUARANTEE AND WARRANTY

A. A three-year warranty covering performance, parts, workmanship and instrument characteristics shall commence with the date at which the CEMS is certified by the third party testing organization.

B. The Contractor shall guarantee that the installed system shall pass all applicable Performance Specification Tests as defined in the applicable federal, state of California, the South Coast Air Quality Management District and the Construct /Final Decision All actions required to correct systems which do not fully pass performance tests and all re-tests shall be paid for by the Contractor.

C. The Contractor shall guarantee that the system shall successfully pass the calibration requirements within 15 Calendar days after initial operation.

D. Performance audits performed by the General Manager on a quarterly basis, the unit annual performance certification test, and RATA tests will be used to ascertain the proper functioning of the CEMS. If the CEMS fails to meet the performance audit requirements the contractor shall be responsible for carrying out the required repairs/modifications to the system at his own expense.

E. In the event Federal, EPA, State, or Local regulatory authorities challenge emissions data the Contractor shall be required to have their maintenance personnel testify on the General Manager's behalf to the proper maintenance and operation of the equipment and to the accuracy of data generated by the reporting system.

F. Recertification test and report for any part of the system if maintenance is so extensive that test is required for continued uninterrupted operation of the plant.

PART 2 - PRODUCTS

2.1 TECHNICAL REQUIREMENTS

A. The CEMS system shall comply with all applicable USEPA, State of California and South Coast Air Quality Management District monitoring and reporting requirements as delineated under the amended Clean Air Act. The CEMS shall comply with all USEPA requirements of 40 CFR 60, 75 and 40 CFR 98 under the Clean Air Act Amendments of 1990 and the CEMS system shall meet all the Clean Air Act Amendments of 1990 certification requirements as listed in 40 CFR Parts 60 and 75, in addition, State of California AB 32, and SCAQMD Regulation XX, SCAQMD Rule 218 & 218.1. Contractor shall note that the gas turbine will be regulated as a SCAQMD major source of NOx under Regulation XX and the criteria pollutants are subjected to the best available control technology requirements (lowest achievable Emissions Reduction technology requirement under EPA regulations) under either SCAQMD Regulation XIII or XX. Exhaust flow and O2 monitoring must also be in compliance with the cited regulations and rules. This specification should be used as a guideline for establishing basic minimum requirements for the system. If for any reason, due to improper performance of the CEMS equipment, the supplied CEMS fails any part of the USEPA and/or the applicable State of California and the SCAQMD acceptance qualifications, the CEMS Contractor shall incur all costs to change and/or modify the CEMS and re-certify such system, thus guaranteeing ultimate acceptance of the CEMS for General Manager.

B. The system shall contain a probe, a sample line, monitoring and conditioning equipment to dry and sense gas concentrations, and a method of dynamically calibrating the system. The dynamic calibration shall use span gases that are injected in the system at the probe junction into the sample transport line. Span gases shall follow the same path within the monitor as incoming stack gas. Provisions shall be made to remove particulate from the probe in the stack by an automatic backflush system without requiring personnel to climb up the stack.

C. Before installing the probe, a stratification test will be conducted and the probe will be located so that a representative sample will be supplied to the analyzers in accordance with 40 CFR 60, 75, & 98, state of California and SCAQMD Regulation XX SCAQMD Rule 218 & 218.1.

D. Automatic calibration and verification of drift tolerance shall be initiated daily by the system.

E. A method of zero checking the analyzers shall be provided.

F. The system shall be capable of zero and automatic span checks at fixed preselected intervals with override for manual calibration. The instrumentation shall be designed for rapid zero and span checks. Federal and local requirements are for daily zero and span checks. These system checks shall appear as part of the emission record. The system shall be designed to allow ninety days between normal maintenance periods. Zero and span gas shall meet all applicable federal, State of California, and SCAQMD regulations.

G. Gas concentration sensing devices shall not show an interference caused by a two-order-of-magnitude concentration change of any material in the gas stream other than the monitored gas. The sensing devices shall respond to a change of two (2) percent of the concentration of the specific gas being monitored.

H. Electrochemical type fuel cells are not acceptable.

I. All exposed parts that are subject to high operating temperatures or are energized electrically, and all moving parts that might constitute a hazard to operating personnel, shall be insulated, fully enclosed, and/or guarded.

J. Contractor shall ensure that vibrations common to power plant stacks do not affect the equipment's ability to meet all functional requirements.

K. Equipment may be subjected to large transient voltages and currents due to lightning striking the stack. Contractor shall make recommendations to minimize equipment damage from such occurrences.

L. The General Manager will furnish a 480 volt 3 phase supply source. The Contractor shall be responsible for supplying all transformers and/or power supplies, power distribution and disconnects for his equipment to utilize this power source.

M. A 120 VAC UPS power source will be brought to the CEMS shelter by others for back-up of critical equipment.

N. The CEMS shelter will be provided with R30 insulation on the roof and R19 or better insulation on the walls.

O. The CEMS shelter will be provided with integral HVAC units to meet requirements of the site conditions. Contractor to perform calculations to size HVAC to provide adequate heating and cooling.

P. The system will be integrated with the plant control system (DCS) via hardwire connections and/or serial interface. The Contractor will provide any software and hardware upgrades that may be required to the CEMS in order to accomplish this objective.

Q. Data Acquisition and Handling System (DAHS) The DAHS shall be microprocessor based and use a Windows 2008 Server or Windows XP operating system with a web based operator interface. It shall be coordinated with the control system to provide the following:

1. The software for the DAHS shall be designed so that the preparation of daily, monthly, quarterly, semi-annual, and annual reports per SCAQMD Rule 2012, Rule 218, & 40 CFR Part 75 regulation is automated to the fullest extent possible. Data used in the reports shall be retained in the DAHS for the entire calendar quarter of interest, and at least 45 days into the new quarter to allow the operator time to prepare the final report. (Retention of data from Day 1 is desired) Report formats shall be designed to supply the following information concerning excess emissions in accordance with the standard reporting format as specified by the governing department.

    a. The magnitude of excess emissions computed in accordance with 40 CFR 60 & 75, State of California AB 32, and SCAQMD Regulation XX, SCAQMD Rule 218 & 218.1, any conversion factor(s) used, and the data and time of commencement and completion of each time period of excess emissions.
    b. Specific identification of each period of excess emissions that occurs during startups, shutdown, and malfunctions of the affected facility. The nature and cause of any malfunction (if known), the corrective action taken or preventative measures adopted.
    c. Time and date identifying each period during which the continuous monitoring system was inoperative except for zero and span checks and the nature of the system repairs or adjustments.
    d. Each period of excessive emissions shall be specifically identified with starting time and date, and ending time and date. The absolute value of the excessive emission is to be given, along with a reason code description. The reason code is used to identify the cause of the excessive emission, such as startup, shutdown, or malfunctions. The reason code shall be entered from the keyboard by a "user friendly" protocol. At any time up to final report generation, the reason code can be changed, comment space (up to 120 characters) shall be allowed for each period of excessive emissions; to describe corrective action taken. These comments will be retained in the database and can be added/modified at any time up to final report generation.
    e. In a similar fashion, periods of "CEMS out of service" are to be chronologically reported on a quarterly basis. Each occurrence shall be explicitly time tagged, identified as a parameter, and at least 120 characters of comment space allowed for operator statements.
    f. Reports shall be designed to compactly provide all data reduction on a daily format. Raw average resolution for gasses shall be in accordance with 40 CFR 75 and any applicable State of California and SCAQMD rules. The sample rate of the DAHS shall be at least once every 10 seconds. All status flags such as maintenance fault, calibration, etc. shall be recorded in real time alongside the data values. All other parameter and constants used to convert the emission parameter to units of the Standard shall be printed for each hour. Flags shall highlight emission violations that will appear in the quarterly report format described above.

2. A method shall be employed to archive on magnetic media or equivalent, the database used to generate the above reports. At a later time, the archive copies can be restored to the system and hard copy reports generated. The archive is required to be automatically performed at the end of each day, so that the user is protected against a system failure that would destroy the database. Also, the operator must be able to obtain archive copies of the database upon command.
3. The system shall include battery backup with power-fail-auto-restart circuitry, and a real time clock. Spare board slots shall be available for future system expansion. The Signal

Conversion hardware shall provide differential inputs of at least 16-bit resolution for each signal input. Contact closure sensing inputs shall be provided for instrument status signals - fault, zero calibration, and span calibration as a minimum. Signal Conversion hardware shall also be expandable.

4. The DAHS shall employ hard disks for non-volatile storage of the database in a RAID 5 configuration. The program is to be prepared such that accumulated data on the hard disk is retained and available for use in the event of a "cold start" after a failure. The storage capability shall be one hundred and twenty (120) gigabytes or larger. It shall be sufficient for any required program overlays, for a complete system and CEMS configuration file, and for retaining the stack's data and comments for the entire present and last completed calendar quarter, so that flexibility in editing a final quarterly report is achieved. A CD-RW drive and USB port shall be provided for loading programs and diagnostics, and for extracting and restoring archives of the database. A minimum of a 17" flat panel LCD display, keyboard for operator interface, and laser-jet printer shall also be supplied.
5. The analog outputs to the plant control system shall hold last value during the calibration cycle and return to real time only after a true, stable reading has been established.
6. The CEMS computer shall have integral fault monitors to detect malfunctions of system equipment and both visually and audibly notify control room operations personnel and the General Manager of existing abnormal conditions.
7. The DAHS shall be capable of displaying real time data on the workstation and on reports that any applicable rules require.
8. Communications between the DCS and CEMS shall be via Modbus RTU over **TCP/IP**.
9. CEMS Supplier shall provide a DAHS workstation, monitor and report printer and remote CEMS DAHS monitor in the plant control room which will be tied to the CEMS controllers via a dedicated fiber link for each CEMS unit.
10. The data acquisition unit is designed around a central processing unit which is an IBM compatible desktop computer. The computer consists of the following components:

    a. Speed: Dual Core 2.2 GHz minimum
    b. RAM: 2 GB RDRAM
    c. Hard disk: 160GB minimum
    d. Monitor: 17in LCD
    e. System: Windows 2008 Server or Windows XP
    f. Modem 56kbps
    g. B/U Hard Drive: dual 250GB

11. DAHS shall substitute missing data in accordance with 40 CFR 60, 75 & 98, California AB 32, and SCAQMD Regulation XX SCAQMD Rule 218 & 218.1.
12. DAHS shall communicate and report certain data daily by 5:00pm the next day to the SCAQMD Central Station per Rule 2012 chapter 7.
13. At a minimum, DAHS shall generate and record CO, NH3, NOx concentration and mass rate, O2, stack gas flow rate, fuel flow rate and fuel type data points for each successive 15 minute period on the hour and at equally spaced intervals thereafter.
14. The probe shall be located at a location which meets the “Guidelines for Construction of Sampling and Testing Facilities in the SCAQMD” Source Test Manual. 40 CFR parts 60, 75 & 98.
15. Each CEMs and component thereof shall be capable of completing a minimum of one cycle of operation (sampling, analyzing and data recording) for each successive 15-minute interval.

16. DAHS shall be fully accessible remotely at multiple stations either through VPN/Remote Connection or a web site.
17. DAHS shall provide CEMs status in accordance with SCAQMD rule 2012.

R. The Sample System

1. Probe

   a. The Contractor shall provide a multi-point probe by *M&C (Mac-Products)* or 4 multipoint probes tubes approximately 56 inches in length, each with 4 drilled sample orifices or approved equivalent and related equipment as required to extract gas samples continuously from the stack specified in Appendix B2. The Multipoint probe arrangement shall be installed in the stack and the one single port probe upstream of SCR catalyst.
   b. Probes shall be furnished with an amorphous silica coating, Silco or approved equivalent.
   c. Probes shall be equipped with a particulate filtering element as required to remove entrained particulates from the sample.
   d. In cases of high risk of sample line contamination, the probes and associated filter assembly shall be designed such that cleaning can be achieved by compressed air blowback at programmed intervals. The source of compressed air for blowback shall only be available near the analyzer cabinet. Compressed air will be available at 60 to 80 psig.
   e. Probe shall be designed such that it may be easily removed from the gas stream for service and/or cleaning.
   f. The Contractor shall provide companion flange complete with bolts, gaskets and all necessary hardware for the mounting of the probe assembly. Probe assembly, bolts, and flanges exposed to flue gases shall be made out of corrosion resistant material designed for this kind of service.
   g. Probe shall be constructed of 316 stainless steel.

2. Sample Line

   a. Per SCAQMD Rule 2012 Chapter 2 B. 15, the Contractor shall provide either self-regulating heated sample lines or temperature controllers, capable of maintaining the sample temperature above the dew point of the sample. Heated sample lines are not required for dilution probe systems where no sample condensation occurs.
   b. The sample lines shall consist of TFE or 316 stainless steel tubing for sample, TFE for calibration gases, polypropylene or equal for blowback air lines, and heating elements, insulation, electrical wiring, and a scuff-resistant jacket.
   c. Tubing shall be sized by the system supplier to ensure an adequate sample is supplied to the analyzers and to minimize pressure loss, however, it shall not be less than 1/4" diameter.
   d. The Contractor shall provide automatic air blowback of sample tubing,
   e. The Contractor shall supply the exact amount of sample line required as specified in Appendix C2. Sample line fittings shall comply with materials specified.
   f. All valves in contact with wet sample gas either before or after any sample conditioning shall be Teflon lined or approved equal. Valves shall be the sealed type to prevent any non-Teflon component from being wetted by the gas. All Teflon lined valves used to control instrument air over 10 psi must have a 316 SS valve upstream on the instrument air operating in conjunction with the Teflon lined

valve to prevent the Teflon line valve from having to seal against the instrument air pressure.

g. A thermocouple shall be included, located approximately 50 feet from power end of the line, used for sample line temperature control and alarming. Temperature controller shall be included in the CEMS enclosure designed to control the sample line and heated probe filter box temperature. A high/low temperature alarm shall be provided in the DAHS data logger.

3. Sample Conditioning System

a. The Contractor shall provide a sample conditioning system as necessary to extract a continuous gas sample. As a minimum, the system shall protect the monitoring system components from particulate and moisture caused by condensation.

b. The sample conditioning system include all necessary tubing, valves, fittings, pumps, coolers, drains, dryer, filters, etc., required to efficiently condition the raw sample to a state suitable for the gas analyzers. The design of the conditioning system shall maintain sample integrity and shall minimize sample degradation by chemical reaction. In addition, sample conditioning system shall control pressure and volumetric flow rate of the sample and distribute it to the individual analyzers. Pressure regulators with gauges and flow meters with control valves shall be provided so that flow rates to individual analyzers can be controlled and monitored from the front panel.

c. Tubing, fittings, valves, pump components, miscellaneous hardware etc., in contact with the sample gas, prior to drying, shall be heated to maintain the sample gas temperature above its dew point and shall be constructed of material compatible to the service, or Teflon coated.

d. Extraction motive force shall be provided by a dual-head positive displacement diaphragm type pump with Teflon diaphragms or eductor. All wetted surfaces of the pump shall be Teflon lined or Stainless Steel. Single head pump is acceptable for the inlet NOx system.

e. An electronic refrigerant gas compressor type sample cooler, M&C or equivalent, shall be included with peristaltic pumps to dry samples below 4°C. The sample shall be dried to a dew point below the interference level. Glass impinger shall be provided. Sample residence time with condensate shall be minimized to prevent absorption of the gasses to be measured. The sample outlet temperature will be measured and recorded per SCAQMD regulations.

f. An integral moisture sensor alarm and secondary filter shall be provided downstream of the sample conditioner. The secondary filter shall remove 99% of the particles down to 2 microns. Filter material shall not absorb gasses of interest. Moisture sensor alarm shall be wired back to the CEMs controller. An automatic relay shall be provided that will shut down the vacuum pump in the event of moisture alarm.

g. NH3 scrubber must be used before analyzers in CEMs to prevent ammonia bisulfate salts from accumulating in the analyzer. For SCR application which have ammonia slip present in the sample, ammonia scrubber desiccant shall be provided downstream of the sample conditioner. The ammonia scrubber will remove ammonia slip from the sample gasses so as to not contaminate downstream analyzer equipment. A moisture drain shall be provided and plumbed to the shelter drain.

h. An automatic and manual system shall be provided to inject calibration gasses at the instrument directly (local calibration) or through the probe (stack calibration).

Calibration control and monitoring functions shall be performed by the DAHS PLC. Electronic solenoid valves shall be provided for each separate calibration gas cylinder for daily gasses and quarterly audit gasses. Two stage stainless steel calibration gas bottle regulators shall be provided for all daily and quarterly calibration cylinders. Brackets shall be mounted to the exterior of the shelter for securing the calibration gas cylinders in accordance with OSHA regulations. Calibration gas cylinders shall be located so as to be accessible to plant personnel for replacement. Included pressure transducers and transmitters for daily calibration gasses.

S. Analyzer Cabinet

1. Meter readouts to indicate the instantaneous value of the analyzed gases as listed in Appendix C2 in PPM or percent as measured in pounds per million Btu shall be furnished.
2. The ability to control the verification cycle shall be furnished. One (1) dry form C contact output shall be provided for each measured gas to indicate when the instrument is in a verification cycle. The contacts shall open to indicate verification and shall be rated not less than 0.5 amperes at 120 VAC.
3. Fault monitors to detect malfunctions of system equipment. One (1) dry form C contact output (0.5 amp at 120 VAC) shall be provided for General Manager's use.

T. The Contractor shall supply all necessary documentation in accordance with this specification.

2.2 TOOLS

Contractor shall provide special tools and device required for operation, maintenance, and calibration of the system.

PART 3 - EXECUTION

3.1 TRAINING, SUPERVISION

A. The Contractor shall provide at least five (5) days on site installation/start up supervision/assistance of a qualified field engineer for reporting/control system and analyzers. This shall not include time required to institute software changes and debugging of the Contractor’s equipment.

B. Should the Contractor need any information or clarification from any permitting or regulatory agency or from any major equipment Contractor (e.g. gas turbine generator, etc.) such request shall be made, in writing, to Design Engineer. There shall be no direct correspondence between the Contractor and any agency or equipment Contractor regarding the Authority to Construct / Final Decision or scope of this specification, without permission of the General Manager.

C. The Contractor shall provide 6 hard copies of manuals for the DAHS.

D. The Contractor shall conduct on site hands-on training for a minimum of 3 days or more as necessary. This may not be necessary for the selected Contractor that has an identical or very similar CEMs/DAHS that already exists at the facility.

3.2 TESTS, INSPECTIONS, REPORTS

A. The Contractor shall perform all factory and field test including alignments and adjustments required by applicable EPA, State of California and SCAQMD regulations including, but not limited to, the applicable requirements of 40 CFR 60,75 & 98, SCAQMD Rule 2012, SCAQMD Rule 218 & 218.1 and all pertinent federal, state and local air quality regulations.

B. The Contractor shall notify the General Manager thirty (30) days prior to the performance of a factory or field tests. EPA Performance Specification Tests shall be coordinated with the General Manager and allow sufficient time for any prior notifications to agencies if required.

C. Should the General Manager elect not to be present during factory test, contractor shall conduct the tests and shall furnish the General Manager with test reports. Data shall be reported as taken during testing and converted to EPA requested units and tables. Decision by General Manager not to witness tests shall in no way relieve the Contractor from furnishing a complete and certifiable system.

D. The Contractor shall prepare and submit to the General Manager six (6) hard copies and an electronic copy of all factory and field test reports required by the EPA. Test reports shall be submitted within thirty (30) calendar days of test completion. Final test reports shall be submitted within 5 calendar days of receiving final comments by the General Manager.

E. Factory Tests:

1. The Contractor shall conduct all standard factory tests including factory calibrations and DAHS verification.
2. The Contractor shall perform a factory operational test of the assembled gas monitoring system including, but not limited to, the following:

    a. Test all wiring for grounding, open circuits and proper continuity.
    b. Test the control schemes for complete and proper operation of all switching, relaying, lights and interlocks.
    c. Test all tubing, fittings and connections for leaks at two (2) times the operating pressure.
    d. These tests shall be subject to witness by the Customer's engineer. The Contractor shall notify the General Manager at least twenty (20) days in advance of the tests.
    e. Test emission equations, reports, missing data substitution, alarms, reason codes and verification of input and output parameters.

F. Field Tests:

1. The Contractor shall prepare for and perform the Performance Specification Test Procedures outlined in applicable Sections of 40 CFR part 60, 75 and part 98, State of California and the SCAQMD Rule 2012. The Contractor shall provide personnel to remain on site throughout the duration of the Relative Accuracy Test Period.

2. The equipment will be tested by an independent third party testing organization retained by Contractor to verify its proper performance. Testing is to be in accordance with 40 CFR 60, 75, 98, SCAQMD Regulation XX, SCAQMD Rule 218 & 218.1 and the Permit to Construct / Final Decision. Equipment failing the tests shall be promptly modified, repaired, or replaced at the Contractor's sole expense. Subsequent re-testing shall be at Contractor's sole expense.
3. Start up support shall include the following as a minimum:

    a. An installation checklist shall be reviewed and a walk-down performed to ensure that all equipment is ready for activation
    b. Power up the system and perform a thorough test of all system functions per a site specific checklist.
    c. Monitor on-line operation and calibration over a two day period.
    d. Check DAHS software to ensure proper data reduction, calculations, substitution, alarm, display and reporting functions. Checking DAHS software shall include test with simulated input data.

APPENDIX A – INFORMATION, DRAWING REQUIREMENTS FROM CONTRACTOR - REFER TO ATTACHMENT 11 – DRAWING SCHEDULE

APPENDIX B – PROJECT SPECIFIC DATA

B1 Estimated emission concentration & stack gas flow rates depending on gas turbine model
All concentrations are based on ppmvd @15% O_2

Normal Operation 50% to 100% load

	LM 6000
Turbine Exhaust	
NOx	25
CO	9-37
Stack	
NOx	2
CO	2
NH3	5
Flue gas Flow Rate	1150000 lb/hr @882.1°F

Start-Up

	LM 6000
Turbine Exhaust & Stack	
NOx	25-87
CO	7-156
NH3	0-5

Shut – Down

	LM 6000
Stack	
NOx	2-6
CO	0.5-7.2
NH3	0-5

B2 STACK PHYSICAL DATA

Four (4) EPA sampling ports will be provided on the stack for acceptance and source testing and shall consist of 4-inch 150# RF flange and 4-inch blind flange. A sampling platform or other means of providing safe access to the sampling ports will be installed.

An additional 4-inch 150# RF flanged port will be made available for the CEMS sample probe.

Exhaust Stack Parameters (Estimated- numbers):

Parameter

Stack Height (ft)	125
Stack Inside Diameter (ft)	10.17
Exit Gas Flow (1000 lb/h))	1,161
Exit Gas Temperature (ºF)	882.1°F (LM6000)
Water Vapor Concentration	12.3% or 13.1% by volume (no water droplets present)

B3 SCR INLET PHYSICAL DATA

A 4-inch 150# RF flange ahead of the OTSG SCR will be provided for the CEMS sample probe.

B4 PARAMETERS APPLICABLE TO EMISSIONS

Refer to Section 480020 - Site Conditions

APPENDIX C – PERFORMANCE DATA

C1 WORK SCOPE REQUIREMENTS

The work shall meet the monitoring and reporting requirements of the Permit to Construct / Final Decision, as it applies to CEMS, and these Specifications. The monitoring system shall comply with all applicable provisions of 40 CFR 60, 75 & 98, California Air Resources, California GHG mandatory reporting requirements, South Coast Air Quality Management District's Regulation 2000, SCAQMD Rule 218 & 218.1, Rule 2011 and Rule 2012.

Analyzers shall continuously monitor NOx, CO, O_2, NH3 concentrations, fuel flow rate, gross MW (combined output of the gas turbine and steam turbine), water injection rate, NH3 injection rate, SCR inlet temperature, SCR inlet NOx concentration, differential SCR pressure, & differential CO oxidation catalyst with performance specifications that meet or exceed specifications in 40 CFR 60 and 40 CFR75.
Continuous emission monitoring of Volatile Organic Compounds (VOC), SOx, CO_2, and PM10 is not required. The CEMS computer shall calculate ROC, SOx, CO_2, and PM10 from derived emission factors and report in lb/hr, lb/day, and tons/yr. The CEMS computer shall calculate stack volumetric flow in dscfm. Calculations shall be corrected to 15% O_2 (dry).

An analog signal (4-20 mADC) will be provided from the plant control system for recording the flow of natural gas. An analog value of megawatt production will be provided from the plant control system for reporting and calculations.

C2 ANALYZERS AND ENCLOSURES

PROBE ASSEMBLY - Two (2) probe assemblies with coarse filter at sample port. Refer to attached General Arrangement drawing to estimate the appropriate probe lengths. Probes are further defined in section 2.1.R

ANALYZERS

1. One (1) Stack Gas Carbon Monoxide (CO) Monitor (dual range)

   The CO monitor shall respond to concentrations in the range consistent with applicable regulations as stated in 40 CFR 75 and SCAQMD Rule 218 and Rule 2012, specific to the requirements for instrument ranges.

   Range 0-10/2000 ppm. Normal expected reading 5-10 ppm on gas.

2. One (1) Stack Gas Oxides of Nitrogen (NOx) Monitor (dual range)

   The NOx monitor shall respond to concentrations in the range consistent with applicable regulations as stated in 40 CFR 75 and SCAQMD Rule 2012, specific to the requirements for instrument ranges.

   Range 0-10/100 ppm. Normal expected reading 1-3 ppm.

3. One (1) Stack Gas Oxygen (O_2) Monitor

   The O_2 monitor shall respond to concentrations in the range of 0 to 25%.

4. One (1) SCR inlet Gas Oxides of Nitrogen (NOx) Monitor (dual range)

   The NOx monitor shall respond to concentrations in the range consistent with applicable regulations as stated in 40 CFR 75 and SCAQMD Rule 2012, specific to the requirements for instrument ranges.

   Range 0-100 ppm. Normal expected reading < 25 ppm.

5. One (1) Ammonia to NOx converter analyzer (0-10/100, dual range)

   Stack NOx monitor *(item 2*) will be used in conjunction *with this analyzer* for the NH3 slip calculation. NH3 slip will be calculated per the following:
   NH3 slip. ppm = NOx ppm (converted) – NOx ppm, (total, unconverted)

   One (1) Analyzer Cabinets — including sampling pumps, sample conditioning systems (moisture removal and fine filters), analyzers for NOx, CO, O_2, and moisture or moisture sensors and calibration systems.

   ENCLOSURE

   Free-standing environmental enclosures, prewired and pre-piped to house analyzer cabinets, local calibration assembly, rotameters, PLC and DAHS. Enclosure shall include redundant electrical HVAC as required for ambient conditions listed in site data. A 10 ft. x 12 ft. area will be provided near each stack.

   SAMPLE TUBING

   (TBD, length of sample tubing will be determined later) feet of heat traced and insulated sample tubing from the CEMS enclosure to the stack port. Minimum temp per Site design criteria is 17 degrees F. Approximately (TBD, length of tubing to be determined later) feet of heat traced and insulated sample tubing from the CEMS enclosure to the SCR inlet sample port.

C3 Microprocessor based report generating system to be located in the CEMS shelter with a remote unit in the control room for CEMS unit. The printer, monitor, keyboard, and microprocessor shall be rack mounted. In addition, CEMS data, report generating capability, and other functions shall be accessible by the Engineer of Environmental Programs via VPN/Remote Connection.

C4 EMISSIONS ANALYSIS MICROPROCESSOR-BASED CONTROL UNIT I/O

Analog Input (from the plant control system to the CEMS Microprocessor Unit): 4-20 mADC

1. Gas Turbine stack volumetric gas flow.
2. Gas Turbine Generator Gross Megawatts.
3. Steam Turbine Generator Gross Megawatts.

Analog Outputs (to the plant control system from the CEMS Microprocessor Unit): 4-20 mADC

1. Stack NOx@15% O2 concentration.
2. Stack CO@15% O2 concentration.
3. Stack NH3@15% O2 concentration.
4. Stack O2.
5. SCR Inlet NOx concentration.
6. Stack moisture. (if required)
7. Ambient temperature. (if required)
8. SCR inlet temperature
9. Stack Ammonia concentration (calculated)
10. Fuel flow
11. CO2 mass emission rate
12. Flue gas flow rate

Digital Outputs (to the plant control system from the CEMS Microprocessor Unit): dry contact outputs

1. Stack CEMS is in calibration.
2. SCR inlet CEMS is in calibration.
3. Stack CEMS is valid.
4. SCR inlet CEMS is valid.
5. Stack CEMS Excess Emissions.
6. CEMS Common Alarm.
7. DAHS Common Alarm.
8. Stack CEMS Fault.
9. SCR inlet CEMS Fault.
10. Fuel type: Natural Gas
11. Unit status: Commissioning
12. Unit Status: Cold Start-up
13. Unit Status: Warm Start-up
14. Unit Status: Shut Down

Digital Input (to the plant control system from the CEMS Microprocessor Unit): dry contact input.

1. Unit Status : Turbine Start-up
2. Unit Status: Turbine Shut Down
3. Unit Status: Turbine On-Line

Soft Datalink Input (from the plant control system)

1. Water or steam injection rate.
2. Ammonia injection rate.
3. SCR differential pressure.
4. Oxidation Catalyst differential pressure.
5. Other parameters required by the air quality regulatory agencies.

Soft Datalink Output (to plant control system)

1. NOx Lbs/Hr.
2. CO Lbs/Hr.
3. Stack NOx@15% O2 average to monitor permit condition.
4. Stack CO@15% O2 average to monitor permit condition.
5. Stack NH3@15% O2 average to monitor permit condition.
6. Other emissions required to monitor permit conditions.

Contractor shall wire all outputs to terminal blocks for connection to plant control system. General Manager will wire inputs to contractor's terminal blocks.

Contractor shall supply 10% spare I/O and terminal block capacity.

Any calibration gas shall be NIST/EPA approved standard reference material, certified reference materials or shall be certified in accordance with the latest EPA Traceability protocol for Assay and Certification of Gaseous Calibration Standard and /or any other applicable regulatory requirements.

ADDITIONAL FEATURES AND TRAINING TO BE INCLUDED

1. CEMS remote operator terminal for each GTG and printer located in main control room. This is in addition to the local operator terminal and printer in each CEMS enclosure.

2. The Contractor shall provide a classroom type training course and instructional materials/manuals for a minimum of ten (10) people at the plant in the principles of operation, programming, and maintenance of the system. Upon training completion, General Manager's personnel shall be familiar with procedures to change software or hardware, initialize and load software into reporting system, known maintenance and preventative maintenance procedures, and run diagnostics on all system equipment to locate faulty components.

3. CEMS will have a capability to download WATERS report from the SCAQMD website, generate a report shown in Attachment 1 and then generate a hybrid report (see Attachment II) from the WATERS report and the Attachment I report and QA/QC the hybrid report for monthly reporting of RECLAIM NOx emissions.

APPENDIX D – PAPERLESS CHART RECORDER – SCAQMD REQUIREMENTS

1. The paperless chart recorder (PCR) shall record data at the same or greater frequency as the DAHS takes in raw data from the analyzer or monitor, if that frequency is greater than once per minute, then the PCR shall record data at once every minute.
2. The PCR shall be installed in the same configuration as the original paper chart recorder. (not applicable to new applications)
3. The PCR shall continuously archive the data on either directly to a "write once-read many" medium (e.g. CD-R), or in encrypted format to non-volatile data storage. Encrypted means that the data cannot be read except by the use of decryption software. Non-volatile data storage means that the data will not be lost if a power outage occurs.
4. Encrypted files shall be such that they cannot be changed without destroying the files or leaving signs of tampering.
5. Decryption software shall be a commercially available product, not custom software written only for this application.
6. The decryption software shall be provided (at no cost) to the AQMD. Decryption software enables the user to view the data on a PC as if it were a strip chart and to print the chart (equivalent to a paper strip chart) to a standard PC printer.
7. Conversion software shall be provided (at no cost) to the AQMD. Conversion software enables the user to convert the graphical data to numeric data in a standard output such as ASCII or Excel, to facilitate calculations
8. The data shall be viewable on the PCR in the same manner as if it were a paper strip chart recorder (i.e. it must have a screen w/reasonable resolution).
9. The PCR shall have an integrated real-time clock accurate to within one minute, and each data point shall include a "date and time stamp" and any printout of a chart shall include time stamps periodically, including the month, day, year and time of day (hr, min, sec) in local time.
10. The facility shall be able to create a chart printout, and encrypted file, or a converted file (Excel, ASCII, etc.) of any past data, up to and including data collected for the current day upon request without more than a 30 minute wait.
11. Any printout of a chart shall include (and identify) the parameters on the chart.
12. Archived digital data shall be stored and protected in a manner at least equivalent to paper chart storage, and shall store in an environment compatible with the archival storage medium chosen.
13. The PCR shall record all configuration changes and when they occurred.
14. The facility shall have set protocol that must be approved by District of how & when to archive to media from internal memory, and if removable media is used for archiving, how staff is alerted to replace media when it is full.
15. The PCR shall have chart annotation capability and all annotations shall be recorded in the archived data files and displayed when data files are viewed as charts.
16. The PCR shall have auto-recovery from power failures (no need to re-boot) without loss of data, and automatically log the time and length of power failure.

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 480020
Site Conditions

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 480020
Site Conditions

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: GREGG HARWOOD AND STEVE HARRIS

REVISION HISTORY		
DATE	REVISED BY	REVISION
07/13/2011	S.HARRIS	A
09/09/2011	T. CLARK	B
12/07/2011	T. CLARK	C
05/04/2012	T. CLARK	D
06/15/2012	B. HRITSCO	E
08/24/2012	G. DRAKE	F
08/29/2012	T. CLARK	G
10/04/2012	T. CLARK	H
09/10/2013		I – CONTRACT VERSION

SECTION 480020
SITE DESIGN CONDITIONS

TABLE OF CONTENTS

PART 1 - GENERAL INFORMATION 1

1.1 PURPOSE 1
1.2 PROJECT LOCATION 1
1.3 LOCAL CLIMATE 1

PART 2 - AMBIENT CONDITIONS 1

2.1 WEATHER STATIONS 1
2.2 ELEVATION 1
2.3 TEMPERATURE 1
2.4 PRECIPITATION 2
2.5 WIND 2
2.6 EVAPORATION 2
2.7 DUST 2

PART 3 - DESIGN CONDITIONS 3

3.1 OPERATING AMBIENT 3
3.2 DESIGN AMBIENT 3
3.3 SITE INVESTIGATION 3
3.4 WIND 4
3.5 ELECTRICAL EQUIPMENT 4
3.6 HVAC 4
3.7 NOISE 5
3.8 AIR EMISSIONS 5

PART 4 - INTERFACE PARAMETERS 6

4.1 NATURAL GAS 6
4.2 RAW WATER 7
4.3 TREATED WATER 7
4.4 DEMINERALIZED WATER 8
4.5 CONDENSATE 8
4.6 STEAM 8
4.7 COOLING WATER SYSTEM 9

PART 5 - CODES & STANDARDS 10

5.1 GENERAL REQUIREMENTS 10
5.2 APPLICABLE LAWS, ORDINANCES, REGULATIONS, AND STANDARDS (LORS) 10

SECTION 480020
SITE DESIGN CONDITIONS

PART 1 - GENERAL INFORMATION

PURPOSE

A. All equipment and system design shall comply with the following site design conditions.

PROJECT LOCATION

B. The Project is located within the existing Glenarm Power Plant Site, which is located at 72 East Glenarm Street, in Pasadena, California. The new Unit GT-5, CTG/STG/OTSG, will be located on the west side of the existing GT-1 and GT-2 turbine/generators and south of the existing Glenarm Building. The new Unit GT-5, CTG/STG/OTSG, will replace the existing B-3 Boiler/STG in the adjacent Broadway Power Plant.

C. The GT-5 Site consists of predominately disturbed native soil. The property is relatively flat. The elevation of the property is approximately 751' above mean sea level (AMSL).

D. Site improvements related to the Project are limited to ~2 acres. The designated temporary construction areas are limited to ~4.1 acres.

LOCAL CLIMATE

E. Pasadena is an urban city in the Los Angeles area of Southern California. Precipitation occurs primarily from mid-fall to mid-spring. Summers are long and hot; winters are typically mild. Equipment and system design shall be suitable for the hot, dry and dusty environment.

PART 2 - AMBIENT CONDITIONS

WEATHER STATIONS

A. LA USC Downtown Cam (USAF: 722874, WBAN: 93134)

ELEVATION

B. The approximate site elevation is 751 FT AMSL

TEMPERATURE

C. Ambient temperatures and corresponding relative humidity are summarized below:

1. Annual Average: 64° F / 61% RH
2. Design Condition: 75° F / 50% RH
3. Summer Normal High: 97° F / 42% RH
4. Winter Normal Low: 32° F / 70% RH
5. Summer Extreme High: 113° F / 16% RH

6. Winter Extreme Low: 17° F / 71% RH

D. Monthly average temperatures and corresponding relative humidity:

1.	January	58.6°F / 51.8% RH
2.	February	58.6°F / 56.2% RH
3.	March	61.1°F / 57.0% RH
4.	April	62.7°F / 58.5% RH
5.	May	66.7°F / 61.8% RH
6.	June	69.9°F / 63.9% RH
7.	July	73.9°F / 63.1% RH
8.	August	74.0°F / 61.6% RH
9.	September	72.5°F / 59.7% RH
10.	October	68.4°F / 57.4% RH
11.	November	63.0°F / 52.5% RH
12.	December	57.7°F / 52.0% RH

PRECIPITATION

E. Annual average precipitation for the area is 14.77 IN.

F. The rainy season is from December to January.

G. The 24-hour storm events are: 25-Year 6.41”-8.8”, 50-Year 9.01”-12”.

WIND

H. Prevailing winds are summarized below:

1. Wind Direction: From the WSW
2. Wind Average Speed: 1.2 MPH
3. Wind design conditions are specified below 0

EVAPORATION

I. Estimated annual average pan evaporation rate is 78”.

J. Estimated annual average solar insulation is 5.5 kWh/m^2/day (average)

DUST

K. Occasional windblown dust concentrations from ground level exceeding equipment height. Outdoor filter systems and enclosures shall be suitable for the blown dusty environment.

PART 3 - DESIGN CONDITIONS

OPERATING AMBIENT

A. The plant shall be capable of operation over the load range with permitted emissions levels within the following operating ambient temperature and humidity conditions without any reduction in design performance or reliability:

1. Annual Average: 64° F / 61% RH
2. Design Condition: 75° F / 50% RH
3. Operating Summer Normal High: 97° F / 42% RH
4. Operating Winter Normal Low: 32° F / 70% RH

DESIGN AMBIENT

B. The equipment shall be designed to withstand and operate within the following ambient temperature and humidity conditions without damage or life degradation:

1. Summer Design High: 113° F / 16% RH
2. Winter Design Low: 39° F / 50% RH

SITE INVESTIGATION

C. The project shall be designed under the California seismic codes and standards based upon the following factors:

Site Coefficients	**Reference**
S_S = 255.1% S_1 = 60%	2010 CBC, USGS Seismic Curves
Site Class = D	2010 CBC, Table 1613.5.2
F_a = 1.0 F_v = 1.5	2010 CBC, Tables 1613.5.3(1) and (2)
$S_{MS} = F_a S_S$ = 255.1%	2010 CBC, Equation 16-37
$S_{M1} = F_v S_1$ = 127.5%	2010 CBC, Equation 16-38
$S_{DS} = 2/3\ S_{MS}$ = 170%	2010 CBC, Equation 16-39
$S_{D1} = 2/3\ S_{M1}$ = 85%	2010 CBC, Equation 16-40
Occupancy Category = III	2010 CBC Table 1604.5
Seismic Design Category = D	2010 CBC, Tables 1613.5.6(1) and (2)
I or I_E = 1.25 (non-hazardous material) I or I_E = 1.50 (hazardous material)	ASCE/SEI 7-05 Table 11.5-1

D. Structural calculations for all tank and equipment support and anchorage systems, structural framing systems, pipe support systems and any and all other items subject to seismic support requirements in accordance with the applicable building and structural codes shall be performed and stamped by a Registered California Structural Engineer.

E. The geotechnical investigation recommends supporting heavy structures on mat foundations.

F. Ground water was not encountered during geotechnical investigations summarized in the Hydrologue Soils Engineering Investigation report dated August 1, 2011.

G. Geotechnical Report:

1. Firm: Hydrologue, Inc., Contact: Seyed M. Mortazavi, Ph.D., 626-585-9696
2. Report: Soils Engineering Investigation, Proposed Glenarm Repowering Project (Unit GT-5 Combined Cycle Installation), Pasadena, California, August 1, 2011, Project No. 3626-04-01

H. Site Survey:

1. Coory Engineering Project 05-S-0139, Phone: 714-202-8700

I. Live Loads:

1. Elevated Floors, Platforms, walkways, and stairs:

a. Uniform Load, 100 pounds per square foot.
b. Concentrated Load, 2,000 pounds on 2.5-foot square floor area (without uniform load).
c. Concentrated Load, 1,000 pounds on support beams (without uniform load).
d. Equipment, storage, or lay down weight (without uniform load).

WIND

J. The project wind design conditions are summarized below:

1. Category: 85 MPH (3 second gust wind speed)
2. Exposure: C
3. Factors: Iw = 1.15

ELECTRICAL EQUIPMENT

K. Transformers shall be designed for a 24-hour average ambient temperature of 40˚C and maximum temperature of 50˚C. Transformers shall have required capacity based upon the 55˚C winding temperature rise rating.

L. Transformer seismic qualification is HIGH.

HVAC

M. HVAC systems shall be N+1 redundant. HVAC systems for enclosed spaces shall be packaged units installed at ground level. HVAC systems shall be suitable for the occasional heavy windblown dust concentrations.

N. Controlled Temperature:

1. Occupied: 75° F Summer, 70° F Winter, +/- 3° F Variance
2. Unoccupied (workshop): 80° F Summer, 65° F Winter, +/- 5° F Variance
3. Electrical Module: Summer 75° F, Winter 65° F, +/- 5° F Variance
4. Battery Room: 75° F Summer, 65° F Winter, +/- 5° F Variance

O. Controlled Humidity:

1. Occupied: Maximum 50% RH, all other spaces no control

P. Electrical panels containing electronic devices located external to environmentally controlled areas shall be equipped with N+1 redundant conditioning equipment.

NOISE

Q. Refer to Section 480031 Combined Cycle Power Island Noise Control Performance detailed noise requirements.

AIR EMISSIONS

R. Treated gas turbine exhaust emissions to air shall be guaranteed not exceed the concentrations defined in the table below during normal operation or the total annual emissions set by the SCAQMD air permit. For guarantees, refer to Attachment 6 - Performance Guarantees.

Constituent	**Value**	**Units**
NOx	2.0	ppmvd (at 15% O2, 1 hr rolling average)
CO	2.0	ppmvd (at 15% O2, 1 hr rolling average)
VOC	2.0	ppmvd (at 15% O2, 1 hr rolling average)
SOx (Assumes 0.5 grains per 100 scf)	<1.0	lb/hr
PM10	5.0	ppmvd (at 15% O2, 1 hr rolling average)
NH3 Slip	5.0	ppmvd (at 15% O2, 1 hr rolling average)

PART 4 - INTERFACE PARAMETERS

NATURAL GAS

A. The project is permitted to operate on pipe line quality natural gas only. The fuel source is supplied by Southern California Gas Company (SEMPRA) and has the following composition based on a volatile organic analysis for C1 to C15 performed by AccuLabs, Inc.:

Analyte			**Analysis Results**	
Methane	94.4	vol %	Total Hydrocar-bons%	96.9
Ethane	2.17	vol %	Total Mol. Wgt.	17.02
Propane	0.130	vol %	SG (relative to air)	.5878
iso-Butane	0.064	vol %	HHV, Btu / scf	1,012
n-Butane	0.063	vol %	LHV, Btu / scf	912
iso-Pentane	0.019	vol %	LHV, Btu / lb	20,246
n-Pentane	0.015	vol %	HHV, Btu / lb	22,468
Hexane & Isomers	0.021	vol %		
Heptane & Isomers	208	ppmv		
Octane & Isomers	93	ppmv		
Nonane & Isomers	90.5	ppmv	Temperature	77°F
Decane	<10	ppmv		
C11	<10	ppmv		
C12	<10	ppmv		
C13	<10	ppmv		
C14	<10	ppmv		
C15	<10	ppmv		

B. Fuel gas supply pressure at the site terminal point is approximately 150 PSIG.

C. The project will have a continuous maximum fuel supply demand of approximately 587 MMBTU/HR.

D. The project equipment (GTG) has a minimum fuel gas pressure requirement of 725 psia.

E. Gas fuel for GTG must meet MID-TD-0000-1 in Attachment 10.

RAW WATER

F. Raw water will be used for cooling tower make-up and reverse osmosis system feed.

G. The project raw water source* is City potable water from Pasadena Water & Power and has the following composition **ranges and average values**:

Constituents	Range	Average	Units
Total Hardness	84-300	237	mg/l
Calcium	49-71	57	mg/l
Magnesium	20-28	23	mg/l
Sodium	83-98	89	mg/l
Alkalinity	63-130	107	mg/l
Sulfate	160-250	194	mg/l
Chloride	84-94	88	mg/l
Nitrate (NO3)	ND-1.8	1.4	mg/l
Fluoride	0-7-1.0	0.9	mg/l
Silica	N/A	12.0	mg/l
Total Dissolved Solids	470-630	532	mg/l
Specific Conductivity	460-1000	889	µS/cm
pH	7.6-8.6	7.9	
Color	N/A	1	
Odor	N/A	2	
Turbidity	0.03-0.06	0.05	NTU
Aluminum	ND-0.20	0.11	ppm
Arsenic	ND-2.7	1.9	ppb
Barium	ND-0.13	0.11	ppm
Chromium	0.04-0.10	0.06	ppb
Copper	N/A	ND	ug/l
Lead	N/A	ND	ug/l
Zinc	N/A	ND	ug/l
Perchlorate	N/A	ND	ug/l

* Raw Water Analysis based on Pasadena Water & Power's Water Quality Test Data 2010 for MWD Weymouth Plant Treated Surface Water Data as well as recent raw water source tests (5/03/2012).

TREATED WATER

H. Treated water will be used for ion-exchange system feed.

I. The station water treatment system supplies treated water through a reverse osmosis process with the following historical quality:

1. Reverse Osmosis Permeate

Constituents	Analysis Results
Silica	0.009 mg/l
Conductivity	2.36 µS/cm
Sodium	No analysis available
TDS	0 mg/l

DEMINERALIZED WATER

J. Demineralized water will be used for steam cycle make-up, NOx injection and performance augmentation. Demineralized water for NOx injection and performance augmentation shall meet Contractor's specification MID-TD-0000-3 in Attachment 10.

K. The existing station water treatment system supplies demineralized water through an ion-exchange process with the following historical quality:

1. Demineralized Water

Constituents	Analysis Results
Silica	0 mg/l
Conductivity	2.5 µS/cm
Sodium	56 mg/l
Sulfate	1.21 mg/l
Hardness	5 mg/l
TDS	2.0 mg/l
ORP	349 mV
pH	6.74
TOC	1.10 mg/l

CONDENSATE

L. The boiler water and feedwater will be maintained within the recommendations of the American Boiler Manufacturers Association (ABMA) "Boiler Water Limits and Steam Purity Recommendations for Water Tube Boilers", 1995 Fourth Edition and the American Society of Mechanical Engineers (ASME) "Consensus on Operating Practices for the Control of Feedwater and Boiler Water Quality in Modern Industrial Boilers", ASME, 1979.

STEAM

M. The OTSG shall be designed to ensure high purity steam is forwarded to the turbine at all times. The steam purity shall be maintained at the lowest practical level of contaminants and shall not exceed the following:

1. Steam Purity

Constituents	Analysis Results
Sodium	0.005 ppm
Conductivity	0.30 µS/cm
Silica	0.01 ppm

N. Under normal operating conditions, the dissolved oxygen in the condensate will not exceed 0.005 cc/liter (7 ppb).

COOLING WATER SYSTEM

O. The station cooling water system is based upon a wet counter-flow cooling tower with the following expected cold water temperatures:

Ambient Dry Bulb, F	Ambient RH, %	Ambient Wet Bulb, F	Cooling Water, F
32	70	29.1	51
59	60	51.4	65
64	61	56.0	68
97	42	77.3	83
Cooling Tower Capacity is 145.6 MMBTU/HR (12,400 gpm at 20 F range)			
Condenser Cooling Demand is < 112.2 MMBTU/HR (10,790 at 20 F range)			

P. The station cooling water system will be used for steam cycle equipment cooling as well as lube oil cooling for the CTG and STG, TEWAC generator cooling, and fuel gas compressor cooling (lube oil and compressed gas discharge), and any auxiliary equipment that requires off-skid cooling. If a chiller is supplied for inlet air conditioning, the heat from the compressors will be rejected back to the same cooling tower.

1. Auxiliary Cooling Water Capacity: 8.03 MMBTU/HR maximum available (803 gpm at 20˚F range)
2. Auxiliary Cooling Water Cold Temperature: 68˚F (at 64˚F ambient design case)

Q. The treatment program for the cooling water system includes the following:

Control	Product	Limits
Phosphate	CL-4830	125 ppm Product, 5 -8 ppm phosphate
Corrosion Inhibitor	CL-4830	125 ppm Product, 4 -6 ppm TTA
Dispersant	CL-4830	125 ppm Product, 10 - 15 ppm dispersant
Acid	H2SO4	7.5-7.7 pH
Bleach	Sodium Hypochlorite	0.2-0.4 ppm free
Non-Oxidizing Biocide	ChemTreat CL 2156 & CL 2030	Batch Feed
Raw Water Make-up Softening	TBD	TBD
Cooling Tower Cycles of Concentration: 7.0		
Conductivity: 4000-4500 umhos/cm		

PART 5 - CODES & STANDARDS

GENERAL REQUIREMENTS

A. The project shall be designed and constructed in accordance with all Federal, State and Local laws, ordinances, regulations and standards.

B. The project design shall comply with the requirements as set forth in the CEQA conditions and air permit constraints.

C. The project shall comply with the applicable parts of 2010 California Code of Regulations Title 24 Building Codes.

D. The project shall comply with the electrical interconnection requirements of NERC and WECC.

APPLICABLE LAWS, ORDINANCES, REGULATIONS, AND STANDARDS (LORS)

E. The following list of LORS applicable to the project design and construction methods is not meant to be all encompassing or relieve the contracted entity in any way of the responsibility to research and comply with all applicable codes and standards. Design specifications and construction of the Project shall be in accordance with (1) applicable laws, regulations, codes and standards of the Federal Government and State of California, as set forth below and, (2) and applicable local (including county and city) laws, regulations, codes and ordinances, as set forth below. In the event of any change in applicable laws, regulations, codes and standards, or any applicable laws, regulations, codes and standards not set forth below, the Parties shall use the provisions in Article 15 in the Contract to make any adjustments if necessary.

SECTION 480020
SITE DESIGN CONDITIONS

1. General

Jurisdiction	LORS
Federal	Federal Code of Regulations (CFR) - 40 CFR 60/75
State	California Code of Regulations (CCR) Title 24 (Building Codes)
State	California Code of Regulations (CCR) Title 8 (Cal OSHA)
State	California Accidental Release Program (Cal ARP)
State	California Public Utilities Commission General Orders
State	Business and Professions Code
State	Health and Safety Code (H&SC)
State	California Environmental Quality Act (CEQA)
State	State Water Resources Control Board (SWRCB)
State	California Integrated Waste management Act (CIWMA)
State	California State Fire Marshalls (CSFM) - Listing and Labeling
State	California Air Resources Board (CARB)
Local	Los Angeles County APCD Regulations
Local	City Building Department
Local	City Planning Department
Local	City Public Works Department
Local	Local Fire Department Approvals and Standards
Local	South Coast Air Quality Management District (SCAQMD)
Standard	National Fire Prevention Association (NFPA)
Standard	Underwriters Laboratories (UL) - Listing and Labeling
Standard	Factory Mutual (FM) - Listing and labeling

2. Civil, Architectural and Structural Engineering

Jurisdiction	LORS
Federal	Americans with Disabilities Act (ADA)
State	California Building Code Part 2 (Building Code)
State	Alquist Priolo Earthquake Fault Zoning Act
Standard	The Green Book - Standard Plans for Public Works Construction
Standard	The Green Book - Standard Specifications for Public Works Construction
Standard	American Association of State Highway and Transportation Officials (AASHTO)
Standard	American Society of Civil Engineers (ASCE)
Standard	American Concrete Institute (ACI)
Standard	American Institute of Steel Construction (AISC)
Standard	American Reinforcing Steel Institute (ARSI)
Standard	American Iron and Steel Institute (AISI)
Standard	Aluminum Manufacturer's Association (AMA)
Standard	Builders Hardware Manufacturer's Association (BHMA)
Standard	Metal Building manufacturer's Association (MBMA)
Standard	Steel Door Institute (SDI)
Standard	Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
Standard	Society of Steel Protective Coatings (SSPC)
Standard	The Masonry Society (TMS)
Standard	Research Council on Structural Connections (RCSC)
Standard	International Code Council (ICC)
Standard	ACI 318-08 Building Code Requirements for Structural Concrete
Standard	ACI 530/ASCE 5/TMS 402 Building Code Requirements for Masonry Structures
Standard	ASCE 7-05 Minimum Design Loads for Building and Other Structures
Standard	AISC ASD/LRFD 13th Edition Steel Construction Manual
Standard	RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts
Standard	AISC Specification of Structural Steel Buildings - Allowable Stress Design and Plastic Design
Standard	IEEE 693 Recommended Practice for Seismic Design of Substations

3. Mechanical Engineering

Jurisdiction	LORS
State	California Building Code Part 4 (Mechanical Code)
State	California Building Code Part 5 (Plumbing Code)
State	California Building Code Part 6 (Energy Conservation)
State	California Building Code Part 9 (Fire Code)
Standard	American National Standards Institute (ANSI)
Standard	American Society of Mechanical Engineers (ASME)
Standard	ASME Power Test Codes (PTC)
Standard	American Society for Testing and Materials (ASTM)
Standard	American Petroleum Institute (API)
Standard	American Water Works Association (AWWA)
Standard	American Welding Society (AWS)
Standard	American Standard of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
Standard	Thermal Insulation manufacturers Association (TIMA)
Standard	Tubular Exchanger Manufacturers Association (TEMA)
Standard	Heat Exchanger Institute (HEI)
Standard	Pipe Fabrication Institute (PFI)
Standard	Hydraulic Institute (HI)
Standard	Cooling Technology Institute (CTI)
Standard	Compressed Air and Gas Institute (CAGI)
Standard	Expansion Joint Manufacturing Association (EJMA)
Standard	Manufacturers Standardization Society (MSS)
Standard	American Refrigeration Institute (ARI)
Standard	American Gear manufacturers Association (AGMA)
Standard	NFPA - 10, 13, 14, 15, 20, 22, 30, 37, 54. 70, 72, 72E, 80, 85B, 90B, 101, and 850
Standard	ANSI - B15.1, B16.36, B16.5, B31.1, B31.3, K61.1, and K93.2
Standard	ASME - Boiler and Pressure Vessel Code, PTC 22, and PTC 46
Standard	ASTM - Material Specifications (as applicable), Sampling and Testing Standards (as applicable), and Nondestructive Examination Procedures and Criteria.
Standard	NACE International (NACE)

4. Electrical and Controls Engineering

Jurisdiction	LORS
Federal	ANSI/NFPA 70 - National Electrical Code (NEC)
Federal	ANSI C2 - National Electrical Safety Code (NESC)
State	California Building Code Part 3 (Electrical Code)
State	General Order 95 (GO-95)
State	California Independent System Operator (CAISO)
State	CEC Power Plant Lighting Requirements
Standard	Instrumentation, Systems and Automation (ISA)
Standard	Association of Edison Illuminating Companies (AEIC)
Standard	Anti-Friction Bearing manufacturers Association (SFBMA)
Standard	Institute of Electrical and Electronic Engineers (IEEE)
Standard	Illuminating Engineering Society (IES)
Standard	National Electrical Manufacturers Association (NEMA)
Standard	ANSI C29.2 & C29.9 - National Insulator Standards
Standard	ANSI C50.10 – Rotating Electrical Machinery – Synchronous Machines
Standard	ANSI C50.14 – Requirements for Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators
Standard	IEEE Standard 80 Guide for Safety in AC Substation Grounding
Standard	ANSI/IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of Ground System
Standard	ANSI/IEEE 979 – IEEE Guide for Substation Fire Protection
Standard	ANSI/IEEE 980 – IEEE Guide for Containment and Control of Oil Spills in Substations
Standard	ANSI/IEEE C37 – Guides and Standards for Circuit Breakers, Switchgear, Substations and Fuses
Standard	ICEA P-46-425 – Power Cable Ampacities
Standard	ICEA P-54-440 – Ampacities in Open top Cable Tray
Standard	IEEE 112 – IEEE Standard Test Procedure for Polyphase Induction Motors and Generators
Standard	IEEE 141 – Recommended Practice for Electric Power Distribution for Industrial Plants
Standard	IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
Standard	IEEE 422 – Guide for the Design and Installation of Cable Systems in Power Generating Stations
Standard	IEEE 450 – IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Application
Standard	IEEE 484 – IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
Standard	IEEE 493 – Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems
Standard	IEEE 665 - Guide for Generating Station Grounding

Jurisdiction	LORS
Standard	IEEE 693 – Recommended Practice for Seismic Design of Substations
Standard	IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
Standard	IEEE C37.2 – Standard Electric Power System Device Function Numbers and Contact Designations
Standard	IEEE C57.105 – IEEE Guide for Application of Transformer Connections in Three Phase Distribution Systems
Standard	IEEE C57.12.00 - Guide for Liquid-Immersed Distribution, Power and Regulating Transformers
Standard	IEEE C57.91 – IEEE Guide for Loading Mineral-Oil-Immersed Transformers
Standard	IEEE C57.93 – IEEE Guide for Installation of Liquid-Immersed Power Transformers
Standard	IEEE C62.23 – IEEE Application Guide for Surge Protection of Electric Generating Plants
Standard	IEEE C62.41 – IEEE Recommendation Practice on Surge Voltages in Low-Voltage AC Power Circuits
Standard	NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
Standard	NEMA AB-1 – Molded Case Circuit Breakers
Standard	NEMA ICS2 – Industrial Control and System Controllers, Contactors and Overload Relays rated 600 Volts
Standard	NEMA MG1 – Motors and Generators
Standard	NEMA MG2 – Safety Standard for Construction and Guides Selection, Installation and use of Electric Motors and Generators
Standard	NEMA PB-1 – Panel Boards
Standard	NEMA TR-1 – Transformers, Regulators, and Reactors
Standard	NEMA VE 1 Cable Tray Systems
Standard	NEMA WC5 – Thermoplastic – Insulated Wire and Cables
Standard	NFPA 780 – Lightning Protection Code
Standard	UL 50– Enclosures For Electrical Equipment
Standard	UL 514B – Standard for Fittings for Conduit and Outlet Boxes
Standard	ANSI ICS6 - Enclosures for Industrial Control Systems
Standard	SP51 Instrumentation Symbols and Identifications

5. LM6000 GTG codes and standards

Contractor considers the applicable sections of the following US and ISO Codes and Standards to be the most relevant standards for gas turbine equipment. Our designs and procedures are generally compliant with applicable sections of the following:

ANSI A58.1	Minimum Design Loads for Buildings and Other Structures
ANSI B1.1	Unified Inch Screw Threads
ANSI B1.20.1	Pipe Threads
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory-Made Wrought Steel Butt Welding Fittings

ANSI B16.21	Non-Metallic Flat Gaskets for Pipe Flanges. (Spiral-wound gaskets per API 601 may be used, particularly in turbine compartment piping)
ANSI B31.1	Pressure Piping and Gas Turbine Piping Systems Comply
ANSI B133.2	Basic Gas Turbine
ANSI B133.3	Gas Turbine Auxiliary Equipment
ANSI B133.4	Gas Turbine Controls and Protection Systems
ANSI B133.5	Gas Turbine Electrical Equipment
ANSI B133.8	Gas Turbine Installation Sound Emissions
ANSI/NAFPA 12	Carbon Dioxide Extinguishing Systems
ANSI/NFPA 70	National Electrical Code
ANSI/IEEE C37.90	Standard for Relays and Relay Systems Associated with Electrical Power Apparatus
ANSI C37.90A/ EEE-472	Guide for Surge Withstand Capability (SWC) Tests
ANSI C50.10	General Requirements for Synchronous Machines
ANSI C50.14	Requirements for Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators
ANSI C57.94	American Standard, Guide for Installation and Maintenance of Dry Type Transformers
ANSI C83.16	Relays Associated with Electrical Power Apparatus
ANSI/IEEE 100	IEEE Standard Dictionary of Electrical and Electronic Terms
ANSI/NEMA MG1	Motors and Generators
ANSI/NEMA MG2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motor and Generators
ANSI S1.2	Method for the Physical Measurement of Sound
ANSI S1.4	Method for the Measurement of Sound Pressure Levels
ANSI S1.13	Specification for Sound Level Meters
ANSI S6.1/ SAE/J184A	Qualifying a Sound Data Acquisition System
AGMA 6011	Standard Practice for High Speed Helical and Herringbone Gear Units
API 613	Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry
API 614	Lubrication, Shaft Sealing, and Control - Oil Systems for Special Purpose Applications
API 616	Gas Turbine for Refinery Services
API 650	Welded Steel Tanks for Oil Storage
API 670	Vibration Monitoring System
API 671	Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services
API 678	Accelerometer Based Vibration Monitoring Systems
API RP11PGT	Packaging Combustion Gas Turbines
ASME PTC22	Gas Turbine Power Plants - Performance Test Codes
ASME SECTION VIII	ASME Boiler and Pressure Vessel Code
ASME SECTION IX	ASME Boiler and Pressure Vessel Code
ANSI IEEE C37.2	Electrical Power System Device Function Numbers (Contractor complies with respect to device designations except that in a few

	case device number had to be modified or added to fit Contractor's needs).
IBC 2009	International Building Code
IEEE STD 421	IEEE Standard Criteria and Definitions for Excitation Systems for Synchronous Motors
EIA RS-232	Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange
EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
CAN/CSA 22.2 No. 1010.1-92	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
ANSI/ISA S82.02.01 1999	Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment - General Requirements
UL 796	Printed Circuit Boards
ANSI IPC Guidelines	
ANSI IPC/EIA Guidelines	
EN 55081-2	General Emission Standard
EN 50082-2	Generic Immunity Industrial Environment
EN 55011	Radiated and Conducted Emissions
IEC 61000-4-2	Electrostatic Discharge Susceptibility
IEC 61000-4-3	Radiated RF Immunity
IEC 61000-4-4	Electrical Fast Transit Susceptibility
IEC 61000-4-5	Surge Immunity
IEC 61000-4-6	Conducted RF Immunity
IEC61000-4-11	Voltage Variation, Dips & Interruptions
ANSI/IEEE C37.90.1	Surge
EN 50021 Electrical	Apparatus for Potentially Explosive Atmospheres
CAAA	Clean Air Act and Amendments Comprehensive Environmental Response, Compensation and Liability Act of 1980.
CFR	Code of Federal Regulations
Title 29,	Code of Federal Regulations (CFR), Part 1910 Occupational Safety and Health Standards
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FAA	Federal Aviation Administration Regulations
NERC	North American Electric Reliability Corporation (Reference to generator and excitation system only)
Cal/OSHA	Title 8, Ladders, Platforms & walkways.

CALTRANS State of California Department of Transportation, Standard Specifications and applicable Special Provisions and Reference Specifications, as last Revised

CBC California Building Code, 2010 Edition, (Including Title 24 – Requirements for California PE Stamped Finite Element Anal-ysis)

CCRs California Code of Regulations

- Business and Professions Code Section 6704, et seq.; Section 6730 and 6736. (Requires state registration to practice as a Civil Engineer or Structural Engineer in California).
- Vehicle Code Section 35780, et. Seq. (Requires a permit for Cal-trans to transport heavy loads on state roads).

Contractor's Gas Turbine Drafting Standards are based on the following Standards as appropriate to the gas turbine. Please note that in several instances, symbols, etc. have been devised for Contractor's special needs (such as flow dividers and manifolds:

ANSI Y14.15B	Electrical and Electronics Diagrams (On base gas turbine and accessory base equipment)
ANSI Y14.17	Fluid Power Diagrams
ANSI Y14.36	Surface Texture Symbols
ANSI 299/IEEE 315	Graphic Symbols for Electrical and Electronics Diagrams
ANSI Y32.10	Graphical Symbols for Fluid Power Diagram
ANSI Y32.11	Graphical Symbols for Process Flow Diagram
ANSI Z32.2.3	Graphical Symbols for Pipe Fittings, Valves & Piping
AWS A2.0-68	Welding Symbols

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 480031
Combined Cycle Power Island
Noise Control Performance

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 480031
Combined Cycle Power Island
Noise Control Performance

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: EMERY W. TUTTLE

REVISION HISTORY		
DATE	REVISED BY	REVISION
06/01/2011	Emery W. Tuttle	A
06/03/2011	Emery W. Tuttle	B
08/02/2011	Emery W. Tuttle	C
08/12/2011	Emery W. Tuttle	D
10/17/2011	Emery W. Tuttle	E
12/01/2011	Emery W. Tuttle	F
02/02/2012	Gregg Harwood	G
05/04/2012	Gregg Harwood	H
09/10/2013		I – CONTRACT VERSION

SECTION 480031
COMBINED CYCLE POWER ISLAND NOISE CONTROL PERFORMANCE

TABLE OF CONTENTS

PART 1 SUMMARY OF REQUIREMENTS 1

1.1 GENERAL 1
1.2 GUARANTEED NOISE LEVEL LOCATIONS 1
1.3 BACKGROUND NOISE (PRE EXISTING PLANT NOISE AND COMMUNITY NOISE) 1
1.4 NOISE PERFORMANCE ACCEPTANCE TESTS 1
1.5 CORRECTIVE WORK 2

PART 2 GUARANTEED NOISE LEVELS 2

2.1 IN-PLANT LOCATIONS 2
2.2 COMMUNITY LOCATIONS OUTSIDE THE PLANT 2

PART 3 OBLIGATION TO PERFORM, LIQUIDATED DAMAGES, AND PENALTIES 2

PART 4 NOISE CONTROL PERFORMANCE AND TESTING PROCEEDURES 2

4.1 GENERAL SUMMARY 2
4.2 IN-PLANT NOISE LEVEL PERFORMANCE DURING NORMAL SYSTEM START-UP AND SHUTDOWN **ERROR! BOOKMARK NOT DEFINED.**4
4.3 IN-PLANT NOISE LEVEL PERFORMANCE DURING NORMAL PRODUCTION 5
4.4 COMMUNITY NOISE LEVEL PERFORMANCE DURING NORMAL SYSTEM START-UP AND SHUTDOWN 6
4.5 COMMUNITY NOISE LEVEL PERFORMANCE DURING NORMAL PRODUCTION 7
4.6 NOISE MEASUREMENT SYSTEM REQUIREMENTS 9
4.7 NOISE CORRECTIONS FOR MEASUREMENTS INSIDE THE PLANT 10
4.8 NOISE CORRECTIONS FOR MEASUREMENTS OUTSIDE THE PLANT 12
4.9 GUARANTEED NOISE PERFORMANCE AT IN-PLANT LOCATIONS 13
4.10 GUARANTEED NOISE PERFORMANCE AT COMMUNITY LOCATIONS 14
4.11 TOLERANCE FOR TEST MEASUREMENTS 14
4.12 NOISE PERFORMANCE ACCEPTANCE TEST REPORT 14

PART 5 REFERENCE STANDARDS AND PROCEDURES 15

PART 6 ABBREVIATIONS, ACRONYMS, AND DEFINITIONS 16

PART 7 EXHIBITS 20

PART 1 - SUMMARY OF REQUIREMENTS

1.1 GENERAL

Noise affecting the community is a critical issue for the Glenarm Repowering Project (GT-5 Combined Cycle Installation). The total noise levels occurring during the operation of all GT-5 Combined Cycle equipment operating as a composite noise producing system whether on, off, at full load, or any partial load during start-up, shutdown and continuous operation are limited to maximum noise levels both inside and outside the plant. Sensitive receptor locations outside the plant have been selected and a maximum noise level determined for each location. In addition, the GT-5 Combined Cycle equipment operating as a composite noise producing system shall not exceed an average noise level of 85 dBA inside the plant when measured at a standard distance of three feet from noise producing equipment and five feet above the ground. Any noise produced during an Emergency Shut-Down of the system shall not be required to meet the noise performance requirements inside the plant (near field locations) or outside the plant (far field locations).

1.2 GUARANTEED NOISE LEVEL LOCATIONS

The guaranteed noise levels inside the plant shall be an equipment package average as described in Section 4.2A at a standard distance of three feet from all new noise producing equipment in this contract when measured five feet above ground. The guaranteed noise levels outside the plant shall be met at each of fourteen locations around the plant as depicted on Exhibit A of this specification. The guaranteed noise levels shall be in accordance with the procedures described throughout PART 4 of this specification.

1.3 BACKGROUND NOISE (PRE EXISTING PLANT NOISE AND COMMUNITY NOISE)

Pre-existing plant noise sources shall not be included in the noise performance of the GT-5 Combined Cycle power generation system. Corrections for the background noise and balance of plant equipment noise within the plant shall be treated as described in Section 4.7 of this specification. Corrections for the background noise and balance of plant equipment noise outside the plant shall be treated as de-scribed in Section 4.8 of this specification.

1.4 NOISE PERFORMANCE ACCEPTANCE TESTS

After completion of construction and start-up of the GT-5 Combined Cycle power generation system, Noise Performance Acceptance Test(s) as described throughout PART 4 will be conducted to deter-mine if the Contractor has met all the requirements of the noise guarantee and noise control specifications contained herein. The City will hire and pay for the services of a consultant to conduct the initial Noise Performance Acceptance Test no later than 15 days following completion of the GT-5 power generation performance and air emissions tests. The noise measurement procedures will be as de-scribed throughout this specification. All measurement data and calculation results gathered or developed for the acceptance

tests will be compiled into a single report. Copies of that report will be pro-vided to the Contractor within 2 weeks after test completion. Contractor comments on the results of the Noise Performance Acceptance Test shall be submitted to the City no later than two weeks after receipt of the test report. The City and Contractor shall provide their own authorized representatives to witness all noise level measurements. No measurement will be recorded without the City's and Contractor's representatives in attendance.

1.5 CORRECTIVE WORK

Refer to the Contract terms.

PART 2 - GUARANTEED NOISE LEVELS

2.1 IN-PLANT LOCATIONS

The package of equipment shall be Warranted and Guaranteed by the Contractor not to exceed the Maximum Sound Pressure Level Average (L_{EQ}), shown in the Contract, Attachment 6 – Performance Guarantees, when measured at 3 feet from the equipment and five feet above ground as described in Section 4.2. The guaranteed noise level shall be a composite of all noise sources included in this con-tract operating simultaneously. The guaranteed noise level shall be a simple arithmetic average of all measurement locations evenly spaced around all equipment, and shall not be more than 15 feet apart nor less than 8 feet apart. The guaranteed noise level during normal power production at base load operation shall not exceed an average of 85 dBA.

2.2 COMMUNITY LOCATIONS OUTSIDE THE PLANT

When operating as a composite system, all components in this contract shall be warranted and guaranteed by the Contractor not to exceed the maximum sound pressure level average (L_{EQ}) at each location listed in the Contract, Attachment 6 – Performance Guarantees. The receptor locations listed on these submittal forms are mapped on Exhibit A. The guaranteed level at all locations outside the plant shall be a composite of all noise sources included in this contract, but shall not include community background noise or any *pre-existing plant noise*. In addition, the noise produced by the equipment in this contract shall not create audible tones that last more than 30 seconds at any community location outside the plant as described in Sections 4.4E and 4.5E.

PART 3 - OBLIGATION TO PERFORM, LIQUIDATED DAMAGES, AND PENALTIES

Refer to the Contract terms.

PART 4 - NOISE CONTROL PERFORMANCE AND TESTING PROCEEDURES

4.1 GENERAL SUMMARY

The GT-5 Power Island System (Power Island) shall meet the noise level performance requirements as specified hereinafter. All noise levels described in the proceeding sections shall be the sound pressure level (or SPL) of the equipment noise emissions. The sound pressure levels used hereafter shall have a *reference pressure* of 20 micropascals. The term "noise level" shall be interchangeable with the terms, "sound level," or "sound pressure level." All noise levels shall be A-weighted (unless specified otherwise) and shall utilize the slow response on a metering system with a three-decibel *exchange rate*. *Italicized* words and acronyms are defined in PART 6 of this specification.

Compliance shall be demonstrated through a series of noise measurements conducted as part of the *Noise Performance Acceptance Tests*, according to the procedures specified hereinafter. The *Guaranteed Noise Performance* shall apply to all noise producing components in the Power Island as a composite noise (as opposed to individual requirements for each component). The composite noise shall be referred to as the *Power Island Noise*. The noise level performance requirements and measurement procedures shall apply as follows:

A. In-Plant Noise Level Performance:

The *Power Island Noise* shall not exceed a sound pressure level average (L_{EQ}) specified in the proceeding sections during normal base load operation. Except where specified, the in-plant measurement distance shall be 3 feet to the side of the overall equipment package and 5 feet above the ground level. The *Noise Performance Acceptance Tests* in the plant shall be conducted for base load operation only. All normally operating equipment associated with GT-5, referred to as the *Total System Noise,* shall be operating during the noise measurements at each location within the plant. Existing power plant equipment shall not be operating during the *Noise Performance Acceptance Tests* for GT-5. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be removed from the measured levels of the *Total System Noise* by mathematical calculation using the methods described in Section 4.7. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the Power Island. The *Contractor* shall guarantee and be responsible for meeting their *Power Island Noise* level guarantees according to the Contract, Attachment 6 – Performance Guarantees for in-plant measurement locations. The *Guaranteed Noise Performance* shall be demonstrated in the *Noise Performance Acceptance Tests.*

B. Community Noise Level Performance:

The *Power Island Noise* shall not exceed a maximum sound pressure level average (L_{EQ}) at any location in the surrounding community while the system is operating under any load condition. The *Power Island Noise* shall not contain audible tones at any community location as described in Sections **Error! Reference source not found.**~~4.4E~~ and 4.4E~~4.5E~~. The *Noise Performance Acceptance Tests* in the community shall include separate tests for the following three stages of operation: (1) normal system start-up, (2) normal production operation of the system at the *worst-case load condition*, and (3) normal system shutdown. All normally operating equipment associated with GT-5, referred to as the *Total System Noise*, shall be operating during the noise measurements at all test locations outside the

plant. Existing power plant equipment shall not be operating during the *Noise Performance Acceptance Tests* for GT-5. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be removed from the measured levels of the *Total System Noise* by mathematical calculation using the methods described in Section 4.8. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the Power Island. The *Contractor* shall guarantee and be responsible for meeting their *Power Island Noise* level guarantees according to the Contract, Attachment 6 – Performance Guarantees. The *Guaranteed Noise Performance* shall be demonstrated in the *Noise Performance Acceptance Tests*. The in-plant noise performance requirements described in Section 4.2 shall not take precedence over but shall be in addition to the community noise level performance requirements.

4.2 IN-PLANT NOISE LEVEL PERFORMANCE DURING NORMAL PRODUCTION

A. Maximum Noise Limits:

The PIE system shall not exceed a sound pressure level average (L_{EQ}) of 85 dBA, while operating at base load, and when measured at a distance of 3 feet from the overall equipment package of the system. The guaranteed noise level shall be an average of all measurements locations as specified in Section 4.2B. The noise shall be measured as an energy-averaged L_{EQ} at each measurement point with a 3-decibel exchange rate on an integrating sound level meter. All valid measurements shall be recorded around each piece of equipment and shall be average together using a simple arithmetic average to determine compliance with the 85 dBA noise limit. All measured levels below 72 dBA shall be considered invalid and discarded from the tabulation of measurements, and therefore not included in the overall average noise level of the power island equipment. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the Power Island.

B. Measurement Locations:

The averaged 85 dBA limit shall apply at an imaginary perimeter around the overall equipment package at a distance of 3 feet from major noise-producing surfaces along the package perimeter, spaced not more than 15 feet apart nor less than 8 feet apart, and 5 feet above the ground level at the perimeter. If the equipment is located in an enclosure intended to reduce the noise, the measurement shall be taken outside the enclosure at a distance of 3 feet. All measurement locations shall be diagramed with respect to the noise source and the noise level tabulated for each position.

C. Measurement Duration:

The duration of the noise measurement at each measurement position shall be between 15 and 40 seconds if the noise is relatively steady state (i.e., the level and pitch do not change by more than 3 dB over time). If the noise source is not steady state (i.e., is intermittent or changes in level or pitch by more than 3 dB over time), the measurement time shall be increased as required to adequately capture the changing state of the noise level.

D. Measurement Conditions:

The GT-5 *total system noise* shall be measured while operating at base load. P*re-existing plant noise* from existing power generation systems shall not be present during the measurements of the GT-5 normal production noise. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 *Total System Noise* measurements, and shall be used to correct the measurements of the Power Island as described in Section 4.7. Noise measurements shall not be permitted if the constant wind speed exceeds 7 mph at any measurement location.

4.3 COMMUNITY NOISE LEVEL PERFORMANCE DURING IMPULSIVE VENT NOISE AT START-UP AND SHUTDOWN

A. Maximum Noise Limits:

The *Power Island Noise* produced during natural gas venting that typically occurs during start-up and shutdown, shall not exceed the guaranteed impulse sound pressure level (*LIMP*) shown in the Contract, Attachment 6 – Performance Guarantees at two (2) locations in the community. The vent noise shall be measured on a Sound Level Meter using the Impulse response setting and the A-Weighting. A minimum of (2) vent impulse noises during two separate start-ups and (2) vent impulse noises during two separate shutdowns shall be measured. The highest of these shall be reported as the final result for the vent noise performance. The guaranteed noise limits for vent noise shown in the Contract, Attachment 6 – Performance Guarantees, are based solely on the *Power Island Vent Noise* and shall not include *pre-existing plant noise, background noise,* or *balance of plant equipment noise.* If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and *balance of plant equipment noise* shall be measured together for two to three minutes using the *LIMP* noise metric at the two test locations both before and after the GT-5 vent noise measurements, and shall be used to correct the measured vent noise as described in Section 4.8.

B. Measurement Locations and Times:

Two locations shall be measured for the vent noise, C08 west of Fair Oaks Avenue, and the center of State Street at a point due South of the Glenarm Building Reference Point as shown on Exhibit A. The measurement height shall be 5 feet above the ground surface at the measurement location, and a minimum of 25 feet from any large, flat, sound reflective surface such as buildings or walls whenever practical. The measurements shall be between the hours of 2 AM and 4 AM at both test locations. Late night measurements may need to be conducted over more than one nighttime period to complete these and other tests associated with the GT-5 noise performance.

C. Measurement Duration:

The duration of the noise measurement at the two measurement positions shall be as required to adequately capture the highest level of the impulsive vent noise during start-up and shutdown. The duration of the vent noise shall also be noted and reported.

D. Measurement Conditions:

P*re-existing plant noise* from existing power generation systems shall not be present during the measurements of the GT-5 system start-up and shutdown noise. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 start-up and shutdown vent noise measurements, and shall be used to correct the measurements of the noise as described in Section 4.8. Passing street vehicles closer than 50 feet to the microphone shall not be included in any measurement outside the plant. Measurements shall not be conducted if continuous wind speeds are greater than 5 mph at any measurement location. Two vent noise events shall be measured during two separate start-ups and two events during two separate shutdowns. The highest impulse level L_{IMP}, of the four measured events shall be reported as the final result for the vent noise performance.

4.4 COMMUNITY NOISE LEVEL PERFORMANCE DURING NORMAL SYSTEM START-UP AND SHUTDOWN

A. Maximum Noise Limits:

The *Power Island Noise* produced during start-up and shutdown consisting of noise from intermittent or occasional noise sources such as gas venting, steam bypass, auxiliary start-up equipment, or any other noise that typically occurs during start-up or shutdown, shall not exceed the maximum sound pressure level averages (L_{EQ}) shown in the Contract, Attachment 6 – Performance Guarantees at fourteen locations in the community. The fourteen locations are mapped on Exhibit A, and consist of residential and commercial land uses. The noise limits shown in the Contract, Attachment 6 – Performance Guarantees are based entirely on contributions from the *Power Island Noise* and shall not include *pre-existing plant noise, background noise,* or *balance of plant equipment noise.* The noise shall be measured as an energy-averaged L_{EQ} with a 3-decibel exchange rate on an integrating sound level meter. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 start-up and shutdown noise measurements, and shall be used to correct the measured noise as described in Section 4.8. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the Power Island.

B. Measurement Locations and Times:

A maximum of five measurement positions will be selected by the City from the fourteen possible locations in the surrounding community as shown on Exhibit A. The measurement height shall be 5 feet above the ground surface at the measurement location, and a minimum of 50 feet from any large, flat, sound reflective surface such as buildings or walls at measurement locations C01, C03, C04, C09, C11, C12, and C14. At measurement locations C02, C05, C06, C07, C08, C10, and C13, the measurement microphone shall not be less than 25 feet from large reflective surfaces other than the ground surface. The system start-up noise shall be measured at the five "selected" positions to determine the noise performance and compliance. The measurements shall be between the hours of 2 AM and 4 AM at all

five test locations. Late night measurements may need to be conducted over more than one nighttime period to complete all measurement locations.

C. Measurement Duration:

The duration of the noise measurement at each measurement position shall be between 1 and 15 minutes. If the measurement location is: (a) not near one of the busier streets; and (b) passing vehicle noise is not dominant, and (c) the overall noise is reasonably steady state (i.e., the minimum and maximum levels do not vary from each other by more than 15 decibels over the measurement period), a measurement between 1 and 5 minutes can be performed. If street traffic noise is dominant and the overall noise is not reasonably steady state (i.e., is intermittent or the minimum and maximum levels vary from each other by more than 15 decibels over the measurement period), a 5 to 15 minute measurement must be performed as required to adequately capture the changing state of the noise level.

D. Measurement Conditions:

P*re-existing plant noise* from existing power generation systems shall not be present during the measurements of the GT-5 system start-up noise. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 start-up and shutdown noise measurements, and shall be used to correct the measurements of the noise as described in Section 4.8. Passing street vehicles closer than 50 feet to the microphone shall not be included in any measurement outside the plant. This can be accomplished by pausing the measurement if necessary when a passing street vehicle is anticipated. Measurements shall not be conducted if continuous wind speeds are greater than 5 mph at any measurement location. A separate system start-up and shutdown shall be repeated at each measurement location in the community to demonstrate the noise performance and compliance at each of the five selected locations outside the plant.

E. Audible Tones:

During normal system start-up and shutdown, the Power Island equipment shall not produce noise that contains *dominant tonal characteristics* that can be detected at any location in the surrounding community for *more* than 30 seconds. A dominant tonal characteristic shall be determined when <u>both</u> of the following conditions are found present at any location in the surrounding community outside the power plant: (1) the average *Power Island Noise* level (L_{EQ}, un-weighted) in any one-third octave band from 125 Hz and lower exceeds the noise level in both of the adjacent one-third octave bands by an average of fifteen or more decibels, or exceeds the noise level by an average of eight or more decibels in the adjacent bands from 160 Hz and higher; and (2) the overall average A-weighted noise level (L_{EQ}) of the *Total System Noise* at the measurement location in the community is within nine decibels (below) the *background noise*, or higher. The *Power Island Noise* shall not contain such tonal characteristics at any location in the community. If dominant tonal noise is determined to be present based on the two conditions above, the third-octave band *background noise* and *balance of plant equipment noise* shall be checked to see if tonal noise is present. If tonal noise is present in the isolated measurement of the *background noise* and *balance of plant equipment noise* alone, appropriate calculations shall then

be performed and reported to determine if the *power island noise* contains tonal noise. If the overall average A-weighted noise level of the *Total System Noise* is ten or more decibels below the *background noise* at a particular location outside the plant, audible tones shall not be a factor in determining noise compliance at that location.

4.5 COMMUNITY NOISE LEVEL PERFORMANCE DURING NORMAL PRODUCTION

A. Maximum Noise Limits:

The Power *Island Noise* level shall not exceed the maximum sound pressure level averages (L_{EQ}) at the locations listed in the Contract, Attachment 6 – Performance Guarantees and mapped on Exhibit A, while operating under the *worst-case load condition* that produces the highest noise level. The *Power Island Noise* shall be measured as an energy-averaged L_{EQ} with a 3-decibel exchange rate on an integrating sound level meter. Existing power plant equipment shall not be operating during the *Noise Performance Acceptance Tests* for GT-5. If there is any unavoidable *pre-existing plant noise* present during the *Noise Performance Acceptance Tests*, it shall be removed in a post-measurement calculation. The *background noise* and the *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 production noise measurements, and shall be used to correct the measurements of the production noise as described in Section 4.8. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the Power Island.

B. Measurement Locations and Times:

A maximum of five measurement positions will be selected by the City from fourteen possible locations in the surrounding community as shown on Exhibit A. The measurement height shall be 5 feet above the ground surface at the measurement location, and a minimum of 50 feet from any large, flat, sound reflective surface such as buildings or walls at measurement locations C01, C03, C04, C09, C11, C12, and C14. At measurement locations C02, C05, C06, C07, C08, C10, and C13, the measurement microphone shall not be less than 25 feet from large reflective surfaces other than the ground surface. The *Power Island Noise* shall be measured at the five selected positions to determine the noise performance and compliance. The measurements shall be between the hours of 2 AM and 4 AM at all five test locations. Late night measurements may need to be conducted over more than one nighttime period to complete all measurement locations.

C. Measurement Duration:

The duration of the noise measurement at each measurement position shall be between 1 and 15 minutes. If the measurement location is: (a) not near one of the busier streets; and (b) passing vehicle noise is not dominant, and (c) the overall noise is reasonably steady state (i.e., the minimum and maximum levels do not vary from each other by more than 15 decibels over the measurement period), a measurement between 1 and 5 minutes can be performed. If street traffic noise is dominant and the overall noise is not reasonably steady state (i.e., is intermittent or the minimum and maximum levels vary from each other by more than 15 decibels over the measurement period), a 5 to 15 minute measurement must be performed as required to adequately capture the changing state of the noise level.

D. Measurement Conditions:

Pre-existing *plant noise* from existing power generation systems shall not be in operation during the measurements of the GT-5 *Power Island Noise*. The *background noise* and the *balance of plant equipment noise* shall be measured together at each location both before and after the GT-5 production noise measurements, and shall be used to correct the measurements of the production noise as described in Section 4.8. Passing street vehicles closer than 50 feet to the microphone shall not be included in the measurement. This can be accomplished by pausing the measurement if necessary when a passing street vehicle is anticipated. Measurements shall not be conducted if continuous wind speeds are greater than 5 mph at any measurement location. To determine the load condition that produces the highest noise level, a series of noise measurements shall be conducted at receptor C07 shown on Exhibit A, and at a location in the center of State Street due south of the Glenarm Building reference point. The operating load shall be varied in increments of 10 MW between the minimum and maximum loads of the system. The A-weighted noise level shall be recorded at each 10 MW increment for the two locations. When measuring the noise level at guaranteed locations west of the plant (C01 through C10), the load condition creating the highest measured A-weighted noise level at receptor C07 shall be the *worst-case load condition*. When measuring the noise level at guaranteed locations south of the plant (C11 through C14), the load condition creating the highest measured A-weighted noise level at the State Street location shall be the *worst-case load condition.*

E. Audible Tones:

While operating under any load condition, the Power Island equipment shall not produce noise that contains *dominant tonal characteristics* that can be detected at any location in the surrounding community for *more* than 30 seconds. A dominant tonal characteristic shall be determined when <u>both</u> of the following conditions are found present at any location in the surrounding community outside the power plant: (1) the average *Power Island Noise* level (L_{EQ}, un-weighted) in any one-third octave band from 125 Hz and lower exceeds the noise level in both of the adjacent one-third octave bands by an average of fifteen or more decibels, or exceeds the noise level by an average of eight or more decibels in the adjacent bands from 160 Hz and higher; and (2) the overall average A-weighted noise level (L_{EQ}) of the *Total System Noise* at the measurement location in the community is within nine decibels (below) the *background noise*, or higher. The *Power Island Noise* shall not contain such tonal characteristics at any location in the community. If dominant tonal noise is determined to be present based on the two conditions above, the third-octave band *background noise* and *balance of plant equipment noise* shall be checked to see if tonal noise is present. If tonal noise is present in the isolated measurement of the *background noise* and *balance of plant equipment noise* alone, appropriate calculations shall then be performed and reported to determine if the *power island noise* contains tonal noise. If the overall average A-weighted noise level of the *Total System Noise* is ten or more decibels below the *background noise* at a particular location outside the plant, audible tones shall not be a factor in determining noise compliance at that location.

4.6 NOISE MEASUREMENT SYSTEM REQUIREMENTS

The *Noise Performance Acceptance Tests* shall be conducted using an ANSI S1.43-1997 (R2007) Type 1 integrating *RTA* sound level meter and microphone system, or an IEC 60804 (2000) Integrating-averaging Sound Level Meters, or an integrating sound level meter meeting IEC 61672-1 (2003) Electroacoustics, Sound Level Meters, Specifications. The tests shall be conducted by an approved noise specialist with a minimum of 7 years of experience specifically in the environmental and/or industrial noise measurement and analysis fields. The measurements as described herein shall be conducted to determine compliance with the noise performance requirements of the GT-5 power generation system. All measured sound pressure levels shall have a reference quantity of 20 micropascals. The sound level meter shall be equipped with the following:

A. a random-incidence microphone (or random incidence corrected free-field microphone) and preamplifier system;
B. a 3.5-inch diameter microphone windscreen;
C. a one-third octave-band filter set from 25 Hz to 20 kHz;
D. selectable A and Linear weighting networks;
E. exchange rate setting of 3 decibels;
F. capable of measuring the average noise level (L_{EQ});
G. capable of measuring the impulse response noise level (L_{IMP}) and
H. capable of measuring six statistical noise levels simultaneously (L_{01} through L_{99}, L_{MAX}, and L_{MIN}).

A manufacturer's approved windscreen shall be used during all measurements. The sound level meter shall be certified with NIST traceability according to the manufacturer's calibration standards within a 12-month period prior to the *Noise Performance Acceptance Tests*. Alternatively, an annual calibration certificate for a laboratory reference standard instrument can be supplied if reciprocity with the field measurement system used in these test measurements can be demonstrated. In no case shall a field measurement system be used which has not undergone laboratory calibration by the manufacturer within a three-year period. The instrument shall be calibrated in the field using an acoustic calibrator with NIST traceability before and after each series of measurements. Instrument drift shall be noted for each series of measurements. A series of measurements with a field calibration drift of more than 0.4 dB shall be considered invalid and shall be repeated, if the results affect the pass/fail status of the measurements at those locations. No corrections shall be made for measurements with a calibration drift of 0.1 dB or less. All measured values of the overall A-weighted noise within a series of measurements which have a calibration drift between 0.2 to 0.4 dB shall be corrected with one-half of the drift value (e.g., if the field calibration after a series of measurements shows 0.4 dB higher than the calibrated level before the series of measurements, all A-weighted levels in that series shall be corrected by -0.2 dB). The overall measured levels shall be A-weighted and shall include the following noise metrics: L_{EQ}, L_{IMP}, L_{MAX}, L_{01}, L_{10}, L_{25}, L_{50}, L_{90}, L_{99}, and L_{MIN}. Measurements shall also include one-third octave-band filtered levels from 25 Hz to 20 kHz with no weighting applied (linear frequency weighting). Calibration drift corrections shall not be applied to the one-third octave-band data. All measurement results shall be reported as described in Section 4.12 of this specification and shall include a record of the manufacturer's calibration certificates and a record of field calibration data. The temperature, wind speed, wind direction, and percent relative humidity shall be recorded at all measurement locations outside the plant using an appropriate hand-

held or portable meteorological measurement device. Noise measurements shall not be permitted at any location inside or outside the plant if the constant wind speed exceeds 5 mph at that location.

4.7 NOISE CORRECTIONS FOR MEASUREMENTS INSIDE THE PLANT

While operating at the *base load operating condition*, the *Total System Noise* (TSN) measurements at all locations inside the plant will contain noise contributions from: (1) the *background noise* (BGN); (2) the *balance of plant equipment noise* (BOP); and (3) the *Power Island Noise* (PIN). The BGN and BOP noise shall be measured together both before and after the TSN measurements at all locations in the plant. If the difference between the before and after measurements is more than 3 dB at any one location, the measurement shall be considered invalid, and the *Total System Noise* measurement shall be repeated at that location with a new set of before and after measurements. If the before and after measurements are valid, they shall be averaged as shown below. When the measured BGN and BOP noise is more than 17 decibels below the measured TSN noise at any location, no correction is necessary for that measurement location. Otherwise, the measured TSN noise levels shall be corrected using the formulas below so that the *background noise* and *balance of plant equipment noise* is removed by calculation:

$$L_{BGNBOP}AVG = (L_{BGNBOP}BEFORE + L_{BGNBOP}AFTER) \div N, \quad \text{in dBA}$$

$$L_{PIN}CORR = 10 \times LOG_{10}(10^{(L_{TSN}MEAS/10)} - 10^{(L_{BGNBOP}AVG/10)}), \quad \text{in dBA}$$

Where:

$L_{BGNBOP}AVG$ = the linear average of the before and after measurements of the *background noise* and *balance of plant equipment noise* at a location within the plant.

$L_{BGNBOP}BEFORE$ = the before measurement of the *background noise* together with the *balance of plant equipment noise* at a location within the plant.

$L_{BGNBOP}AFTER$ = the after measurement of the *background noise* together with the *balance of plant equipment noise* at a location within the plant.

N = the number of measurements to be averaged at a particular location, in this case, 2.

$L_{PIN}CORR$ = the corrected *Power Island Noise* level at a location within the plant with the *background noise* and the *balance of plant equipment noise* removed by calculation. The $L_{PIN}CORR$ has the same definition as the *Power Island Noise* level and must comply with the requirements in Sections 4.1A, 4.2, and the guaranteed noise levels shown in the Contract, Attachment 6 – Performance Guarantees.

$L_{TSN}MEAS$ = the measured GT-5 *Total System Noise* level at a location within the plant with the *balance of plant equipment noise* and *background noise* included.

LOG_{10} = the common logarithm (base 10).

dBA = the abbreviation for decibels, A-weighted.

All calculated values of $L_{PIN}CORR$ for normal production noise at the *base load operating condition* that are below 72 dBA shall be considered invalid and discarded from the tabulation of measurements. Invalid values shall not be included in the overall average of noise levels for normal production noise. The final noise level shall be calculated by taking a simple arithmetic average of the $L_{PIN}CORR$ values for each measurement location. A final noise level shall be calculated for normal production noise at the *base load operating condition.*

Example 1:

$L_{BGNBOP}BEFORE$ = 76.5 dBA

$L_{BGNBOP}AFTER$ = 78.5 dBA *(before and after measurements are within 3 dB of each other; therefore, valid)*

$L_{BGNBOP}AVG$ = $(76.5 + 78.5) \div 2$

$L_{BGNBOP}AVG$ = <u>77.5 dBA</u>

$L_{TSN}MEAS$ = 83.0 dBA

$L_{PIN}CORR$ = $10 \times LOG_{10}(10^{(83.0/10)} - 10^{(77.5/10)})$

$L_{PIN}CORR$ = <u>81.6 dBA</u> *(corrected Power Island Noise with balance of plant equipment noise and background noise removed by calculation)*

Example 2:

$L_{BGNBOP}BEFORE$ = 63.5 dBA

$L_{BGNBOP}AFTER$ = 65.5 dBA *(before and after measurements are within 3 dB of each other; therefore, valid)*

$L_{BGNBOP}AVG$ = $(63.5 + 65.5) \div 2$

$L_{BGNBOP}AVG$ = <u>64.5 dBA</u> *(more than 17 dB below the corrected Power Island Noise, $L_{PIN}CORR$)*

$L_{TSN}MEAS$ = 82.0 dBA

$L_{PIN}CORR$ = $10 \times LOG_{10}(10^{(82.0/10)} - 10^{(64.5/10)})$

$L_{PIN}CORR$ = <u>81.9 dBA</u> *(no correction was needed since this is less than one-tenth of a decibel from the measured value of the Total System Noise of 82.0 dBA; in other words, the background noise and the balance of plant equipment noise do not contribute significantly to the Power Island Noise at this location)*

4.8 NOISE CORRECTIONS FOR MEASUREMENTS OUTSIDE THE PLANT

While operating at the *worst case load condition*, the *Total System Noise* (TSN) measurements at all locations in the community will contain noise contributions from: (1) the *background noise* (BGN); (2) the *balance of plant equipment noise* (BOP); and (3) the *Power Island Noise* (PIN). The BGN and BOP noise shall be measured together both before and after the TSN measurements at all locations in the community. If the difference between the before and after measurements is more than 3 dB at a particular location, the measurements shall be considered invalid, and the *Total System Noise* measurement shall be repeated with a new set of before and after measurements for that location. If the before and after measurements are valid, they shall be averaged as shown below. The measured TSN noise levels shall be corrected using the formulas below so that the *background noise* and *balance of plant equipment noise* is

removed by calculation (background noise measurement corrections for vent noise using the *LIMP* metric are similar to procedures shown below):

$L_{BGNBOP}AVG = (L_{BGNBOP}BEFORE + L_{BGNBOP}AFTER) \div N$, in dBA
$L_{PIN}CORR = 10 \times LOG_{10}(10^{(L_{TSN}MEAS/10)} - 10^{(L_{BGNBOP}AVG/10)})$, in dBA

Where:

$L_{BGNBOP}AVG$ = the linear average of the before and after measurements of the *background noise* and *balance of plant equipment noise* at a location outside the plant.
$L_{BGNBOP}BEFORE$ = the before measurement of the *background noise* together with the *balance of plant equipment noise* at a location outside the plant.
$L_{BGNBOP}AFTER$ = the after measurement of the *background noise* together with the *balance of plant equipment noise* at a location outside the plant.
N = the number of measurements to be averaged at a particular location, in this case, 2.
$L_{PIN}CORR$ = the corrected *Power Island Noise* level at a location outside the plant with the *background noise* and the *balance of plant equipment noise* removed by calculation. The $L_{PIN}CORR$ has the same definition as the *Power Island Noise* level and must comply with the requirements in Sections 4.1B, 4.3, 4.4~~4.5~~, and the guaranteed noise levels shown in the Contract, Attachment 6 - Performance Guarantees.
$L_{TSN}MEAS$ = the measured GT-5 *Total System Noise* level at a location outside the plant with the *balance of plant equipment noise* and *background noise* included.
LOG_{10} = the common logarithm (base 10).
dBA = the abbreviation for decibels, A-weighted.

Example 1:

$L_{BGNBOP}BEFORE$ = 56.4 dBA

$L_{BGNBOP}AFTER$ = 58.4 dBA *(before and after measurements are within 3 dB of each other; therefore, valid)*

$L_{BGNBOP}AVG$ = $(56.4 + 58.4) \div 2$

$L_{BGNBOP}AVG$ = 57.4 dBA

$L_{TSN}MEAS$ = 58.3 dBA

$L_{PIN}CORR$ = $10 \times LOG_{10}(10^{(58.3/10)} - 10^{(57.4/10)})$

$L_{PIN}CORR$ = 51.0 dBA *(corrected Power Island Noise with balance of plant equipment noise and background noise removed by calculation)*

Example 2:

$L_{BGNBOP}BEFORE$ = 65.4 dBA

$L_{BGNBOP}AFTER$ = 66.6 dBA *(before and after measurements are within 3 dB of each other; therefore, valid)*

$L_{BGNBOP}AVG = (65.4 + 66.6) \div 2$

$L_{BGNBOP}AVG$ = <u>66.0 dBA</u>

$L_{TSN}MEAS$ = 67.1 dBA

$L_{PIN}CORR = 10 \times LOG_{10}(10^{(67.1/10)} - 10^{(66.0/10)})$

$L_{PIN}CORR$ = <u>60.6 dBA</u> *(corrected Power Island Noise with balance of plant equipment noise and background noise removed by calculation)*

4.9 GUARANTEED NOISE PERFORMANCE AT IN-PLANT LOCATIONS

The *Guaranteed Noise Performance* shall include a composite noise level average as measured around the overall Power Island package inclusive of the following equipment:

- ☐ Gas Turbine Combustion Air Intakes
- ☐ Generator Enclosure
- ☐ Generator Cooling Air Duct
- ☐ Generator Ventilation Air Inlet Vent
- ☐ Generator Ventilation Air Exhaust Vent
- ☐ Generator Enclosure Access Doors and Door Seals
- ☐ Combustion Air Duct
- ☐ Gas Turbine Cooling Air Duct
- ☐ Gas Turbine Enclosure
- ☐ Turbine Enclosure Access Doors and Door Seals
- ☐ Turbine Enclosure Vent
- ☐ Gas Turbine Variable Bypass Vent
- ☐ Expansion Joint between Turbine Enclosure and OTSG
- ☐ Once Through Steam Generator (OTSG)
- ☐ OTSG Stack
- ☐ OTSG Chemical Feed Skid
- ☐ Chiller Package
- ☐ Steam Turbine Generator
- ☐ STG Condenser
- ☐ GSU Transformers
- ☐ Cooling Tower
- ☐ Circulating Water Pumps
- ☐ Boiler Feedwater Pumps
- ☐ Condensate Pumps
- ☐ Ammonia Flow Control Unit
- ☐ Gas Turbine NOX Water Injection System
- ☐ Noise producing start-up and shutdown equipment (incl. gas venting, and steam bypass sources)
- ☐ Fuel Gas Compressor Skid
- ☐ Air Compressor and Receiver
- ☐ Other noise producing sources in Power Island package

The *Guaranteed Near Field Noise Performance* is provided in the Contract, Attachment 6 – Performance Guarantees.

4.10 GUARANTEED NOISE PERFORMANCE AT COMMUNITY LOCATIONS

The *Contractor* guaranteed Far Field Noise performance is provided in the Contract, Attachment 6 – Performance Guarantees. The southwest corner of the "Glenarm Building" has been selected as a common reference point within the plant from which the distance to each of the fourteen receptors shown on Exhibit "A" has been determined. Distances to each receptor location and the ground elevations at each receptor are shown in the Contract, Attachment 6 – Performance Guarantees for informational purposes.

The specific site conditions that exist at the fourteen receptor locations shall be considered a valid, inclusive part of the guaranteed noise levels and measurement results. The effects from terrain features, building structure attenuations and reflections, ground absorption and reflections, and other anomalies specific to the existing site conditions at each test site shall be considered a valid part of the test measurements and the Contractor's noise guarantee. Each of these effects are to be included in the guaranteed noise levels and measurement results. No additional corrections shall be permitted to normalize the results to a standardized "flat-world" test site, other than those listed below.

The other site conditions (not listed above) may have a significant effect on the measurement results and shall be corrected with appropriate post-measurement adjustments or avoided during the measurements. These site conditions include the following:

1. existing background noise from the power plant and/or community;
2. large reflective surfaces other than the ground surface that are closer than 50 feet to the measurement microphone at locations C01, C03, C04, C09, C11, C12, and C14;
3. large reflective surfaces other than the ground surface that are closer than 25 feet to the measurement microphone at locations C02, C05, C06, C07, C08, C10, and C13; and
4. atmospheric conditions such as temperature, wind, humidity, inversions layers and temperature lapses.

The above site conditions shall not be included in the Contractor's guarantee or the measurement results if the effects are considered significant

4.11 TOLERANCE FOR TEST MEASUREMENTS

All test measurement results shall be rounded up or down to the nearest whole decibel value after all corrections are applied according to the procedures listed in these specifications. The resulting decibel level after rounding shall be the used to determine compliance with the guaranteed noise levels shown in Attachment 6 of the Contract, at near-field (in plant) and far-field (community) locations.

4.12 NOISE PERFORMANCE ACCEPTANCE TEST REPORT

A performance acceptance test report shall be submitted to the Contractor not more than two (2) weeks after completion of the tests which summarizes the results of the test measurements for the GT-5 Power Island. The report shall include the following:

a. a description of all measurement instrumentation and settings used;
b. measurement forms with field calibration records and instrument drift;
c. date, time of day, and duration of measurement for all measurements (in-plant and community);
d. approximate duration of start-up and shutdown noise sources such as gas venting or steam bypass;
e. drawing or sketch showing measurement locations inside the plant;

f. aerial map showing measurement locations in the surrounding community;
g. photos of measurement positions (in-plant and community);
h. background and balance of plant noise measurement results (in-plant and community);
i. GT-5 system start-up and shutdown noise measurement results (community) showing corrections applied for background and balance of plant noise;
j. GT-5 system production noise measurement results (in-plant and community) showing corrections applied for background and balance of plant noise;
k. operating load of GT-5 during all measurements (in-plant and community);
l. record of temperature, wind direction, wind speed, and percent relative humidity at all measurement locations outside the plant in the surrounding community;
m. a statement of compliance or non-compliance for each measurement location; and
n. annual calibration certificates for microphones and meters used for the tests.

PART 5 - REFERENCE STANDARDS AND PROCEDURES

The referenced standards and procedures listed below shall be used for general definitions and guidelines, but shall not supersede the noise performance evaluation and measurement procedures listed in these specifications. The *Contractor's* design shall reference current editions of the relevant standards listed below (or the most current versions at the date of notice to proceed). In the event of a discrepancy, conflict, or variance between the performance evaluation and measurement procedures described in these specifications and other standards or procedures external to these specifications, the procedures listed in these specifications shall prevail. Where conflicts exist between the standards listed below, the more stringent requirements shall prevail. Deviations from relevant standards shall only be implemented with the written approval of the City.

1. American National Standards Institute (ANSI)

   a. ANSI S1.4 (R2001) – American National Standard Specification for Sound Level Meters
   b. ANSI S1.13 (R2010) – American National Standard Methods for Measurement of Sound Pressure Levels in Air
   c. ANSI S1.40 (R2011) – Specifications and Verification Procedures for Sound Calibrators (For the use of sound level calibrators manufactured on or after 2006 – latest, preferred)
   d. ANSI S1.40 (1984) - Specifications and Verification Procedures for Sound Calibrators (For the use of sound level calibrators manufactured before 2006)

2. American Society for Testing and Materials (ASTM)

   a. ASTM C634 – Standard Terminology Relating to Building and Environmental Acoustics
   b. ASTM E1686 – Standard Guide for Applying Environmental Noise Measurement Methods and Criteria
   c. ASTM E1014 – Standard Guide for Measurement of Outdoor A-Weighted Sound Levels
   d. ASTM E1124 – Standard Test Method for Field Measurement of Sound Power Level by the Two Surface Method
   e. ASTM E1779 – Standard Guide for Preparing a Measurement Plan for Conducting Outdoor Sound Measurements

f. ASTM E1780 – Standard Guide for Measuring Outdoor Sound Received from a Nearby Fixed Source

3. National Institute of Standards and Technology (NIST)

4. American Society of Mechanical Engineers (ASME)

   a. ANSI/ASME PTC 36 (2004) – Measurement of Industrial Sound

   b. ASME B133.8 (2011) – Gas Turbine Installation Sound Emissions

5. International Electrotechnical Commission (IEC)

   a. IEC 60651 (1979 or 1993) – Sound Level Meters (For the use of sound level meters manufactured before 2003)
   b. IEC 60804 (2000) – Specifications for Integrating-Averaging Sound Level Meters (For the use of integrating sound level meters manufactured before 2003.)
   c. IEC 61672-1 (2003) – Electroacoustics. Sound Level Meters, Specifications (For the use of integrating and non-integrating sound level meters manufactured on or after 2003 – latest, preferred.)
   d. IEC 60942 (2003) – Electroacoustics. Sound Calibrators (Referenced by IEC 61672-1 (2003) – preferred)
   e. IEC 60942 (1997) - Electroacoustics. Sound Calibrators (For the use of sound level calibrators manufactured before 2003)

PART 6 - ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

ANSI. American National Standards Institute.

ASME. American Society of Mechanical Engineers.

ASTM. American Society for Testing and Materials.

Audible Tones. See *Dominant Tonal Characteristics*.

A-Weighted Decibels. Decibels are a unit of measure for sound pressure level. A standard reference quantity of 20 micropascals is used for all noise levels or sound pressure levels used in the noise control performance specifications. The A-weighting is an electronic filter or correction that is applied by the sound level meter to approximate the sensitivity of the human hearing system; it is abbreviated dBA when used in these noise control performance specifications.

Background Noise. The measured background noise level at a particular location inside or outside the plant with all *pre-existing plant noise* and the new GT-5 *total system noise* inoperative. The measured background noise levels shall only be used to determine the GT-5 equipment noise levels alone with the background noise and *balance of plant equipment noise* removed by mathematical calculation. The background noise shall include distant surface and air traffic noise and other existing mechanical noises from the community. Measurements of the background noise shall be averaged (L_{EQ}) over a period of 1 to 15 minutes (depending on the statistical results) and shall include noises from both near and far, but shall not include unusual transient noises that significantly affect the measurement results. Examples of unusual transient noises include street vehicle or rail vehicle passbys closer than 50 feet to the measurement microphone, lawn mowing, garbage truck pickups, construction noise, low flying helicopter or aircraft flights directly overhead, nearby dog barking, and nearby human conversation. If a transient noise is anticipated, the measurement shall be paused until the event passes and then resumed. The background noise measurements shall be repeated at a particular loca-

tion if the following statistical results are not met at that location: the *L10* shall be between 2 and 5 decibels higher than the LEQ for the measurement period; and the *LMAX* shall not be more than 15 decibels higher than the LEQ for the measurement period. The duration of the measurement can be increased if the two conditions are not being met.

Base Load Operating Condition. The base load for power generation shall mean the design load that produces the maximum output power of GT-5 that is guaranteed by the Contractor.

Balance of Plant Equipment Noise. Noise producing equipment associated with the GT-5 power generation system excluding all noise generated by equipment in the Power Island contract. Noise generating equipment in the balance of plant contract includes: auxiliary transformers; demineralized water pumps, and possibly steam piping and valves. The balance of plant noise shall not include *pre-existing plant noise*.

BGN. Background Noise.

BOP. Balance of Plant equipment.

City. The City of Pasadena, California; the equipment purchaser and owner.

Contractor. The party chosen by the City to provide materials and services for the Power Island Equipment.

dB or dBA. dB is the abbreviation for decibel; dBA is the abbreviation for A-Weighted decibels.

Dominant Tonal Characteristics. Noise which contains audible tones. Noise whose tonal quality can be characterized as having dominant tones such as a whine, a pitch, a buzz, a hum, a squeal, etc. A dominant tonal characteristic shall be determined when <u>both</u> of the following conditions are found present at any location in the surrounding community outside the power plant: (1) the average *Power Island Noise* level (*LEQ,* un-weighted) in any one-third octave band from 125 Hz and lower exceeds the noise level in both of the adjacent one-third octave bands by an average of fifteen or more decibels, or exceeds the noise level by an average of eight or more decibels in the adjacent bands from 160 Hz and higher; and (2) the overall A-weighted noise level of the *Total System Noise* at the measurement location in the community is within nine decibels (below) the *background noise*, or higher.

Exchange Rate. The rate of integration of the sound level over time when calculating noise exposure limits. A 3-decibel exchange rate permits the noise exposure time to double with each 3-decibel decrease in noise level. Conversely, the allowable exposure time halves with each 3-decibel increase in the noise level.

Gleanarm Building Reference Point. An established point of reference located at the southwest corner of the historical Glenarm Building, which is just south of Glenarm Street and just east of Fair Oaks Avenue. The reference point is shown on Exhibit A in PART 8 of these specifications.

Ground Level. Ground level is a measurement position that is on the finished grade where the PIE is to be located for this project. It shall not include elevated areas such as accessible walkways, catwalks, crows nests, or platforms.

Guaranteed Noise Performance. The *Contractor* shall be responsible for submitting noise level guarantees at locations inside the plant near the equipment, and outside the plant at selected receptor locations. The noise performance of the GT-5 Power Island will be measured at each of the locations to demonstrate compliance with the guaranteed noise levels. The noise level guarantee shall be based on all equipment included in the GT-5 Power Island contract creating a composite or combined noise level. For all noise measurements inside the plant and outside the plant, the *balance of plant equipment noise* and *background noise* shall be mathematically subtracted from noise measurements of the GT-5 Power Island by the methods described in Sections 4.7 and 4.8.

IEC. International Electrotechnical Commission.

L10. A statistical rating of the overall sound pressure levels occurring during a measurement period at a specified location, expressed in decibels, and shall be A-weighted. The number following the "L" (10

in this case) indicates the percentage of time that the noise level was higher than the resulting decibel value during the measurement period. Other statistical levels such as L_{01}, L_{25}, L_{50}, L_{90}, and L_{99} are similar.

LEQ. The energy-averaged overall sound pressure level in decibels at a specified location, using a 3-decibel exchange rate in the measurement of the level unless otherwise stated. The overall LEQ shall be A-weighted. LEQs shall also be used for one-third octave band levels, but without any weighting applied.

LMAX. The overall maximum sound pressure level in decibels that occurs during a measurement period at a specified location, expressed in decibels, and shall be A-weighted using the slow response setting on a sound level meter.

LIMP. The overall impulse sound pressure level in decibels that occurs during a measurement period at a specified location, expressed in decibels, and shall be A-weighted using the impulse response setting on a sound level meter.

LMIN. The overall minimum sound pressure level in decibels that occurs during a measurement period at a specified location, expressed in decibels, and shall be A-weighted using the slow response setting on a sound level meter.

NIST. National Institute of Standards and Technology.

Noise Performance Acceptance Tests. A series of noise measurements conducted during the operation of the GT-5 Power Island. The results of the measurements shall determine the system's compliance with the requirements of the noise performance specifications as described herein.

PIE. Power Island Equipment or Equipment Package.

PIN. Power Island Noise.

Power Island Noise. The combined or composite noise of all noise producing equipment included in the GT-5 Power Island contract only while operating at the base load operating condition for measurements inside the plant, and the *worst-case load condition* for measurements outside the plant. Noise generating equipment in the Power Island contract includes the components listed in Section 4.9. The Power Island Noise shall not include noise from the *pre-existing plant noise* sources. For all noise measurements inside the plant and outside the plant, the *balance of plant equipment noise* and *background noise* shall be mathematically subtracted from noise measurements of the GT-5 Power Island by the methods described in Sections 4.7 and 4.8.

Power Island Vent Noise. An impulsive noise event caused by the release of natural gas during system start-up and shutdown. There is usually one impulsive noise event during each start-up and one event during shutdown. The vent noise level is to be measured with a specially designed vent noise silencer installed so that the impulsive noise created by the gas venting is minimized.

Pre-Existing Plant Noise. All existing power plant noise at the project installation site, which is part of the existing noise environment prior to the installation of the GT-5 Power Generation System. Pre-existing plant noise includes noise from existing power plant equipment only (B3, GT1, GT2, GT3, and GT4 power generation systems). The pre-existing plant noise shall not include surface and air traffic noise, existing community noise, the GT-5 *Power Island Noise*, or the *balance of plant equipment noise* associated with the GT-5 Power Generation System.

RTA. Real Time Analyzer. A sound analyzer that is capable of analyzing the complete sound spectrum in all frequency bands simultaneously in real time. The analyzer shall be equipped with a one-third octave-band filter set from 25 Hz to 20 kHz.

Reference Pressure. Pertaining to sound pressure and sound pressure level. The reference pressure is a predetermined sound pressure in which sound pressures are referenced to in order to determine the sound pressure level, in decibels. The reference pressure used throughout these specifications is 20 micropascals.

Sound Pressure Level or SPL. The term "sound pressure level" shall be interchangeable with the terms, "sound level," or "noise level," expressed in decibels (dB or dBA). All sound pressure levels shall be an RMS (root-mean-squared) value based on a *reference pressure* of 20 micropascals, and shall utilize both slow and impulse response settings on a metering system with a 3-decible *exchange rate*, unless otherwise noted. Noise levels measured with octave-band filtering shall be linear weighted (or no weighting), and overall broadband noise levels shall utilize the A-weighting.

Sound Power Level or PWL. The term "sound power level" shall be interchangeable with the terms, "PWL," or "power level," expressed in decibels (dB). All sound power levels shall be based on a *reference power* of 1 picowatt. All power levels expressed as the overall broadband level or as octave-band levels shall be linear weighted (or no weighting).

Total System Noise. The combined or composite noise of all noise producing equipment from the Power Island and the balance of plant equipment associated with the GT-5 Power Generation System while operating at the base load operating condition for measurements inside the plant, and at the *worst-case load condition* for measurements outside the plant. The Total System Noise shall not include *pre-existing plant noise*.

TSN. Total System Noise.

Worst-Case Load Condition. The operating load of the GT-5 Power Generation System which produces the highest noise level when measured at: (1) receptor C07 shown on Exhibit A, and (2) at the center of State Street due south of the *Glenarm Building Reference Point*. The operating load of GT-5 shall vary in increments of 10 MW between the minimum and maximum loads of the system. The A-weighted noise level shall be recorded at the two measurement locations for each 10 MW increment. When measuring the noise level at any location inside the plant or at guaranteed locations outside of and west of the plant (C01 through C10), the load condition creating the highest measured A-weighted noise level at receptor C07 shall be the *worst-case load condition*. When measuring the noise level at guaranteed locations outside and south of the plant (C11 through C14), the load condition creating the highest measured A-weighted noise level at the State Street location shall be the *worst-case load condition.*.

PART 7 - EXHIBITS

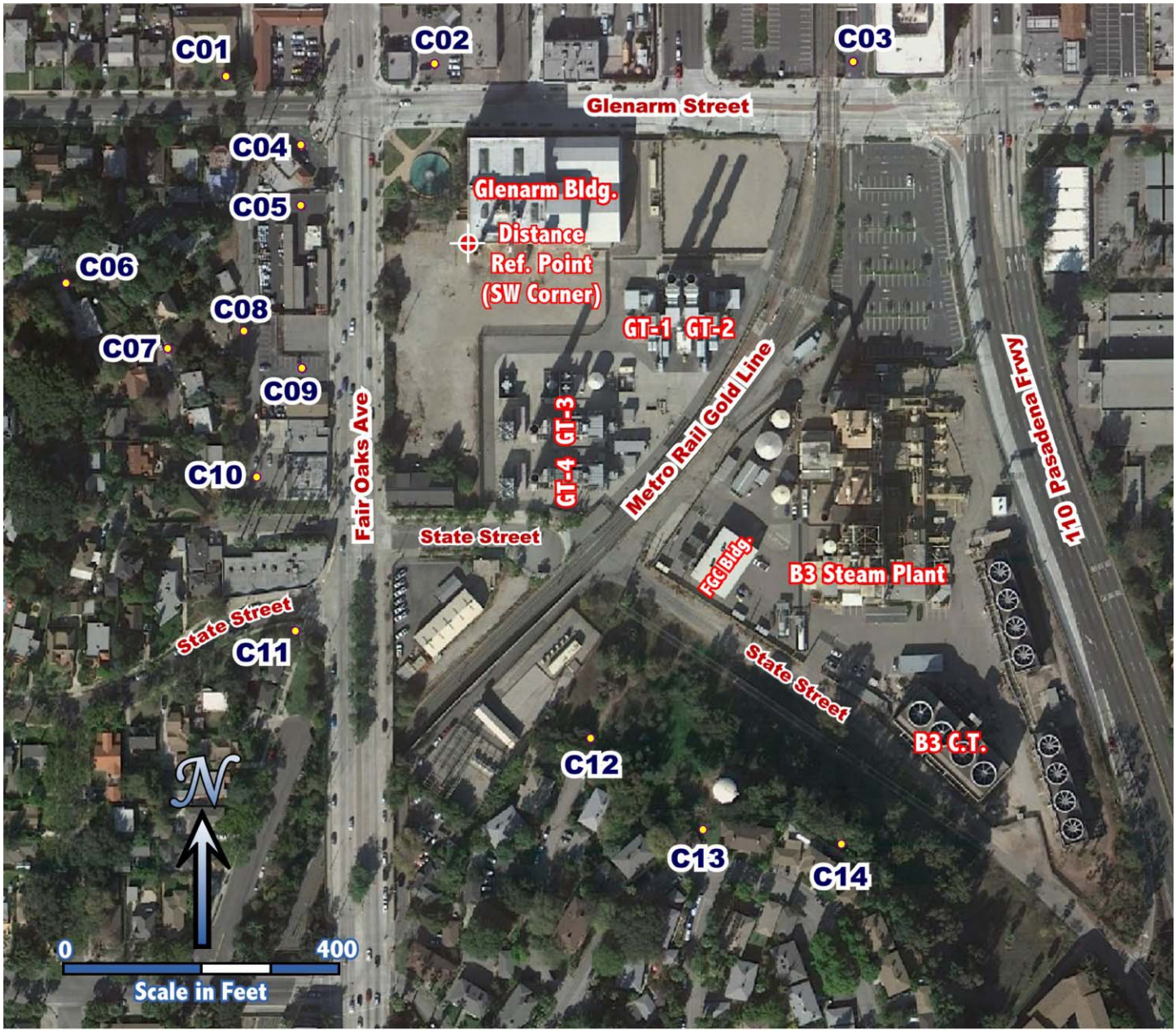


Exhibit A. Locations Outside the Plant for the Noise Performance Guarantees and the Noise Performance Acceptance Tests

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 480032

Power Island Performance

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 480032
Power Island Performance

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
7/20/11	T. Clark	A
9/9/11	T. Clark	B
12/7/11	T. Clark	C
4/12/12	T. Clark	D
8/24/12	G. Drake	E
9/12/12	T. Clark	F
10/4/12	G. Harwood	G
9/10/13		H – CONTRACT VERSION

SECTION 480032
POWER ISLAND PERFORMANCE

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 1
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 2
1.7 SUBMITTALS 3
1.8 QUALITY ASSURANCE ..... 5~~4~~
1.9 SITE CONDITIONS ..... 5~~4~~
1.10 WARRANTY ..... 5~~4~~

PART 2 - PRODUCTS 5~~4~~

PART 3 - EXECUTION 5~~4~~

3.1 COMMISSIONING ..... 5~~4~~
3.2 PERFORMANCE TESTING ..... 6~~5~~

PART 4 - ATTACHMENTS 9~~8~~

4.1 TECHNICAL DATASHEET ..... 9~~8~~

SECTION 480032
POWER ISLAND PERFORMANCE

PART 1 - GENERAL

1.1 SUMMARY

A. This section and Attachment 6 - Performance Guarantees describes the requirements for verification of the power island performance to meet contract guarantees for net heat rate, total plant net output, air emissions, water consumption and discharge, and noise emissions.

B. The Contractor shall have single source responsibility for all equipment and services furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall provide the following equipment and services for performance testing, including but not limited to the following:

1. TAs for performance testing and to witness performance tests
2. Local gauges, instruments, data loggers, etc. required for the performance test
3. Special tools required for the performance test
4. Performance test schedule of test activities
5. Performance correction curves from ambient to 75°F, 50% humidity.
6. Training of the General Manager's personnel appointed to operate the equipment and involved in commissioning and performance testing
7. Summary performance testing report

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Performance test schedule and site coordination of test activities
2. Plant operators, electricians, mechanics, laborers, and other crafts and labor supervision necessary to assist with performance testing.
3. Rigging/hoisting equipment, man lifts and scaffold
4. Unloading and storage of equipment at jobsite
5. Calibrated station instruments as part of normal operating control system
6. Power supply and temporary lighting
7. Field wiring, cable and conduit connecting Contractor supplied components
8. Compressed air supply to Contractor's connections
9. Fill of all lubrication and control oils, gases, and water

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 480031, Combined Cycle Power Island Noise Control Performance

C. Section 481100, Combined Cycle Power Island

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific services supplied under this Section.

1. American Society for Mechanical Engineers (ASME)

a. PTC 1: General Instructions
b. PTC 4.4: Gas Turbine Heat Recovery Steam Generators
c. PTC 6/6.2: Steam Turbines / Steam Turbines in Combined Cycle
d. PTC 12.2:Steam Surface Condenser
e. PTC 19.1: Test Uncertainty
f. PTC 19.2: Pressure Measurement
g. PTC 19.3: Temperature Measurement
h. PTC 22: Gas Turbines (with Contractor comments)
i. PTC 23: Atmospheric Water Cooling Equipment
j. PTC 46: Overall Plant Performance

2. Cooling Technology Institute (CTI)

a. ATC-105: Acceptance Test Code for Water Cooling Towers
b. ATC-107R: Characteristic Curve for use with ATC-105
c. ATC-128: Code for Measurement of Sound from Water Cooling Towers
d. STD-201: Certification Standard

3. International Organization for Standardization (ISO)

a. ISO 2314: Gas turbines - Acceptance tests (with Contractor comments)
b. ISO 3977: Gas Turbines - Procurement - Part 2: Standard Reference Conditions and Ratings

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

A. Installation and Commissioning Plan

1. The Contractor shall support the BOP Contractor's preparation of the detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 6 months prior to the commencement of site testing.
2. Commissioning plan shall include as a minimum:

a. All tests to be performed by Contractor, referencing the appropriate testing codes and standards including those listed in this Section and equipment specific Sections. Tests to be performed shall be derived from the minimum requirements of the testing codes listed and any additional testing deemed necessary by Contractor in order to prove the equipment to be compliant with the performance requirements specified in the contract documents.
b. Sample data collection sheets listing expected values and having provisions for measured values as defined in the appropriate testing codes listed shall be incorporated into the ICS manuals described.
c. A testing schedule which shall be sufficiently accurate and detailed to facilitate incorporation into the balance of plant construction schedule. The testing schedule shall be submitted in two phases: 1) Preliminary schedule no later than 3 months following contract award, 2) Project-specific schedule submitted with the commissioning plan, no later than 6 months prior to commencement of site testing. The schedule shall detail at a minimum, individual equipment testing and anticipated durations. The schedule shall be constructed using appropriate logic with predecessors and successors assigned to activities to prevent out-of-sequence work and impractical resource loading.
d. Installation and Commissioning Manual, described in subpart 3.1D.
e. Curriculum vitae of any and all proposed Installation and Commissioning Managers, stating their respective experience and qualifications.

B. Test Results

1. A Summary performance test report which contains the plant performance testing results as detailed herein as well as completed equipment performance test data tables, as detailed in the individual equipment specifications under the respective "Instrumentation and Controls" sections. Equipment performance test data tables are found at the back of the respective equipment specification. Plant performance test report for power and heat rate testing shall be made available two weeks after fuel sample analysis is received from the City.

2. Certified copies of test results shall be submitted to the General Manager for acceptance before performance testing is considered complete.

1.8 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

1.9 SITE CONDITIONS

A. Refer to Section 480020 Site Conditions.

1.10 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

A. Not used

PART 3 - EXECUTION

3.1 COMMISSIONING

A. General

1. The Contractor shall provide onsite commissioning and testing of the Power Island Equipment.
2. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning and testing.
3. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon acceptance of the performance testing by General Manager. Any and all such instrumentation shall have valid calibration certification, performed within 12 months of the use of the instrumentation. Where instrumentation does not have proof of calibration certification, Contractor shall furnish the services of a qualified instrument technician to field calibrate and certify the instrumentation.

B. Chemical Cleaning and Steam Blows

1. The Contractor shall support final cleaning and steam blow of boiler and steam piping prior to startup completed per the Contractor's standard procedure.

C. Installation and Commissioning Plan Scope

1. The base scope of the installation and commissioning plan shall provide:

a. Demonstration of advance knowledge of project schedules, completion dates, and key event dates.
b. General definition of manpower and material resources required.
c. Demonstration of the means of verifying that all critical calibrations, both mechanical and electrical, have been checked.
d. In addition to the documentation that makes up the base scope the Contractor shall include the services of an Installation and Commissioning Manager to monitor and continuously update the plan during the installation and commissioning period. Proposed Installation and Commissioning Managers shall have sufficient qualifications and experience in the practice of power plant commissioning. If the Installation and Commissioning Manager is deemed incapable, irresponsible or otherwise unfit during the course of commissioning, General Manager shall have the authority to direct his or her removal from the project and direct Contractor to provide a replacement Installation and Commissioning Manager.

D. Installation Commissioning and Startup (ICS) Manual

1. The ICS Manual shall be an integral part of the Installation and Commissioning plan. Each activity in the ICS manual shall be detailed and documented in the Activities Manual and step-by-step instructions provided for carrying out each activity.
2. Contractor shall generator an ICS manual for each major piece of equipment to be tested. Standard GTG Installation and Commissioning manuals are provided.
3. Each activity sheet shall identify as a minimum:

a. The equipment on which the activity is to be carried out
b. Any and all drawings necessary to facilitate commissioning including but not limited to: electrical drawings, wiring schematics, and mechanical drawings.
c. Relevant engineering standards against which the testing is being carried out
d. Special tools required
e. Torque and alignment specifications
f. Piping connection information and drawing identification codes
g. Wiring junction box locations and terminal designations
h. Copies of all calibration reports for gas fuel flow meter on GTG and require PIE vendors to submit calibration reports for instruments they are providing

4. Log sheets shall be provided for recording any and all critical information (alignments, clearances, calibration points achieved etc.) generated during each activity. Log sheets shall include expected values or those ranges required and or permitted by the relevant testing code.
5. Each activity sheet shall also provide signature blocks for the Contractor and General Manager to sign off, thereby verifying the activity was completed to both their satisfaction.

3.2 PERFORMANCE TESTING

A. General

1. The Contractor shall be responsible for demonstrating that all systems in the scope of supply meet design requirements and the complete Power Island System meets performance guarantees.

2. The performance test will be carried out to the equipment manufacturer's standards in general accordance with internationally recognized standards.
3. In general, the method to determine plant heat rate, net output, and noise and air emissions shall be derived from the performance test codes of the relevant International Standards of each component of the equipment, which also provides the criteria for the comparison between the guaranteed and test measured values.

B. Correction to Guarantee Basis Conditions

1. The Contractor shall supply to the City, all correction curves and formulae for the equipment performance parameters which may be required to correct the as-run test values to the specified guarantee values.
2. The tests results recorded during the performance test shall be corrected, as applicable, to those which would have been achieved had the test been carried out at the guarantee basis conditions by using the correction curves and/or formulae.
3. The correction curves and formulae shall be provided in the performance test procedure. A full set of final Correction Curves shall be provided by the Contractor at least 60 days prior to the start of performance testing.
4. The correction curves and/or formulae will include, but may not necessarily be limited to:

    a. ambient temperature
    b. ambient relative humidity
    c. barometric pressure and altitude
    d. fuel gas heating value
    e. fired hours
    f. power factor
    g. gas turbine exhaust back pressure
    h. gas turbine inlet pressure
    i. instrumentation tolerance

C. Performance Test Program

1. The performance test program shall consist of several separate tests. The Contractor shall assure the systems and equipment within the Power Island properly supports each test.

    a. Equipment Operational and Performance Tests

        1) The procedure shall include demonstration of all major equipment trips
        2) Test procedures provided by the equipment Contractor shall be performed to establish a baseline for the General Manager to reference for future periodic performance testing.
        3) Refer to Section 481100, Combined Cycle Power Island for the Contractor's role in testing of individual equipment.

    b. Control System Tests

        1) Demonstrate full capability of the control system.

    c. Power Island Performance Tests

1) Demonstrate ability to meet guarantees for net MW output, net heat rate, auxiliary loads, ramp rates, equipment trips, noise tests, water consumption, ammonia injection rates, etc.

d. Plant Emissions Tests

1) Verify Power Island Equipment meets all guarantee and permitted requirements for air and noise emissions at the required operating loads.
2) Source testing shall be coordinated by the Contractor to be done with CEMS certification.

e. Noise Emissions Tests

1) Refer to 480031 Combined Cycle Power Island Noise Control Performance for noise emission and testing requirements.

D. Remedial Action (refer to Contract terms)

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET

Item	Description	Units	Technical Data
1.0	**General**		
	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number		123374
2.0	**Performance Guarantee Requirements**		
	Ambient Temperature at Guarantee	˚F	75
	Relative Humidity at Guarantee	%	50
	Gross plant Output	MW	71 maximum (all conditions)
	Auxiliary Loads at Guarantee	kW	*
	Max Net Plant Output	MW	67 minimum (75˚F, 50% RH)
	Aux Cooling Load at Guarantee 33/67	MMBTU/hr	
	Maximum Auxiliary Cooling Load 33/67	MMBTU/hr	
	Net Heat Rate at Guarantee 33 MW	BTU/kWh	*
	Net Heat Rate at Guarantee 67 MW	BTU/kWh	*
	GTG Cold Start to Base Load	minutes	10
	Combined Cycle Power Island Cold Start to Emissions Compliance	minutes	120
	STG Cold Start to Base Load	minutes	*
	Fuel Gas Consumption at Base Load	MMBTU/hr	*
	Fuel Gas Temperature at Guarantee	˚F	*
	Fuel Gas Pressure at Guarantee	psig	*
	Raw Water Consumption Rate	gpm	*
	Wastewater Discharge Rate	gpm	*
	Ammonia Consumption Rate	lbs/hr	*
	Air Emissions		
	NOx		Refer to Section 480020, Site Conditions
	CO		Refer to Section 480020, Site Conditions
	VOC		Refer to Section 480020, Site Conditions
	PM10		Refer to Section 480020, Site Conditions
	Ammonia Slip at OTSG Stack		Refer to Section 480020, Site Conditions

Item	Description	Units	Technical Data
	Noise Emissions		
	Max Within Plant Boundary	dBA	Refer to Section 480031
	At Plant Boundary	dBA	Refer to Section 480031
	Far Field	dBA	Refer to Section 480031

*To be determined by Power Island final design

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 481100

Combined Cycle Power Island Equipment

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 481100
Combined Cycle Power Island Equipment

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *STEVE HARRIS*

REVISION HISTORY		
DATE	REVISED BY	REVISION
04/13/2011	S. Harris	A
06/02/2011	S. Harris	B
09/09/2011	T. Clark	C
12/05/2011	T. Clark	D
12/07/2011	G. Harwood	E
02/02/2012	B. Hritsco	F
05/04/2012	T. Clark	G
05/30/2012	T. Clark	H
06/15/2012	B. Hritsco	I
08/29/2012	G. Harwood	J
08/30/2012	T. Clark	K
09/12/2012	T. Clark	L
10/04/2012	G. Harwood	M
09/10/2013		N – CONTRACT VERSION

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 2
1.3 FURNISHED BY OTHERS 3
1.4 RELATED SECTIONS 4
1.5 CODE AND STANDARDS 5
1.6 DEFINITIONS ..... 7~~6~~
1.7 SYSTEM DESCRIPTION 7
1.8 SUBMITTALS 10
1.9 QUALITY ASSURANCE ..... 12~~11~~
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 13
1.11 FUEL QUALITY 14
1.12 SERVICE/PROCESS UTILITIES 15
1.13 WARRANTY 15

PART 2 - PRODUCTS 15

2.1 MATERIALS AND WELDING 15
2.2 ACCESSORIES 16
2.3 INSTRUMENTATION AND CONTROLS ..... 18~~17~~
2.4 ELECTRICAL 22
2.5 CIVIL AND STRUCTURAL 23
2.6 FABRICATION 25
2.7 SOURCE QUALITY CONTROL ..... 27~~26~~

PART 3 - EXECUTION 28

3.1 INSTALLATION 28
3.2 FIELD QUALITY CONTROL ..... 29~~28~~
3.3 COMMISSIONING ..... 30~~29~~
3.4 TRAINING ..... 30~~29~~
3.5 SPARE PARTS ..... 31~~30~~
3.6 REPAIR AND MAINTENANCE PROGRAM PRICING ..... 31~~30~~

APPENDIX A – CONTRACTOR DATA REQUIREMENTS 32~~31~~

SECTION 481100
COMBINED CYCLE POWER ISLAND

PART 1 - GENERAL

The City of Pasadena proposes to complete a new 1 x 1 combined cycle power plant utilizing two primary contracts. The first is the Combined Cycle Power Island Equipment (PIE) contract which will include the supply and delivery of the major plant equipment. The second contract will be a separate future Balance of Plant (BOP) contract performed by the BOP Contractor which will include the detailed engineering scope of work for the power plant, procurement of equipment not supplied under the Combined Cycle Power Island Equipment contract, along with the construction, installation and commissioning of the new plant.

The plant shall be capable of being operated from the BOP Contractor supplied Power Distribution Center (PDC), as well as the new Control Building Control Room. The turbine control panel equipment, supplied by the PIE Contractor, shall be located in the PDC along with the BOP Contractor supplied Plant Control System (PCS). The PIE Contractor shall supply the Human Machine Interface (HMI) in both the PDC, and remotely in the Control Building Control Room for operating the GTG equipment. The PIE Contractor shall coordinate with the BOP Contractor so that the entire scope of equipment provided under this Section may be operated from the PCS in either location. Plant control system integration is by the BOP Contractor.

The plant needs to have the capability to operate in islanding mode for an indefinite period of time. The proposed equipment described within this specification needs to be equipped to operate in this condition. Islanding mode is defined as a condition where the City of Pasadena's 34.5kV system is disconnected from Southern California Edison, and the Pasadena Water and Power generators continue to operate, responding as necessary, to changes in load. Depending on current operating scenarios, this may mean some of the plant's generators will need to start and come up to load or if already in operation, continue to operate as necessary, responding to changes in load, frequency and voltage. Automatic isochronous load sharing function with other generators in the power plant is not provided by the Contractor. Islanding/droop mode MW setpoint is by operator via GTG HMI or PCS. A black start generator is not a requirement of this specification.

The PIE Equipment shall be designed to accommodate a future auxiliary boiler to maintain temperature of the STG and associated piping systems in warm stand-by mode.

Site plans have been provided for the contractor to be aware of the limited project area available. The site is constrained by the Glenarm Building to the north, the existing GT 3 & 4 gas turbines to the south and existing GT1 & 2 gas turbines to the east. Equipment sizes and configurations proposed by the PIE prospective contractor shall not significantly deviate from the provided site plans.

1.1 SUMMARY

A. This specification including datasheets, appendices, and references identifies requirements for design, shipment, installation, testing, and performance of a complete Combined Cycle Power Island within the scope boundaries provided. The installation of the specified equipment, which is part of the GT5 Combined Cycle installation, will be performed by the BOP Contractor under a separate contract.

B. Equipment supplied shall be new and unused. Refurbished or used equipment is not acceptable. Major equipment shall be sourced from original equipment manufacturers (OEMs).

C. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

D. It is not the intent to specify completely herein all details of design and construction of the equipment/systems. However, the equipment and systems shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall furnish, design, fabricate and test the specified equipment and accessories, including but not limited to the following:

1. Gas Turbine Generator (GTG) and accessories
2. Gas Turbine Inlet Conditioning Equipment (if required for performance)
3. Once-Through Steam Generator (OTSG) with exhaust ductwork, stack, and emissions monitoring connections including expansion joint between GTG and OTSG.
4. 2x100 Tempering Air Fans per OTSG.
5. Steam Turbine Generator (STG) including weather/ sound enclosure
6. ST Steam bypass to condenser valves
7. Platforms and stairs as defined by the detailed equipment specifications. All guard rails and handrails will be three pipe design with toe plate. No angle iron handrail or guard rail will be permitted.
8. Water cooled condenser
9. Wet Cooling Tower and Circulating Water Pumps for STG Condenser Cooling Water
10. Condensate Hotwell Pumps
11. Boiler Feedwater Pumps
12. GTG Emissions control system for NOx and CO to meet air quality permit conditions and applicable federal, state, and local regulations.
13. Continuous Emissions Monitoring System (CEMS) and Data Acquisition & Handling System (DAHS) to meet applicable EPA, state, and SCAQMD regulations including permit conditions
14. Generator Step-up Transformer (one three-winding GSU for both the GTG and STG)
15. 100% Steam Turbine Bypass Valves to Steam Surface Condenser (for sustained operation in bypass mode) along with feedwater desuperheating control valves
16. 2x100% Fuel gas compressors with acoustic enclosure(s)
17. Fuel gas filtration, conditioning, and pressure control to meet Contractor's gas turbine supply requirements
18. Condensate Polisher
19. Microprocessor based control system with one local and four remote HMIs (operator stations) including GTG control system configuration and graphics programming
20. Fire protection within Contractor supplied enclosures compatible with local requirements (excluding STG / Condenser acoustical enclosure, which will be a wet system by the BOP contractor)
21. Lighting and electrical outlets in Contractor supplied enclosures
22. Supervisory instrumentation and protective devices within the Contractor's supply boundaries including terminal connections in the GTG control system panels for wiring connection between GTG/ STG instruments/ control system and BOP control system.

23. Isolation and control valves within the Contractor's supply boundaries
24. Instrument air piping, and actuators within Contractor's scope of supply
25. Compressed, filtered & dried instrument air supply
26. Motors for all motor driven equipment furnished under this specification
27. Couplings, coupling bolts (turbine/generator rotors), and coupling guards
28. Sizing drawings and information (in English units) for all concrete embedments necessary for all equipment or skids furnished, including anchor bolts and conduit
29. Shear lugs normally supplied with engineered equipment.
30. Cleaning and finishing prior to shipment
31. Contractor's standard gray (RAL 7038) and white (RAL 9010) painting for GTG. OTSG will be primer painted only.
32. Startup spares and special tools
33. Engine Performance testing at factory and test reports of results
34. Drawings to support facility design, construction and maintenance
35. Inspection certificates and quality control documentation listed in this Section
36. Complete set of component cut sheets
37. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
38. Priced list of recommended spare parts for two years of operation
39. Special tools and lifting devices required for assembly, operation, maintenance and disassembly of equipment furnished under this specification.
40. Packing and shipping DDP to the Glenarm Power Plant jobsite or alternate location to be identified by the General Manager in the city of Pasadena, CA or other nearby city.
41. Technical advisory services for installation, commissioning and performance testing activities. The PIE Contractor shall provide an on-site project manager and support staff to coordinate technical issues during the installation phase of the project. The project manager will schedule the various sub-vendor technical advisors with the BOP Contractor. The project manager will interface with the BOP Contractor and General Manager for equipment deliveries, assist BOP Contractor warehousing equipment parts, attend weekly project meetings, act as liaison to resolve technical discrepancies with PIE vendor home offices, witness installations, ensure installation manuals are being completed to support turnover and commissioning efforts, etc. The on-site project manager will develop monthly reports for the scope of work he is responsible for. The PIE Contractor should expect to have this manager at the project site from approximately one month prior to the first major equipment shipment through commissioning of the plant. The PIE Contractor will also provide pre-placement on-site inspection of the major foundations, if requested by the General Manager.
42. Operations training
43. Mechanical, electrical and instrumentation maintenance training
44. A full set (5 hard copies and 2 electronic copies) of integrated operations and maintenance procedure manuals of the major equipment provided under the equipment specifications supplied under this Section.
45. Repair and maintenance program pricing for scope of gas turbine services described in this Section

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. All interconnecting mechanical, electrical, and structural materials between Contractor-supplied items (pipe, pipe rack, pipe supports, tubing, fittings, piping accessories, etc.).
2. Balance of Plant Distributed Control System and control system integration
3. Black start emergency diesel generator
4. Auxiliary cooling water pumps
5. Boiler water monitoring and chemical treatment
6. Motor Control Centers (MCC) for Contractor supplied equipment (Power Island Contractor shall furnish all necessary motor and load information to enable the Balance of Plant Contractor to purchase MCC's meeting the requirements of the Power Island Contractor's requirements.)
7. 24 VDC and 125 VDC battery systems and chargers
8. Site grounding grid and lightning protection
9. Water storage tanks for demineralized water, fire protection, and boiler makeup
10. Drains tanks for GTG water wash, boiler blowdown, steam drains, turbine drains
11. Oily water separator(s)
12. Water treatment for boiler makeup and process discharge
13. Chemical receiving and storage equipment
14. Ammonia storage and forwarding system for NOx control
15. Plant lighting and FAA warning lights (if required)
16. Uninterruptible power supply (UPS) system
17. Plant fire protection system (Gas turbine fire protection by Power Island vendor)
18. Foundations and anchor bolts
19. Initial fill of lubricants and chemicals for Contractor supplied equipment
20. All control room furniture required for Contractor supplied terminals, keyboards and printers
21. Bus duct between the generator, generator circuit breaker, line side cubicle and step-up transformer
22. Current transformers (CTs) and voltage transformers (VTs) not integral to generator and terminal compartment
23. Field wiring, cable and conduit connecting Contractor supplied components
24. Finish painting of all enclosures, ducting, stacks and inlet filter house
25. Receipt and off-loading at site
26. Onsite installation labor and equipment
27. Material lay-down area defined by the General Manager
28. Balance of plant control system configuration and graphics programming
29. Electrical, instrumentation and controls wiring up to Contractor's connection points
30. Field labor and plant operator support of Contractor's commissioning and testing engineers

1.4 RELATED SECTIONS

A. Section 260000 - Electrical Mechanical Equipment

B. Section 261200 – Generator Step-up Transformer (GSU)

C. Section 409413.22 – Continuous Emissions Monitoring System (CEMS)

D. Section 480020 - Site Conditions

E. Section 480031– Combined Cycle Power Island Noise Control Performance

F. Section 480032 - Power Island Performance

G. Section 485122.11 – Steam Turbine Bypass Valves

H. Section 485221 - Steam Turbine and TEWAC Generator

I. Section 485222 - Gas Turbine Generator

J. Section 485311.10 - Condensate Pumps

K. Section 485311.20 - Boiler Feedwater Pumps

L. Section 485312 – Circulating Water Pumps

M. Section 485374.21 - Compressed Air System

N. Section 485374.22 - Fuel Gas Compressor

O. Section 485413 – Once-Through Heat Recovery Steam Generator (OTSG)

P. Section 485432 - Surface Condenser

Q. Section 485471 – Gas Turbine Inlet Air Chiller System

R. Section 485491– Cooling Tower

S. Section 485952 – Condensate Polisher

1.5 CODE AND STANDARDS

A. The Contractor's design shall comply with the current editions, at the date of notice to proceed, of relevant national and internationally recognized codes, standards and regulations and all applicable codes, standards, and regulations for the Site as described in Section 480020 Site Conditions. Where conflicts exist between standards, the more stringent requirements shall prevail. Deviations from relevant standards shall only be implemented with the written approval of the General Manager. Listed below are the minimum standards organizations and standards to be observed. Individual equipment specifications may refer to additional applicable standards not cited under this Section. Refer to Codes and Standards section in GTG scope of supply that Contractor considers the applicable sections of the US and ISO Codes and Standards to be the most relevant standards for gas turbine equipment.

1. California Code of Regulations Title 24

   a. Part 1 - California Building Standard Administrative Code
   b. Part 2, Volumes 1 and 2 - California Building Code
   c. Part 2.5 - California Residential Code
   d. Part 3 - California Electrical Code
   e. Part 4 - California Mechanical Code
   f. Part 5 - California Plumbing Code
   g. Part 6 - California Energy Code
   h. Part 8 - State Historical Building Code

i. Part 9 - California Fire Code

2. American Institute of Steel Constructors (AISC)

   a. AISC 341 - Seismic Provisions for Steel Construction
   b. AISC 360 - Steel Construction Manual

3. American National Standards Institute (ANSI)

   a. S1.4 - Sound Level Meters
   b. S1.6 - Preferred Frequencies and Band Numbers for Acoustical Measurements
   c. S1.11 - Octave, Half-Octave, and Third Octave Band Filter Set

4. American Petroleum Institute (API)
5. American Society of Mechanical Engineers (ASME)

   a. ASME B16.34 – Valves-Flanged, Threaded, and Welding End
   b. ASME B16.5 – Pipe Flanges and Flanged Fittings
   c. ASME B31.1 - Power Piping
   d. ASME Section IX - Welding and Brazing Qualifications
   e. ASME Section VIII - Unfired Pressure Vessels

6. American Society for Testing and Materials (ASTM)

   a. ASTM - Standards for Materials
   b. ASTM A105 – Carbon Steel Forgings for Piping Applications

7. American Welding Society (AWS)

   a. AWS D1.1 - Structural Welding Code

8. Factory Mutual (FM)
9. Institute of Electrical & Electronic Engineers (IEEE)
10. Instrumentation, Systems, and Automation Society (ISA)
11. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)

    a. Standard Marking System for Valve, Fittings, Flanges, and Unions

12. National Electrical Manufacturers Association (NEMA)
13. National Fire Protection Association (NFPA)

    a. NFPA 70 - National Electrical Code
    b. NFPA 85 - Boiler and Combustion Systems Hazards Code

14. Occupational Safety and Health Administration (OSHA)

    a. Title 8, Division of Industrial Safety Unfired Pressure Vessel Safety Orders, Register 76, No. 32, Article 6

15. California Occupational Safety and Health Administration (CalOSHA)
16. Underwriters Laboratories (UL)

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements:

1. The Combined Cycle Power Island shall be designed for outdoor installation and anticipated plant operational life of 30 years subject to the required maintenance, component replacements due to wear and tear, and other factors such as economics and environmental regulation. The expected wear life of expendable, consumable and wear parts will be consistent with good design practice for the following operating profile – Refer to Attachment 1 – Scope of Supply, General Plant Description.

OPERATING PROFILE (FOR PERMITTING PURPOSES ONLY)	
Annual	
Operating Hours	8,760
Total Startup/ Shutdown Cycles	750
Cold Starts (shutdown ≥ 24 hrs)*	365 (one per day) **
Warm Starts (≥ 8 and < 24 hrs)*	365
Hot Starts (< 8 hrs)*	20
**since previous shutdown*	** Contractor notes that since it takes 24 hours for the plant to cool, it is not possible to start cold more than 200 times per year.
Daily	
Startup/ Shutdown Cycles	5 Maximum
Commissioning Hours	200
Black Start Capability	Required (A Black Start Generator is not part of the Power Island Scope)

2. All equipment shall be designed for continuous 24 hour per day outdoor operation with ability to cycle daily from off-line to full load.
3. No single failure of an auxiliary component or system (lube oil pump, Enclosure fans, etc.) shall result in major equipment damage. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.
4. Equipment supplied under this specification shall include additional features recommended by the manufacturer for reliable operation in the ambient conditions described in Section 480020 Site Conditions. This may include but is not limited to gas turbine inlet deicing, enclosure space heaters, etc.
5. Seismic and Wind Loading Design: All major equipment supplied under this specification, as well as auxiliary system equipment and their enclosures, are to be designed, as a minimum, to meet the seismic and wind requirements detailed in Section 480020 Site Conditions.

B. Performance Requirements:

The Power Island shall be guaranteed to meet the following performance requirements:

1. The Gross Electrical Output, or electrical output of the combined cycle plant at the generator terminals, cannot exceed 71 MW on a 64°F day with 61% relative humidity.

2. The gas turbine generator must have a 10 minute start capability with prior established system purge credit . A 10 minutes start is defined as a cold start to full power in 10 minutes or less. There shall be no additional maintenance penalty associated with a 10 minute start.
3. The gas turbine generator in conjunction with the single pressure heat recovery steam generator or Once Through Steam Generator (OTSG) must be capable of operating dry for unlimited periods during start-up and shutdown and emergency trips. That is with no water flow through the tubing, even though the gas turbine is at full or part load for unlimited periods during start-up and shut down of the combined cycle plant. The steam cycle shall be able to startup while the gas turbine is in operation at full load.
4. The CO and NOx catalyst shall be capable of performing without risk of damage or adverse effect on life cycle guarantee in the dry OTSG operating mode. The Contractor shall define how this will be achieved in the Combined Cycle Power Island Proposal.
5. The plant will implement evaporative cooling for steam cycle heat rejection by use of a cooling tower. The cooling tower is to be sufficiently sized to reject all the heat from the steam cycle, auxiliary equipment cooling, and continuous full steam bypass to the surface condenser as well as a mechanical chiller if used for combustion turbine inlet cooling.
6. The Contractor shall provide correction curves or computer software that will permit the General Manager to establish accurate Power Island performance when varying operating parameters; for example:

    a. Ambient air temperature, specific humidity, and barometric pressure
    b. Gas turbine inlet air temperature and relative humidity
    c. Gas turbine and steam turbine load
    d. Power factor
    e. The new plant gross electrical output will be limited at the generator terminals.
    f. The GTG will be required to be designated as an Advanced Turbine Technology under the SCAQMD.
    g. Fired hours on GTG
    h. GTG Inlet pressure drop
    i. GTG exhaust pressure
    j. GTG evaporative cooling water injection or other inlet air treatments
    k. Condenser cooling circulation water temperature and pressure drop
    l. Steam enthalpy (entering condenser, UEEP) characteristic curves vs. exhaust steam flow entering condenser at different vacuum in the condenser (1.5”, 2”, 2.5”, 3” Hg abs)

7. Emissions:

    a. Maximum permissible emission levels which are to be met at the exhaust gas stack within the continuous operating range. The Contractor shall guarantee these emissions limits for a minimum of five years. Refer to Attachment 6 – Performance Guarantees.

8. Noise

    a. The Power Island Equipment must comply with the noise requirements as outlined in Section 480031, Combined Cycle Power Island Noise Control Performance.

9. Reliability Guarantee

    a. Contractor shall guarantee that the Equipment will achieve a reliability factor of at least ninety-eight percent (98%) for a rolling 14 consecutive days during the performance of a reliability test.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

A. Information required after Contract Award:

1. After the award of contract, the following data and drawings shall be submitted to the General Manager in accordance with the submittal schedule (Refer to Attachment 11 – Drawing Schedule):

B. Quality Assurance/Control Submittals

1. Submit qualification, inspection and testing procedures for review. GTG quality plan shall be provided. Quality related submittals may include:

    a. Design Data
    b. Test Reports
    c. Certificates
    d. Manufacturer's Instructions
    e. Manufacturer's Field Reports

C. Installation, Operation, Maintenance, and Training Manuals

1. Contractor shall submit for General Manager's review Field Erection Manuals (refer to standard Installation and Commissioning manuals for GTG) and Operation & Maintenance Manuals prepared for the specific equipment furnished under this specification. The manuals shall be an integrated set consisting of information for all the individual pieces of equipment. Where general or standard instructions are used, inapplicable data sheets shall be removed.
2. The Field Erection Manual shall include:

    a. Complete and detailed description of all procedures to be followed to install the equipment and ready it for initial commissioning.
    b. Drawings required for installation

3. Product Operational and Maintenance Manuals shall include:

    a. Five full sets of Operation and Maintenance documentation and two sets of electronic manuals. Electronic manuals shall follow the hard copy format and shall be indexed with the same table of contents to the extent that it is practical.

Electronic manuals shall be searchable pdf format, there will be no exceptions granted to this requirement.

b. Detailed description of all equipment, components, and systems furnished under this Section
c. Installation, Operating and Maintenance Procedures
d. Drawings required for operation, maintenance and repair. Reproducible 11" x 17" prints of wiring diagrams and schematics as required under the electrical and instrumentation portion of these specifications.
e. Descriptive system literature
f. Special shipping, handling, and storage instructions
g. Recommended maintenance frequency and listing of suggested spare parts
h. Maintenance and repair instructions, including procedures and tolerances
i. Special tool as per Attachment 15
j. Bill of materials
k. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)
l. Settings: settings of valves, equipment-protection devices, relays and alarm contact settings for proper operation and/ or as left following factory testing.
m. Text of the manuals with drawings, illustrations, and diagrams shall be in English. They shall refer specifically to the equipment supplied and will be specifically prepared for this project.
n. In addition to operation and maintenance information, the manuals shall also include all necessary information required for the installation of the equipment including but not limited to hoisting, setting on equipment foundations and leveling procedures.
o. Operating instructions shall include all normal startup, running, emergency trip, shut down procedures, emergency troubleshooting and operating procedures, restart following a trip, forced cooling, and precautions recommended to prevent plant deterioration during periods of non-operation and emergency trip.

4. Operations and Maintenance Manuals must be furnished by the Contractor prior to conducting training.
5. Operations and Maintenance manuals shall include literature on all instruments and devices furnished with the equipment.

D. Noise Data

1. Refer to Section 480031, Combined Cycle Power Island Noise Control Performance in the specification for technical requirements.

E. Project Closeout Submittals

1. Contractor shall provide the General Manager with electronic media of all drawings, manuals, and instruction books. All project closeout drawings shall be submitted as .dwg files compatible with AutoCAD.

F. Manufacturers' Warranties refer to Article 13 in the Contract

1.9 QUALITY ASSURANCE

A. General:

1. Contractor shall submit its quality plan to the General Manager within 30 days of Notice to Proceed. This program shall include procedures for quality assurance of all manufacturing activities. As a minimum, it shall address the following:

   a. Responsibilities and authorities
   b. Document control
   c. Design verifications
   d. Subcontractor assessment and control
   e. Calibration requirements
   f. Traceability
   g. Non-conformance control
   h. Inspection and test plans
   i. Internal audits
   j. Records

2. On request Contractor shall submit actual data of quality control inspections results from the Contractor's manufacturing facility.
3. Equipment specified is subject to surveillance during manufacture by the General Manager.
4. The General Manager reserves the right to review any procedures referred to in the Quality Plan.
5. The Contractor shall submit for review by the General Manager the measures to be taken for storage and maintenance of equipment and materials prior to installation, during installation, as well as for the period between the completion of the installation and the time that the equipment is placed in service.

B. Subcontractors

1. The Contractor's sub-suppliers may be subject to quality audit by the General Manager. The Contractor shall include in all orders to sub-suppliers a notice indicating all materials and equipment is subject to inspection by the General Manager as determined by the Quality Plan.

C. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification. GTG Package structural welding and fabrication is performed in accordance with AWS D1.1 to include inspections. GTG package Contractor's quality assurance weld inspection specification meets or exceeds all requirements stated in AWS D1.1 for all NDE methods, including visual. All visual weld inspections are performed by AWS certified weld inspectors.

   Contractor's weld program complies with ASME IX and Contractor's policies require sub-suppliers to comply as well.
2. Visual examination shall be by personnel certified to AWS QC1 requirements. All other NDE shall be by personnel qualified to Level II or Level III requirements of SNT-TC-1A of the American Society for Non Destructive Testing.
3. Visual examination shall be performed before other NDE.

4. Radiographic examinations required shall be done in accordance with the requirements of the appropriate fabrication code or this specification.

D. Testing

1. General Manager reserves the right to witness all factory tests. Contractor shall notify General Manager of scheduled tests 10 working days prior to such tests.
2. Signoff reports of all shop tests shall be submitted to the General Manager for review.
3. General Manager may request for additional or repeat test at City's expense, as deemed necessary by General Manager, in order to declare the equipment in compliance with specification(s).
4. All tests required by regulatory agencies shall be witnessed by an Agency inspector unless specifically waived, in writing, by the Agency. All items tested for regulatory compliance shall be pre-tested prior to scheduling the agency inspector.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Packaging, Storage, and Handling (for LM6000 GTG, Contractor's standard packaging, delivery, storage and handling procedures are applied to the project.)

1. Packing shall be accomplished in accordance with acceptable commercial practices and at a minimum, the prescribed shipping methods in the original equipment manufacturers' literature.
2. Where the physical size and arrangement permit, equipment shall be shipped completely shop assembled.
3. Shipments to include detailed packing lists. Packing lists shall detail by number, items consigned with each separate shipment.
4. Fabricated pieces shall be blocked, strapped, or otherwise held in position during shipment and shall be further separated by dunnage as necessary to prevent damage. Temporary bracing must be painted yellow for identification.
5. Instrumentation and piping which cannot be adequately protected if attached to the vessel during shipment shall be shipped loose with the vessel. Items shipped loose shall be packed in durable boxes or containers to protect items during shipment. Containers shall be numbered and the container numbers shall be included on the accompanying invoice or shipping bill.
6. Lifting and support points shall be clearly identified.
7. Packages shall be identified with items and serial numbers, purchase order number, and items description. Identifying tags shall be corrosion and weather resistant.
8. The General Manager reserves the right to inspect equipment prior to shipment. Contractor shall notify the General Manager of pending shipment 15 days before shipping date.
9. All equipment shipped by rail shall be supplied with impact recorders (hump meters) mounted securely on the equipment with the car sealed at the factory.
10. Piece marks shall be clearly identified with weather proof enclosures.
11. Vessel nozzle flanges and other connections shall be protected for shipment by securely attaching covers, plugs or other protection to the connections. Blanking flanges shall utilize at least four bolts. Covers shall be constructed of wood, metal or other suitably durable materials and shall be attached with stainless steel tie wire or other suitable fasteners.
12. Unpainted surfaces shall be protected from the weather with weatherproof covers. Machined surfaces shall be coated with a heavy grease or similar material before covering.

13. Weld-ends shall be protected with a consumable rust preventive coating such as Deox-aluminite or equal, and shall be capped prior to shipment.
14. Equipment to be completely free of water prior to packaging for delivery.
15. Where applicable, space heaters furnished as an integral part of any equipment described in these specifications or component thereof shall be designed to operate during equipment storage and after equipment installation, using temporary power prior to installation of permanent power. Such operation of the space heaters on temporary power shall not void the equipment or component warranty. Space heater wiring connections or terminations shall be readily accessible for this purpose.

B. Delivery

1. The packaging, load out, and protection of all equipment to be furnished and delivered by Contractor under the Power Island Equipment contract shall be the full responsibility of the Contractor.
2. Contractor shall be responsible for shipment of all equipment under the Power Island Equipment contract to Glenarm Plant or a place to be identified by the General Manager in Pasadena, California, or a nearby City. The delivery point for equipment will be identified and given to Contractor at least a month prior to start of equipment delivery.
3. The General Manager and/or the BOP Contractor shall be responsible for receiving all Power Island Equipment. In the event the delivered item has an apparent damage, the General Manager and/or BOP Contractor will inform the equipment carrier and Contractor of such apparent damage for further action.
4. Contractor shall replace items damaged in shipment unless the repair scope and procedure has been approved by the General Manager.
5. The unloading of Contractor-furnished Power Island Equipment at the point of delivery specified in subpart 1.10B.2 above will be the responsibility of the BOP contractor under a separate contract.
6. Any special tools for lifting or rigging shall be provided by the Contractor.
7. Contractor shall coordinate major equipment deliveries with the BOP Contractor. Adequate notice shall be provided to the site for mobilization of heavy lifting equipment. Contractor shall not ship weather sensitive equipment without prior coordination with the BOP Contractor.
8. The delivery of all Power Island Equipment shall be done in a span of 16 months. If necessary, equipment shall be temporarily stored at the equipment manufacture's facility or other storage place until ready for shipment. The temporary storage of any equipment prior to shipment to General Manager's designated delivery point shall be at the expense of the Contractor.
9. The transfer of Title and Risk on any Contractor-furnished equipment shall occur at the point of delivery specified in subpart 1.10B.2 above.

C. Contractor shall replace items damaged in shipment unless the repair scope and procedure has been approved by the General Manager.

1.11 FUEL QUALITY

A. Refer to Section 480020 Site Conditions for fuel composition. Fuel to be used for GTG shall meet GE natural gas fuel specification MID-TD-0000-1

1.12 SERVICE/PROCESS UTILITIES

Fire Water	City Water
Potable Water	City Water
Service Water	City Water, GTG water wash water shall meet GE specification MID-TD-0000-4.
Demineralized Water	Existing Demineralizer on the Broadway Site, Water for NOx suppression and SPRINT injection into gas turbine engines shall meet GE specification MID-TD-0000-3.
Instrument Air	80 psig to 125 psig
Service Air	80 psig to 100 psig
Aqueous Ammonia	19% Concentration

1.13 WARRANTY refer to Article 13 in the Contract

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Materials of Construction:

1. Products which contain asbestos are prohibited. This prohibition includes items such as packings or gaskets even though the item is encapsulated or the asbestos fibers are impregnated with binder material.
2. Materials shall be identified with the applicable AISI, ASTM, ASME or SAE number, including material grade on pump data sheets.
3. If the Contractor recommends any materials that are superior to or alternate to the materials specified, the materials shall be listed as an alternate on the data sheets submitted with the Contractor's proposal.
4. Minor parts not identified shall have corrosion resistance equal to that of specified parts in the same environment.
5. Mating parts, such as studs and nuts, constructed of carbon steel, 18-8 stainless steel or of materials having similar galling tendencies shall be lubricated with an anti-seize compound as required by Contractor.
6. Materials of construction for fabrication are as per Contractors' standard.
7. Welding between stainless and carbon steel shall not be permitted.

B. Insulation

1. Vessels, piping and valves shall be insulated for heat conservation as per Contractor's requirements.
2. Contractor shall supply and install external tank insulation including insulating materials, insulation supports as required, insulation cements if required, and insulation jacketing and banding.
3. Insulation materials that meet Contractor's spec are provided. Contractor utilizes winterization consisting of heat tracing and insulation resulting in suitability of the unit for the ambient temperature of the project.
   Any Steam Turbine thermal insulation in Contractor's scope will be in accordance with manufacturer's standard procedure.
4. Insulating Cement shall be the requirements of ASTM C474.

C. Welding:

1. Personnel performing or supervising the visual examination of welds, including ASME Boiler and Pressure Vessel equipment, shall be qualified or Certified Welding Inspectors in accordance with the American Welding Society, AWS QC-1.
2. All welds shall receive 100% visual examination in accordance with AWS Dl.1 or ASME codes. Records of these examinations shall be created and documented.
3. All welding on pressure containing components shall be performed in accordance with ASME BPV Section IX "Welding and Brazing Qualifications".
4. Welding procedures shall be qualified in accordance with ASME BPV Code Section IX. Welders shall be qualified in accordance with ASME BPV Code Section IX. Welding procedures and welder qualification records shall be made available to the General Manager upon request.
5. Welding on non-pressure containing structural components such as vessel supports may be performed in accordance with AWS D1.1 "Structural Welding Code".
6. General Manager will provide the services of an independent testing laboratory for field nondestructive examination. Any defective weld shall be removed, rewelded, and retested at Contractor's expense.
7. Nondestructive examination procedures shall be submitted. All nondestructive examinations shall be documented in accordance with the applicable code.
8. For the Steam Turbine, all welding for internal parts will be in accordance with manufacturer's standard procedure except the high pressure parts such as turbine casing and equipment with ASME U Stamp.
9. GTG Package structural welding and fabrication is performed in accordance with AWS D1.1 to include inspections. GTG package Contractor's quality assurance weld inspection specification meets or exceeds all requirements stated in AWS D1.1 for all NDE methods, including visual. All visual weld inspections are performed by AWS certified weld inspectors. Contractor's weld program complies with ASME IX and Contractor's policies require sub-suppliers to comply as well.

2.2 ACCESSORIES

A. Valves

1. All fuel gas isolation valves and bypass valves shall be ball type valves with Class VI shutoff. Instrument valves shall be ball type. All valves shall be located and positioned such that they are manually operable within five feet, measured vertically from the adja-

cent working grade or platform surface. Where placement of a valve for manual operation is not practical or possible, valve shall be furnished with a complete means of remote operation including but not limited to, chain wheel operator and chain or operating rod extension shaft with associated mounting bracket and hardware.

2. All valves shall be API 607 "fire safe" certified or meet the requirements of API-6FA
3. Globe valves shall be ANSI forged steel, butt or socket welded unless otherwise specified.
4. Ball or plug valves shall be ANSI cast steel with raised face flanges.
5. Valves used in GTG packages and BOP equipment skids are as per Contractor's standard design.

B. Skid Mounting

1. When equipment is provided as part of a skid mounted system, the skid base shall be fabricated of structural steel welded to provide a complete base. The base shall contain lifting lugs or trunnions so skid can be moved and positioned with conventional lifting equipment. The base shall be provided with anchor bolt holes for bolting onto a foundation. The size and location of these holes shall be specified on the Vendor's outline drawing.
2. Where more than one heater is provided on a single skid, isolation valves shall be supplied to permit removal of one heater from service while the others are operating.
3. Where more than one piece of equipment is provided on a single skid, the control panel shall be designed and fabricated to permit the complete electrical isolation of one piece of equipment and still have the capability to run the other piece of equipment.
4. Skids shall be designed to facilitate the capture of leaks and furnished with a drain port, designed to allow for the complete drainage of any and all liquid entrapped by the skid structure and/or the skid surface. Such a surface shall be designed with appropriate sloping to permit all liquid to drain to a low point. Steam Turbine skid decks will not be sloped to permit drainage.
5. If a skid is fabricated with a deck or flooring surface, the surface shall be have a minimum of two penetrations per structural steel cell to allow for the simultaneous placement and venting of grout.
6. Control panels and their associated electrical equipment furnished as part of skid-mounted equipment shall be designed and fabricated with appropriate protection from the elements including but not limited to exposure to direct sunlight. Means of protection include protective sun shields and coverings and cabinet heating and cooling systems.
7. Regular maintenance of any and all serviceable elements on an equipment skid shall not require the disassembly or disconnection of any process piping, electrical feeds or control and instrumentation feeds.

C. Marking of Equipment

1. The Contractor shall provide a nameplate for the equipment showing the data required by the ASME BPV Code. All pressure vessels rated higher than 15psig are built to ASME Pressure Vessel Code Section VIII and bear U stamp. Pressure Vessels have ASME U1-A nameplate and data report with National Board registration will be provided.
2. Equipment shall be provided with permanently attached stainless steel nameplates and data shall be stamped or engraved on nameplates. The nameplate material shall be compatible with material to which it is attached to prevent galvanic corrosion. Nameplates shall not be attached to pressure containing surfaces with mechanical fasteners.
3. All equipment nameplates shall be in English.

4. Legends for equipment identification nameplates shall be submitted with drawings.
5. Instrument tags shall also be stainless steel with data engraved or stamped on the tags. The tags shall be securely wired to the supplied instrument

2.3 INSTRUMENTATION AND CONTROLS (Contractor's standard instrumentation and controls are provided for LM6000 GTG)

General

1. The Power Island shall be equipped with all necessary controls configured for complete start-up, automatic or manual synchronizing, loading, operation and shutdown from the General Manager's main control room and from a Contractor furnished local operator interface located in the self-contained control compartment of the Electrical/Control Package. The self-contained control compartment (provided by Others) shall be climate conditioned and contain Contractor furnished vibration monitoring equipment, GTG and STG protective relay and meter control panel, auxiliary panels (as required), motor control centers (provided by Others), battery packs and chargers (provided by Others) for DC powered equipment, and one of the operator interface workstation or HMI. Contractor to furnish the electrical support interface requirements and loads imposed on the foundation. All equipment furnished under this scope of work shall be able to interface with the plant control system via Modbus TCP.
2. Remote operator interface workstations or HMI for (Four for GTG and one for STG) shall also be provided by the Contractor for installation in the General Manager's main control room for remote operations of the gas turbine and steam turbine generators. Main control room furniture for Contractor-supplied controls components will be supplied by Others.

Limit Switches

1. Limit switches, when required, shall be factory mounted on the valves with provisions for adjusting the limit switch +/- 12mm (0.5 inches) along the axis of the valve stem.
2. All control valves not specified to be equipped with a position transmitter on the respective control valve data sheet shall be provided with fully opened and fully closed limit switches.
3. In general, limit switches and/or electrical connections shall be weather tight inside NEMA 4 approved enclosures with readily accessible terminal blocks in accordance with Section 260000 Electrical-Mechanical Equipment.

C. General Transmitters

1. Transmitters shall be rated for installation in the hazardous area classification listed in the attached data sheets.
2. All transmitters shall meet the following minimum requirements:

D.C. Voltage Level	Between 12 to 42 volts
Signal current	Between 4 to 20 mA
Accuracy (of signal current with respect to measured variable) of instrument	From 1% to 2.5% according to the measurement range and type of instrument

Linearity	0.1% of span
Repeatability	0.1% of span
Stability	0.1% of nominal input range per annum
Dead Band	Not exceeding 0.1% of span
Hysteresis	Less than 0.2% of output span
Maximum permissible effect on output for vibration between 5 and 300 Hz at $10m/s^2$ (1g)	+/- 1.0% of output span
Maximum shock without permanent damage	$1000\ m/sec^2$ (100g) in any plane
Relative Humidity range	5 - 95%
Ambient temp. range	-18˚C - 80˚C (0˚F - 175˚F)
Ambient temp. effect	Not exceeding 0.5% of maximum span per 10˚C change
Design pressure rating	Not less than 200% of maximum process static pressure

3. Pressure Transmitters

   a. Rosemount Pressure or equal Transmitters shall be “Smart” and support 2-wire, 4-20mA signal with HART protocol communications for device calibration, configuration, and testing, communication of HART variables to the control system via HART is not required. Transmitter shall allow range change on site by re-programming via HART communicator. HART communicator is not provided in Contractor’s scope of supply.
   b. Pressure transmitters shall be capable of continuous operation at the maximum pressure rating of the line or vessel.
   c. Transmitters shall be furnished with an inline block-and-bleed valve.
   d. Transmitters shall be wired out to junction box for connection to turbine control system.
   e. Transmitters shall be completely factory calibrated and configured as appropriate for design conditions.
   f. BOP Equipment skid pressure transmitters are per manufacturer’s standard.

4. Temperature Transmitters

   a. Temperature transmitters shall be used to provide 4-20mA temperature signals to the Contractor’s Control System.

b. Transmitters shall be fitted with a local indicator factory configured to display temperature in ˚F where possible.
c. Temperature element may be dual element probes.
d. Thermowell shall be provided appropriately sized for design conditions.
e. Transmitters shall be completely factory calibrated and configured as appropriate for design conditions.
f. Temperature transmitters and element assemblies shall be provided with weatherproof terminal heads and shall be installed so as to totally prevent ingress of foreign material.

5. Position Transmitters

a. Valve position transmitters shall be provided for all modulating control valves and shall be either integral to valve positioner or factory mounted on the valve. Position transmitter feedback to the Contractor's Control System may be via analog 4-20mA analog signal. Position transmitters shall be reliably coupled to the valve shaft and shall provide position indication with repeatable accuracy of within 1% at all times. The positioner transmitter shall be housed in weather tight; NEMA approved enclosures in accordance with Section 260000 Electrical-Mechanical Equipment. Transmitters shall have a temperature rating of 80˚C (175˚F). Transmitters shall be factory calibrated and capable of calibration in place in the field.
b. Analog 4-20mA type position transmitters shall transmit valve position to the Plant Control System (PCS) via Modbus TCP/IP communication link.

D. Positioners

1. Positioner shall be designed for a control signal input range of 4-20 mA. Positioner shall not be provided with bypasses.
2. All positioners shall be equipped with 40 micron filter/regulator air supply sets mounted on the valve yokes. If the positioner can accept the maximum air supply pressure, a 40 micron air filter only shall be provided. All air venting enclosure ports shall have stainless steel screens with goose neck vents to protect from direct exposure to water or dirt. Digital positioners shall be used.

E. Solenoid Valves

a. Valves shall be selected to incorporate body construction, trim materials, and internal arrangements suitable to the application. Solenoid enclosures shall be housed in weather tight; NEMA approved enclosures in accordance with Section 260000 Electrical-Mechanical Equipment. Solenoid coils shall be Class H (High Temperature/Heavy Duty) construction and shall be suitable for continuous duty.
b. Solenoid valves shall be rated for 8.6 barg (125 psig) air supply pressure.
c. Solenoid valves shall be the three-way type and four-way type depending upon application, with trip reset and manual operators for auto-controlled valves.

F. Level Gauges

1. Reflex glass or magnetic level gauges will be used. Level gauges for high pressure service will have suitable personnel protection. Gauge glasses used in conjunction with lev-

el instruments will cover a range that includes the highest and lowest trip/alarm set points.

G. Gauge Glasses

1. A protected liquid level gauge glass shall be provided with necessary gauge valves as required. The visible section of the gauge glass shall span the full operational range with an additional 38mm (1.5") above and below the highest and lowest range levels.

H. Pressure Gauges

1. Pressure gauges shall be white background with black text. Normal operating pressure should fall within 30 – 70% of the gauge span.
2. Ashcroft type 1279 pressure gauges or equal shall be supplied for visual monitoring of gas pressures. All pressure gauges shall be 115 mm (4-1/2") in size, and liquid filled with Phenolic cases.
3. The gauges shall be isolated from the line by a root valve and rear blowout type.

I. Level Switches

1. All Level switches shall be isolated by flanged ball valves. The liquid level switches shall be rated so that the internal floats will float in fluids with a specific gravity of 0.500 or higher.
2. Switches and electrical shall be furnished with explosion proof housings. Switch contacts will have a dual form "C" configuration.
3. Type: External cage displacer
4. Switches: 5A@125 VDC or 24 VDC

J. Automatic Liquid Level Controllers and Drain Valves

1. Where liquid accumulation is expected to be frequent, the drains system for each vessel shall include one externally caged differential gap liquid level controller complete with flanged isolating ball valves, and one (1) pneumatically actuated 25 mm (1") automatic drain valves (fail closed), globe type, RF flange ends with 25 mm (1") SW ends isolating ball valves and 25 mm (1") SW ends globe bypass valve. The drain valve will use air for actuation. Control valves shall be supplied with actuators, positioners, regulators, and other accessories to provide an operable system.

K. Temperature Gauges

1. Temperature gauges shall have at least 1% accuracy.
2. Ashcroft type 50EL42E or equivalent with 5 inch dials and every-angle stems shall be used. The normal operating temperature shall be at least 50% of the full scale.
3. All temperature gauges shall use thermowells appropriately sized for design conditions.

L. Instrumentation Tubing and Valves

1. All gages shall be provided with isolation valves. All instrumentation fittings are to be Swagelok. Instrument valves shall be stainless steel ball, needle, or globe as required.
2. Instrument tubing shall be 12mm (0.5") O.D. stainless steel. Tubing is to be properly supported at no less than 1 m (3 ft) intervals and shall not support weight of valves and

instruments. Sensing lines shall be sloped downward toward the process a minimum of 2%.

3. All gas or vapor process connections to instruments shall have 6" long drip legs with drain valves at the instrument connection point to permit the periodic drainage of accumulated condensation.
4. All instrumentation capable of being read directly shall be mounted such that they are visible during normal operation of equipment. Where instrumentation is located in areas that may not be occupied during operation of equipment, provisions shall be made for the reading of instruments in those locations by means of remote indication. Examples of instruments that require observation but are not accessible during equipment operation may include jacking oil filter differential pressure within the generator enclosure and compressor oil level in the chiller module.
5. For GTG scope, All tubing and piping shall be adequately supported with sufficient separation/clearance to prevent rubbing or chafing. Tubing shall be seamless stainless steel per ASTM A269.

2.4 ELECTRICAL

A. General

1. All electrical components shall meet appropriate requirements for hazardous classified locations. Wiring shall run through conduit suitable for hazardous area classification given on the attached data sheet.
2. The complete electrical installation of the scrubber skid shall comply with the requirements of the National Electrical Code.
3. All the electrical devices shall be wired and connected in the Contractor's factory as much as possible. All wiring, which requires connections external to the skid, shall be brought out to a junction box with terminal boards or directly connected to the devices. The junction box shall be located at the edge of the skid base.
4. All terminals in the junction box shall be identified and wiring shall be run in rigid steel conduit. Terminal boxes on all electrical devices pull boxes, and other conduit fittings shall be watertight and all conduit threads shall be sealed. Conduit shall be adequately supported. All conduit shall be RGS and all cut threads shall be touched up / re-coated to prevent oxidation.
5. See Section 260000 Electrical Mechanical Equipment for specific requirements of supplied electrical equipment.

B. Generator Rating

a. Electrical generators shall be capable of delivering rated load at any set voltage within plus or minus 5% of the nominal voltage. The minimum generator MW rating is specified in 480020 Site Conditions.
b. Electrical generators shall be fully capable of operation within the power factor range specified in 480020 Site Conditions under all conditions without limitation by any device such as the under excitation limiter or over excitation limiter. The only allowable exception to this is due to coordination with steady-state stability limits in which case calculations shall be provided by the Contractor to show that is required.

c. Electrical generators shall be capable of sustaining 130% of rated armature current for one minute and 125% of rated field current for one minute without damaging the unit.
d. Electrical generators shall be able to withstand a 20% overspeed for one minute without damage to itself and shall be braced for full short circuit 3 phase fault at terminals for ten seconds, according to IEEE C50.13, latest revision.
e. Electrical generators shall be capable of synchronizing and parallel operation without excessive harmonic and circulating currents. The Contractor shall submit maximum levels for these currents.
f. Electrical generators shall comply with the following IEEE standards:

1) C50.10 General Requirements for Synchronous Machines
2) C50.13 Requirements for Cylindrical Rotor Synchronous Generators
3) C50.14 Gas Turbine Driven Cylindrical Rotor Synchronous Generators

C. Grounding

1. Two ground cable connector pads shall be supplied and mounted on opposite corners of the base of every skid supplied, refer to Contractor's earthing and bonding drawing for GTG scope.

2.5 CIVIL AND STRUCTURAL (refer to installation footprint drawing 969224 for GTG scope)

A. General: The Contractor shall specify all foundation requirements including normal, wind, seismic, and transient loads for major equipment and accessories (e.g., size and number of anchor bolts, grouting requirements).

B. Platforms and Stairs

1. Platforms and caged ladder(s) shall be furnished to provide adequate access for maintenance of the inlet air filter system. All permanent platforms, ladders and handrails shall be in full compliance with OSHA standards. Handrails and guardrails shall be three-rail with toe plates. The location of ladder(s) shall be coordinated with the General Manager to avoid possible interferences.
2. Where space permits, platforms shall be a minimum of 3' - 0" wide and overhead clearance for personnel shall be a minimum of 7' - 0". In any case, platforms are to meet OSHA and CalOSHA standards.

C. All structural and miscellaneous steel design shall be in accordance with the requirements of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

1. If, by calculation, shear lugs are required to transfer shear loads from a column to the foundation, the Contractor shall provide shear lugs welded to the bottom of the baseplate.
2. Full provision shall be made so that each component can expand and contract under the operating cycle of temperatures without damage. Expansion joints, guides, braces, stiffeners, etc. shall be provided as required so thermal movement can be accommodated in a conservative manner without deleterious side effects.
3. All structural components shall be stiffened and braced to prevent detrimental distortion, deformation or excessive vibration. Stress analysis shall consider the most severe load combinations.

4. Structures, equipment, buildings, acoustical enclosures and the top surface of horizontal ducts shall be designed so that the surfaces are self-draining.
5. Shop connections shall be either welded or high strength bolted. Size, location, and type of field welds shall be identified on appropriate drawings.
6. All structural joints using high-strength steel bolts shall be slip-critical connections when required by AISC. All bearing connections shall be designed with threads in the shear plane.
7. All structural steel welding shall be in accordance with AWS D1.1

D. Loads: Equipment shall be designed structurally for the following load conditions:

1. Dead Loads (DL): Dead load shall consist of the weight of all permanent construction including, but not limited to, fixed equipment, framing, piping, floors, walls, roofs, partitions, insulation, stair, handrail, ductwork, siding, cable trays and other structures and the contents of all tanks. However, the contents shall not be considered in resisting column uplift loads.
2. Live Loads (LL): Live loads shall be considered as loading not permanently fixed to the structure and occurring over areas not occupied by equipment.
3. Equipment laydown loads shall be considered as live loads. However, no live load reduction will be permitted in areas where laydown loads are considered.
4. Wind Loads (WL): Wind pressure and shape factors to be applied to all outdoor system components and exposed equipment shall be determined in accordance with the governing building code(s).

    a. Allowance shall not be made for the effect of shielding by other non-Contractor supplied plant structures within the plant site.
    b. The overturning moment calculated from wind pressure shall not exceed two-thirds of the dead load resisting moment.
    c. The uplift forces calculated from the wind pressure shall not exceed two-thirds of the resisting dead loads.
    d. For determining stresses, all vertical design loads, except roof live loads and crane loads (both vertical and horizontal), shall be considered to be acting simultaneously with the wind pressure.

5. Seismic Loads (SL): Seismic and snow loads shall be applied to all system components as applicable in accordance with the governing building code(s). No credit for friction shall be taken in designing anchor systems to resist lateral loads.
6. Thermal Loads (TL): All components and equipment shall be designed with due consideration to the forces due to contraction or expansion resulting from temperature changes, shrinkage, moisture changes, creep in components materials, or combinations thereof.
7. Load Combinations: Most severe of the following load combinations shall be used in the design of buildings and structures excepting reinforced concrete structures.

    a. Dead plus Live Loads
    b. Dead plus Wind or Seismic Loads (with appropriate load reductions)
    c. Dead plus Live plus Wind or Seismic Loads (with appropriate load reductions)

8. Deflection Limits: In general, member deflections shall be limited to ensure good structural performance. Deflection of primary structural framing members, including beams supporting platforms and other working surfaces, shall not exceed 1/240 of their span. Deflection of secondary member shall not exceed 1/180 of their span.

E. Materials: All materials shall be new and provided in accordance with the material standards listed in this Section. Structural steel members shall be blast cleaned and primed in accordance with Contractor's paint specification for GTG scope.

1. The following materials shall be used for structural steel members unless prior authorization is approved by the General Manager.

a. Structural Steel: ASTM A36 or ASTM A572 Gr. 50
b. Ladder(s): ASTM A36
c. High Strength Steel: ASTM A572, Gr. 50
d. Structural Tubing: ASTM A500 Gr. B
e. High Strength Bolts ASTM A325, Type 1
f. High Strength Nuts/Washers: ASTM A563 Gr. DH/ASTM F436
g. Common Bolts: ASTM A307 Gr. B
h. Pipe Handrail: 1 1/2 in. Schedule 40, ASTM A53 Type E or Type S, Gr. B or ASTM A500 Gr. B
i. Safety Chain, 1/4 in. diameter with 1 1/4 in. links: ASTM A413, Class PC.
j. Steel Floor Grating and Stair Treads: ASTM A569
k. Checkered Floor Plate ASTM A786, Pattern No. 4
l. Miscellaneous Structural Catwalk and Stair Tower: Steel shall be hot-dipped galvanized excluding the internal SCR catalyst access platforms and ladders

2. High Strength Bolting:

a. Obtain and submit certifications that bolts, nuts, and washers comply with all of appropriate requirements of applicable specifications. Provide complete manufacturer's test reports to document that the chemical and mechanical requirements of applicable specifications are achieved. For acceptance of fasteners, lot numbers must appear on product containers and correspond to lot identification numbers on test reports. Verify manufacturer's symbol and grade markings appear on all bolts and nuts.
b. Complete and submit representative sample tests for bolt tightening per AISC Specification for Structural Joints for approval prior to installing any bolts.
c. High-strength bolting inspections, tests, test and inspection acceptance standards, and remedial procedures for slip-critical type connections: AISC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," except as specified herein.
d. Randomly inspect 10% of all high strength bolted slip-critical type connections for each bolt size as follows:

1) Inspect bolts tightened using the turn of the nut method: Specification 9(b) of AISC Specification for Structural Joints.
2) Bolts tightened using direct tension indicator washers: Feeler gauge to acceptance requirements in ASTM F959.

e. Method of sampling for high-strength bolts: "Production Lot Method", ASTM A 325.

2.6 FABRICATION

A. Shop Assembly

1. Skid mounted systems shall be fully assembled for functional checks in the Contractor's facility prior to shipment. Skids may be partially disassembled if necessary for shipment.

B. Shop/Factory Finishing

1. Cleaning

a. Surfaces of the base shall be cleaned of all scale, rust, grease and other foreign matter. Contractor supplied pre-painted items; stainless steel tubing and any other non-carbon steel items shall be solvent cleaned.

2. Painting

a. After cleaning, the base and the exposed non-stainless steel piping shall be painted. Prior to shipment of skid mounted systems, the entire skid including the base, exposed piping, pre-painted Contractor items, tubing and all other non-stainless steel items shall be painted.
b. Color scheme for painting will be specified by the Contractor and applied per Contractor's standard procedures.
c. Structural and Miscellaneous Carbon Steel

1) The following requirements shall apply for all exposed structural and miscellaneous carbon steel shapes, plates, stiffening or support elements extending through insulation that are not hot-dipped galvanized.
2) Surfaces shall only be primed. General Manager will apply the finish paint. Surfaces to be primed shall be blast cleaned in accordance with Contractor's paint specification for GTG scope.
3) One of the following painting systems, or Contractor approved equivalent, shall be used:
   a) Ameron Dimecote 9HS
   b) Carboline Carbo Zinc 11HS
   c) Tnemec Co., Inc 90E-92 Treme-Zinc
   d) USC Ameron PSX700 or Contractor Standard.

3. Cleanliness and Workmanship:

a. All parts, components and assemblies shall be thoroughly cleaned prior to and after assembly and test, including removal of all loose, spattered or excess soldering or welding materials, burrs and sharp edges. All openings are to be securely covered against entry of foreign material after cleaning.
b. All hydrocarbon based preservatives and/or compounds must be flushed out of the vessel prior to hydro testing.
c. Hydro testing shall be performed with demineralized water containing non-hydrocarbon based corrosion inhibitor.
d. At the completion of the hydro testing, the vessel shall be drained and internally air-dried with 200^{o}F fan forced dry hot air for a minimum of 4 hours and then protected by the application of a corrosion inhibitor.

2.7 SOURCE QUALITY CONTROL

GE Aero is ISO 9001:2008 certified facility. The Quality Management system is applicable to design, manufacturing, factory repair/refurbishment, and project management of installation and commissioning of Aeroderivative gas turbine generators.

Contractor shall supply the GTG equipment in accordance with its Quality Procedures.

A. Tests and Inspections

1. Inspection and testing shall be in accordance with the codes specified.
2. Instruments shall be protected during hydro testing.
3. Wiring shall be checked for continuity and insulation integrity.
4. Control system IO shall be loop checked.
5. Filters shall be removed for hydro test of filter housing.
6. Full information describing the tests which are included in the bid price shall be included with the Proposal.
7. Certified copies of all the minimum test results detailed below and identified in equipment specific Sections shall be submitted for acceptance before shipment of the equipment is made.
8. As a minimum, the following tests shall be performed:

    a. Hydro Test in accordance with the requirements of the ASME Boiler Pressure Vessel Code, Section VIII, Division I or ASME B 31.1
    b. Electrical Wiring Check-Out
    c. Equipment Performance Test

9. All tests required by regulatory agencies shall be witnessed by an Agency Inspector unless specifically waived, in writing, by the Agency. All items tested for regulatory compliance shall be pre-tested prior to scheduling the Agency Inspector.

B. Verification of Performance

1. Certified copies of test results shall be submitted for acceptance before shipment of the equipment is made.
2. Copies of the ASME U-1 reports, test, and inspection results shall be furnished to the General Manager.

C. Contractor shall give General Manager at least three weeks prior notice in writing of the date on and the place at which any Works shall be ready for inspection and testing.

D. The General Manager shall have the right to reject equipment or equipment components if found not to conform to the specifications.

E. The Contractor shall establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The Contractor shall cooperate with, and assist as necessary, the General Manager’s inspectors and provide reasonable access to the Contractor's facilities to observe tests and make inspections in accordance with the Contract.

F. Weld inspection, examination and testing

1. Personnel performing or supervising the visual examination of welds, including ASME Boiler and Pressure Vessel equipment, shall be qualified or Certified Welding Inspectors in accordance with the American Welding Society, AWS QC-1.
2. All welds shall receive 100% visual examination in accordance with AWS Dl.1 or ASME codes. Records of these examinations shall be created and documented.
3. General Manager will provide the services of an independent testing laboratory for field nondestructive examination. Any defective shop weld shall be removed, re-welded, and retested at Contractor's expense.
4. Nondestructive examination procedures shall be submitted. All nondestructive examinations shall be documented in accordance with the applicable code.

G. Instrument Calibration

1. Calibration reports shall be provided for any and all instruments furnished as part of the equipment listed in these specifications. It is recommended that the Contractor be especially mindful of this requirement.
2. Calibration reports shall be provided by the Contractor for instrumentation calibrated by the Contractor at the Contractor's works, instrumentation that is purchased by the Contractor "factory calibrated" from an instrumentation manufacturer and instrumentation supplied as part of a packaged skid purchased by the Contractor from a third party. In any case where instrument calibration reports are not available for any equipment listed in these specifications, Contractor shall, at own expense, perform field calibration and provide a field calibration report to satisfy this requirement.
3. Performance of such field calibration of instruments shall not void any equipment warranty.

H. The Contractor shall prepare a test report for each shop test. The test report shall indicate as a minimum, actual measured values, required values, manufacturer's accepted values (where requirements are not specifically identified as part of these specifications), what procedure was used to perform the test, the date of the test and personnel who performed and witnessed the test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Painting (Contractor's standard painting system for GTG shall be provided)

1. Structural and Miscellaneous Carbon Steel

a. The following requirements shall apply for all exposed structural and miscellaneous carbon steel shapes, plates, stiffening or support elements extending through insulation that are not hot-dipped galvanized.
b. Surfaces shall only be primed. General Manager will apply the finish paint. Surfaces to be primed shall be blast cleaned in accordance with SSPC-SP6, "Commercial Blast Cleaning."

c. One of the following painting systems, or General Manager approved equivalent, shall be used:

1) Ameron Dimecote 9HS
2) Carboline Carbo Zinc 11HS
3) Tnemec Co., Inc 90E-92 Treme-Zinc

d. All painting for STG will be in accordance with manufacturer's standard painting procedure.
e. All painting for Air Compressor, Inlet Chiller, Gas Compressor and CEMS will be in accordance with manufacturer's standards panting procedure.
f. OTSG will be prime painted only.

3.2 FIELD QUALITY CONTROL

A. Field Testing

1. The field testing scope of the combined cycle plant comprises two major components; individual equipment commissioning and plant performance testing. Individual equipment commissioning requirements are described in this Section and the respective equipment specifications. Plant performance testing requirements are described in Section 480032 Power Island Performance.
2. The Power Island Equipment Contractor (Contractor) shall be responsible for successfully completing the individual equipment commissioning to the satisfaction of the General Manager. The Contractor will be performing these duties under the direction and supervision of General Manager's BOP Contractor, who shall have ultimate responsibility for scheduling, coordinating and supervising individual equipment commissioning as well as plant performance testing.
3. The BOP Contractor shall also be responsible for collecting and organizing test documentation for submittal to General Manager. Contractor shall be responsible for validating all equipment commissioning and plant performance test results data against the requirements of the specifications and verifying that the performance criteria were met prior to furnishing test data to the BOP Contractor.
4. Contractor shall cooperate fully with the BOP Contractor in the performance of testing responsibilities, which includes but is not limited to prompt and responsive scheduling of field technicians, making available manufacturers' factory technical agents for trouble-shooting assistance, finalizing and furnishing test records and general support of BOP Contractor in all aspects as needed to facilitate testing.

B. Field Acceptance Tests

1. In the event that the plant does not meet performance guarantees, Contractor to test individual plant components as required to locate the deficient equipment.
2. The entire expense of the field tests required indicating the effect of such deficiencies and remedial alteration and modifications shall be borne by the Contractor. The "entire expense" shall be interpreted as all expenses incurred during the field testing other than the normal operating staff of the General Manager.
3. The Contractor shall prepare a certified test report for each field test. The test report shall indicate as a minimum, actual measured values, required values, manufacturer's accepted values (where requirements are not specifically identified as part of these specifications),

what procedure was used to perform the test, the date of the test and personnel who performed and witnessed the test.

4. Certified copies of test results shall be submitted for acceptance before field testing is considered complete.

C. Performance Tests

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Contractor shall accommodate this objective in the design of their equipment and Contractor shall furnish any and all transmitting instrumentation required to observe and record the process conditions listed in the attached datasheets.
2. Performance testing instruments shall be furnished regardless of whether or not they are required by Contractor's control system for ordinary equipment operation. These instruments shall be furnished and calibrated in accordance with the requirements listed in this Section.
3. The performance data sheets shall then be completed and submitted as part of the plant performance testing described in Section 480032, Power Island Performance Testing.
4. Plant performance testing shall only be performed following successful completion of all individual equipment and unit system commissioning.

3.3 COMMISSIONING

A. Refer to 480032 Power Island Performance for Power Island commissioning and performance test requirements.

3.4 TRAINING

A. Operation and maintenance training shall be provided during 3 different shifts for up to 25 end user operation and maintenance personnel (not including travel and accommodations) and shall include the following topics:

1. Minor mechanical and electrical maintenance
2. Controls and instrumentation
3. Specialist training

B. The training program shall be appropriate for the end user's staff including Engineers, Supervisors, Operators, and Technicians.

C. The training program shall be conducted at the General Manager's facility unless there is a need to visit equipment at the manufacturer's facility or an operating site with similar equipment.

D. Training for particular equipment shall be based on the site specific Operations and Maintenance manuals provided by the Contractor.

3.5 SPARE PARTS

A. Contractor shall furnish with the equipment a set of spare parts and consumables required for startup and commissioning.

3.6 REPAIR AND MAINTENANCE PROGRAM PRICING refer to Attachment 16 in the Contract

APPENDIX A – CONTRACTOR DATA REQUIREMENTS Refer to Attachment 11 -Drawing Schedule

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485122.11

Steam Bypass Valves

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 485122.11
Steam Bypass Valves

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/31/2011	T. Clark	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
05/04/2012	T. Clark	D
09/10/2013		E – CONTRACT VERSION

SECTION 485122.11
STEAM BYPASS VALVES

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 5
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.11 SITE CONDITIONS 5
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS 5
2.2 EQUIPMENT 6
2.3 COMPONENTS 7
2.4 INSTRUMENTATION 11
2.5 FABRICATION 12
2.6 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 13

3.1 SPARE PARTS 13
3.2 FIELD QUALITY CONTROL 14
3.3 COMMISSIONING 14

APPENDIX A – VALVE DATA SHEETS 15

SECTION 485122.11
STEAM BYPASS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimal technical requirements for the design, manufacture, testing, and furnishing of steam bypass control valves, actuators, and instrumentation. It is not the intent to specify completely herein, all details of design and construction of the equipment/systems. However, the equipment/system shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Steam turbine bypass to condenser with steam conditioning equipment
2. Feedwater control valves for desuperheating
3. Automated valve heating arrangements for bypass valve bodies
4. Special tools required for maintenance and adjustments of the valves, actuators, and accessories.
5. One set of blow through kits per valve with the base valve order to support the valve-commissioning program.
6. Hydro kit for each bypass valve type and size
7. Shop testing and inspection of the fully assembled valves
8. Cleaning and shop painting of all valves, actuators, and accessories
9. Drawings and design data to support facility design, construction and maintenance
10. Inspection certificates and quality control documentation listed in this Section
11. Complete set of component cut sheets
12. Operating, commissioning, installation and maintenance manuals for the supplied equipment
13. Priced list of recommended spare parts for two years of operation
14. Valve trim sets shall be shipped separately.
15. Packing and shipment FOB to the Glenarm Power Plant jobsite or alternate location to be identified by the General Manager in the city of Pasadena, CA or other nearby city.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be include the following:

1. Receipt, off-loading, storage, protection of equipment at General Manager's designated delivery point, and erection of equipment at the plant site
2. Installation, commissioning, and field performance testing
3. Hydrotesting of steam lines and steam blowout operation. Install the final trim and commission the valves under the supervision of the steam bypass valve supplier
4. Plant control system (PCS) configuration and graphics programming
5. Instrumentation and controls wiring
6. Quick opening steam isolation block valves at the upstream of steam bypass valve
7. Pipe insulation
8. Steam bypass piping to and from surface condenser and once-through steam generator (OTSG).

1.4 RELATED SECTIONS

A. Section 480020 - Site Conditions

B. Section 480031 - Combined Cycle Power Island Noise Control Performance

C. Section 480032 - Power Island Performance

D. Section 481100 - Combined Cycle Power Island

E. Section 485221 - Steam Turbine and TEWAC Generator

F. Section 485413 - Once-Through Steam Generator

G. Section 485432 - Steam Surface Condenser

1.5 CODES AND STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American National Standards Institute (ANSI/ISA)

a. ANSI FCI 70-2 – Control Valve Seat Leakage
b. ANSI/ISA-77.13.01- Fossil Fuel Power Plant Steam Turbine Bypass System

2. American Society of Mechanical Engineers (ASME)

a. ASME B31.1 – Power Piping
b. ASME Boiler and Pressure Vessel Code – Section VIII
c. ASME PTC-36- Measurement of Industrial Sound

3. International Electrotechnical Commission (IEC)

a. IEC 60534-8-3 - Control Valve Standard, Part 8: Noise Considerations - Section 3: Control Valve Aerodynamic Noise prediction Method (1995).

4. Instrumentation, Systems, and Automation Society (ISA)

a. ISA-75.01 Through ISA-75.25 - Control Valves

5. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)

a. MSS SP-61 – Pressure Testing of Steel Valves

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Each bypass valve shall fulfill the following requirements:

a. Control the pressure of the main steam header during unit startup.
b. Control the pressure of the main steam bypassing the turbine.
c. Control the flow and temperature (flow and temperature limits set by condenser sparger) of the steam dumped into the condenser.
d. During transient operation, help prevent lifting of OTSG safety valves while operating within the limits of the bypass system.
e. The Contractor shall supply and coordinate the sizing of integral steam conditioning valve (desuperheater, coordinated spray water control valve, and spray water block valve) to function together and also to achieve a full range of coordinated operating parameters of pressure, temperature and flow. The spray water shall be introduced after pressure reduction stage.

2. Characteristics:

a. The bypass control valves supplied shall be suitable for outdoor installation and service under the conditions described in Section 480020 Site Conditions.

b. The design, construction and choice of materials shall be suitable to resist mechanical, thermal and fluid induced wear and shall take into account all operational deviations including pressure surge and thermal shock.

3. When the bypass is not in the operation, piping downstream of the bypass valve will be under vacuum. Bidder shall give their recommendations for stem vacuum sealing.

B. Performance Requirements

1. Steam is produced in a single pressure OTSG by gas turbine exhaust heat recovery and will flow from the superheater steam outlet lines through the main steam header to the turbine stop valve.
2. The steam turbine bypass systems will be designed to accommodate the steam generated in the OTSG during startup of the gas turbine before steam turbine admission, and the steam generated following a steam turbine trip. The bypass system shall be sized to allow continuous full-load operation of the OTSG with 100% gas turbine load heat input.
3. Startup Operation:

a. After establishing the gland steam, the vacuum pumps will be put into service and the bypass valves will be set at 1.72-3.44 barg (25-50 psig) higher than header pressure. The steam header pressure is measured and compared to a setpoint; this difference is used to regulate the bypass control valves. The steam pressure set point is limited within the minimum and maximum value and ramped smoothly. The bypass valve(s) are not permitted to open if the desuperheater spray water pressure is insufficient or if the block valve is not fully open. With bypass operation and steam dumping in the condenser, the steam parameters in the system are ramped up in a controlled manner.

4. Abnormal Operation:

a. In the event the steam turbine or generator trips when the plant is at full base load, the steam turbine trip signal will send a quick opening signal to the bypass valves to open to a preset value and then will go into a modulation mode to regulate the quantity of steam dumped to the condenser. Any excess steam not handled by the bypass system will escape through OTSG safety valves. It is preferable not to lift safety valves during upset conditions.
b. Control system will override bypass demand and close the control and attemperation block valve in the event of condenser pressure high, condenser temperature high, hotwell very high or attemperation spray water pressure low. The condenser pressure high trip set point during a steam turbine coast down will be automatically adjusted per Manufacture's recommendation based upon turbine speed.
c. The bypass system shall be intended to provide for cold startup, warm start, hot restart, load rejection and unit trips. The bypass valves shall provide a means of controlling the pressure, temperature and flow of steam around and through the turbine.

5. Noise and Sound Control Requirements

a. The noise levels and controls shall meet the requirements of Section 480031, Combined Cycle Power Island Noise Control Performance.

C. Reliability: Bidder shall provide control valves that are suitable for daily cycling and a long service life of 30 years. The expected wear life of expendable, consumable and wear parts shall be consistent with good design practice for the particular service and fluid handled.

D. System Improvement

1. Bidder may provide design enhancements to maximize equipment service life in cycling and peaking plant applications with the proposal and highlighted in the bid documents.
2. Bidder can provide recommendations for the improvement in system design, such as thermal heat tracing to avoid thermal shock, design to avoid water hammer in the downstream lines, any material upgrades etc.

1.8 SUBMITTALS REFER TO ATTACHMENT 11 – DRAWING SCHEDULE

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general Packaging, Delivery, Storage, and Handling requirements.

1.11 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Valve body materials shall generally be one of the following specifications:

Carbon Steel (Spray Attemperation Block Valve)	Cast	ASTM A216 Grade WCB
	Forged	ASTM A105
Chrome-Moly Steel (Steam Bypass Valve and Attemperation Spray Control valves)	Cast	ASTM A 216 Gr WCB
	Forged	ASTM A105

B. All materials shall be in accordance with the latest ASTM standards or materials listed in ASME B31.1.

C. All castings shall meet the requirements of MSS-SP-55 internally and externally after machining.

D. All control valves shall have stems, guide bushings, cages, plugs, seat rings, stem lock, pins, stuffing box parts, and other trim, all made of stainless steel. Valve plugs, guides, cages, and seat rings shall be hardened materials for valves where required for proper operation.

E. Welding for all components and repair welding for all weld defects shall be in accordance with the requirements of ASME B31.1, ASME BPVC Section I (as applicable).

2.2 EQUIPMENT

A. The Steam Bypass Valve shall fulfill the following requirements:

1. Control the pressure of the main steam header during unit startup.
2. Control the pressure and temperature of the main steam bypassing to condenser
3. During transient operation, to help prevent lifting of OTSG safety valves while operating within the limits of the bypass system.
4. The valve supplier shall coordinate the sizing of integral desuperheater, spray water control valve and spray water block valve to function together and also to achieve a full range of coordinated operating parameters of pressure, temperature and flow. The spray water shall be introduced in the turbulent zone at the discharge of the pressure reduction stage.
5. The Steam Bypass Valve shall be provided with an automated valve heating arrangement, with a temperature control valve to modulate the steam flows and to reduce the energy losses.
6. The Steam Bypass Valve shall be CCI Drag, Fisher TBX, or equivalent valve with integral desuperheater

    a. Block type shutoff per class V.
    b. Performance as per process conditions defined by the Contractor
    c. Design conditions as defined in by the Contractor
    d. Minimum Turndown to 10:1 based on rated Cv

7. Bidder shall furnish guidelines for the bypass valve location with respect to straight lengths, temperature and pressure tap points for proper functioning of the bypass valve.

2.3 COMPONENTS

A. Attemperation Spray Water Valve:

1. ANSI Class V Leakage
2. Open/Close time of less than 4 seconds thru the positioner
3. Performance as per process conditions defined by the Contractor
4. Design conditions as defined by the Contractor
5. Continuous operation at turndown of 20:1 minimum based on Rated Cv to achieve the flows defined on process data sheets
6. Trim exit fluid velocity shall be limited to 75 ft/sec for cavitation, flashing and erosive application

B. Valve Construction Features

1. Valves shall have a mechanical means to indicate valve position.
2. The direction of flow shall be indicated on the valve body by a permanently attached stainless steel arrow, or with a marking that is cast or stamped into the valve body.
3. Plugs shall be removable from the top of the valve (toward the actuator).

C. Valve Sizing:

1. Globe type control valves used for modulating service shall be selected such that equal percentage control valves operate between 15% and 85%, and linear control valves operate between 10% and 90% of full open travel over the required control/modulating range of the system. In no case shall a control valve be selected for continuous operation below 10% of full open travel.
2. Each control valve shall be sized using the methods and equations described in the standard ISA-75.01. Each control valve shall be sized and selected, including trim and plug design, actuators, valve materials, and valve accessories to properly satisfy all operating and design conditions of each application as listed in the Data Sheets.
3. Pipeline sizes listed in the Data Sheets do not include reducers that may be required adjacent to the valve body.
4. The valve body size shall not be less than two pipe sizes smaller than the nominal inlet pipeline size, unless otherwise specified.
5. Shutoff leakage for each valve shall not exceed the appropriate leakage class as defined in ANSI/FCI 70-2 and as specified on the Data Sheets.

D. Valve Trim

1. Sliding Stem Type Bodies: Unless otherwise noted, trim shall include a seat ring that is held in place by a cage and the body bonnet in a “quick change” arrangement. Seat rings shall not be welded or threaded into the valve body. Plugs shall be guided by the cage directly or by heavy-duty stem guides. Diffusers in the valve shall not be welded to the valve body and should be removable from the top.
2. Trim type, characteristic, and materials shall be as required by the specified design conditions and as specified on the Data Sheets.
3. Where cavitation damage is predicted by an analysis of specified valve design conditions, special trim or other features shall be provided to eliminate the cavitation (by dividing the total pressure drop into a series of smaller drops) or to direct the location of the bubble collapse away from the body or trim surfaces. Use of harder valve body or trim materials

may be used in addition to the special trim, but such use of hard materials as the sole or primary means of cavitation protection is not acceptable. Sufficient number of discrete pressure drop stages shall be offered to maintain the trim exit velocity below 75 ft/sec for cavitation, flashing & erosive services

4. Noise reduction trim or other features as required shall be provided to meet the limits specified as listed on the attached Control Valve Data Sheets.
5. Valves susceptible to flashing at any point in the operational range of the valve shall be provided with suitable protection. As a minimum, this is to include the use of metal seats, but could require hardened trim materials, an angle-style valve body, or a more erosive resistant body material. Sufficient number of discrete pressure drop stages shall be offered to maintain the trim exit velocity below 75 ft/sec for cavitation, flashing & erosive services

E. Valve Bodies:

1. Valve body style and material shall be selected as appropriate for the intended service and provided under Section 481100, Combined Cycle Power Island Equipment.
2. Valve inlet and outlet sections shall be equipped with 1" socket weld connections and an automatic warming valve for warming purposes if required.

F. End Connections

1. Valve end connections shall be prepared and welded as appropriate for the intended service and provided under Section 481100, Combined Cycle Power Island Equipment unless end connection type is specified otherwise.
2. All welding connections for valves 2-1/2 inches and larger in nominal size shall be butt-welded. All welding connections for valves 2 inches and smaller in nominal size shall be socket welded. All welding ends shall be in accordance with ASME B16.34 and B16.25. Weld backing rings are not permitted and therefore, all butt-welded ends shall be machined according to ASME B16.25 Figure 2(a), 3(a), 4, 5, or 6 as appropriate.

G. End Extensions and Reducers:

1. If the size of a welded end valve is different than the field pipe size, the valve shall be furnished with shop welded concentric reducers matching the upstream and downstream pipe size, material and wall thickness.
2. Shop welded end extensions shall be provided for the turbine bypass valves with body material that is different than the field piping material (such as alloy valve bodies to be welded into carbon steel pipelines or vice versa) or for valves with different end connection size than the piping.
3. End extensions shall be a pipe section at least 6 inches long.
4. End extensions and reducers shall be factory installed on the valve body and stress relieved in accordance with ASME B31.1. End extensions and reducers shall be shown on the valve drawing and included in the shop end-to-end or center-to-face dimensions.

H. Valve Actuators

1. All control valves shall be furnished with the type of actuator shown on the Data Sheets.
2. Valve actuators with valve action "fail open" or "fail closed", shall be provided with a mechanical spring or a trip valve and volume tank to fully open or close the valve as ap-

plicable on loss of air pressure. Steam valves include pneumatic piston actuators. 'Fail position' is achieved using volume tank and not using springs.

3. Valve actuators and stems shall be adequate to maintain desired process control at 110 percent of the unbalanced forces occurring under the normal operating flow conditions. The valve manufacturer shall include this factor in their calculations when selecting an actuator. Actuators shall be designed to function with instrument air pressure ranging from 60 to 125 psig. All actuator tubing shall be a minimum of 3/8" AISI 316 stainless steel. Tubing fittings shall be Swagelok compression type.
4. HART smart valve positioners shall cause the control valves to operate over their full stroke by means of a HART 4-20mA signal. Pneumatic actuators and drive units shall automatically return to the rest position upon loss of 4-20 mA signal and/or air supply failure unless "process control" or the Technical Specification requirements dictate for "fail fixed" response. The primary HART variable shall be valve position.
5. Actuators shall be sized for at least 1.5 times the breakout torque required to open and close the valve based on the specified operating conditions.

I. Pneumatic Actuators:

1. Pneumatic actuators shall cause the valve or driven unit to operate over its full stroke, from a 3.0 to 15 psig signal by means of any of the following:

   a. Electronic signal to electro pneumatic converter.
   b. Electrical signal to solenoid pilot valve.

2. Pneumatic actuators and drive units shall automatically return to the rest position upon signal and/or air supply failure unless "process control" or the Technical Specification requirements dictate for "fail fixed" response.
3. Where "lock up" devices are provided on those services requiring the actuator to remain in the position prevailing immediately before an operating medium failure ("fail fixed"), the following two methods of "freezing" are acceptable:

   a. The pneumatic system may be locked, but equipment used for this purpose shall always be installed between a positioner output and an actuator input.
   b. The final regulator may be locked by mechanical means upon receipt of a falling supply pressure signal.

4. Lock-up pneumatic relays shall be set to trip at a supply air pressure of 60 psig.
5. The lock-up actuator shall permit a maximum valve position movement of no more than 5% when the pressure difference across the valve is at the maximum value specified.
6. All pneumatic control equipment, control drives and control valves, shall be capable of satisfactory operating on a main air supply pressure of approximately 125 psig normal down to 80 psig minimum.
7. Actuators shall be sized for at least 1.5 times the breakout torque required to open and close the valve based on the specified operating conditions.

J. Solenoid Operated Valves:

1. Solenoid operated valves shall be designed for full solenoid operation. All units shall be provided with supplementary manual operating means if specified in the data sheet, to ensure that systems can be made safe in the event of failure of the normal driving source

of the solenoid. A manual retaining catch shall be included with electrical interlocking where required to ensure that the solenoid is not energized until the valve is hand reset.

2. All valves shall be supplied with an adjustable permanent "lock off" where the application requires this feature.
3. For high ambient temperature and units operating on hot fluids, adequate external insulation against heat shall be provided. In addition a heat insulating barrier shall be fitted between the valve and solenoid section. Solenoids shall be continuously rated and insulated with at least Class "B" insulation in a totally enclosed dustproof enclosure and of waterproof construction where necessary, i.e. same class as for electric actuators.
4. The units shall be provided with additional contacts at OPEN or CLOSE positions for electrical interlocking or remote indication purposes where required.
5. All electrical terminals shall be adequately insulated and shrouded and shall be of size not less than 0.25 inch unless otherwise approved. Set or pinch type screws shall not be used. All terminals shall be provided with lock washers or lock nuts.
6. All contacts shall be form “C”, snap acting. They shall be easily removable.

K. Valve Types:

1. Globe Control Valves, Cage Type Trim:

   a. The cage and plug shall be hard stainless steel as a standard. Coefficients of thermal expansion for cage and plug shall be similar, so that required clearances are maintained over the range of operating temperatures.
   b. Reduced trim for one nominal size smaller than valve body size shall be available as a standard option.

2. Globe Control Valves, Conventional Plug and Seat Rings:

   a. A linear characteristic shall be provided when the pressure drop across the control valve under all operating conditions is more than 2/3 of the pressure drop across the valve in the closed position. Unless otherwise approved, an equal percentage characteristic shall be provided for all other cases.
   b. Plug and seat rings shall be hard stainless steel or stellite as standard.
   c. Hardened guide material may be 350 BHN minimum, with a differential hardness not less than 125 BHN between sliding metal surfaces.
   d. The bonnet and bottom flange, where supplied, shall be interchangeable so as to permit reversal of the valve action without additional parts or alterations.

L. Control Valve Accessories

1. Travel Stop

   a. Travel stops shall be top mounted screw assembly with lock nut and cover, designed to limit the stem travel on loss of air pressure. Limit shall be manually adjustable using a wrench.

2. Manual Override Actuators

   a. Top Mounted Hand wheels can be used as an adjustable travel stop with handwheel and lock nut. Top mounted Hand wheels shall be arranged to move the

stem against the spring action and to limit the stem travel on loss of air pressure and shall be selected to limit operating forces to 80 pounds at the rim of the hand wheel.

b. Side Mounted Hand wheels shall be side mounted, with neutral position to allow normal automatic operation of the actuator. Hand wheels shall be capable of manually moving the valve fully in both directions against the spring, and limiting the travel of the actuator in at least one direction. Hand wheels shall be heavy duty with totally enclosed gearing, designed for frequent use and shall be selected to limit operating forces to 80 pounds at the rim of the handwheel.

c. Hydraulic Overrides shall be used, when the force requirements of the pneumatic actuator exceed the capabilities of side mounted hand wheels.

3. Volume Tanks

a. Volume tanks shall be designed to withstand a minimum pressure of 125 psig.

b. All volume tanks shall be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 (stamped UM).

M. Special Tools

1. Manufacturer shall provide one complete set of all special tools required for maintenance and adjustment of the valves and actuators.

2. Manufacturer shall provide the following items for each bypass valve type.

a. Hydro Trim Set

b. Blow Out Trim Set

N. Identification

1. Each valve is assigned a unique valve tag number and shall have a permanent stamped metal tag bearing the "Valve Tag Number" securely attached to the valve. Each valve shall be legibly marked in accordance with MSS SP-25. For the tag number to use, refer to the Control Valve Data Sheets. The tag number shall be punched or etched into the tag so that the tag number is recognizable even if the tag has been painted.

2. Each valve identification tag shall indicate the valve tag number, manufacturer's serial number, type, body material, seat material, bonnet material, pressure rating, and actuator air signal pressure range and bench set.

2.4 INSTRUMENTATION

A. Limit Switches

1. Limit switches shall be provided for remotely controlled on/off type valves and shall be factory mounted on the valves with provisions for adjusting the switch point.

B. Position Transmitters

1. Valve position transmitters for the turbine bypass valves shall be LVDT 2 wire type transmitters or General Manager approved alternative, as shown on the Data Sheets, factory mounted on the valve, and shall produce an electrical 4-20 mA dc signal in direct

relationship to the position of the control valve stem. Transmitters shall be provided with NEMA 4 or better enclosures.

2. Valve position feedback for the steam bypass valves and all the spray valves shall be obtained by utilizing the HART communicating protocol of the positioner in conjunction with a conditioning device (provided by others) to convert the HART signal to an analog output

C. Positioners

1. Positioners shall be electro-pneumatic type utilizing the HART communication protocol and shall be provided with pressure gauges for indicating the air supply, and control signal pressures. The input signal will be loop powered by General Manager's control system. Positioners shall be designed for a control signal input range of 4-20 mA, unless two control valves are required to be split-ranged, in which case the input ranges will be 4-12 and 12-20 mA and preset at the factory. Positioners shall provide an output signal from 0 psig to the full supply air pressure to the valve actuator. Positioners shall not be provided with bypasses.
2. Advanced Diagnostics functionality shall be provided for all control valves addressed in this specification as indicated in the data sheets.
3. All positioners shall be equipped with filter / regulator air supply sets factory mounted on the positioner or the valve yoke.

D. Solenoid Valves

1. Valves shall be selected to incorporate stainless steel body construction, with trim materials, and internal arrangements suitable to the application. Solenoid enclosures shall be NEMA 4 with 1/2-inch threaded conduit hub.
2. Solenoid valves shall be the three-way type and four-way type depending upon application, with trip reset and manual actuators, as required, for auto-controlled valves.

2.5 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

B. Shop/Factory Finishing:

1. All exterior surfaces of valves, operators, and accessories shall be thoroughly cleaned of mill scale, heat treating scale, heavy oxide, slag, flux, weld splatter, oil, grease, organic matter, dirt, or any other foreign materials by grit blasting or wire brushing.
2. Exterior surfaces of valves and accessories, with the exception of flanged surfaces and edges prepared for field welding for a distance of 1-½ inches from the welding edge, shall be given a shop coat of corrosion resistant primer. Manufacturers using a coating process that does not include a primer coat shall properly clean, chemically treat and prepare the exterior surfaces prior to the application of a corrosion and UV resistant paint.
3. All edges of valves prepared for field welding shall be protected against corrosion with a coat of rust inhibiting coating applied after inspection and cleaning.
4. External flanged surfaces of carbon steel and alloy steel valves shall be protected against corrosion with the application of a coat of water soluble, rust inhibiting coating.

5. Stainless steel valves shall not be painted or coated.
6. Exterior surfaces of operators and accessories shall be given a coat of corrosion resistant primer and a coat of Manufacturer's standard finish paint. Manufacturers using a coating process that does not include a primer coat shall properly clean, chemically treat and prepare the exterior surfaces prior to the application of a corrosion and UV resistant paint.

2.6 SOURCE QUALITY CONTROL

A. Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections

1. As a minimum, the following tests shall be performed:

a. Factory Hydrostatic Tests:

1) Valves and attemperators shall be subjected to a hydrostatic leak test meeting the requirements of ASME B&PV Code Section I, Section VIII, or ASME B31.1, Power Piping Code or the applicable Code or Standard to verify integrity of the pressure boundary. No leakage is acceptable through the pressure boundary wall or assembly joints.
2) Parts shall not be primed or painted until hydro testing is successfully completed.

b. Leakage Tests

1) Control valve leakage shall be tested in accordance with ANSI/FCI 70.2.
2) In all cases, maximum seat leakage requirements shall be met.

c. All cast valves used in systems designed to ASME B31.1 requiring radiographic examination of the piping shall have the weld ends radiographic inspected.
d. In addition to Contractor's standard shop tests and inspections, a hydrostatic test on the body and seat of each steel valve shall be performed in accordance with ASME B16.34.
e. Prior to shipment, the valves shall be completely assembled, wired, and functionally tested at Contractor's factory. The wiring shall be checked for proper connections and grounds.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for general requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements.

B. Performance Tests

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Refer to Section 481100 Combined Cycle Power Island for individual equipment baseline performance testing.
2. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.

3.3 COMMISSIONING

A. General

1. Refer to Section 480032, Power Island Performance for general commissioning requirements.

END OF SECTION 485122.11

APPENDIX A – VALVE DATA SHEETS
Data to be furnished during project execution

SECTION 485122.11
STEAM BYPASS VALVES

POWER ENGINEERS

PROJECT: Glenarm Repowering Project
MFR SERIAL#_____
MANUFACTURER: _____

DATA SHEET:
TAG:
Quantity: 1
DWG :
SERVICE: Main Steam Bypass Valve

1 FLUID : Main Steam — CRIT PRES PC _____

	SERVICE CONDITIONS	UNITS	MAX FLOW	NORM FLOW	MIN FLOW	SHUT OFF
2	INLET FLOW RATE (Steam)	lb/hr x 1000				
3	INLET PRESSURE (Steam)	psia				
4	OUTLET PRESSURE	psia				
5	INLET TEMP (Steam)	^{0}F				
6	SPEC WT/SPEC GRAV/MOL WT	MWt.				
	Required Temp/ Enthalpy at downstream of steam conditioning valve	BTU/lbm				
	Attemperation water flow	lbm/hr				
9	*REQUIRED Cv (Steam)					N/A

LINE

13 PIPE LINE SIZE: IN _____
14 & SCHEDULE: OUT _____
15 PIPE LINE INSULATION: _____

VALVE BODY/BONNET

16 *TYPE: : Pressure Reducing and Desuperheating
17 *SIZE
18 MAX PRESS/TEMP
19 *MFG & MODEL_____
20 *BODY/BONNET MATL
21 * MAT (inlet/outlet)
22 *END : IN Butt Welded
23 CONNECTION: OUT Butt Welded
24 *FLG FACE FINISH N/A
25 *END EXT/MAT_____
26 FLOW DIRECTION: _____
27 *TYPE OF BONNET _____
28 LUB & ISO VALVE_____None LUBE N/A__
29 *PACKING MATERIAL Grafoil
30 *PACKING TYPE_Standard_____
31

TRIM

32 *TYPE , Cage Guided
33 *SIZE _____RATED TRAVEL _____
34 *CHARACTERISTIC_____
35 *BALANCED/UNBALANCED__Balanced____
36 *RATED Cv _____FL 0.9 XT 0.75____
37 *PLUG MATERIAL _____
38 *SEAT MATERIAL _____
39 *CAGE/GUIDE MATERIAL_____
40 *STEM MATERIAL_____
41 _____
42

SPECIALS/ ACCESSORIES

43 NEC CLASS N/A GROUP____DIV__
44 Notes:
45 1. Contractor shall verify/complete all items on data sheet marked with an asterisk or blank spaces.
46 2. Valves to be Bench Set at Factory
47 3. Valve shall be designed for low noise 90dBA at 3ft with a 5.3 dB insulation noise credit.
48 4. Valves with quick opening time will be preferred.
49 5. Bypass valve shall be provided with automatic valve heating arrangement.
50 6. Boiler drum water will be used as water spray and will include traces of amine, phosphate and hydrazine dosing.
51 7. This valve will be used for bypassing HP steam (after press reducing and desuperheating) to the condenser.
52

ACTUATOR

53 *TYPE _____
54 *MFR & MODEL _____
55 *SIZE _____EFF AREA_____
56 ON/OFF: MODULATING: YES
57 SPRING ACTION Spring to Close
58 *MAX ALLOWABLE PRESSURE_____psig__
59 *MIN REQUIRED PRESSURE__psig__
60 AVAILABLE AIR SUPPLY PRESSURE:
61 MAX: 125 psig____ MIN: 60 psig
62 *BENCH RANGE_____
63 ACT ORIENTATION Horizontal Actuator,
64 HANDWHEEL TYPE Required
65 AIR FAILURE VALVE__Yes__SET AT____70 Psig
66
67 INPUT SIGNAL 4-20mA is 0% to 100% Open, Direct Acting

POSITIONER

68 *TYPE_____
69 *MFR & MODEL_____
70 *ON INCR SIGNAL OUTPUT INCR/DECR ___Open___
71 GAUGES Yes BY-PASS No____
72 *CAM CHARACTERISTIC _____
73 Input signal failure: Valve closes

SWITCHES & TRANSMITTER

74 TYPE Integral Quantity_____
75 *MFR & MODEL
76 CONTACTS/RATING
77 ACTUATION POINTS
78 POSITION TRANSMITTER 4-20 mA 0-100% OPEN

AIR SET

79 *MFR & MODEL _____
80 *SET PRESSURE_____
81 FILTER Yes GAUGE Yes
82

TESTS

83 *HYDRO PRESSURE_____
84 A. Seat Tightness per ANSI-B16.104, Class V
85
86

REV	DATE	REVISION	ORIG	APP

Additional Notes:

8 The steam flow rates and the steam pressures depend upon the plant operating mode. Bidder shall workout the steam flow rates and steam parameters from the startup curves (will be furnished later) and the heat balance diagrams.
9 Bidder shall include hydroplug and steam blowout trim in their quote.
10 Bidder shall indicate the actuator opening time and how fast the valve can be put in operation during a trip of the steam turbine

SECTION 485122.11
STEAM BYPASS VALVES

POWER ENGINEERS	PROJECT: Glenarm Repowering Project MFR SERIAL#_____ MANUFACTURER: _____	DATA SHEET: TAG: _____ Quantity: 1 DWG: SERVICE: Steam Bypass Attemperation Flow Control Valve

1 FLUID : Feedwater (Main Steam Bypass Attemperation Water) | CRIT PRES PC_____

	SERVICE CONDITIONS	UNITS	MAX FLOW	NORM FLOW	MIN FLOW	SHUT OFF
2	FLOW RATE	lb/hr x 1000				
3	INLET PRESSURE	psia				
4	OUTLET PRESSURE	psia				
5	INLET TEMPERATURE	^{0}F				
6	SPEC WT/SPEC GRAV/MOL WT	MWt.				
9	*REQUIRED Cv					
10	*TRAVEL	DEG				

LINE

13 PIPE LINE SIZE: IN _____
14 & SCHEDULE: OUT _____
15 PIPE LINE INSULATION:

VALVE BODY/BONNET

16 *TYPE Globe/Angle/Ball Valve
17 *SIZE _____
18 MAX PRESS/TEMP
19 *MFG & MODEL_____
20 *BODY/BONNET MATL: _____
21 *LINER MATERIAL/ID N/A_____
22 *END : IN _____
23 CONNECTION: OUT _____
24 *FLG FACE FINISH N/A
25 *END EXT/MATERIAL N/A_____
26 *FLOW DIRECTION
27 TYPE OF BONNET _____
28 LUB & ISO VALVE___N/A__LUBE____N/A
29 *PACKING MATERIAL Grafoil
30 *PACKING TYPE_____Standard___
31

TRIM

32 *TYPE _____
33 SIZE _____ RATED TRAVEL _____
34 *CHARACTERISTIC___Equal %___
35 *BALANCED/UNBALANCED_____
36 *RATED Cv ____FL___XT_____
37 *PLUG/BALL/DISK MAT _____
38 *SEAT MATERIAL _____
39 *CAGE/GUIDE MATERIAL_____
40 *STEM MATERIAL_____
41 _____
42

SPECIALS/ ACCESSORIES

43 NEC CLASS N/A_____GROUP___DIV__
44
45 Notes:
46 1. Contractor shall verify/complete all blank spaces or items marked with an asterisk on the data sheet
47 2. Valves to be Bench Set at Factory
48
49 3. The attemperation flow rates depend upon the plant operating mode. Bidder shall workout the same from startup curves (will be furnished later) and the heat balance diagrams
50 .

ACTUATOR

53 *TYPE _____Pneumatic_____
54 *MFR & MODEL _____
55 *SIZE ___ EFF AREA_____
56 MODULATING: YES
57 FAIL POSITION CLOSED
58 *MAX ALLOWABLE PRESSURE_____
59 *MIN REQUIRED PRESSURE_____
60 AVAILABLE AIR SUPPLY PRESSURE:
61 MAX: 125 psig___ MIN: 60 psig
62 *BENCH RANGE_____
63 ACT ORIENTATION _____
64 HANDWHEEL TYPE Required
65 AIR FAILURE VALVE_Yes__SET AT___75 Psig
66
67 INPUT SIGNAL 4-20mA is 0% to 100% Open, Direct Acting

POSITIONER

68 *TYPE_____
69 *MFR & MODEL_____
70 *ON INCR SIGNAL OUTPUT INCR/DECR _____Open___
71 GAUGES Yes BY-PASS No___
72 *CAM CHARACTERISTIC _____
73 Input signal failure: Valve closes

SWITCHES & TRANSMITTER

74 TYPEIntegral___Quantity_____
75 *MFR & MODEL
76 CONTACTS/RATING
77 ACTUATION POINTS
78 POSITION TRANSMITTER 4-20 mA 0-100% OPEN__

AIR SET

79 *MFR & MODEL _____
80 *SET PRESSURE_____
81 FILTER GAUGE
82

TESTS

83 *HYDRO PRESSURE_____
84 Seat Tightness per ANSI-B16.104, Class V
85
86

REV	DATE	REVISION	ORIG	APP

SECTION 485122.11
STEAM BYPASS VALVES

PROJECT: Glenarm Repowering Project MFR SERIAL#_____ MANUFACTURER:_____	DATA SHEET: 3/15 TAG: 1BFW-MOV-112 / 2BFW-MOV-112 Quantity: Two (2) DWG :M3-50 SERVICE: Main Steam Bypass Attemperation Flow Block Valve

FLUID : Feedwater (Main Steam Bypass Attemperation Water Block Valve) — CRIT PRES PC_____

SERVICE CONDITIONS	UNITS	MAX FLOW	NORM FLOW	MIN FLOW	SHUT OFF
FLOW RATE	lb/hr x 1000				
INLET PRESSURE	psia				
OUTLET PRESSURE	psia				
INLET TEMPERATURE	^{0}F				
SPEC WT/SPEC GRAV/MOL WT	MWt.				
*REQUIRED Cv					
*TRAVEL	DEG				

LINE

PIPE LINE SIZE: IN
& SCHEDULE: OUT
PIPE LINE INSULATION: _____

VALVE BODY/BONNET

*TYPE GLOBE / ANGLE
SIZE _____
MAX PRESS/TEMP
*MFG & MODEL_____
*BODY/BONNET MATL: _____
*LINER MATERIAL/ID N/R
*END: IN _____
CONNECTION: OUT _____
*FLG FACE FINISH NA
*END EXT/MATERIAL_____N/A
*FLOW DIRECTION Flow to Close
*TYPE OF BONNET _____
LUB & ISO VALVE___N/A_LUBE_____
*PACKING MATERIAL Graphite
*PACKING TYPE Standard

TRIM

*TYPE _____
SIZE __RATED TRAVEL _____
*CHARACTERISTIC_____
*BALANCED/UNBALANCED_____Balanced
*RATED Cv ___FL___XT__
*PLUG/BALL/DISK MATERIAL
*SEAT MATERIAL
*CAGE/GUIDE MATERIAL__
*STEM MATERIAL_____
_____

SPECIALS/ ACCESSORIES

NEC CLASS N/A_____GROUP___DIV__

1. Contractor shall verify/complete all items on data sheet marked with an asterisk or blank spaces.
2. Valves to be Bench Set at Factory
3. The integral desuperheater, spray water control valve and the spray water block valve design shall be coordinated.
4. The valve opening time shall be chosen to achieve the desired bypass valve opening time.

ACTUATOR

*TYPE Diaphragm
*MFR & MODEL _____
*SIZE _____EFF AREA_____
MODULATING: NO
FAIL POSITION CLOSED
*MAX ALLOWABLE PRESSURE_____psig
*MIN REQUIRED PRESSURE_____psig
AVAILABLE AIR SUPPLY PRESSURE:
MAX: 125 psig MIN: 60 psig
*BENCH RANGE_____
ACT ORIENTATION Vertical Actuator,
HANDWHEEL TYPE : Required
AIR FAILURE VALVE Yes SET AT Psig

INPUT SIGNAL N/A

POSITIONER

*TYPE_____
*MFR & MODEL N/A_____
*ON INCR SIGNAL OUTPUT INCR/DECR _____N/A_____
GAUGES Yes BY-PASS No
*CAM CHARACTERISTIC _____
Input signal failure: Valve closes

SWITCHES & TRANSMITTER

TYPE SPDT Quantity 2
*MFR & MODEL
CONTACTS/RATING 10A @ 110 VAC
ACTUATION POINTS Full Open, Full Close
POSITION TRANSMITTER

AIR SET

*MFR & MODEL _____
*SET PRESSURE_____
FILTER GAUGE

TESTS

*HYDRO PRESSURE_____psig

Seat Tightness per ANSI-B16.104, Class V

REV	DATE	REVISION	ORIG	APP

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485221

Steam Turbine and TEWAC Generator

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 485221
Steam Turbine and TEWAC Generator

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *BRIAN HRITSCO*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/25/2011	B. Hritsco	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
05/04/2012	T. Clark	E
10/04/2012	G. Harwood	F
09/10/2013		G – CONTRACT VERSION

SECTION 485221
STEAM TURBINE & TEWAC GENERATORS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 3
1.4 RELATED SECTIONS 4
1.5 CODES AND STANDARDS 4
1.6 DEFINITIONS 5
1.7 SYSTEM DESCRIPTION 5
1.8 SUBMITTALS 7
1.9 QUALITY ASSURANCE ..... 7~~11~~
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING ..... 8~~11~~
1.11 SITE CONDITIONS ..... 8~~12~~
1.12 WARRANTY ..... 8~~12~~

PART 2 - PRODUCTS 8~~12~~

2.1 MATERIALS AND WELDING ..... 8~~12~~
2.2 MANUFACTURED UNIT ..... 8~~12~~
2.3 EQUIPMENT ..... 9~~12~~
2.4 COMPONENTS ..... 15~~20~~
2.5 INSTRUMENTATION AND CONTROLS ..... 24~~28~~
2.6 FABRICATION ..... 31~~35~~
2.7 SOURCE QUALITY CONTROL ..... 31~~35~~

PART 3 - EXECUTION 34~~38~~

3.1 INSTALLATION ..... 34~~38~~
3.2 FIELD QUALITY CONTROL ..... 34~~38~~
3.3 COMMISSIONING ..... 34~~39~~
3.4 TRAINING ..... 35~~39~~

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 36~~40~~

APPENDIX B – PASADENA GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET 38~~42~~

APPENDIX C – TECHNICAL DATASHEET BY CONTRACTOR 39~~43~~

SECTION 485221
STEAM TURBINE & TEWAC GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of a steam turbine generator (STG) where the generator is a totally enclosed water to air cooled (TEWAC) design. It is not the intent to specify completely herein all details of design and construction of the equipment and its related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager. Reference to other codes, standards and regulations shall be interpreted as an integral part of this specification.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Steam Turbine Generator (STG) and Accessories including:

a. Steam Turbine with totally enclosed water to air cooled (TEWAC) generator and standard accessories
b. A heated and ventilated acoustic enclosure covering the steam turbine, generator, lube oil skid, condenser, condensate pumps, vacuum pumps, steam bypass valves, and various accessories designed to meet noise requirements of Section 480031, Combined Cycle Power Island Noise Control Performance. The enclosure must have provisions for allowing maintenance, such as removable roof panels, wall panels, etc., as required. The enclosure will be finish painted and mounted to foundations at grade. *PIE Contract bidders are required to describe the proposed enclosure with their bids.* Man doors, louvers, etc., shall be provided with the enclosure.
c. Neutral grounding transformer and resistor for generator neutral
d. Line termination hardware and cubicles (VTs, PTs, lightning arrestors and surge capacitors) provided for bottom entrance cable connection
e. Microprocessor based control system with one local (in the PDC) and one remote HMI, protocols for bidirectional communication with plant PCS system
f. Lubricating oil system with an oil conditioning purifier using a centrifugal separator. Include sight glass.
g. Electro-Hydraulic Control (EHC) system

h. Turbine and generator supervisory instrumentation and protective devices
i. Main steam stop and control valves with internal strainers and valve supports/hangers, as well as temporary valve cover(s) for steam blow and boiler cleaning.
j. Couplings, coupling bolts (turbine/generator rotors), and coupling guards
k. Acoustical/weather enclosures (finish painted) for the steam turbine and generator on outdoor units meeting the noise requirements in Section 480031, Combined Cycle Power Island Noise Control Performance.
l. Sole plates and shear lugs
m. Removable insulation blankets for turbine casing and stop and control valves
n. Skid mounted turbine shaft sealing system including pressure control valves, gland steam condenser, and 2x100% capacity gland steam exhausters with all valves, piping and instrumentation required for a complete system.
o. AC motor driven turning gear
p. Motors for all motor driven equipment furnished under this specification
q. Motor starters for all DC motors furnished under this specification
r. All auxiliary skids and electrical cabinets located outdoors are to be weather proofed suitable for the ambient conditions delineated in Section 480020, Site Conditions and shall meet the sound level requirements as delineated in Section 480031, Combined Cycle Power Island Noise Control Performance.
s. Shims, soleplates with leveling screws, fixators, keys, restraining blocks, shear lugs and any other non-embedded foundation components for the STG
t. Piping on the turbine generator proper and on Contractor supplied skids
u. Wiring and conduit in or on Contractor supplied enclosures or skids and the turbine generator proper
v. Turbine, steam leads, and valve drains complete with pneumatically actuated drain valves and manual isolation valves
w. Steam blow blanking plate(s) and fixture(s) for main steam stop valve and intercept valve
x. For main steam stop and control valves made from non-ASTM materials, Contractor shall supply transition piping made from ASTM materials welded to the stop and control valve in the factory
y. Brushless excitation system
z. Steam turbine local gauge panels
aa. Lube oil, EHC and turbine drain interconnecting piping and supports (exclusive of building steel)
bb. Lube oil and EHC system flush jumper hoses and hardware provided on a loan and return basis
cc. Sizing drawings and information (in English units) for all concrete embedments necessary for the STG including anchor bolts and conduit

2. Special tools and lifting devices required for assembly, operation, maintenance and disassembly of equipment furnished under this specification. Final thermal kit including all required correction curves or computer Heat Balance output for all customer cases, to verify performance at off-design conditions
3. Special services including field support, installation support, start-up and performance testing support, and training as specified
4. Drawings, data, Instruction Books, and other information as indicated in the attached "Contractor Data Requirements" including PE stamped drawings and calculations

5. Review and comment on STG foundation design drawings prepared by the BOP Contractor (interface information only). Such review shall not relieve the General Manager of responsibility for the foundation design.
6. Start-up and commissioning spares

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Unloading, storage, and erection of equipment at jobsite
2. Rigging and hoist for original setting of all equipment.
3. Rigid frame concrete pedestal for turbine-generator and concrete bases for all other Contractor supplied equipment.
4. Foundations, foundation bolts, nuts, washers, sleeves and standard shims. Anchor/jacking/pull-down plates, bearing pads, expansion anchors, Nelson studs, headed studs, spacer blocks, support plates and any other embedments required by the Contractor's equipment and identified on his drawings.
5. Grout for sole plates.
6. Piping in connection with the following ST systems will be supplied by others:

    a. Vent piping from oil reservoir vapor extractor, as required
    b. Vent piping from gland steam condenser exhauster
    c. Steam seal supply piping to a single, pre-defined location near Contractor's steam seal inlet
    d. Miscellaneous steam seal piping low point drains
    e. Cooling water piping to and from the lube oil coolers
    f. Cooling water piping to and from the generator coolers
    g. Condensate supply to exhaust hood spray system
    h. Steam seal vent outlet to gland steam condenser
    i. Condensate piping to and from the gland condenser

7. Supports for all piping external to Contractor's scope of supply.
8. Pipe insulation and lagging external to Contractor's scope of supply
9. Field wiring, cable and conduit connecting Contractor supplied components, except prefabricated cables with connectors.
10. Balance of plant control system shall be embedded in the plant PCS for control of General Manager supplied equipment
11. All control room furniture required for Contractor supplied terminals, keyboards and printers
12. AC motor starters
13. Synchronizing breakers
14. Switchgear and utility metering
15. CTs and VTs not integral to generator and lineside cubicle
16. Batteries and associated chargers for DC powered equipment
17. Gland steam desuperheater for main steam supply
18. Steam piping from Once Through Steam Generator (OTSG) terminal points to turbine terminal points
19. Interconnecting piping to the steam turbine condenser terminal points
20. STG exhaust / condenser expansion joint
21. Heat tracing

22. Turbine oil as required to flush and fill the lube oil and hydraulic oil systems.
23. Initial fill of all lubrication and control oils, all gases, all water
24. Field performance testing
25. Utilities as delineated in the attached "Technical Datasheet by General Manager"

1.4 RELATED SECTIONS

A. Section 260000 - Electrical Mechanical Equipment

B. Section 262050 - Specification for Low Voltage (NEMA) Motors

C. Section 480020 - Site Conditions

D. Section 480031 - Combined Cycle Power Island Noise Control Performance

E. Section 480032 - Power Island Performance

F. Section 481100 - Combined Cycle Power Island

G. Section 485122.11 - Steam Turbine Bypass Valves

H. Section 485432 - Steam Surface Condenser

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American National Standards Institute (ANSI)

a. C50.13 - Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above

2. American Society of Mechanical Engineers (ASME)

a. PTC 6/6.2 - Steam Turbines / Steam Turbines in Combined Cycle

B. Notes on code applications:

1. All heat exchangers, except generator coolers, shall be designed and constructed to meet or exceed the requirements of the applicable sections of the HEI standards, the ASME BPV Code Section VIII, Division 1 and Power Piping Code B31.1.
2. All piping shall be designed and fabricated to meet or exceed the requirements of ANSI B31.1 with components in accordance with the appropriate ANSI/ASME standard.
3. All material shall be designed and fabricated to meet or exceed the requirements of the relevant ASTM number or General Manager approved equal.
4. Performance determination, guarantees and testing shall be in accordance with ASME codes with testing in accordance with the applicable Performance Test Codes (PTC).

5. Recommended Practices for Prevention of Water Damage to Steam Turbines Used for Electric Power Generation, ASME TDP-1shall be followed.
6. ISA Standards and Practices shall be used for instrumentation.
7. Equipment and System designs shall be in accordance with the rules and regulation of OSHA and CALOSHA.
8. Electrical equipment shall be designed, constructed and tested in accordance with the relevant IEC, IEEE, NEMA and ANSI standards.

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Reference Section 481100 Combined Cycle Power Island for general design requirements and expected operating profile.
2. The steam turbine, generator and accessories shall be designed for stable operation from minimum to full load.
3. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
4. The steam turbine generator shall be designed per the steam inlet conditions as defined by the power island final design.

B. Performance Requirements – Steam Turbine

1. The steam turbine shall be designed for main steam admission variable (sliding) pressure control and shall also be capable of operating in inlet pressure control (IPC) mode. The STG shall be designed for continuous unrestricted operation in the ambient conditions listed for operating cases in Section 481100, Combined Cycle Power Island. The STG shall be considered to require daily cycling operation. The turbine generator control system must be designed to maintain acceptable frequency limits while accommodating all types of load changes and operating modes.
2. The turbine-generator shall meet the Performance Guarantees referenced in subpart 1.7E when operating at 95% of the steam valves wide open (VWO) turbine heat balance conditions.

3. At the rated inlet, exhaust and makeup conditions specified in datasheets and guarantee conditions referenced in subpart 1.7E, the turbine shall be capable of operating continuously with the steam flow rate not less than 5% greater than the guarantee flow. This will be defined as the valves wide open (VWO) point.
4. The turbine shall be designed for continuous operation with 105% throttle pressure. Brief incursions into higher abnormal pressures (>105%) should not to exceed 12 hours per 12 month operating period.
5. Average throttle steam temperature per 12 month operating period will not exceed turbine manufacturer's limit.
6. Net power output shall be measured at the guarantee point. The net electrical generating capacity shall be defined as the net power output after all the power for excitation, mechanical losses, and the electrical losses up to the generator terminals have been deducted.
7. Generator output and heat rate performance guarantees shall be stated at the ISO 3977 standard reference ambient conditions described in Section 480020, Site Conditions. Contractor's correction curves and Heat Balance output for all General Manager specified cases shall be the basis for performance guarantees at ambient conditions for testing other than ISO 3977 standard reference conditions.

C. Performance Requirements – Generator

1. The generator open circuit terminal voltage wave deviation factor shall not exceed 10% as defined by ANSI standard
2. The generator shall be capable of operating continuously with the turbine at VWO and 5% overpressure conditions.
3. Starting from stabilized temperature at rated conditions, the generator armature shall be capable of operating at 130% of rated armature current for at least one minute.
4. Starting from stabilized temperature at rated conditions, the generator field windings shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute.
5. The stator windings shall satisfactorily withstand a normal maintenance, high-potential test without damage. There shall be no visible abnormal deformation or damage to the winding coils and connections resulting from the test.
6. Generator shall be capable of withstanding, without damage, the thermal effects of unbalanced faults at the generator terminals including the decaying effects of field current (where protection is provided by causing field current reduction, such as with a field breaker or equivalent) and the DC component of the stator current, for times up to 120 seconds, provided the integrated product $[(I_2)^2 t]$ of generator negative phase sequence current (I_2) and time (t) does not exceed Contractor's quoted rotor heating constant, $[(I_2)^2 t=30$.
7. The generator shall be capable of withstanding without mechanical damage of any type of short circuit at its terminals for times not exceeding the short time thermal capabilities, when operating at rated kVA and power factor and 5% overvoltage, provided the maximum phase current is limited by external means to a value which does not exceed the maximum phase current obtained from the three-phase fault.
8. Generator, controls and all applicable equipment shall be designed to accept full grid load rejection without overspeed and shall be capable of maintaining house loads, as necessary

D. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of

causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

E. Guaranteed Performance Refer to Attachment 6 – Performance Guarantees

1. The Contractor shall guarantee the following parameters when operating the turbine generator through the range of identified operating cases for the plant:

   a. The STG shall be guaranteed to operate reliably across the range of operating load conditions specified in Section 481100, Combined Cycle Power Island.
   b. Turbine Guaranteed Heat Rate based on the Plant Heat and Mass Balance at required main steam stop valve inlet conditions, with a manufacturer's tolerance of 0.33%.
   c. The net electrical generating capacity shall be defined as net power output after all power for excitation, mechanical losses, and electrical losses up to generator terminals have been deducted.
   d. The Output Voltage shall be 13.8 kV.
   e. The temperature rise of the Generator Rotor and Generator Stator shall fall within the limits of NEMA MG-1 with Class B temperature.
   f. The sound levels shall meet the requirements of Section 480031, Combined Cycle Power Island Noise Control Performance.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

A. Shop Drawings

1. Refer to Section 481100 Combined Cycle Power Island for general shop drawing requirements.

B. Operation and Maintenance Manuals

1. Refer to Section 481100 Combined Cycle Power Island for general operation and maintenance manual requirements.
2. Maintenance instructions shall include as a minimum the following topics:

   a. Regular preventative maintenance required for reliable operation of the equipment
   b. Periodic major planned maintenance or replacement of major parts
   c. Lubrication details
   d. Major and minor overhauls inspections
   e. Tests, settings, and calibrations
   f. Method of calculating effective operating hours

1.9 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping

1. Refer to Section 481100 Combined Cycle Power Island for general packaging and shipping requirements.
2. The steam turbine generator and accessories shall be packaged for shipment to allow for outdoor storage as prescribed by Contractor for a period of six months without damage from dust, sun, wind, or rain. Preparation for shipment shall require:

a. Equipment to be completely free of water prior to packaging for delivery.
b. Flanges and threaded connections to be coated with rust preventatives and blanked-off or plugged. Blanking flanges shall utilize at least four bolts. Open ends of pipe shall be caps or plugged.
c. Unpainted surfaces to be protected from weather with weather tight and weatherproof covers. Machined surfaces shall be coated with a heavy grease or similar material before covering.
d. Lifting and support points shall be clearly identified.
e. Packages shall be identified with items and serial numbers, purchase order number, and item descriptions. Identifying tags shall be corrosion and weather resistant.
f. Temporary bracing and covers shall be painted yellow.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100 Combined Cycle Power Island for general material and welding requirements.

2.2 MANUFACTURED UNIT

A. Structural Requirements

1. General

a. Refer to Section 481100 Combined Cycle Power Island for general structural design requirements.

2.3 EQUIPMENT

A. General

1. The steam turbine generator shall be of modern design with proven durability, efficiency and reliability. The STG construction shall permit controlled acceleration from zero speed to full speed. At a minimum, the STG shall be capable of withstanding 110% overspeed at 6" HgA backpressure. Turbine blade designs shall preclude the occurrences of blade resonant frequencies throughout the expected operating range. At General Manager's request, turbine blade design criteria and modeling information shall be made available to General Manager for review prior to fabrication. The Contractor shall provide data on off-frequency operation capabilities and limitations.

B. Steam Turbine

1. The Contractor shall select and provide suitable materials of proven design for the turbine blading, diaphragms, casing, nozzles, and other parts that are in contact with the steam.
2. Turbine design shall allow all bolting 2" (50.8 mm) and larger to be tightened by heating and cooling, or by a hydraulic device that shall be furnished with the turbine.
3. The Contractor's steam purity requirements shall be based on an OTSG boiler feed water treatment scheme employing all volatile treatment (AVT) and existing site Demineralized Water quality as indicated in Section 480020, Site Conditions. The Contractor's steam purity requirements shall be submitted to General Manager with the Proposal.
4. Piping supplied by Contractor with the exclusion of the main steam leads, shall be in accordance with ASME B31.1. All Contractor-furnished piping shall be provided with a minimum 1/16 inch corrosion allowance. Minimum allowable pipe diameter is 1.0 inch for all steam, condensate and drain lines, however, there are some occasions where smaller drains are required.. For all other systems, the minimum allowable pipe diameter is a 1/2 inch. No PVC pipe is allowed.
5. The steam turbine and generator shall be factory assembled and skid mounted to the maximum extent possible.
6. The speed reducing gear shall be complete with sole plates and alignment screws, lubrication equipment, instrumentation and wiring, conduits and junction boxes.
7. The generator shall be shipped completely assembled with the exclusion of the inlet ducting and filter house. The lubricating oil, EHC and sealing steam systems shall be skid mounted assemblies, factory wired and piped to the greatest extent possible.
8. The steam turbine and associated piping systems shall conform to ASME Standard TDP-1, "Recommended Practices for the Prevention of Water Damage to Steam Turbines Used for Electric Generation."
9. The use of screwed, flanged or other non-welded joints in the lube oil, seal oil, and EHC systems shall be minimized. This does not apply to stainless steel tubing connections. The General Manager has final approval rights on the utilization of non-welded joints in these systems.
10. Welded connections 2" (50 mm) nominal pipe size (NPS) and smaller shall be socket weld couplings in accordance with the requirements of ANSI B 16.11 and ANSI B31.1. Welded connections greater than 2" (50 mm) NPS shall be butt weld connections.
11. Carbon steel piping shall be pickled, rinsed and protected against corrosion by coating with a rust preventative. The rust preventative shall be compatible with the fluids carried.
12. Contractor-furnished steam piping shall be internally cleaned by the Contractor either by pickling or by grit blasting. If grit blasted, only iron grit or steel shot shall be used.

13. Stainless steel piping shall have mill scale removed and be suitably protected for shipment and storage.
14. Contractor-furnished field butt-welded piping and valves shall have ends weld prepped prior to shipment.
15. Contractor shall use a suitable thread lubricating compound on all fasteners utilized in the factory assembly of the STG and accessories.
16. Structural and support welding shall be performed in accordance with AWS D1.1.
17. Pressure vessels (lube oil coolers, filters, gland steam condenser, etc.) shall be designed, fabricated, and tested per ASME Section VIII, Division 1.
18. The design of the turbine and generator baseplate(s) shall be provided with optical alignment provisions and jacking systems.
19. All connections required to perform ASME Performance Test Code (PTC) 6S – Steam Turbines.
20. The General Manager furnished foundation embedments shall be manufactured using English dimensions (non-metric). Contractor shall size all equipment embedments and anchors using English dimensions. The mating equipment components shall also be designed to accommodate English sized anchor bolts and embedments.

C. Turbine Rotors
1. The rotor design shall minimize stress concentrations. The fully assembled rotors shall be statically balanced in the factory. The turbine rotor will be low speed balanced, and vibration level is checked during no-load mechanical running test at shop.

D. Generator

1. Rating

a. The generator shall be 3 phase, 60 Hz, wye connected for high resistance grounding. The generator shall be capable of delivering rated load at any set voltage within plus or minus 5% of the nominal voltage. Generator rating shall be sized appropriately rated to allow maximum turbine rating power delivery at rated power factor.
b. The generator shall be fully capable of operation within the power factor range specified in the attached “Technical Datasheet by General Manager” under all conditions without limitation by any device such as the under excitation limiter or over excitation limiter. The only allowable exceptions to this are those due to coordination with steady-state stability limits, in which case calculations shall be provided by the contractor to show that is required, or allowed elsewhere within this specification.
c. With the design cooling water temperatures as shown in the attached “Technical Datasheet by General Manager”, the generator shall be capable of continuous, uninterrupted operation at the allowable outputs prescribed by the generator capability curve with a temperature not exceeding the Class F temperatures in accordance with IEEE C50.13.
d. The generator shall be capable of sustaining 130% of rated armature current for one minute and 125% of rated field current for one minute without damaging the unit.
e. The generator shall be able to withstand a 20% overspeed for one minute without damage to itself and shall be braced for full short circuit 3 phase fault at terminals for ten seconds according to IEEE C50.13, latest edition.

f. Both ends of the stator windings shall be brought out of the side of the generator housing through bushings located at one end of the generator. Stator windings shall be wye connected, with the neutral connection made up external to the generator housing. Enclosure around the bushings shall be included in Contractor's scope of supply.
g. A minimum of six (6) stator winding RTD's (two per phase), located in those areas expected to attain the highest temperature, shall be provided. RTD's shall also be provided to monitor generator bearing metal temperatures.
h. All temperature sensors shall be wired to terminal blocks in dust-tight and drip-proof terminal boxes (NEMA 4) accessible from outside the generator housing.
i. Space heaters shall be provided for the generator to prevent condensation when not in operation.
j. The generator shall be clearly marked with an arrow showing the direction of rotation and the terminals shall be marked with the corresponding phase rotation sequence.
k. The generator shall be capable of synchronizing and parallel operation without excessive harmonic and circulating currents. For the generator as specified, the Contractor shall submit maximum levels for these currents.
l. The generator shall comply with IEEE C50.13 Requirements for Cylindrical Rotor Synchronous Generators as applicable.

2. Generator Cooling System

a. The generator shall be totally enclosed water to air cooled (TEWAC).
b. The generator cooler tubes and tubesheet materials are specified in the attached "Technical Datasheet by General Manager", according to the selected cooling system type. Tubes shall be seamless, minimum 5/8 inch OD, with 22 BWG minimum thickness. Tube velocity at the design cooling water flow rate shall be 7 to 9 feet per second (fps). The surface area of the generator coolers shall be based on 100^{o}F cooling water. An 85% cleanliness factor shall be used in the design calculations to determine the required heat transfer surface area. Design conditions for the coolers shall be as delineated in the attached "Technical Datasheet by General Manager".
c. The cooling system shall be designed such that valving one cooler out of service does not prevent operating the generator at 66% of rated MVA.

E. Lube Oil System

1. A complete skid mounted lubricating oil system shall be provided by the Contractor including oil pumps, coolers, strainers, filters, heaters, skid piping and pipe supports, valves, instrumentation and oil reservoir.
2. The lube oil and hydraulic oil systems shall be self-contained and designed to meet the lubrication requirements of the turbine, generator, turning gear (if external lubrication is required for this component), and all other Contractor supplied equipment requiring continuous lubrication and the requirements of all Contractor supplied actuators requiring hydraulic fluid.
3. Two (2) 100% capacity AC motor driven main lube oil pumps shall be provided. These pumps shall be reservoir mounted. A common strainer shall be supplied in the return line. Two redundant pressure switches shall be provided to automatically start the standby pump in the event of low lube oil pressure.

4. One (1) 125 VDC motor driven emergency lube oil pump shall be provided. The emergency lube oil pump shall be sized to handle a STG shutdown in the event of AC power failure. The DC pump shall also auto-start on a low-low lube oil pressure. The pump shall be reservoir mounted and contain a coarse suction strainer.
5. A duplex, in-line, bypass type full flow 10-micron filter shall be provided with provisions to change out one filter while the other is in operation.
6. Two (2) 100% capacity, shell and tube single pass coolers or two pass coolers with a return waterbox shall be provided. U-tube or plate and frame heat exchangers are not acceptable. Tubes may be either seamed or seamless with a minimum OD of 0.75 inch and a minimum design pressure of 125 psig. Maximum tube side pressure drop shall be 13 psig. An 85% cleanliness factor shall be used in the design calculations to determine the required heat transfer surface area. On-line transfer capability shall be provided. The oil cooler system shall be provided with inlet and outlet temperature indicators, pressure test connections (inlet and outlet) and a thermal relief valve if required for compliance with the governing design codes. Cooling water for the oil systems and other auxiliary components will be supplied by the Contractor. Cooling water temperature, tube/tubesheet materials and tube velocities for the coolers shall be as delineated in the attached "Technical Datasheet by General Manager".
7. One lube oil reservoir sized in accordance with these specifications shall be provided. The reservoir shall be provided with a self-contained thermostatically controlled immersion heater with a maximum heating density of 12.9 W/in^2 (2 W/cm^2).
8. The lube oil reservoir level shall be measured locally plus a level transmitter for control room indication shall be provided. The reservoir shall be sized for a 5 minute "working capacity" time (low - level alarm to suction-loss level) at normal flow rate.
9. The oil reservoir shall be prefabricated, pre-piped, prewired, and shipped as a packaged unit with provisions for lifting. The lube oil reservoir shall feature access doors to the reservoir interior.
10. The oil reservoir shall also include connections for feed and return lines to the purification equipment. Reservoir internal piping shall be such that complete drainage through either connection is not possible.
11. A slight vacuum shall be maintained within the lube oil system by an AC motor driven vapor extractor mounted on the reservoir. A butterfly valve in series with the extractor shall allow precise adjustment of vacuum pressure. Two (2) 100% capacity lube oil vapor extractors complete with a Koch-Otto York, Dollinger or General Manager approved equal mist eliminator shall be provided.
12. All skid and turbine proper lube oil piping, interconnecting piping between the turbine and the skid, tubing, manual valves and instrumentation shall be provided by the Contractor.
13. Means shall be provided for testing of the standby pump auto start circuits.
14. Contractor supplied lube oil supply piping to the two turbine bearings shall be guarded from the lube oil tank to the bearings with an external thin wall mild steel pipe to minimize fire hazard. Piping shall be designed to eliminate pockets and hideouts to aid in flushing system. Welded pipe shall be used where practical to minimize leakage. Contractor shall provide all necessary piping between the lube oil reservoir skid and the turbine, generator and speed reducing gear.
15. Any contractor-furnished oil piping, fittings (including flanges) and valves from the lube oil filters to the bearings shall be 316L stainless steel. Valve bodies may be carbon steel if the trim that is in contact with the oil is 304 or 316 stainless steel and an isolating flange kit designed for isolating dissimilar metals is installed between the carbon steel and stainless steel flanges. The isolating kit shall be of an appropriate material and pressure and temperature rating designed for lube oil service.

16. Pressurized lube oil piping adjacent to the turbine and other hot surfaces shall be shielded such that oil leakage or spray is directed away from the hot surfaces. All oil piping shall be located on the same side of the STG and slope toward the reservoir for gravity drain when the lube oil pumps are not operating to prevent water from accumulating.
17. The use of screwed, flanged or other non-welded joints in the lube and seal oil supply systems shall be permitted only where components must be removed during routine maintenance. This requirement does not apply to tubing.
18. A sight flow glass and one Type K duplex ungrounded thermocouple (simplex wired) will be supplied and mounted in each individual bearing drain by General Manager.

F. Lube Oil Conditioning Purifier

1. The Contractor shall provide a centrifugal separator to remove water and particulates from the lube oil system with flanged connection to the lube oil reservoir.
2. The Contractor shall size the centrifugal separator appropriately to maintain lube oil with the steam turbine manufacturer's requirements for lube oil purity.
3. The centrifugal separator shall be AC motor drive in a 1x100% arrangement mounted on or near the lube oil reservoir. It shall be designed for intermittent or continuous operation as necessary to maintain lube oil purity within steam turbine manufacturer's requirements.

G. Electro-hydraulic Control (EHC) System - Manufacturer's standard turbine control oil system common with lube oil system will be provided instead of EHC. Refer to Attachment 1 – Scope of Supply.

1. A complete Electro-hydraulic Control (EHC) system shall be provided by the Contractor including oil pumps, coolers, strainers, filters, heaters, skid piping and pipe supports, interconnecting piping, valves, instrumentation and fluid reservoir. The EHS turbine control system shall be complete with protection, vibration monitoring, and turbine supervisory instrumentation.
2. The EHC system shall be skid mounted and totally independent from the lube oil system using fire resistant EHC fluid (Fyrquel or equal).
3. Two 100% capacity AC motor driven positive displacement pumps shall be provided. The pumps shall take suction directly from the EHC reservoir with suction strainers provided for each pump. Each pump shall also be provided with a full capacity relief valve, check valve, isolation valve, and discharge pressure gauge. Pressure switch(es) shall be provided to automatically start the standby pump in the event of low EHC system pressure. Means shall be provided for testing of the standby pump auto start circuits.
4. Two (2) 100% capacity cartridge type, 3-micron filters shall be provided with provisions to change out one filter while the other filter is in operation.
5. Two (2) 100% capacity, air-cooled EHC coolers shall be provided. On-line transfer capability shall be provided.
6. Redundant full capacity hydraulic fluid accumulators shall be provided.
7. All EHC skid mounted piping, tubing, manual valves, "last chance" filters, servo valves and instrumentation shall be provided. EHC system piping and tubing shall be 316L stainless steel.
8. The EHC reservoir shall be fabricated of stainless steel and be furnished with a self-contained thermostatically controlled immersion heater with a maximum heating density of 18 W/in^2. The EHC reservoir level shall be measured locally plus a level transmitter for control room indication shall be provided.

H. Emergency Trip System

1. The Emergency Trip System shall include all devices (pressure transmitters, thermocouples, speed pickups, vibration probes, etc.) required to automatically shutdown the steam turbine generator. The Emergency Trip System shall contain redundant sensors with redundant protection circuitry. Sufficient redundancy shall be provided in the protection scheme so that no single failure of an instrument (excluding vibration probes) will cause a turbine trip. Redundant trip circuitry shall be configured to allow on-line testing of trip functions without compromising unit safety, as indicated below.
2. The Emergency Trip System shall include, as a minimum, the following trips:

    a. Overspeed (primary and secondary) (on-line testing [remote] with 2 out of 3 voting logic required)
    b. Low – low lube oil pressure (on-line testing [local] with 2 out of 3 voting logic required)
    c. High – high exhaust hood pressure (2 out of 3 voting logic required)
    d. High – high exhaust hood temperature (2 out of 3 voting logic required)
    e. High – high bearing vibration (1 out of 2 voting with a time delay)
    f. Thrust bearing failure (1 out of 2 voting logic)
    g. Generator protection
    h. External trip initiated from General Manager's control system (not redundant)
    i. Emergency manual trip
    j. High – high bearing metal temperature
    k. Low – low lube oil level

    Note: all non-manual initiated trips shall have a pre-alarm

I. Turbine Shaft Sealing System

1. A skid mounted automatic shaft sealing system shall be provided. The shaft sealing system shall utilize a single point main steam supply provided by the Contractor furnished OTSG for the source of sealing steam during start-up and low load as well as normal operation, as soon as the OTSG is producing steam. The desuperheater for the main steam supply to the shaft sealing skid and all other required desuperheaters for shaft sealing shall be provided by the Contractor.
2. Gland sealing system including gland steam condenser with exhauster, all valves and instrumentation required for a complete system, and the following piping shall be provided:

    a. Steam seal regulator piping, including piping within the unit, re-entry lines, and steam seal header, from a single Contractor/General Manager sealing steam supply terminal point.
    b. Drain valves for the stop valve, casing and miscellaneous drains.
    c. Piping of control valve stem leak-off to steam seal header.

3. The shaft sealing system shall be provided with all necessary pneumatic control valves (steam regulator and dump valves), manual isolation and bypass valves, strainers, steam traps, drains, vents and instrumentation to support both local-manual and remote-automatic operation (General Manager's PCS control) of the steam seal system. As a minimum, one local pressure gauge, two pressure transmitters and one local thermometer

shall be provided. The shaft sealing system shall be skid mounted with all associated piping and wiring. The Contractor shall supply the steam piping from the sealing system skid to the turbine glands. The General Manager will supply the piping from the dump valve to the main surface condenser.

4. The Contractor shall supply all piping from control valve stem leak-off to the steam seal header, including all necessary valves and drains.
5. A skid mounted gland evacuation system shall be provided complete with condensate-cooled gland steam condenser, two 100% capacity AC motor driven gland steam exhausters, manual isolation and balancing valves, and instrumentation.
6. The gland steam condenser shall be a single pass, shell and tube heat exchanger and shall be designed with the Contractor's standard margin (200% the normal operating steam and air flow rates). The tubes shall be ASME SA-249 TP316L stainless steel tubes, minimum ¾ inch OD, 22 BWG minimum thickness with a tube side minimum design pressure of 400 psig and a minimum design temperature of 200°F. Maximum tube side pressure drop at maximum turbine exhaust flow shall be 5 psig. The tubesheets shall be fabricated from ASME SA-240 TP316L stainless steel. The shell and waterboxes shall be fabricated from carbon steel and be provided with a 1/8-inch corrosion allowance. The gland steam condenser shell shall be provided with a pressure gauge.

J. Heat Trace and Insulation

1. Refer to Section 481100 Combined Cycle Power Island for general heat trace and insulation requirements.

K. Platforms and Stairs

1. Refer to Section 481100 Combined Cycle Power Island for general platform and stairs requirements.

L. Turbine Rotor Lifting Equipment

1. Any special casing and/or rotor lifting beams and guides shall be provided. Beams shall be provided with certification of their safe load capacities.

M. Foundation Design

1. The Contractor shall specify all foundation requirements including normal, seismic, wind, and transient loads for the STG and accessories (e.g. size and number of anchor bolts; all Contractor equipment embedment requirements such as size, number, loads and location; concrete strength requirements; grouting requirements; etc.). Seismic loads shall be applied to all system components as applicable in accordance with the governing building code(s) specified in Section 480020, Site Conditions.
2. The General Manager shall be responsible for foundation design including the design of all embedments and the calculations to verify the embedment details are adequate for the Contractor specified loadings.

2.4 COMPONENTS

A. Casing and Exhaust Hood

1. Borescope inspection ports shall be provided in the turbine casings. For down exhaust arrangements, the exhaust hood is to be provided with rupture disc(s). For side or axial exhaust arrangements, Contractor shall recommend whether the condenser is to be provided with rupture disc(s) and the exhaust hood rupture disc(s) are not required. Disc capacity shall be sufficient to prevent exhaust hood or condenser over pressurization with all turbine steam admission valves fully open, at maximum throttle pressure, all extraction lines isolated, and complete loss of condenser circulating water.
2. An exhaust hood spray system shall be provided by the Contractor with spray control available through a General Manager-supplied PCS.
3. The exhaust hood spray system shall be designed for fully automated operation, but include means for hand operation in the event of failure of the power supply to electrically controlled equipment.

B. Acoustic Enclosure

1. The steam turbine and various accessories shall be housed in weather-tight acoustical enclosures. The unit shall be designed and packaged into fully integrated, compact modules with provisions for in-package maintenance. All auxiliary skids and electrical cabinets located outdoors shall be weather proofed suitable for the ambient conditions and shall meet the sound level requirements delineated in Section 480032, Combined Cycle Power Island Noise Control Performance. All gauges and manual valve operators shall be unobstructed and accessible from an immediately adjacent platform or grade.
2. Enclosures shall be designed such that adjoining panels and otherwise exterior mating surfaces are gasketed sufficiently to prevent the intrusion of rain water. Where gasketing is impractical or impossible, enclosure shall be designed for and Contractor shall include weatherproof sealant or caulking that is compatible with the materials on which it is to be applied and the environment to which it will be exposed.
3. A minimum 72" clearance shall be provided for all passageways inside the enclosure and modules. Roof hatches shall be provided as necessary for removal of equipment and large valves.
4. The steam turbine enclosure shall have a walk-in area around the turbine and be provided with a complete system of platforms, walkways and ladders inside the enclosure to allow access to all equipment, valves and instruments as required for routine operations and maintenance.
5. Any conduit requiring removal to access removable maintenance roof panels shall include quick disconnects. No conduit, piping, air ducts, or accessories shall be mounted on removable panels.
6. Turbine enclosure ventilation air enters the turbine compartment at the front corners of the turbine enclosure through ventilation ducts.
7. Pressure in the enclosure is established by AC motor driven fans.
8. Ventilation dampers shall automatically close upon actuation of the fire protection system. The dampers shall be capable of manual testing.
9. Remote temperature monitoring of the turbine compartment shall be provided by others for elevated temperatures caused by leaking piping or turbine flanges.
10. Enclosures having any type of hazard to personnel shall be provided with a secondary means of emergency egress.

C. Turbine Drains

1. Interior recesses and passageways in the turbine in which condensation may collect shall be adequately drained.

2. Drain valves that are required during startup and/or during shutdown shall be pneumatically actuated.

D. Turning Gear

1. The turning gear shall be AC motor driven or hydraulically driven and shall engage and start automatically upon zero turbine rotor speed. The turning gear shall automatically disengage when turbine speed exceeds the turning gear speed. The turning gear shall be controlled to prevent operation at turbine speeds above turning gear disengaging speed. A low lubricating oil pressure trip interlock shall be provided to prevent turning gear operation without oil to the bearings. Means shall be provided for manual operation of the turning gear in the event of power loss.

E. Couplings and guard

1. A rigid flange type coupling shall be provided for the turbine generator. Contractor shall provide hydraulic tapered coupling bolts (i.e.: Pilgrim bolts) for the turbine rotor to generator coupling. If a stub coupling is utilized (flanged both ends) at the generator, hydraulic coupling bolts shall be provided for both ends.

F. Turbine Connections

1. Turbine steam connections and piping shall be arranged such that condensate formed is free draining away from the turbine.

G. Steam Strainers

1. A strainer assembly integral with the stop valve shall be provided on the main steam admission. A wye or tee strainer shall be provided upstream of the gland steam regulator valve.
2. Each strainer shall have a permanent screen of either coarse mesh or perforated plate. All strainer filter elements shall be removable and shall be fabricated of stainless steel.

H. Turbine Valves and Steam Lead Piping

1. The Contractor shall provide all stop valves and steam admission control valves. Flanges shall be provided for valve removal during steam blows for valves incapable of being provided with blanking plates.
2. The turbine stop valves shall be hydraulically operated with spring closure on loss of hydraulic pressure. Control of these valves shall be provided by the turbine EHC system. A means of testing (full closure or partial stroking) individual valves under load shall be provided to assure the valves are functioning properly. The stop valve shall rapidly close on turbine trip to prevent unacceptable turbine overspeed and shall be capable of on-line calibration and partial stroke testing.
3. The turbine stop valve shall be equipped with inputs as required by the turbine control system and one valve open switch (for testing) and one valve closed switch.
4. The main steam stop valve shall be suitable for use as the steam turbine isolation valve during field hydrostatic testing (not to exceed 1.5 times the isolation valve's maximum design pressure). The main steam stop valve shall also be designed to allow steam flow through the valve body during start-up steam blows. The Contractor shall provide steam

blow blanking plate(s), assorted gaskets and fixture(s) to protect the valve trim during steam blows.

5. Turbine control valve shall utilize LVDT analog valve position feedback instead of limit switches. Turbine control system shall mimic a limit switch as a digital output via its configuration logic when necessary for interlocking purposes.
6. The Contractor shall provide all steam lead piping and pipe supports from the main steam stop valve to the turbine steam chest. If the Contractor's main steam stop and control valve is made from non-ASTM materials, Contractor shall also furnish transition piping made from ASTM material matching interconnecting steam piping material from the OTSG. This transition piping shall be factory welded to the Contractor's valve(s).
7. All pneumatic, hydraulic, or motor operated on/off valves shall have control room indication of open or closed status via two SPDT position limit switches or proximity switches. All critical control valves that are modulated via the PCS shall be provided with a position transmitter. Critical valves will be mutually agreed to by General Manager and Contractor during P&ID reviews. Valves shall have a local position indicator wherever practical. Position transmitters shall be provided for the main and reheat steam valves. Limit switches shall be provided for the pneumatic drain valves.
8. All MOV actuators shall be Limitorque or General Manager approved equivalent.
9. All pneumatically actuated control valves shall be Fisher or General Manager approved equal.

I. Generator Components

1. Insulation:

   a. Insulation shall be Class F, suitable for all service conditions. The windings shall be so designed that the insulation temperature rise at rated load will not exceed the continuous Class B insulation temperature limit. Winding insulation shall be resistant to the recommended lube oil.

2. Bearings

   a. Generator bearings shall be pressure lubricated.
   b. Close running shaft seals shall prevent oil leakage as well as prevent the entrance of foreign materials such as water and dirt in the bearing area.
   c. All bearings shall be insulated. Shaft ground brushes or an equivalent system shall be provided at the turbine end of the generator to prevent shaft current and resulting bearing damage.
   d. Rotor endplay limits shall be marked.

3. Leads and Terminal Boxes

   a. The generator power leads shall terminate in the generator enclosure that shall also contain the current transformers (CTs). Contractor shall also supply a separate VT/Surge cubicle for the STG containing voltage transformers (VTs), surge capacitors. The generator enclosure and VT/Surge cubicle shall provide adequate space for termination of General Manager-furnished isolated phase bus. Provisions shall be provided by the Contractor for terminating excitation transformer leads and voltage transformer leads.
   b. The VT/Surge cubicle shall be arranged for side cable entry and shall be sized to allow service access to the VTs and surge arresters provided by the Contractor.

c. Terminal boxes shall be provided with each voltage level (space heaters, RTDs, voltage regulator, etc.) separated by barriers or other means as required to maintain voltage separation. All leads shall be uniquely identified and numbered.

4. Neutral Grounding System

a. The generator shall be suitable for and provided with a high impedance neutral grounding assembly consisting of a standard distribution type transformer with a resistor connected to its secondary side.

5. Current and Voltage Transformers

a. Current Transformers (CTs):

1) The generator shall be provided with current transformers having a minimum ANSI relay accuracy of C-400 and ANSI metering accuracy of 0.3B-1.8 at the highest anticipated burden.
2) Current transformers shall have polarity marks clearly marked on each transformer and at the lead termination at the associated terminal blocks.
3) Quantity and location of CTs shall be as shown on Contractor's single-line drawing.
4) Redundant protective relaying (such as redundant multi-function generator protection relays) shall be connected to separate redundant sets of current transformers in order to preserve full redundancy.

b. Voltage Transformers (VTs):

1) The generator shall be provided with wye connected (4-wire) voltage transformers located in a weatherproof VT/Surge Cubicle.
2) Voltage transformers shall be of draw-out construction and shall have voltage, volt-amp, and BIL ratings suitable for the application. Voltage transformers shall have a metering accuracy of 0.3 for burdens W, X, M & Y when applied at 69.3 volts AC.
3) Quantity and location of VTs shall be as shown on Contractor's single-line drawing.
4) Redundant protective relaying (such as redundant multi-function generator protection relays) shall be connected to separate redundant sets of voltage transformers in order to preserve full redundancy.

6. Lightning Arresters and Surge Capacitors

a. Station type lightning arresters and surge capacitors shall be provided in accordance with Contractor's standard design and mounted in the VT/Surge Protection Cubicle.

7. Temperature Measurement

a. Six duplex RTDs (two per phase) or twelve simplex RTDs (four per phase) shall be imbedded in the stator windings or in the air discharge of the stator coil. One duplex RTD (simplex wired) per journal bearing shall be provided to monitor bearing metal temperature. At least one duplex RTD on the hot air side and one

duplex RTD on the cold air side shall be provided to monitor generator cooling air temperatures. The RTDs and thermocouples shall be uniquely identified and numbered, and terminated on thermocouple terminal blocks in separate boxes. One duplex Type K ungrounded thermocouple (simplex wired) will be provided and installed by General Manager in each bearing drain to monitor drain lube oil temperature.

8. Space Heaters

   a. Space heaters shall be provided for the generator. Location and maximum surface temperatures of the heaters shall be such that no damage can be caused to any insulation or other equipment. Heaters shall be suitable for operation on 1 phase, 110 V or 3 phase, 480 V power supplied by General Manager's MCC and designed to turn upon receipt of a signal from General Manager's PCS.

9. Excitation System

   a. Generator shall be supplied with one digital automatic voltage regulator including voltage adjust system, one manual field current controller with regulation, and a brushless excitation system. In addition to the requirements contained herein and the requirements contained in the standards, the performance of the excitation system shall meet any performance requirements of relevant organizations (such as interconnected utilities).
   b. The following protections shall be provided, as a minimum, with the generator excitation system:

      1) Under-excitation limiter
      2) Over-excitation limiter
      3) Over-excitation trip to trip the machine if excessive excitation remains for a predetermined time both in automatic and manual operation.
      4) Voltage-per-hertz limiter
      5) Automatic and continuous ground detection equipment, including facilities to permit in service tests of the ground detection system at any time.
      6) Voltage unbalance detector
      7) Field over-current limiter, which shall have characteristics similar to the thermal capability of the rotor in order to permit full utilization of the rotor thermal capability while protecting the rotor from damaging over-currents.
      8) A SEL-551 three-phase over current relay (50/51) for the protection of the excitation transformer (is not required due to brushless excitation PMA is supplied).

   c. The automatic voltage regulator shall maintain the generator terminal voltage within plus or minus 0.5% of the voltage set point over the range from no load to maximum load at the rated generator frequency. Manual voltage regulation capability shall be included as an independent feature.
   d. Excitation system shall be capable of changing generator power factor throughout the range required in the attached "Technical Datasheet by General Manager" and shall provide an interface to the automatic power factor control incorporated in the turbine control system.
   e. The exciter shall be wide range stabilized to permit stable operation down to 25% of rated exciter voltage.

f. The exciter ceiling voltage, as defined by ANSI standards, will be at least 120% of rated voltage when operating with a load resistance equal to the generator field. The exciter shall be capable of supplying ceiling excitation under load for at least one minute.
g. The response ratio of the exciter as defined by ANSI standards will be at least 0.5. The response ratio will be 0.5 for an error signal of 10%.
h. Terminal voltage shall be held within ±0.5% from no load to full load at rated voltage.
i. The excitation system shall provide field ground alarm information through the MODBUS connection, for General Manager's use.
j. The excitation system shall be suitable for automatic operation controlling voltage from the STG control system. Note: Power Factor control as well as VAR control is prohibited on units connected to the WECC transmission system. The Contractor shall be responsible for initial setup including any and all calculations necessary to support proposed settings to the General Manager or relevant organization.
k. The excitation system shall be sized to provide adequate field voltage and current to continuously produce rated MVA at the maximum rated generator output voltage. A redundant AVR as part of the controls that switches from one AVR to the other upon failure is provided.
l. All equipment necessary (such as field breaker, relays, metering, protective devices, and supervisory safety monitoring devices) to provide a fully functioning excitation system shall be provided.
m. Generator excitation equipment shall be provided in a metal enclosed NEMA dead front dust proof enclosure with internal illumination, hinged access doors, observation windows, cooling system, and any other required equipment. The voltage regulator will be mounted in the generator instrument & relay cubicle.
n. The collector shall be furnished in an enclosure suitable for indoor or outdoor installation. The enclosure shall be air cooled with ventilation provided by a centrifugal blower that is integral to the collector shaft assembly. The enclosure shall include a base that supports the stationary components and a door on each side. It shall include grounding lugs, air temperature RTD's and space heaters.
o. Enclosures shall include convenience outlets for maintenance equipment and incandescent lights and switches necessary to provide adequate lighting. All equipment mounted in enclosures shall be completely wired with all instrument, meter and control leads wired to terminal blocks for external connections. All major items shall be identified with engraved nameplates acceptable to General Manager.

10. Alarms and trips: The generator shall be provided, at the minimum, with the necessary instrumentation to provide the following pre-alarm and trip initiations:

a. High generator stator coil discharge gas or winding temperature
b. High generator bearing metal temperature alarm
c. High – high generator bearing metal temperature trip. (optional)
d. High generator rotor vibration level alarm
e. High – high generator rotor vibration level trip
f. High lube oil supply temperature alarm
g. Generator field ground
h. High and low voltage
i. Over-excitation limit
j. Under-excitation limit

k. Volts per hertz limit

11. Enclosure Grounding: The generator shall be provided with a minimum of two permanently attached grounding connectors located on opposite sides of the generator. The grounding connectors shall be corrosion resistant metal pads with each containing a minimum of two NEMA sized threaded holes.
12. Insulation Against Stray Currents: The generator shall be adequately insulated against stray currents.
13. The generator enclosure shall be constructed of prefabricated panels. Structural members will be erected individually and the panels will be hung onto the structural framework. Erection of the structural members, erection of the panels, and final outfitting will be performed on-site by others.

J. Motors and Accessories

1. All motors shall conform to IEEE 841, with respect to material, workmanship, design, and tests. All motors shall be designed for the environmental atmosphere as described in this document. All motors shall be "premium efficiency".
2. Motors shall permit the driven equipment to develop its specified capacity continuously without exceeding the specified temperature and without encroaching on the service factor.
3. Electrical Motor Design

a. Motors shall be squirrel cage induction type and shall have a design life objective of 30 years when operated with the connected load at rated voltage.
b. Parts that require replacement to achieve design life shall be readily replaceable.
c. All motors rated below ½ HP shall be single phase, 120 VAC, 60 Hz.
d. All motors rated 1 HP up to and including 200 HP shall be three phase, 480 VAC, 60 Hz.
e. Motors rated at ½ HP and ¾ HP can be either single phase, 120 VAC or 3 phase, 480 VAC at 60 Hz.
f. All motors above 200 HP shall be three phase, 4160 VAC, 60 Hz.
g. DC motors shall be rated at 125 VDC for service from the General Manager furnished battery system.
h. Variable frequency and variable speed controls are acceptable. Motors shall be provided with Class F non-hygroscopic insulation limited to a Class B rise.
i. Motors shall be designed for across-the-line starting and shall be capable of accelerating the connected load to full load speed with 80% of rated voltage at the motor terminals.
j. DC motors shall be capable of accelerating the connected load and operating continuously at 105 VDC to 140 VDC.
k. A maximum rated voltage starting current of 6.5 times rated full load amps must not be exceeded for all motors rated larger than 3 HP.
l. Where repetitive starting is restricted, the permissible number of starts shall be clearly indicated on the nameplate.
m. The full load current when operating at plus or minus 10% of rated voltage shall not exceed 1.11 times rated full load current.
n. Motor safe locked rotor time at rated locked rotor current shall be equal to or greater than the maximum accelerating time at 80% of rated voltage.
o. Motors shall be selected to permit the connected load to develop its specified output continuously without encroaching on the service factor under normal

operating conditions. Service factor shall be 1.15 for all 480 VAC and lower voltage motors.

p. Motors shall be selected to permit operation up to, but not to exceed, their service factor rating during infrequent and short periods of operation.

4. Mechanical Motor Design

a. 480 VAC motors shall be totally enclosed fan cooled (TEFC).

b. 480 VAC motor bearings shall be anti-friction type, conservatively sized, suitable for continuous service under the conditions specified, and sealed against the entrance of dirt and the loss of lubricant. Grease lubricated bearings shall be lubricated prior to shipment. Bearings requiring periodic re-greasing shall have provisions for in-service positive lubrication with means to prevent damage due to over greasing. Bearings of the completely sealed or the pre-lubricated type shall not have provisions for in-service lubrication.

5. Motor Accessories

a. Separate terminal boxes shall be provided for main leads, space heater leads, and temperature indicating device leads. For motors larger than 20 HP, main terminal boxes shall be one size larger than specified in IEEE 841 or NEMA C50.41 and shall be compatible with the motor enclosure specified. Main terminal boxes shall be capable of rotation in 90˚ steps.

b. Space heaters shall be provided for motors 25 HP and larger. They shall be of low heat density and rated and sized for continuous operation when the motor is off to maintain the internal temperature 10 ˚C above ambient temperature. Heaters shall be mounted in the motor to prevent deterioration of nearby components. Unless otherwise approved, space heaters shall be installed so that they may be serviced or replaced without disassembly of motor. The voltage rating and operating voltage of the heaters shall be at least 120 VAC. Total enclosed motors up to 15 HP shall have at least one drain hole with piping plug at each end.

c. Motors with frame sizes larger than 184 T shall be provided with a suitable NEMA 2 hole grounding pad with tapped holes.

d. Motors shall have permanently attached nameplates indicating the following information in addition to the standard nameplate markings shown in NEMA C50.41 and IEEE 841.

1) Rotation
2) Magnetic center, horizontal motors with sleeve bearings
3) Starting restrictions
4) Terminal leads markings
5) Bearing number, each bearing
6) Recommended lubricant
7) Service factor
8) Full load voltage
9) Full load amperage

6. Motor Tests

a. Tests shall be performed on motors in accordance with IEEE 112, IEEE 113, IEEE 115, IEEE 116, IEEE 841, as applicable. If single phase locked rotor test is performed, polyphase values of a duplicate motor must be available.
b. Tests typically shall include:

1) No-load current input and speed at rated voltage and frequency
2) Locked rotor current input at rated voltage
3) Dielectric test
4) Noise level measurements in accordance with IEEE 85

2.5 INSTRUMENTATION AND CONTROLS

A. General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a Contractor-furnished plant control system (PCS). HMI and all operator workstations for control, monitoring and protection, shall have the capability to digitally communicate with the General Manager's Plant Control System (PCS) for speed/load control and monitoring purposes. This communication shall be MODBUS protocol and shall be redundant.
2. All control devices furnished by the Contractor shall be capable of digitally interfacing with the PCS and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the PCS to remotely start and stop all rotating equipment and to allow automatic switch over to any backup units.
3. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant. Contractor will supply a detailed list of instruments for discussion for meeting this requirement.
4. The Contractor shall permanently install a 1.25 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified “Instrument Tag Number” to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
5. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required for flame scanners, ignition transformers, etc. shall be provided by the Contractor for installation by the BOP contractor.
6. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
7. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.
8. The plant control system is to be designed to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations. Once gas

turbine and steam turbine have been placed in their ready-to-start conditions, balance of plant systems have been filled and vented, and equipment has been placed in automatic mode, normal plant operations can proceed with few operator actions. The operator is required to start each turbine with a single command to bring it to a desired load level. At that point the gas turbine can be put in plant master mode. The operator can then enter a single plant load setpoint to which total plant output is controlled.

9. Plant systems and equipment are to be monitored and/or controlled through the PCS. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant PCS.
10. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
11. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two SPDT position limit switches or proximity switches, unless noted otherwise.
12. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Contractor shall accommodate this objective in the design of their equipment and Contractor shall furnish any and all transmitting instrumentation required to observe and record the process conditions listed in Performance Test Datasheet herein. These instruments shall be furnished regardless of whether or not they are required by Contractor's control system for ordinary equipment operation. These instruments shall be furnished and calibrated in accordance with specification section 481100, Combined Cycle Power Island, Instrumentation and Controls. These performance data sheets shall then be completed and submitted as part of the plant performance testing described in section 480032, Power Island Performance Testing.

B. Instrumentation & Control Devices – Requirements

1. 3-wire, 100-ohm platinum RTDs shall be used.
2. Duplex type K thermocouples shall be used. Appropriate junction devices shall be supplied with thermocouples for use with thermocouple conductors where necessary to avoid cold junction signal distortion.
3. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
4. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters.
5. Control valves and pressure regulators shall be manufactured by Fisher or equivalent pre-approved manufacturer.

C. STG Controls

1. The STG shall be equipped with all necessary controls configured for complete start-up, synchronizing, loading, operation and shutdown from the General Manager's main control room via the Contractor furnished operator terminal with keyboard, printer and dual Operator Consoles screens. Manual synchronization, via a General Manager supplied manual synchronization panel, shall also be possible from the General Manager's main control room.
2. A complete microprocessor based control system using standard ISA tagging shall be provided by the Contractor for the overall control of the steam turbine generator and its auxiliaries. The power supply for the control system equipment will be from the General Manager's power supply system. Refer to Attachment 1 – Scope of Supply.

a. The control system shall be a digital system with manufacturer's standards processor capable of performing unit speed/load control, normal and emergency overspeed control, automated unit start-up, synchronization, loading, frequency, shutdown, steam admission pressure control, unit protection and supervision. The electronic speed governor shall control rotor speed to within 108% of synchronous upon a full load rejection.

b. The generator will normally be operated in parallel with the local SCE utility grid. Should the connection with the PWP grid be lost, the control system shall be designed to trip the steam turbine.

c. The control system shall permit full manual control and partial manual assist control and include on-line and off-line unit protection testing capabilities.

d. Automated unit start-up, synchronization, loading and shutdown shall be controlled utilizing feedback from Contractor's turbine stress evaluation program.

e. The steam turbine and control system shall be capable of providing an immediate and sustained response to abnormal frequency excursions within the machine design parameters. The governor shall provide droop characteristics and be fully responsive to frequency deviations consistent with the capabilities of the turbine and generator.

f. Frequency Control: Generator frequency control shall be maintained during unit run-back operation via the Contractor furnished control system.

g. The control system shall be provided with, but not limited to, the following features:

1) Speed feedback inputs for Speed Control - To be used during startup and shall have a minimum adjustable set point range of 0 - 100% rated speed from the operator's workstation and the General Manager's PCS.
2) Speed indication
3) Speed setpoints / mode selector
4) Ramp rate setpoints
5) Pressure control setpoints
6) Sliding pressure control: Rate sensitive inlet pressure limiter- capable of accepting a throttle pressure setpoint from the station PCS during sliding pressure operation.
7) Load limit and indication for Load Control - To be used during normal operation and shall have a setpoint range of 0-100% maximum capability.
8) Load setpoints / mode selector:

    a) Setpoint Control - Shall be governed by the turbine control system.
    b) Remote Setpoint Control - Shall be arranged to allow for controlling the setpoint remotely from the operator's workstation and General Manager's PCS interface console.

9) Turbine drain controls.
10) Lube oil and EHC system interlocks
11) Emergency trip system
12) On-line and off-line testing capabilities
13) Thermocouples (ungrounded) and/or RTDs to measure steam, bearing, metal and lube oil supply temperatures
14) Power supplies to power the system from both the General Manager's 230 VAC, 60 Hz supply and 125 VDC power supply, as applicable.

h. The Contractor shall provide, at a minimum, the following screens for the operator interface Consoles:

1) Main display
2) Bearing metal temperatures
3) Bearing and Rotor vibration Monitor
4) HP and LP steam pressures and temperatures
5) Valve status
6) Speed/load control
7) Start-up screen and permissives
8) Alarm screen
9) Turbine exhaust temperature monitoring
10) Generator temperature monitoring and generator quantities
11) Sensor reset
12) Turbine Trips
13) Lube Oil system
14) Turbine rotor and casing displacements

i. Following Pushbutton/Selector switches:

1) Speed Control mode selector
2) Load control mode selector
3) Trip & Reset
4) Raise speed/load setpoint (fast and slow pushbuttons)
5) Lower speed/load setpoint (fast and slow pushbuttons)
6) Stop valve test
7) Other pushbutton selector switches as required for Contractor's control interface

j. Digital Indications:

1) Speed
2) Control valve position
3) Vibration at each point
4) Setpoint

k. Indications

1) Stop valve open/closed
2) Stop valve test in progress
3) Low condenser vacuum pressure

l. The control system shall provide, as a minimum, the following interfaces with the General Manager’s control system (PCS):

1) Hardwired Controlled inputs
   a) Emergency trip
   b) Customer trip
   c) Speed raise/lower
   d) Load raise/lower
   e) Control mode selection

2) Selections
   a) Speed control mode selector
   b) Load control mode selector
   c) Trip & Reset
   d) Raise speed/load setpoint (fast and slow pushbuttons)
   e) Lower speed/load setpoint (fast and slow pushbuttons)
   f) Stop valve test
   g) Other selections as required for controls
   h) Manual open/close of each valve

3) Digital Indicators
   a) Speed
   b) Control valve position
   c) Vibration at each bearing
   d) Setpoint
   e) Rotor position
   f) Thrust wear indication

4) Digital Indications
   a) Stop valve open/closed
   b) Stop valve test in progress
   c) High vibration and trip
   d) High condenser vacuum
   e) Turbine-generator control system alarms (i.e., component failure or self diagnostic)

m. Sixteen (16) analog outputs and twelve (12) additional digital inputs/outputs shall be reserved for General Manager's use.
n. The Contractor-furnished control system shall be provided with a redundant communication data link to interface with the General Manager's control system via ModBus or DNP3.
o. All STG alarms and trips shall be printed out on the Contractor-furnished printers.
p. The control system shall have the capability to store historical data for a usable period of time. The system shall be capable of displaying historical data for analysis and importing to a PC database.

3. STG Protective Relay and Meter Control Panel

a. The Contractor-furnished STG protective relay and meter control panel shall be located in General Manager furnished building. All necessary devices shall be provided to allow STG start-up, manual and auto synchronization, loading, operations, and shutdown from the panel. The control and monitoring requirements shall be organized into functional groups.
b. The following equipment, at a minimum, shall be provided on the control panel. The relay functions described below shall be contained within two independent digital generator protection devices (DGPs), a digital transformer protective device and discrete lockout relays.
c. Relays

1) (1) SEL-300G3 generator protective relay equipped with the additional standard I/O board and the latest firmware version. Associated support

material shall include (2) sets of I.Ls, two USB to RS232 cables, and the latest version of the associated communications software (AcSELerator) and event analysis software (SEL-5601).

AND

(1) Beckwith M3425A multifunction generator protection relay including the comprehensive protection function option, Additional I/O, HMI Module, and Target Module. Associated support material shall include (2) sets of I.Ls., two USB to RS232 cables, and the latest version of the associated communications software (IPScom) and event analysis software (IPSplot Plus).

OR

(1) GE G60 generator protective relay equipped with Enhanced front panel with user programmable buttons, CPU with 10 Base FL, 10 Base-T, RS485 communications and IRIG-B port, 16 standard Inputs, (2) 8 Fast Form C outputs modules, (2) standard 4CT/4VT modules with enhanced diagnostics, (1) 4 Form-A output with 8 digital input module. Associated support material shall include (2) sets of I.Ls., and the latest version of the associated communications software and event analysis software. In addition, logic creation software, ViewPoint Engineer and ViewPoint Maintenance shall also be included.

2) (2) SEL-587 station service transformer protection relays.
3) (1) GE MIV voltage protective relay to detect ground faults between the generator PCB and the GSU low-side terminals.
4) (5) Lockout relays, 86G, 86-1, 86AE, 86T, and 86BF (86BF applicable only to units with a low-side generator breaker as delineated in the attached "Technical Datasheet by General Manager"). Each lockout to be furnished with E-Max RAW coil monitoring with a common alarm to the PCS.
5) States FMS test switches applied to each metering and relay current inputs. Each relay voltage, meter voltage, relay contact, and each relay input shall have one Entrelec test switch,
6) Each normally-open contact on each lockout and tripping relays utilized for tripping and breaker failure initiation shall be wired through an Entrelec test switch. Spare contacts for each lockout relay shall also be wired through individual test switch. This shall be consistent across the four available breaker configurations: low-side generator breaker with single high-side line breaker, low-side generator breaker with dual high-side line breakers, single high-side generator breaker, and dual high-side generator breakers.

d. Meters/Transducers: Listed quantities shall be available to the General Manager's PCS system through the data link between the steam turbine control system and the General Manager's PCS system.

1) 1-Watt-hour Meter with Pulse Initiator
2) 1-Var-hour Meter with Pulse Initiator
3) 1-Watt Transducer
4) 1-Digital Monitor, DM1, with hardware to control system. This meter shall be ION 8600 multi-function meter with the following features and functions;

a) Panel display
b) 1-Generator VAR Output to PCS
c) 1-Generator VAR Import/Export Output to PCS
d) 1-Generator Power Factor Output to PCS
e) 3-Generator Current Output to PCS
f) 3-Generator Voltage Output to PCS
g) 1-Generator Frequency Output to PCS

e. 1-Digital Monitor, DM2, with hardwire to turbine control system:

1) 3-System Voltage Output to turbine control system
2) 1-System Frequency Output to turbine control system

f. 1-Digital Meter, DM4:

1) 1-Generator Field Voltage
2) 1-Generator Field Current
Note: the exciter field ammeter and voltmeter quoted will be analog meters with 4-20 mA outputs to PCS.

g. Transducer Input or connection from an IED to General Manager′s Plant PCS and/or SCADA RTU

1) 1-Generator Voltage, Three Phase
2) 1-Generator Current, Three Phase
3) 1-Generator MW
4) 1-Generator MVAR
5) 1-Generator MW-Hour
6) 1-Generator MVAR-Hour (with both Import and Export MVAR-Hour

h. Automatic Synchronizer System

1) 1-Synchroscope with Lights
2) 1-Automatic Synchronizer, 25
3) 1-Synch Check, 25X

4. Vibration and Rotor Position Monitoring Equipment: Contractor's standard vibration package for tripping the unit shall be provided, however as a minimum, the Contractor shall provide a Bently Nevada Series 3500 monitoring package for supervisory purposes with the following devices:

a. Two (2) radial vibration probes (x and y Proximiters), relative type, on each steam turbine and generator bearing.
b. Two (2) axial position probes on the steam turbine front standard. Two out of three probes must indicate a trip condition before tripping the turbine.
c. Keyphasor probe.
d. One proximiter (probe driver) with calibrated leads for each of the above probes.
e. LCD display.
f. Monitoring system with adjustable alert (alarm) and trip signals shall be provided.
g. 4-20 mA outputs for all radial and axial position signals along with a serial link for data transmission.

5. Instrument and Control Wiring

    a. Reference Section 260000, Electrical Mechanical Equipment

6. Conduit

    a. Reference Section 260000, Electrical Mechanical Equipment.

2.6 FABRICATION

A. Refer to Section 481100 Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.7 SOURCE QUALITY CONTROL

A. Tests and Inspection

1. General

    a. Refer to Section 481100 Combined Cycle Power Island for general source quality control, test, and inspection requirements.
    b. The Contractor shall make all connections required to perform tests in accordance with ASME Performance Test Code (PTC) – Steam Turbines, PTC 6/6.2.
    c. The STG and accessories shall be factory tested following manufacturer's standard procedures. The test procedures shall be submitted to the General Manager for information after contract award, with a summary description of factory testing submitted with the proposal.
    d. All castings and forgings used in the construction of the unit shall be high quality and have necessary casting processing, radiographic testing, magnetic particle inspections, and sonic testing performed that are outlined in applicable ASME/ASTM specifications.

2. Shop Inspections & Testing

    a. The equipment and accessories shall be factory assembled into major components and inspected as required to establish critical fits, clearances, alignment, weld connections, mating surfaces and bolt hole alignment to minimize field adjustments.
    b. Inspection and testing shall be in accordance with the codes specified.
    c. Instruments shall be protected during hydro testing.
    d. Wiring shall be checked for continuity and insulation integrity.
    e. Filters shall be removed for hydro test of filter housing.
    f. Full information describing the tests which are included in the price quotation shall be included with the Proposal.
    g. Certified copies of all the minimum test results shall be submitted for acceptance before shipment of the equipment is made

B. Shop Testing: The STG and accessories shall be factory tested following manufacturer's standard procedures. The test procedures shall be submitted to the General Manager for review. As a minimum, the following tests shall be performed.

1. Factory Hydro Tests

   a. Water jackets, coils, coolers, and shop installed piping shall be hydro tested at 1-1/2 times the design pressure in accordance with ASME B31.1.
   b. Pressure retaining components shall be subject to the hydrotest requirements of ASME B&PV Code, Section 1, Section VIII, or ASME B31.1, Power Piping Code, as applicable. Only the prototype castings of turbine pressure retaining components shall be subject to hydro-testing.
   c. Parts shall not be primed or painted until hydro testing is successfully completed.

2. Factory Rotor Balancing: The fully assembled steam turbine and generator rotors shall be individually statically balanced in the factory. The turbine rotor will be low speed balanced, and vibration level is checked during no-load mechanical running test at shop. Acceptance criteria for the factory balance is as follows:

   a. At rated speed, relative vibration shall not exceed 2.0 mils peak to peak absolute, with shaft mechanical and electrical runout compensation.
   b. Shaft runout shall be measured prior to test acceptance.

3. Steam Turbine Factory Overspeed Testing

   a. The steam turbine rotor shall be overspeed tested at a minimum of 110% of synchronous speed.
   b. The generator rotor shall be overspeed tested at a minimum of 120% of synchronous speed and held for a minimum of 2 minutes.

4. Factory Accessory Testing

   a. The accessory equipment shall be functionally tested in the factory. Contractor and General Manager shall mutually agree on what will be tested.

5. Testing requirements on turbine and associated equipment (minimum)

   a. Stop valves shall be mechanically stroked to prove function and to verify closure speed.
   b. Internal clearances shall be confirmed.
   c. The rotor shall be given a heat stabilization test in a semi-finished state to minimize thermal stresses.
   d. Major rotating parts shall have chemical and physical analysis.
   e. The completed rotor shall be balanced to run smoothly without excessive vibration and operated at 120% rated speed for at least 2 minutes.
   f. The rotor shall be ultrasonically tested.
   g. The materials for rotor and rotating blades shall be magnafluxed or ultrasonically tested prior to finish machining.
   h. Contact checks shall be performed on horizontal and vertical casings, and valve chest cover joints.
   i. The high pressure casing shall be hydraulically tested.

6. Mechanical Testing requirements on the generator equipment (minimum)

    a. Rotor mechanical balance.
    b. Rotor overspeed at 120 percent of rated speed.
    c. Mechanical inspection.
    d. Air leakage test.

7. Electrical Testing requirements on the generator equipment (minimum)

    a. Measurement of cold resistance of armature and field winding.
    b. Insulation resistance measurements with armature at 1000 volts DC and field at 500 volts DC
    c. Armature dielectric test with an AC voltage twice the rated generator voltage plus1000 volts for a period of 60 seconds
    d. Field dielectric test with an AC voltage ten times rated excitation voltage applied for 60 seconds
    e. Calibration test for all temperature sensing elements.
    f. Functional test and calibration for turbine-generator controls.

8. Excitation system shall be tested in accordance with manufacturer's standard tests as described in the proposal.
9. The generator shall be tested, along with the excitation system, at 25%, 50%, 75% and 100% current levels to verify temperature rises.

C. Factory Generator Tests

1. Rotor mechanical balance.
2. Rotor overspeed at 120% of rated speed.
3. Mechanical inspection.
4. Air leakage test.
5. Measurement of cold resistance of armature and field windings.
6. Insulation resistance of stator and rotor windings.
7. High potential tests.
8. Dielectric tests of armature and field.
9. Dissipation Factor Measurement (tan δ) for stator winding after impregnation.
10. 8-hour burn-in runs for each voltage regulator and a 48-hour burn-in test for each rectifier assembly diode. These burn-ins may be accomplished concurrently with other shop tests.
11. Resistance temperature detectors test.
12. Calibration test for all temperature sensing elements.
13. Functional test and calibration test for turbine-generator controls.
14. Stator core iron induction test at 1.0 Tesla or other stator core imperfection test subject to approval by the General Manager. This test is required to verify the absence of hot spots in the core iron stacking and shall be performed after completion of the stacking of the stator core.
15. Excitation system shall be tested in accordance with manufacturer’s standard tests Contractor shall describe these tests in the proposal.
16. The generator shall be tested along with the excitation system at different current levels to verify temperature rises, voltage control parameters, exciter compatibility and other appropriate parameters.

D. Control Board and Software Testing

1. Electrical shop tests shall be made on all control boards. These tests shall include high potential tests on power equipment and operating tests to demonstrate that the equipment functions correctly. Electrical tests shall be made in accordance with ANSI C37-20.
2. Control wiring tests shall include those that are necessary to determine that all instruments, meters, relays, instrument transformers, etc. are correctly wired and function in the specified manner when energized. Each circuit shall be continuity tested. Insulation resistance tests shall be conducted on each circuit (except in circuits containing electronic components); the insulation resistance shall be no less than 25 mega ohms.
3. A Factory Acceptance Test (FAT) shall be performed on the complete software system prior to shipment. Simulated (software) inputs are acceptable during the FAT.

E. Instrument Calibration

1. Refer to Section 481100, Combined Cycle Power Island for instrument calibration requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Painting

1. Refer to Section 481100 Combined Cycle Power Island for general field painting requirements of exposed structural and carbon steel elements.

3.2 FIELD QUALITY CONTROL

A. Tests

1. Refer to Section 480032 Power Island Performance for general field acceptance test requirements.

B. Performance Tests

1. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.
2. The performance test will be carried out to the manufacturer's standards in general accordance with the following internationally recognized standards:

   a. ASME PTC 6/6.2 - Steam Turbines / Steam Turbines in Combined Cycle
   b. ASME PTC 19.1 – Measurement Uncertainty

3.3 COMMISSIONING

A. General

1. Refer to Section 480032 Power Island Performance for general commissioning requirements.

3.4 TRAINING

A. Refer to Section 481100 Combined Cycle Power Island for general training requirements.

END OF SECTION 485221

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

The detailed technical data will be furnished by the Contractor during contract execution. The design will be to manufacturer's standards and will support the power island guarantees and will meet the design life requirements.

Project Configuration	
Number of STG Units	1
Type of Turbine	Condensing, Single Pressure, No Reheat
Exhaust Configuration	Axial
Project Location	Pasadena, CA
Installation Location	Outdoors
Generator Cooling (OAC, TEWAC or Hydrogen)	TEWAC
System Design Parameters	
Generator Power Factor Range	0.85 (lagging) to 0.95 (leading)
Power System Stabilizer Required (Y/N)	N
Synchronization Breakers (One Low Side, One High Side, or Two High Side)	One Low Side provided by Others (BOP Contractor)
Mode of Operation	Daily cycling from off line or minimal load to 100%
Main Steam Admission Control	Sliding Pressure and IPC
Cooling Water Supply Loop (Open/Closed)*	Closed
* Cooling Water Supply Loop Selection Above Indicates the Following Parameters:	
Cooling Water Temperature, °F	83˚F
Cooler Tube Material	316 SS or Titanium
Tubesheet Material	316 SS
Cooler Tube Velocity Range	8-10 ft/sec
Utilities Supplied by General Manager	
Instrument Air	80 psig to 120 psig (See Note 1)
Service Air	80 psig to 120 psig
Three Phase AC Power	4160 V/60 Hz, 480 V/60 Hz

Single Phase AC Power	120 V/60 Hz
DC Power	125 V nominal
Lube Oil Coolers	
1) No. of Coolers Required	2-100% Capacity
2) Tube Side Design Pressure	125 psig
3) Tube Side Design Temperature	150 °F
4) Allowable Tube Side Press. Drop	10 psig
5) Cleanliness Factor	85%
EHC Coolers	
No. of Coolers Required	2-100% Capacity
Generator Coolers	
1) No. of Coolers Required	4-25% Capacity
2) Tube Side Design Pressure	125 psig
3) Tube Side Design Temperature	150 °F
4) Allowable Tube Side Pressure Drop	10 psig
5) Cleanliness Factor	85%
Gland Steam Condenser	
No. of Condensers Required	1-100% Capacity
Cooling Water Source	Condensate
Shell and Waterbox Material	Carbon Steel
Shell/Waterbox Corrosion Allowance	1/8 inch
Tube Material	316L Stainless Steel
Tubesheet Material	316L Stainless Steel
Tube Side Design Pressure	400 psig
Tube Side Design Temperature	200 °F
Allowable Tube Side Pressure Drop at Maximum Turbine Exhaust	5 psig

Note 1: Pneumatic actuators shall be designed to provide adequate torque with 60 psig instrument air pressure.

APPENDIX B – PASADENA GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET

STEAM TURBINE PERFORMANCE TEST		**Test #:**				**Date**			
	Reading #:		**1**	**2**	**3**	**4**	**5**	**6**	**AVG**
	Time:								
	PARAMETER	**UNITS**							
1	ST GROSS GENERATION	MW							
2	ST NET GENERATION	MW							
3	ST AUX. LOADS	KW							
4	GENERATOR POWER FACTOR	%							
5	STEAM FLOW	Klbs/hr							
6	FEEDWATER FLOW	Klbs/hr							
7	SPRAY FLOW	Klbs/hr							
8	STEAM TO CONDENSER	Klbs/hr							
9	STEAM TO GLAND SEAL CONDENSER	Klbs/hr							
10	PRESSURE ENTERING ST	PSIG							
11	STEAM PRESS BEFORE SPRAY	PSIG							
12	TURBINE REACTION PRESSURE	PSIG							
13	CONDENSER ABSOLUTE PRESURE	"Hg							
14	BAROMETRIC PRESSURE	"Hg							
15	MAIN STEAM TEMPERATURE	^{o}F							
16	STEAM TEMP. BEFORE SPRAY	^{o}F							
17	STEAM TEMP. AFTER SPRAY	^{o}F							
18	EXHAUST TRUNK TEMP.	^{o}F							
19	CONDENSATE HOT WELL TEMPERATURE	^{o}F							
20	CONDENSATE TEMP. ENTR OTSG	^{o}F							
21	ENTHALPY OF STEAM ENTR CONDENSER	Btu/lb							
22	CONDENSER LOAD	MMB-tu/Hr							
23	AMBIENT AIR DB TEMPERATURE	^{o}F							
24	AMBIENT AIR WB TEMPERATURE	^{o}F							
25	RELATIVE HUMIDITY	%							
26	CIRC. WATER TEMP.ENT. CONDENSER	^{o}F							
27	CIRC. WATER TEMP.LVG.CONDENSER	^{o}F							
28	CIRC. WATER FLOW TO CONDENSER	GPM							
29	CONDENSATE PUMP DISCH. PRESSURE	PSIG							
30	CIRC. WATER PRESS ENTR CONDENSER	PSIG							
31	CIRC. WATER PRESS.LVG.CONDENSER	PSIG							
32	ΔP THROUGH CONDENSER	PSIG							
33	STEAM RATE CORR TO SPC. OPER COND	Lbm/KW h							
34	GEN OUTPUT CORR TO SPC. OPER COND	KW							

APPENDIX C – TECHNICAL DATASHEET BY CONTRACTOR
Data to be furnished during project execution.
Contractor furnished data and information is included in this specification to describe the general design, interface characteristics and construction features of Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by the General Manager are the sole responsibility of Contractor.

Item	Description	Units	Technical Data (Contractor to fill in)
1.0	**Steam Turbine Design Data**		
1.1	Type		
1.2	Model		
1.3	Number of Stages		
1.4	Last Stage Bucket Length	in.	
1.5	Pitch Diameter at Last Stage Wheel	in.	
1.6	Annulus Area	sq. ft.	
1.7	Annulus Velocity	ft/s	
1.8	Maximum LP Exhaust Flow	lb/hr	
1.9	Maximum Back End Moisture	%	
1.10	Exhaust Back Press. (Alarm)	in. HgA	
1.11	Exhaust Back Pressure (Trip)	in. HgA	
1.12	Exhaust Diameter	ft.	
1.13	Exhaust Hood Design Pressure	psia	
1.14	Critical Speeds (Coupled, Damped):		
1.14.1	First	rpm	
1.14.2	Second	rpm	
1.15	Critical Speeds (Uncoupled, Rigid)		
1.15.1	First	rpm	
1.15.2	Second	rpm	
1.16	Vibrational Amplitude		
1.16.1	Normal	mils	
1.16.2	Alarm	mils	
1.16.3	Trip	mils	
1.17	Journal Bearing Metal Temperatures		
1.17.1	Normal	°F	

Item	Description	Units	Technical Data (Contractor to fill in)
1.17.2	Alarm	°F	
1.17.3	Trip	°F	
1.18	Thrust Bearing Metal Temperatures		
1.18.1	Normal	°F	
1.18.2	Alarm	°F	
1.18.3	Trip	°F	
1.19	Steam Inlet Conditions		
1.19.1	Main steam supply pressure	psia	
1.19.2	Main steam supply temperature	°F	
2.0	**Main Steam Stop Valve(s)**		
2.1	Number		
2.2	Material		
2.3	Design Pressure/Temperature	psia/°F	
2.4	Hydrostatic Test Pressure (field steam piping hydro-testing & prototype testing only)		
2.4.1	Shell Test	psig	
2.4.2	Seat Test	psig	
2.5	Size/Connection Type (Flanged or Welded)		
2.6	Valve Trim Materials		
2.6.1	Disc		
2.6.2	Seat		
2.6.3	Stem and Bushing		
2.7	Valve Operation Description		
2.8	Closure Time	sec	
3.0	**Main Steam Control Valve(s)**		
3.1	Number		
3.2	Material		
3.3	Design Pressure/Temperature	psia/°F	
3.4	Hydrostatic Test Pressure (field steam piping hydro-testing & prototype testing only)		

Item	Description	Units	Technical Data (Contractor to fill in)
3.4.1	Shell Test	psig	
3.4.2	Seat Test	psig	
3.5	Size/Connection Type		
3.6	Valve Trim Materials		
3.6.1	Disc		
3.6.2	Seat		
3.6.3	Stem and Bushing		
3.7	Valve Operation Description		
3.8	Closure Time, seconds		
4.0	**IP Admission Stop Valve(s)**		Not applicable
4.1	Number		Not applicable
4.2	Manufacturer/Model		Not applicable
4.3	Type		Not applicable
4.4	Material		Not applicable
4.5	Design Pressure/Temperature	psig/°F	Not applicable
4.6	Size/Connection Type		Not applicable
4.7	Valve Trim Materials		Not applicable
4.7.1	Disc		Not applicable
4.7.2	Seat		Not applicable
4.7.3	Stem		Not applicable
4.8	Valve Operation Description		Not applicable
4.9	Closure Time	sec	Not applicable
5.0	**IP Admission Control Valve(s)**		Not applicable
5.1	Number		Not applicable
5.2	Manufacturer/Model		Not applicable
5.3	Type		Not applicable
5.4	Material		Not applicable
5.5	Design Pressure/Temperature	psig/°F	Not applicable
5.6	Size/Connection Type		Not applicable
5.7	Valve Trim Materials		Not applicable
5.7.1	Disc		Not applicable

Item	Description	Units	Technical Data (Contractor to fill in)
5.7.2	Seat		Not applicable
5.7.3	Stem		Not applicable
5.8	Valve Operation Description		Not applicable
5.9	Closure Time	sec	Not applicable
5.10	**LP Admission Stop Valve(s)**		Not applicable
5.11	Number		Not applicable
5.12	Manufacturer/Model		Not applicable
5.13	Type		Not applicable
5.14	Material		Not applicable
5.15	Design Pressure/Temperature	psig/°F	Not applicable
5.16	Size/Connection Type		Not applicable
5.17	Valve Trim Materials		Not applicable
5.17.1	Disc		Not applicable
5.17.2	Seat		Not applicable
5.17.3	Stem		Not applicable
5.18	Valve Operation Description		Not applicable
5.19	Closure Time	sec	Not applicable
6.0	**LP Admission Control Valve(s)**		Not applicable
6.1	Number		Not applicable
6.2	Manufacturer/Model		Not applicable
6.3	Type		Not applicable
6.4	Material		Not applicable
6.5	Design Pressure/Temperature	psig/°F	Not applicable
6.6	Size/Connection Type		Not applicable
6.7	Valve Trim Materials		Not applicable
6.7.1	Disc		Not applicable
6.7.2	Seat		Not applicable
6.7.3	Stem		Not applicable
6.8	Valve Operation Description		Not applicable
6.9	Closure Time	sec	Not applicable
7.0	**Construction Details**		

Item	Description	Units	Technical Data (Contractor to fill in)
7.1	Cylinder Method of Fastening		
7.2	Blading		
7.3	Blade Material		
7.4	Stages Fitted with Stellite Shields		
7.5	Protective Coatings, Coating/Stage		
7.5.1	Nozzle Protective Coatings		
7.6	Shaft Seal		
7.6.1	Type		
7.6.2	Material		
7.7	Journal Bearings (Turbine)		
7.7.1	Location and Number		
7.7.2	Type		
7.7.3	Diameter	in.	
7.8	Thrust Bearing		
7.8.1	Location		
7.8.2	Type and Size		
7.8.3	Thrust Rating		
7.8.4	Calculated Thrust, Maximum		
7.9	Turbine Anchor Point, Location		
7.10	Main Steam Valve Loop Piping		
7.10.1	Size		
7.10.2	Material		
8.0	**Governor Design Data**		
8.1	Location		
8.2	Type		
8.3	Manufacturer		
8.4	Model Number		
8.5	STG Maximum Speed Rise at Full Load Rejection	% Sync	
8.6	STG Overspeed for Emergency Governor Action	% Sync	
9.0	**Lube Oil System Data**		

Item	Description	Units	Technical Data (Contractor to fill in)
9.1	Reservoir Capacity	gal	
9.2	Reservoir Retention Time	min	
9.3	Main Lube Oil Pumps		
9.3.1	Number		
9.3.2	Motor Horsepower	hp	
9.3.3	Rated Capacity	gpm	
9.4	Emergency Lube Oil Pump		
9.4.1	Number		
9.4.2	Motor Horsepower	hp	
9.4.3	Rated Capacity	gpm	
9.5	Lube Oil Coolers		
9.5.1	Number		
9.5.2	Type		
9.5.3	Required Cooling Water Flow Rate (Max degrees F water temp.)	gpm	
9.5.4	Tube Side Pressure Drop at Above Flow Rate	psi	
9.5.5	Tube Material		
9.5.6	Tube Diameter	in.	
10.0	**EHC Fluid Delivery System Data**		
10.1	EHC Pumps		
10.1.1	Number		
10.1.2	Motor Horsepower, hp	hp	
10.2	EHC Coolers		
10.2.1	Number		
10.2.2	Type		
10.2.3	Motor Horsepower, hp	hp	
10.2.4	Tube Side Pressure Drop at Above Flow Rate, psi	psi	
11.0	**Generator Design Data**		
11.1	Manufacturer/Model		
11.2	Output Voltage	V	

Item	Description	Units	Technical Data (Contractor to fill in)
11.3	Speed	rpm	
11.4	Continuous Rating @ Maximum Ambient Temperature	MVA	
11.5	Cooling Means		
11.6	Grounding		
11.7	Vibrational Amplitude		
11.7.1	Normal	mils	
11.7.2	Alarm	mils	
11.7.3	Trip	mils	
11.8	Journal Bearing Metal Temperatures		
11.8.1	Normal	°F	
11.8.2	Alarm	°F	
11.8.3	Trip	°F	
11.9	Short Circuit Ratio		
11.10	WR^2 Rotor		
11.11	Generator Efficiency (@ Rated PF)		0.85/.90
11.11.1	100% Load	%	
11.11.2	75% Load	%	
11.11.3	50% Load	%	
11.12	Generator Coolers		
11.12.1	Number		
11.12.2	Type		
11.12.3	Required Cooling Water Flow Rate (Max degrees F water temp.)	gpm	
11.12.4	Tube Side Pressure Drop at Above Flow Rate	psi	
12.0	**Exciter**		
12.1	Manufacturer/Model		
12.2	Type		
12.3	Rated Capacity	kW	
13.0	**Voltage Regulator**		
13.1	Manufacturer/Model		

Item	Description	Units	Technical Data (Contractor to fill in)
13.2	Type		
14.0	**Weights**		
14.1	Total Assembled Weight of Turbine	lb	
14.2	Turbine Rotor	lb	
14.3	Upper Casing	lb	
14.4	Total Assembled Weight of Generator	lb	
14.5	Generator Rotor	lb	
14.6	EHC Fluid Delivery Skid	lb	
14.7	Lube Oil Skid	lb	
14.8	Shaft Sealing System Skid	lb	
14.9	Gland Evacuation Skid	lb	
14.10	Heaviest Component to be Handled During Erection		
14.10.1	Component		
14.10.2	Weight	lb	
14.11	Heaviest Component to be Handled During Maintenance		
14.11.1	Component		
14.11.2	Weight, lb	lb	
14.12	Method of Delivery for Steam Turbine Rotor and Generator (truck or rail)		
14.13	Degree of Shop Assembly for HP and LP Steam Turbines		
14.14	Degree of Shop Assembly for Generator		
14.15	Estimated Field Erection Hours	hrs	

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485222
Gas Turbine Generator
(Aeroderivative)

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 485222
Gas Turbine Generator
(Aeroderivative)

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *BRIAN HRITSCO*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/25/2011	B. Hritsco	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
05/04/2012	T. Clark	E
06/15/2012	G. Harwood	F
10/04/2012	G. Harwood	G
09/10/2013		H – CONTRACT VERSION

SECTION 485222
GAS TURBINE GENERATOR (AERODERIVATIVE)

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 3
1.5 CODES AND STANDARDS 4
1.6 DEFINITIONS 4
1.7 SYSTEM DESCRIPTION 4
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 6
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 6
1.11 SITE CONDITIONS 6
1.12 WARRANTY 6

PART 2 - PRODUCTS 6

2.1 MATERIALS AND WELDING 6
2.2 EQUIPMENT 6
2.3 OPTIONAL FEATURES 9
2.4 COMPONENTS 10
2.5 ELECTRICAL COMPONENTS 14
2.6 INSTRUMENTATION AND CONTROLS COMPONENTS 18
2.7 ACCESSORIES 23
2.8 FABRICATION 23
2.9 SOURCE QUALITY CONTROL 23

PART 3 - EXECUTION 24

3.1 INSTALLATION 25
3.2 FIELD QUALITY CONTROL 25
3.3 COMMISSIONING 25
3.4 TRAINING 25

APPENDIX A – TECHNICAL DATASHEETS BY GENERAL MANAGER 26

APPENDIX B – PASADENA GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET 27

APPENDIX C – TECHNICAL DATASHEETS BY CONTRACTOR 30

SECTION 485222
GAS TURBINE GENERATOR (AERODERIVATIVE)

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of an aeroderivative gas turbine generator (GTG). It is not the intent to specify completely herein all details of design and construction of the gas turbine generator and its related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification as defined in Division of Responsibilities in Attachment 1. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Packaged aeroderivative gas turbine with totally enclosed water to air cooled (TEWAC) generator and standard accessories including a heated and ventilated enclosure for outdoor installation. Water temperature to the TEWAC generator shall vary based on ambient or inlet chilling conditions to account for turbine output power capability. For chilling to 48 °F inlet temperature from an ambient of 113 °F, TEWAC cooling water temperature of 85 °F maximum shall be required. For low ambient temperature (17 °F) the water temperature inlet to TEWAC cooler shall be maximum 80 °F. TEWAC water temperature vs. Power output diagram (HEP 31210) shall be provided.
2. Inlet air filtration system, intake silencer and interconnecting ductwork
3. Inlet air filter house and inlet duct support structure including ladders and platforms
4. Fuel gas system (GTG fuel gas module) including final filter
5. Optional systems identified on attached datasheets as described in this Section with segregated pricing for each optional system
6. Fuel gas metering and throttle control valves for GTG control system
7. Compressor water wash system suitable for both on-line and off-line water wash
8. Hydraulic Lubricating oil system
9. Turbine lube oil and Generator/gearbox lube oil systems
10. Turbine starting system and gearbox turning gear assembly
11. GSU transformer
12. Brushless excitation system
13. Line termination hardware and cubicle (CTs, VTs, surge arresters)
14. Neutral grounding equipment (neutral grounding transformer)

15. Microprocessor based control system with one local and four remote HMI units, protocols for bidirectional communication with plant PCS system
16. Gas turbine and generator supervisory instrumentation and protective devices with the means to interface with balance of plant control system via Modbus over TCP/IP communication link
17. Gas turbine generator outdoor weather enclosures including ventilation fans, lighting, and electrical receptacles
18. GTG Contractor shall furnish design information for BOP Contractor supplied motor control centers, batteries, and chargers normally supplied in a PCM, to be installed in a PDC by the Balance of Plant Contractor. GTG Turbine Control Panel physical layout is provided.
19. Fire protection system with associated detection and alarms
20. Sole plates needed for supplied generator/gearbox for GTG
21. All piping, raceway, and wiring contained within or supported by the GTG bases and associated auxiliary system skids
22. Wiring and conduit within or mounted on Contractor supplied equipment enclosures or skids (wiring, cables, and ducts, etc. to electrical motors to be limited to terminal box on individual skid)
23. Interconnect hoses between main unit and auxiliary skid
24. Shear lugs required for seismic restraint
25. On-skid Instrument air piping and actuators
26. Noise mitigation measures to achieve requirements defined in Section 480031, Combined Cycle Power Island Noise Control Performance
27. Special tools and lifting devices (one set of turbine lifting equipment and generator rotor withdrawal equipment for use with an overhead crane) required for assembly and disassembly of equipment furnished under this specification
28. Field advisory services including field support, installation support, start-up support, commissioning support, and training
29. Start-up spare parts and consumables
30. Submittal documents required in this Section as defined in Attachment 11
31. Cleaning and finishing prior to shipment
32. Finish paint of all enclosures, ducting and inlet filter house
33. Static testing at factory and signoff reports of the results with onsite witness by the General Manager
34. All required correction curves to verify performance at off design conditions using Deck Transfer correction methodology, a model based correction procedure using the APPS program.
35. A GTG performance degradation curve showing degradation from “New & Clean” conditions from 0 to 1000 fired hours in 50 hour increments
36. Manuals and drawings to support balance of plant design, installation, operation, and maintenance of the specified equipment as defined in Attachment 11
37. Signoff reports and quality plan listed in this Section
38. Priced list of recommended spare parts for two years of operation
39. Packing and shipment DDP to the Glenarm Power Plant jobsite in the city of Pasadena, CA.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Receipt, off-loading, storage, protection of equipment at General Manager's designated delivery point, and erection of equipment at the plant site
2. Foundations, anchor bolts/nuts, standard embedments, and grout
3. Plant Control System (PCS)
4. Power and control raceway, wiring, instrument tubing, and pneumatic supply piping external to GTG bases and auxiliary equipment skids, including all interconnect wiring between Contractor supplied equipment
5. Fuel gas supply, pressure control and conditioning equipment, except for GTG fuel gas filter
6. Drains and/or vent piping from the gas turbine package to a remote discharge point
7. Site grounding
8. Lightning protection
9. Load management/load shedding system
10. Automatic Isochronous load sharing Control
11. Power systems study
12. Compressed, filtered, and dried instrument air supply to common connection point
13. Initial fill of lube oil, control oil, all gases, all water and all dry fire fighting chemicals
14. Field performance testing
15. All control room furniture required for Contractor supplied terminals, keyboards, and printers
16. Electrical distribution between the generator, generator circuit breaker, and step-up transformer
17. Current transformers (CTs) and voltage transformers (VTs) not integral to the generator and terminal compartments
18. Insulation and heat tracing of Contractor supplied piping as detailed in the Contractor's insulation and heat tracing drawings
19. Initial fuel gas filter/separator, dew point heating, and piping up to the GTG fuel gas filter and piping from GTG fuel gas filter to GTG skid
20. Generator circuit breaker and low voltage power source feeder
21. Utilities as delineated in the "Technical Data By General Manager"
22. Demineralized water treatment plant, storage tank and supply system up to the inlet of the NOx water injection system, at the water wash system, and the SPRINT skid.
23. Cathodic protection

1.4 RELATED SECTIONS

A. Section 260000, Electrical Mechanical Equipment (LM6000 standard electrical mechanical equipment design is provided in Contractor's scope of supply.)

B. Section 262050, Low Voltage Motors (LM6000 standard design motors are provided in Contractor's scope of supply.)

C. Section 480020, Site Conditions

D. Section 480031, Combined Cycle Power Island Noise Control Performance

E. Section 481100, Combined Cycle Power Island

F. Section 485471, Inlet Air Chiller

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. IEEE

   a. C50.13 - Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above

2. American Society of Mechanical Engineers (ASME)

   a. PTC 22 - Gas Turbines (with Contractor comments)

3. International Organization for Standardization (ISO)

   a. 2314 - Gas turbines : Acceptance tests (with Contractor comments)

4. National Fire Protection Association (NFPA)

   a. 12 - Carbon Dioxide Extinguishing Systems

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Reference Section 481100 Combined Cycle Power Island for general design requirements and expected operating profile.
2. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling of each GTG from off-line to full load.

B. Performance Requirements

1. The GTG and accessories shall be mechanically capable of continuous, unrestricted operation (up to the engine mechanical power limitation) over the specified ambient temperature range and from approximately 20% to full load with properly supplied cooling water to the generator.
2. The GTG shall be capable of operating within the specified emissions concentration levels over the specified ambient temperature from 25% to 100% plant load. The Contractor's proposal shall include complete information regarding part load emissions capabilities for the specified ambient temperature range.
3. The GTG shall be designed for operation on the fuel(s) described in Section 480020, Site Conditions which shall meet Contractor's gas fuel spec MID-TD-0000-1 in Attachment 10. The Contractor shall provide detailed fuel specifications to ensure fuel composition and supply flows and pressures are met.
4. The generator shall be rated at nameplate 0.85 power factor, 13.8 kV at 80 °F water temperature where output is greater than the gas turbine capability at all operating conditions.
5. The Contractor shall guarantee the gross power output of the combined cycle plant on a LHV and HHV basis at site design conditions and the ambient temperature stated in Section 480020, Site Conditions, as stated in Attachment 6.
6. Heat rate and gross power output guarantees shall be made at the injection water flow rates and other applicable operating parameters required for meeting exhaust gas emission concentration and mass flow rate guarantees, as stated in Attachment 6.
7. Noise emissions shall meet requirements of Section 480031, Combined Cycle Power Island Noise Control Performance, as stated in Attachment 6.
8. Contractor shall guarantee that the gas turbine generator package shall meet the specified noise criteria when tested in accordance with ASME PTC 36 and/or ASME B133.8, as stated in Attachment 6.
9. Contractor shall state water injection flow rates and the exhaust gas emission rates for NOx, CO, Volatile Organic Compound (VOC), Total Suspended Particles (TSP), PM-2.5, PM-10 and SOx for each of the load conditions specified. Maximum emission rates for the fuel gas firing in ppmvd (at 15% excess O2 averaged over one hour) and lb/hr, over the range of operating conditions at the stated water flow rates shall be guaranteed, as stated in Attachment 6.
10. Contractor shall provide available data hazardous air pollutant (HAP) regulated under 40 CFR Part 63 and toxic air pollutant regulated under state of California and South Coast Air Quality Management District for each of the load conditions specified over the range of operating conditions at the stated water flow rates, as stated in Attachment 6.
11. The vendor shall provide the load level at which water injection begins over the range of site conditions and the range of operating conditions, as stated in Attachment 6.

C. Reliability

1. No single failure of a GTG auxiliary component or system (lube oil pump, GTG enclosure fans, etc.) shall result in GTG damage. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure in Contractor's Cause & Effect matrix drawing 969149.

1.8 SUBMITTALS

A. Refer to Attachment 11

1.9 QUALITY ASSURANCE

A. GTG manufacture shall be ISO 9001:2008 certified facility. The Quality Management system is applicable to design, manufacturing, factory repair/refurbishment, and project management of installation and commissioning of Aeroderivative gas turbine generators. Contractor shall supply the GTG equipment in accordance with its Quality Procedures

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping
   1. GTG package preparation for shipping will be per Contractor packaging and shipping standards.
   2. The gas turbine generator and accessories shall be packaged for shipment to allow for outdoor storage as prescribed by Contractor for a period of six months without damage from dust, sun, wind, or rain. Contractor to notify General Manager for the crates which requires indoor storage. Preparation for shipment shall be provided as per Contractor's standard procedure:

      a. Equipment to be completely free of water prior to packaging for delivery.
      b. Unpainted surfaces to be protected from weather with weather tight and weatherproof covers. Machined surfaces shall be coated for protection.
      c. Lifting and support points shall be clearly identified.
      d. Packages shall be identified with items, purchase order number, and item descriptions. Identifying tags shall be corrosion and weather resistant.
      e. Temporary bracing and covers shall be provided wherever required.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Contractor's structural welding and fabrication shall be performed in accordance with AWS D1.1 to include inspections. Contractor's Quality Assurance weld inspection specification shall meet or exceed all requirements stated in AWS D1.1 for all NDE methods, including visual. All visual weld inspections shall be performed by AWS certified weld inspectors. .

2.2 EQUIPMENT

A. Main GTG Package

1. The gas turbine shall be an aero-derivative type unit, capable of operating in simple or combined cycle as specified in the datasheet attached to the end of this Section. The gas turbine shall operate continuously at base load as defined in Section 481100, Combine Cycle Power Island over the range of ambient conditions and using the fuels specified and meet Contractor's gas fuel specification MID-ID-0000-1 in Attachment 10.
2. The gas turbine shall provide efficient and reliable service throughout the range of operating conditions and environmental requirements as defined in Section 481100, Combine Cycle Power Island. Reliability, prompt starting, ease of operation and a minimum of maintenance attention are primary considerations, and the rating and model size chosen by the Contractor shall reflect this.
3. The gas turbine generator package, as specified herein shall be completely engineered, designed, and an assembled array of equipment components and modules. The components and modules shall be designed, manufactured, and constructed of materials as required by the application for performance, reliability and maintenance.
4. The compressor, combustion system, and turbine shall meet the design criteria specified in ASME B133.2, "Basic Gas Turbine." This shall include lateral and torsional critical speed analysis of the combined turbine and generator. The Contractor is not required to submit lateral and torsional critical speed analysis reports; however these reports shall be presented for review at Contractor's facility after contract award, if requested specifically.
5. The gas turbine may be directly coupled to the generator, via a reduction gear.
6. Rating

    a. Prototype or first time designs are not acceptable. The gas turbine generator model must have demonstrated experience for a minimum of two years operation. Operation experience may be applied to modifications to an established model or family of models that are shown to meet the stated requirements with improved performance (lower heat rate, higher output, etc). The Contractor shall be prepared to provide, upon request, evidence of specific locations where the model and components have the required two years experience.
    b. The gas turbine generator shall be designed for safe and reliable operation at all load conditions and with the range of environmental conditions and fuels specified. The various operations include cold start-up or immediate restart after coast down including synchronization and loading to full capacity.
    c. Exhaust and noise emission requirements shall be met at all specified loads and operating scenarios, as stated in Attachment 6.

7. Blading

    a. The blading and disks of the compressor/turbine shall be designed to be free from resonant vibrations in the normal speed range up to over speed and shall withstand thermal transients without distortion, creep or incremental damage.
    b. The blading shall also be resistant to pitting, corrosion, erosion, crystallization, creep, or other.

8. Combustion Chambers

    a. The combustion chambers shall be designed to accommodate thermal expansion without imposing loads on adjacent parts and shall be mounted so that they can be easily inspected when necessary. The gas temperatures of all combustion chambers shall be closely matched.

b. Automatically operated igniters shall be provided for the burners. The igniters shall be designed for maximum reliability, and their operation shall be automatic. Redundant ignition devices shall be provided.
c. Flame failure detection and automatic cut off the fuel supply in the event of fuel failing to ignite on startup shall be part of the GTG control system and shall be as per defined in Contractor's position paper #60. Also, in the event of fuel failing to ignite on startup, means shall be provided for automatically purging all unburned gaseous fuel from the gas turbine generator.

9. Casing and Rotors

a. Although Compressor Blade maintenance can be accomplished in the package, our engines shall be designed for removal from the package for maintenance on an as needed basis. LPT Module maintenance is planned at the periodic overhauls at Contractor's depot. Refer to Attachment 16 for maintenance detail.
b. Ports shall be provided in the compressor/turbine sections to permit radial inspection of the interior by means of a Borescope.

10. Speed

a. The gas turbine generator shall be designed to have an adequate margin of safety when run 15% above design.

11. Shafts

a. Running surfaces inside bearings shall be polished

12. Seals

a. Arrangements shall be made where possible to enable the compressor/turbine seals to be examined and replaced without the necessity of dismantling the casings. The design shall provide for no gas leakage from seals into enclosures.

13. Bearings

a. Bearing housings shall be horizontally split and designed to allow bearing inspection and replacement The bearings shall be accessible for inspection and repair without moving major components, such as inlet duct or silencer.
b. The main bearings shall be designed consistent with the requirements for continuous service. Guards and shields shall be provided to protect personnel from rotating shafts. The bearing housing shall prevent oil vapors from leaking out and air from leaking in.
c. Hydrodynamic radial and thrust bearings shall be supplied for generator. The radial bearings shall have replaceable pads. The thrust bearing shall be tilting pad, adjustable type for axial positioning of the rotor. Two vibration detectors are mounted 90° apart at each radial bearing (Total 4).
d. For generator bearings, dual element RTDs in the bearing metal and in the oil drain lines provide bearing temperature sensing.
e. Sight glasses shall be located on all generator/gearbox bearing drains and shall be easily read and accessible. GTG shall include ball and roller bearings taking radial and thrust loads.

14. Enclosures

a. The gas turbine and various accessories shall be housed in acoustical enclosures. The unit shall be designed and packaged into fully integrated, compact modules with provisions for in-package maintenance. All auxiliary skids and electrical cabinets located outdoors shall be weather proofed suitable for the ambient conditions and shall meet the sound level requirements delineated in Section 480031, Combined Cycle Power Island Noise Control Performance. All gauges and manual valve operators shall be accessible.
b. Adequate clearance shall be provided for all passageways inside the modules.
c. Gas turbine generator enclosures that have a walk-in area around the gas turbine generator shall be provided with walkways, adequate lighting, valves and instruments as required for routine operations and maintenance.
d. Turbine, generator/gearbox and auxiliary skid enclosures shall be provided with heaters and 100% redundant ventilation fans.
e. Air ducts shall be easily disassembled and independently supported and arranged so that the amount of ductwork that must be removed for gas turbine generator maintenance is minimized. Any conduit requiring removal to access removable maintenance roof panels shall include quick disconnects. No conduit, piping, air ducts, or accessories shall be mounted on removable panels.
f. Ventilation dampers shall automatically close upon actuation of the fire protection system. The dampers shall be capable of manual testing.
g. Remote temperature monitoring of the turbine compartment shall be provided for elevated temperatures
h. Turbine, generator/gearbox enclosures having any type of automatic CO2 fire system shall be provided with a secondary means of emergency egress.
i. Enclosures shall be designed such that adjoining panels and otherwise exterior mating surfaces are gasketed sufficiently to prevent the intrusion of rain water. Where gasketing is impractical or impossible, enclosure shall be designed for and Contractor shall include weatherproof sealant or caulking that is compatible with the materials on which it is to be applied and the environment to which it will be exposed.

2.3 OPTIONAL FEATURES

A. Inlet Air Chilling Coils

1. Inlet air chilling coils shall be provided for each GTG to increase power output during warm ambient conditions.
2. In the chiller system, chilled water circulates through tube coils within the inlet combustion air flow stream.
3. The design shall include sufficient heat transfer capacity to lower the inlet combustion air temperature to the design minimum during the highest ambient temperature conditions specified in Section 480020, Site Conditions. Adequate temperature measurement shall be provided in the inlet air duct to monitor compressor inlet air temperature.
4. The inlet air chilling coil controls as required shall be self contained and capable of data communications interface to the PCS. Capability for remote start/stop of the chiller systems from the plant control system (PCS) is required. Control devices required to perform the automatic and remote control functions of the chiller system shall be included.

B. Water Injection System

1. Control of NOx emissions by water injection shall be based on maintaining a predetermined water to fuel ratio for gas fuel. The water to fuel ratio shall be field adjustable and shall be set based on emissions performance tests.
2. Water injection pumps shall be two 100 % installed capacity pumps, with stainless steel wetted parts. Piping, valves and tube fittings shall be stainless steel. Furnish and install flow bypass check valves.
3. Temperature sensor, flow transmitter, flow metering and controls shall be furnished and installed, incorporating Contractor's standard features for regulation of flow for NOx control. Provide temperature and flow signals to the plant distributed monitoring and control system via Modbus TCP/IP communication link.
4. Water injection equipment shall be skid-mounted, packaged in a weather tight, heated, well lit enclosure with insulation.

2.4 COMPONENTS

The following descriptions include minimum requirements for auxiliary combustion gas turbine systems when provided with the GTG.

A. Inlet Air Filtration and Duct System

1. The self cleaning pulse type inlet air filtration and duct system shall be Contractors standard design comprising of air filtration barrier filters, ducting, guide vanes, silencers, internal lighting and all necessary controls and instruments for the safe and efficient operation of the system. The inlet air filtration and duct system shall at a minimum include the following components, in the direction of the airflow:

    a. Stainless steel wire trash/bird screen
    b. Galvanized (phosphatized / bonderized) and one coat painted steel weather hood
    c. 2-coat painted system over carbon steel construction filter house
    d. Inlet air chilling coils
    e. Inlet filter house 2-coat painted carbon steel plenum
    f. Transition section from filter house to silencer 2-coat painted carbon steel, interior and exterior.
    g. Inlet silencer assembly with 304 stainless steel liner (combustion section)(includes 316 stainless steel transition duct on expansion joint)
    h. The ductwork includes the nylon "last chance" (trash) screen
    i. Stainless steel inlet volute

2. The inlet air filtration system shall include the following components and functionality:

    a. The air filtration shall limit the ingestion of airborne sand and dust into the GTG with more than 99.9% removal of all particles 5.0 microns and larger. A two or three tier arrangement self cleaning filter housing shall be provided to reduce the filter housing foot print area. The filtration system shall be a pulse-jet self cleaning type generally complying with OEM specifications which are applicable to the site conditions.

b. The air to media velocity, filter efficiency shall be based on ARMCO specifications. The initial pressure drop of the system with chilling coils is estimated at 5.0 inch of WC.
c. Contractor provided instrument air system will be used for pulse cleaning during the turbine outage.
d. The air filter controls as required shall be self contained .

3. Contractor's standard 2-coat paint system shall be utilized.
4. The inlet air filtration and duct system shall be supported by Contractor's supplied structural steel based on an outdoor application. Necessary platforms and ladders shall be provided.
5. Although some contingencies in the air filter design that allow for the addition of miscellaneous small loads (such as site conduit runs, etc.). The inlet system is not designed to support more significant loads, such as the chiller coil supply and return piping not in Contractor's scope of supply, without a detailed understanding of the piping configuration and a complete re-analysis of the system. The coil header flanges are not designed to take any load from the City's piping runs.
6. Single stage pulse filter shall be provided. The weather hood provides a deflecting surface to prevent driving rain and snow from entering the filter house. In addition, paper, leaves and wind-blown trash are blocked by the inlet screen. The high-efficiency conical and cylindrical pulse filter elements (provided as a pair) are mounted to a vertically oriented dirty-to-clean air separation sheet ("tube sheet") within the pulse filter modules. The pulse filter removes more than 99.9% of all particles 5.0 micron and larger.
7. The weather hood shall be acoustically lagged.
8. The total estimated inlet air filtration and duct system total pressure loss with chilling coils (at conditions listed on Contractor's guarantee sheet) for loads up to base load is estimated at 5.0 inches of WC.

B. Fuel Gas System

1. Main components for fuel gas system shall include:

a. Final fuel gas filters and strainers
b. Primary and secondary fuel gas shutoff valves
c. Fuel gas control valve and metering valves at GTG module
d. Fuel gas manifolds internal to Contractor supplied enclosures
e. Associated instrumentation (transmitters, thermocouples, and gages)

2. Contractor shall provide one fuel gas flow transmitter for the GTG. Accuracy of the gas flow meter shall be rated at +/-1.0%, but capable of being calibrated in the range of 0.5% to 0.8%. CEMS receives the fuel gas flow via Modbus over Ethernet TCP/IP communication link.

C. Starting Unit

1. A GTG starting system shall be provided by the Contractor. The system shall be capable of rotating the turbine for starting and water washing. It shall be suitable for extended operation at purge, startup, accelerated cool down and compressor cleaning speeds.
2. The system shall be directly operated by AC electric motor with a hydraulic pump and include necessary peripheral equipment for operation.

3. The starting system shall include automatic control features and such additional equipment as is necessary to ensure reliable starting capability in the shortest possible time.
4. The starting sequence shall incorporate a period for purging the gas path of any dangerous fuel/air mixture and drain the system of any un-ignited fuel. Protection shall be built into the sequence so that in the event of an abortive start another start cannot be attempted until conditions are safe to do so.

D. Lube Oil System

1. A complete separate turbine and generator/gearbox lubricating oil systems shall be provided by the Contractor including oil pumps, coolers, strainers, filters, heaters, interconnecting hoses, valves, instrumentation and oil reservoir.
2. The reservoir shall be provided with a self-contained thermostatically controlled immersion heater. The lube oil reservoir level shall be measured locally with a level transmitter provided for control room indication.
3. The lube oil reservoir shall be constructed of 304 stainless steel.
4. 2x100% capacity redundant lube oil AC pumps shall be provided for the generator/gearbox lube oil system. One positive displacement lube oil pump shall be provided for the turbine lube oil system. Two redundant pressure transmitters shall be provided to automatically start the standby pump in the event of low lube oil pressure of the generator/gearbox lube oil system.
5. For the generator/gearbox lube oil system, a DC emergency lube oil pump shall be provided. The emergency lube oil pump shall be capable of handling the GTG shutdown without equipment damage in the event of an AC power failure. The emergency lube oil pump shall auto-start on a low-low lube oil pressure condition.
6. Means shall be provided for testing of the standby pump auto start circuits.
7. All GLO pumps suctions shall either contain a coarse suction strainer or a coarse mesh strainer
8. A sight flow glass and a dual element RTD shall be provided in each generator bearing drain.
9. One pressure balanced duplex filter, 6-micron absolute elements with visual indicator for manual transfer capability shall be provided. A differential pressure transmitter shall be provided.
10. Lube Oil Cooling

    a. 2x100% capacity, shell and tube, single pass coolers or two pass coolers shall be provided. Cooling water for the oil systems and other auxiliary components will be from the Contractor supplied auxiliary cooling water module.

11. One Contractor approved mist eliminator shall be provided. The discharge from the mist eliminator shall be routed in such a manner to prevent vapor induction into the GTG inlet air filter.
12. In general, the use of screwed, flanged or other non-welded joints shall be permitted where components must be removed during routine maintenance. This requirement does not apply to tubing.
13. Oil piping, tubing, fittings (including flanges) are 304 stainless steel, and valves shall be carbon steel with stainless steel trim. Tube fittings shall be Swagelok. Valve bodies shall be carbon steel if the trim that is in contact with the oil is 304 or 316 stainless steel.
14. All oil piping shall slope toward the reservoir for gravity drain when the lube oil pumps are not operating to prevent water from accumulating.

E. Hydraulic Starting Oil System

1. Contractor shall supply one hydraulic oil system with 1x100% capacity fin-fan hydraulic supply system cooler, one dual low pressure with 10 micron element return filter and one simplex case drain return filter with 10 micron element. Filters shall have visual indicators, City to change filter elements on a regular basis and replace them at least once a year regardless of indicator reading, sooner if conditions warrant.
2. The hydraulic oil system shall be enclosed if appropriate for the minimum ambient temperature conditions.
3. The cooler shall be sized such that the GTG can continue to operate normally for two hours with a maximum ambient temperature shown in the Section 480020, Site Conditions without equipment damage, oil degradation. Operation beyond this point will require operator action to correct the abnormal condition.
4. Fluid reservoir level shall be measured and control room indication of the level shall be provided via Modbus TCP/IP communication link.
5. In general, the use of screwed, flanged or other non-welded joints shall be permitted where components must be removed during routine maintenance. This requirement does not apply to tubing.
6. The hydraulic oil reservoir shall be constructed of 304 stainless steel.
7. All hydraulic supply system piping and tubing shall be 304 or 316stainless steel. Tube fittings shall be 316 stainless steel and Swagelok.

F. Water Wash System

1. Contractor shall provide a water wash system suitable for both on-line and off-line water washing of the turbine compressor. The water wash pumps, water storage tank, and accessories shall be provided in a skid mounted enclosure.
2. The water wash system will be permanently located per Contractor's requirements and the Contractor shall supply all on-base and on-skid piping/tubing in addition to all necessary controls. Interconnecting piping from the water wash skid to the GTG unit will be provided by the BOP Contractor.
3. City shall provide water wash water and detergent which shall meet Contractor MID-TD-0000-4 and MID-TD-0000-5 specifications in Attachment 10.

G. Fire Protection System

1. Contractor shall supply a skid mounted fire protection system. A complete self-contained system including the following items shall be provided:

    a. Fire suppressant or CO2 bottles
    b. Sunshield
    c. Manifold and control valves
    d. Gas detectors, optical flame detectors, and thermal detectors
    e. Control panel and all necessary interconnecting materials including piping from the bottles to the protected areas.

2. The BOP Contractor shall perform an actual discharge test to ensure proper concentrations and holding times are achieved per NFPA and local requirements. Refill of the CO2 bottles shall be the BOP Contractor's responsibility
3. In case of fire an emergency, shutdown of the GTG shall initiate and fuel flow stopped.

4. When fuel gas accumulation in the GTG enclosure exceeds the pre-set low explosion limit (LEL), enclosure ventilation dampers shall open for fans to vent fuel gas to atmosphere while fuel flow to the GTG continues.
5. When detectors sense a pre-set high explosion limit of gas accumulation, fuel flow must be stopped, the dampers shall close, and fans shall stop.
6. Detectors are required in all compartments to initiate a release of CO2 in concentrations that meet the requirements of NFPA 12. A complete system shall be provided including nozzles, manifolds, CO2 bottles, and control panel all in accordance with NFPA 12.

H. Instrument Air System

1. Contractor shall supply the instrument air piping/tubing and actuators within the GTG package. All piping/tubing and fittings shall be 304 SS. Tube fittings shall be Swagelok.

I. Enclosure Ventilation

1. Turbine enclosure ventilation air shall enter the turbine compartment around the inlet collector of the turbine enclosure through ventilation ducts.
2. Pressure in the enclosure must be established by AC motor driven fans.

J. Hazardous Area Classification

1. The Contractor shall indicate on drawings any areas of the gas turbine generator which are classified as hazardous in accordance with the National Electrical Code, ANSI/NFPA 70 and the classification for the area. The Contractor shall supply electrical devices where used within the classified area.

K. Foundation Design

1. The Contractor shall specify all foundation requirements including normal, seismic, wind, and transient loads for the GTG and accessories (e.g. size and number of anchor bolts; all Contractor equipment embedment requirements such as size, number, loads and location; grouting requirements.). Seismic loads shall be applied to all system components as applicable in accordance with the governing building code(s) specified in Section 480020, Site Conditions.
2. The General Manager shall be responsible for foundation design including the design of all embedments and the calculations to verify the embedment details are adequate for the Contractor specified loadings.

2.5 ELECTRICAL COMPONENTS

Generator

1. The generator shall be an alternating current synchronous generator, rated to match the maximum turbine output in accordance with the Specification. The generator shall be of cylindrical rotor revolving field type. The enclosure shall be totally enclosed air cooled designed for outdoor application.
2. The stator frame shall be designed and manufactured to withstand forces exerted by electrical and mechanical stresses in the generator core.

3. Insulation of the stator core laminations shall be non-aging and of a type which will maintain its insulating properties at temperatures well above the normal operating range. The windings shall be completely insulated full voltage to ground as defined in ANSI C50.10 using an impregnation process. Wedges shall be polyester glass. Alternate insulation systems shall be pre-qualified and approved by the General Manager prior to proposal submittal. Leads from both ends of all phase windings shall be brought out to an accessible location, for external wye connection.
4. The generator rotor shall be machined from a single alloy steel forging. The rotor shall be cooled by the generator air cooling system with fans provided within the generator housing.
5. The generator shaft shall be designed and constructed with a minimum of two bearings and supports. Bearings shall be split to permit removal of the upper and lower halves for inspection. Bearings shall be lubricated by the unit main lubricating oil system, and provided with visual oil flow sight glass. Stainless steel oil piping shall be provided to the main bearings. Rotor shaft shall be protected from the circulating flow of eddy currents.
6. Cooling air flow utilized to maintain the generator temperature within the operating range shall be of sufficient flow rate so that the unit may operate at 100 % rated kVA at maximum ambient conditions. Cooling air shall be supplied from the filtered turbine intake air system in accordance with this Section.
7. The generator shall be provided with three high voltage terminals for high impedance grounding in neutral cubicle and three high voltage terminals in the generator line side cubicle for bottom cable entry customer connection. Instrument transformer requirements (CTs and PTs mounted in line and neutral compartments as shown on GTG one line diagram) shall be provided.
8. Space heaters shall be provided for the generator to prevent condensation when not in operation.
9. Generator space heater shall be finned type heater. The heater rating shall be sized to maintain windings and internal parts dry when the main breaker is open. Generator shall be equipped with a separate connection box for space heaters.
10. Generator Cooling System

    a. The generator shall be totally enclosed water to air cooled (TEWAC).
    b. The generator cooler tubes material shall be 90/10 CuNi, and tube plates materials shall be carbon steel epoxy coated to suit water analysis. Tubes shall be seamless, shall be 16 mm OD with 0.9mm wall thickness. The surface area of the generator coolers shall be based on 100 °F cooling water. An 85% cleanliness factor shall be used in the design calculations to determine the required heat transfer surface area.
    c. The cooling system shall be designed such that valving one cooler out of service does not prevent operating the generator at 66% of rated MVA.

B. Generator Surge Component

1. Generator surge component shall be totally enclosed.
2. Generator surge protection component shall include three station-type lightning arresters and three single phase (non-PCB) surge capacitors sized/rated appropriately for the machine ratings/characteristics.

C. Generator Neutral Grounding Component

1. The neutral grounding component shall be totally enclosed.

2. The grounding transformer shall be a dry-type epoxy encapsulated unit, with the following minimum ratings:

    a. High voltage winding: 13.8 kV.
    b. Low voltage winding: 240 V.
    c. BIL rating: 95 kV.
    d. Single phase, 60 HZ.
    e. Short time rating: 30 seconds.

3. The secondary resistor shall have the following minimum ratings:

    a. Voltage rating: 240 V, 60 HZ.
    b. Insulation level: 600 V.
    c. Short time rating 30 seconds.
    d. Impedance determined by Contractor in collaboration with the General Manager.

D. Excitation System

1. The excitation system shall consist of a rotating shaft-mounted brushless system.
2. Excitation system shall regulate the generator voltage at any setting from 90 to 105 %of the rated voltage of the generator, from no load to full load, with terminal voltage maintained within +/- 0.5% of setting.
3. Continuous rating of the exciter shall meet the excitation requirements of the generator, at 105% of rated voltage under continuous rated MVA operation requiring maximum field current.
4. The excitation ceiling voltage obtainable by manual control will be at least 120% of rated voltage when operating with a load resistance equal to the generator field. The excitation will be capable of supplying ceiling excitation under load for at least one minute.
5. Excitation system shall be capable of operating throughout a range of system frequencies from 57.0 to 65 HZ.
6. Voltage response ratio shall be 0.5 as defined in IEEE Standard 421, Criteria and Definitions for Excitation Systems for Synchronous Machines. The response ratio will be 0.5 for an error of 10%.
7. The excitation system shall be wide-range stabilized to permit stable operation down to 25% of rated excitation voltage on manual control.
8. Excitation System Protective Devices:

    a. Over excitation protection in AVR shall be provided. The protection shall trip the excitation field and generator main breaker for conditions when the voltage or current levels exceed a safe limit beyond a timed interval.
    b. The excitation system and generator shall be protected against damage from excessive volts-per-hertz operation.
    c. Generator rotor ground fault RGF 64 device shall be provided as defined in Contractor's one line diagram.

9. Excitation System Component Design Features:

    a. The excitation system shall be capable of sustained operation in the event of a temporary loss of AC control supply. Removal or restoration of the control power shall not cause any change in the status of the excitation system during normal operation or during any startup or shutdown sequences of control.

b. The brushless system shall include parallel fully rated diodes for 100% redundancy, protected by individual fuses. Diode failure indication shall be included.

10. Voltage Regulator:

a. An automatic voltage regulator shall be provided and shall have an accuracy of ±/- 0.25% over operating temperature range for a load variation from no load to full load. Manual voltage regulation capability shall be included as an independent feature. The voltage regulation system shall include the following functions:

1) Over excitation protection.
2) PT fuse failure detection blocks voltage increase and alarms on loss of sensing voltage.
3) Voltage set point adjuster monitor via GTG HMI.

b. A digital voltage adjusting system shall be used for the automatic voltage regulator set point.
c. Under excited operation when on the automatic voltage regulator shall be limited by means of an adjustable limiting function that automatically prevents steady-state operation below the rated generator capability for under excited operation. Similarly, maximum excitation limits shall be established.
d. An adjustable reactive current compensator shall be provided for the automatic voltage regulator.
e. The following information shall be provided on GTG HMI:

1) Generator terminal voltage.
2) Exciter field voltage.
3) Exciter field current

f. Other standard offerings provided by specific manufacturer shall be provided.
g. Test switches furnished in the Turbine Control Panel shall permit isolation of the voltage regulator from the generator voltage transformers. A shorting-type test switch shall be provided to permit isolation of the generator current transformer from the reactive current compensator and from the under excitation limit device.

E. Test Switches

1. A sufficient number of Test Switches shall be provided for lockout relays, CTs and VTs.

F. Instrument Transformers

1. Voltage transformers shall be dry type, single ratio, with current limiting primary fuses. The primary fuses shall be arranged and protected to permit ease of removal and replacement. Voltage transformers shall be General Electric ITI Type PTG 5. Secondary wiring shall be brought to terminal blocks in a box housing located external to the transformers.
2. Current transformers shall be single ratio, window-type with accuracy class ratings in conformance with applicable ANSI standards for relaying and metering utilization. Current transformer secondary leads shall be extended to shorting type terminal blocks in a box housing located external to the transformers.

G. GTG Motor Control Center

1. The GTG Motor Control Center will be located in the Power Distribution Center provided by the Balance of Plant Contractor. Power Island Contractor shall furnish necessary motor and load information as shown in GTG MCC schedule drawing to enable the Balance of Plant Contractor to purchase MCC's meeting the requirements of the GTG.
2. The 120 VAC supply for computer, telephone and other critical loads associated with the GTG package will be provided from the General Manager's UPS system.

H. Generator Design Conditions

1. The generator rated voltage shall be 13.8 kV nominal with windings connected for grounded wye 60 HZ operation, in accordance with IEEE standards.
2. The telephone influence factors of the generator shall be in accordance with the latest IEEE standards. The deviation factor of the open circuit terminal voltage wave of the generator shall not exceed 10% as defined by IEEE standards.
3. The generator armature shall be capable of operating at 130% of rated armature current for at least one minute, starting from stabilized temperatures at rated conditions.
4. The generator field windings shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.
5. The generator rotor shall be capable of withstanding, without permanent damage, the thermal effects of unbalanced faults or other unbalanced conditions on the system at the generator terminals, in accordance with the provisions of IEEE standards.
6. The generator shall be capable of withstanding, without mechanical injury, any type of short circuit at its terminals for times not exceeding the short time thermal capabilities, when operating at rated kVA and power factor and 5% overvoltage, in accordance with the provisions of IEEE standards.
7. The generator shall be suitable for continuous operation at rated kVA, power factor, and frequency at any voltage not more than 5% above or below rated voltage, in accordance with the provisions of IEEE standards.
8. The generator shall be capable of operating continuously at full rated load under usual service conditions, (per IEEE standards and ambient temperatures not exceeding 40 ˚C). The total temperatures shall be in accordance with the IEEE C50.13 and shall be based on supplying air cooler with air between minimum and maximum ambient temperatures (see Section 480020, Site Conditions). The total temperatures shall not exceed temperature allowed for Class B insulation when operating at full load or below. The stator and rotor shall be provided with Class F insulation. Generator shall have 0.85 power factor at maximum generator kW rating.
9. The short circuit ratio of the gas turbine-generator shall be 0.5 or greater at the maximum calculated output rating.

2.6 INSTRUMENTATION AND CONTROLS COMPONENTS

A. General

1. Instrumentation and controls design shall be as per Contractor's standard LM6000 PG.
2. The GTG shall be equipped with all necessary controls configured for complete start-up, automatic or manual synchronizing, loading, operation and shutdown from the General

Manager's main control room (local GTG HMI) and from the Power Distribution Center (remote GTG HMI).

3. Turbine Control panel contains GTG protective relay and metering, shall be shipped to the site for installation.
4. Contractor to furnish the electrical support interface requirements and loads imposed on the foundation (refer to Contractor's MCC Schedule 969035 drawing). BOP Contractor to design foundations to satisfy all code requirements. A remote HMI for the GTG unit shall also be provided by the Contractor for installation in the General Manager's main control room for remote operations of the gas turbine generators. Main control room furniture for Contractor supplied controls components will be supplied by the BOP Contractor.
5. It is the intent of the General Manager to integrate the Contractor's equipment into a BOP Contractor-furnished plant control system (PCS). All control devices furnished by the Contractor shall be capable of interfacing with the PCS via communication link or Contractor's standard hardwired signal design and provide sufficient data and status information required for system control via communication link. This includes all data from process sensors (transmitter and switches) furnished on GTG by the Contractor. Components and controls furnished by the Contractor shall allow the PCS to remotely start and stop GTG and to allow automatic switch over to the back-up unit.
6. All critical pneumatic, hydraulic, and motor operated open/close (non-modulating) valves shall have control room indication of the open and/or closed status via one SPDT position limit switches or proximity switches. All critical control valves that are modulated via the GTG shall be provided with a position transmitter.
7. Instruments shall be furnished and calibrated in accordance with Contractor's standard LM6000 PG design. Refer to Attachment 6 for Contractor's performance guarantee.

B. Identification
1. The Contractor shall permanently install an Ø 1-3/16" circle stainless steel identification tag in a conspicuous location on each instrument and control device which are listed on F&ID. The tag shall bear the Contractor's specified standard "Instrument Tag Number". The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other applicable communication with the General Manager.
2. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points as per Contractor's standards. Provisions shall be made for wiring of non-skid mounted devices. Specification for special cables or termination kits, if required for circuits between supplied equipment, shall be provided by the Contractor as per Contractor's interconnect cable schedule drawing for installation by the General Manager.

C. Microprocessor Based Control System: A complete microprocessor based control system using Contractor's standard tagging shall be provided by the Contractor for the overall control of the gas turbine generator. The DC power for the control system equipment located in the electrical/control package will be supplied by the BOP Contractor's 24 VDC and 125 VDC systems and their chargers. The AC and DC power for the control system equipment located within the central control room will be supplied by the General Manager's power supply system.

1. The control system shall be a digital system capable of performing unit speed/load control, normal and emergency overspeed control, automatic unit start-up, synchronization, loading, and shutdown, frequency, and unit protection and supervision.
2. The generator will normally be operated in parallel with the local SCE utility grid. Should the connection with the PWP grid be lost and notification be provided to Contractor's control system via a single contact or signal from others, the combustion gas turbine control system shall be designed to maintain GTG on-line at a minimum present residual load (unit run-back).
3. The gas turbine and control system shall be capable of providing an immediate and sustained response to abnormal frequency excursions within the machine design parameters. The governor shall provide droop characteristics and be fully responsive to frequency deviations consistent with the capabilities of the turbine and generator.
4. The control system shall permit full automatic control and partial manual assist control and include on-line and off-line unit protection testing capabilities.
5. The control system shall include security features to restrict HMI users to certain maintenance functions and to limit access to specific HMI features to appropriate personnel for the intended tasks.
6. The generator shall have the following two modes of operation:

    a. Droop
    b. Isochronous

7. An operator interface shall be provided to allow operation of either governing mode.
8. The Contractor shall provide, at a minimum, the following screens for the operator interface monitors:

    a. Main display
    b. Generator Bearing metal temperatures
    c. Bearing Vibration Monitor
    d. Load/Speed control
    e. Start-up screen and permissives
    f. Alarm screen
    g. Water wash display
    h. Water injection display
    i. SPRINT display
    j. Exhaust LPT inlet gas temperatures
    k. Generator monitoring and generated quantities
    l. Fuel control
    m. Fuel gas system
    n. Turbine trips
    o. Turbine combustion and ventilation system
    p. Lube oil system
    q. Engine Overview temperatures (T2, T3, …)
    r. Turbine counters

9. The following hardwired control inputs to the Contractor furnished control system from the General Manager's control system shall be accommodated:

    a. Emergency Trip
    b. Customer Trip
    c. Load Raise/Lower

d. Isoch/Droop Mode Selection
e. GTG MW Load Setpoint input
f. Ready to start

10. Eight (8) analog outputs and eight (8) additional digital inputs/outputs shall be reserved for General Manager's hardwire use.
11. The Contractor furnished control system shall be provided with a redundant communication data link to interface with the General Manager's control system via ModBus over Ethernet TCP/IP.
12. All alarms and trips shall be printed out on a Contractor furnished printer in the General Manager's control room.
13. The control system shall have the capability to store historical data for a usable period of 30 days. The system shall be capable of displaying historical data for analysis and importing to a PC database.

D. GTG Protective Relay and Metering

1. The Contractor furnished GTG protective relay and metering shall be located in the Turbine control panel. All necessary devices shall be provided to allow GTG start-up, manual and auto synchronization, loading, operations, and shutdown from the panel. The control and monitoring requirements shall be organized into functional groups.
2. The following equipment, at a minimum, shall be provided on the control panel. The relay functions described below shall be contained within two independent digital generator protection devices (DGPs) and two 86G discrete lockout relays.

a. Relays

1) One (1) SEL-300G3 generator protective relay equipped with the standard I/O board and the latest firmware version. Associated support material shall include two (2) sets of I.Ls., two USB to RS232 cables, and the latest version of the associated communications software (AcSELerator) and event analysis software (SEL-5601).

AND

One (1) Beckwith M3425A multifunction generator protection relay including the comprehensive protection function option, HMI Module, and Target Module. Associated support material shall include two (2) sets of I.Ls., two USB to RS232 cables, and the latest version of the associated communications software (IPScom) and event analysis software (IPSplot Plus).

2) One (1) Brush Rotor Ground Fault (RGF 64) device shall be provided in the GTG unit as defined in one line diagram.
3) Two (2) 86G Lockout relays
4) Test switches applied to each metering and relay current inputs. Lockout relays, CTs and VTs shall have ESSAILEC test switches.
5) Each normally-open contact on each lockout as tripping relays utilized for tripping and breaker failure initiation shall be wired through an ESSAILEC test switch.

b. Meters/Transducers
   1) 1-Watt Transducer
   2) 1-Multifunction Digital Meter (DMMF), DMMF information shall be displayed on HMI screen and available via Modbus over TCP/IP communication to PCS;
   3) Synchronizing System

      a) 1-Synchroscope with Lights
      b) 1-Automatic Synchronizer
      c) 1-Synch check relay, 25S in IGPS
      d) 1-Breaker controls switch for use during manual synchronization.
      e) Voltage up and down switch for use during manual synchronization.
      f) Speed up and down switch for use during manual synchronization.
      g) Selection of auto or manual synchronizing mode shall be accomplished in the Contractor's Control System.

E. Vibration and Rotor Position Monitoring Equipment: Contractor's standard vibration package for tripping the unit shall be provided, however as a minimum, the Contractor shall provide a Bently Nevada Series 3500 or 3701 monitoring package for supervisory purposes with the following devices:

1. One (1) accelerometer probe on the compressor rear frame bearing.
2. One (1) accelerometer probe on the turbine rear frame bearing.
3. Two (2) proximity transducers on both generator bearings.
4. One (1) proximity keyphasor probe on drive end of the generator.
5. Two (2) vibration elements on the gearbox.
6. Modbus over TCP/IP communication link shall be available for data transmission.

F. Instrumentation

1. 3-wire, 100 ohm platinum duplex RTDs shall be used.
2. Type K, mineral insulated, 304 stainless steel sheathed thermocouples suitable for use in high temperatures shall be used. Appropriate junction devices shall be supplied with thermocouples for use with thermocouple conductors where necessary to avoid cold junction signal distortion.
3. Thermowells shall be provided as required by Contractor's standard design.
4. Electronic transmitters (PTs, PDTs, RTDs) shall be Yokagawa, Rosemount, or as required by Contractor's standard design as shown on Contractor's F&ID.
5. One (1) Watt transducer shall be provided in the GTG unit. One multifunction digital meter (DMMF) shall be provided in the GTG unit. DMMF information shall be displayed on HMI screen and available via Modbus over TCP/IP communication to PCS.
6. All tubing fittings shall be Swagelok.

G. Instrument and Control Wiring
   1. Contractor provides the following types of wire:

      - Panel

      Type ETFE Multi-core, 600 volt insulation, 18, 14, 12 and 10 AWG

      - Skid

Type CLX, XHHW, 600 volt insulation, 14 and 16 AWG, Belden Special. Instrumentation wiring is single to mult-core with individual and overall shielding.

- Turbine/Generator Enclosure: Power, control and instrumentation: XHHW equivalent, 600 volt insulation, SS braided armor, 10, 12, 14, 16 AWG. Instrumentation wiring is single to multi-core with individual and overall shielding.

Contractor furnishes appropriately sized copper conductors with white insulation. The ground wires are green/yellow. Other color coded insulation is not supplied

H. Conduit
1. Conduit is copper free aluminum per Contractor's standard

2.7 ACCESSORIES

A. Ladders, Platforms and Walkways
1. Ladders, Platforms and Walkways for the GTG inlet air filter shall meet CAL-OSHA requirements.

B. Insulation
1. Insulation materials that meet Contractor's spec are provided. Contractor utilizes winterization consisting of heat tracing and insulation resulting in suitability of the unit for the ambient temperature of the project.

2.8 FABRICATION

A. Fabrication, cleaning, finishing, and painting are as per Contractor standards.

2.9 SOURCE QUALITY CONTROL

A. Source quality control, test, and inspection are as per Contractor's standards.

B. The Contractor shall provide quality plan and all tests to be performed on the combustion gas turbine, generator, control system and accessories.

C. The GTG and accessories shall be factory static tested following manufacturer's standard procedures. The test procedures shall be submitted to the General Manager for information after contract award.

D. Tests and Inspections

1. As a minimum, the following tests shall be performed:

a. Factory Rotor Balancing

1) LM6000 PG shall be balanced per Contractor's standard procedure in order to meet factory vibration acceptance criteria as stated in MID-TD-6000-05.

b. Overspeed Testing

1) Combustion gas turbine rotors shall be capable of 110% of the synchronous speed, which shall be verified by component test and analysis.
2) The generator rotors shall be factory overspeed tested for a minimum of two minutes at a minimum of 120% of the synchronous speed.

c. Factory Accessory Testing

1) The combustion gas turbine package shall be static functionally tested in the factory. Contractor's standard static test procedure is followed.

d. Factory Generator Tests

1) Measurement of cold resistance of armature and field windings
2) Mechanical inspection
3) Insulation resistance of stator and rotor windings
4) High-potential tests
5) Dielectric tests of armature and field
6) Resistance temperature detectors test

e. Control Board and Software Testing

1) Electrical shop tests shall be made on all control boards. These tests shall include high potential tests on power equipment and operating tests to demonstrate that the equipment functions correctly. The Hipot Test performed on the MicroNet Power Supplies shall meet EN 60079-15 (Explosive Atmospheres) and EN 61010-1 (Low Voltage Directive/CE Requirements).
2) Control wiring tests shall include those that are necessary to determine that all instruments, meters, relays, instrument transformers, etc. are correctly wired and function in the specified manner when energized. Each circuit shall be continuity tested. Insulation resistance tests shall be conducted on each circuit (except in circuits containing electronic components); the insulation resistance shall be meggered.
3) A Factory Acceptance Test (FAT) shall be performed on the complete software system prior to shipment. Simulated (software) inputs are acceptable during the FAT.

f. Instrument and Power Cable

1) All instrument and power cables installed to the Contractor supplied skids shall be insulation and continuity checked prior to shipment

g. Instrument Calibration

1) Instrument calibration is by instrument manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Painting

1. Contractor's standard painting system is provided.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements and Attachment 5 in the Contract.

B. Performance Tests

1. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements and Attachment 5 and 6 in the Contract.
2. The performance test will be carried out to the manufacturer's standards in general accordance with the following internationally recognized standards:

a. ASME PTC 19.1, Test Uncertainty
b. ASME PTC 22, Performance Test Code on Gas Turbines
c. ISO 2314, Gas Turbines – Acceptance Tests

3.3 COMMISSIONING

A. General

1. Refer to Section 480032 Power Island Performance for general commissioning requirements.

3.4 TRAINING

A. Refer to Section 481100 Combined Cycle Power Island for general training requirements and Attachment 14 in the Contract.

END OF SECTION 485222

APPENDIX A – Technical Datasheets by General Manager

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number	123374
1.0	**Inlet Section**	
	Inlet Air Evaporative Cooling / Type	Not applicable
	Inlet Air Fogging	As required to meet minimum output requirement in 481100 Combined Cycle Power Island
	Inlet Air Chilling Coil	As required to meet minimum output requirement in 481100 Combined Cycle Power Island
	Filter Pulse Cleaning	By Contractor
2.0	**Compressor Section**	
	Water Injection Intercooling	By Contractor
3.0	**Combustor Section**	
	Dry Low Emissions Combustor	Not applicable
	Single Annular Combustor	By Contractor
	Water Injection	By Contractor
4.0	**Exhaust Section**	
	Stack / Type	OTSG supplied under 481100, Combined Cycle Power Island
5.0	**Generator**	
	Open Air Cooled	Not applicable
	Enclosed Air to Air Cooled	Not applicable
	Totally Enclosed Water to Air Cooled	Required
6.0	**Auxiliary Systems**	
	Component Cooling Water	By Contractor
	Closed System w/ Auxiliary Cooling Water	Required
	Closed System w/ Fin-Fan Cooler	Not Applicable
	Open System w/ Wet Cooling Tower	Not Applicable
	Packaged Chiller System	Option as Required

APPENDIX B – PASADENA GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET to be provided during project execution

GTG PERFORMANCE TEST		**Test #:**				**Date**			
	Reading #:		**1**	**2**	**3**	**4**	**5**	**6**	**AVG**
	Time:								
	PARAMETER	**UNITS**							
1	GROSS GENERATION	MW							
2	NET GENERATION	MW							
3	TOTAL GROSS PLANT AUX. LOADS	MW							
4	POWER FACTOR	%							
5	GAS COMPRESSOR LOAD 4160V	MW							
6	BOP MCC LOAD 480V	MW							
7	BAROMETRIC PRESSURE	PSIA							
8	AMBIENT AIR DB TEMP	^{o}F							
9	AMBIENT AIR WB TEMP	^{o}F							
10	RELATIVE HUMIDITY	%							
11	LP COMP INLET STATIC PRESS, P_0	PSIA							
12	HP COMP INLET PRESS, $P_{2.5}$	PSIA							
13	HP COMP DISCH PRESS, P_{S3}	PSIA							
14	LP TURBINE INLET PRESSURE, $P_{4.8}$	PSIA							
15	COND.COMBUS. AIR TEMP ENTR LPC, T_2	^{o}F							
16	HP COMP. INLET TEMP., $T_{2.5}$	^{o}F							
17	HP COMP.DISCH. TEMP., T_3	^{o}F							
18	LP TURBINE SPEED, XN2	RPM							
19	HP COMPRESSOR SPEED,XN2.5	RPM							
20	GAS FUEL FLOW RATE	SCFM							
21	NOx BIAS	%							
22	NOx WATER INJECTION FLOW RATE	GPM							
23	SPRINT WATER FLOW RATE	GPM							
24	AVG.TEMP. ENTR HP TURBINE	^{o}F							
25	AVG.TEMP. ENT. LP TURBINE, $T_{4.8}$	^{o}F							
26	LP TURBINE INLET TEMP SPREAD	^{o}F							
27	LP TURBINE INLET TEMP.A	^{o}F							
28	LP TURBINE INLET TEMP B	^{o}F							

29	LP TURBINE INLET TEMP.C	^oF							
30	LP TURBINE INLET TEMP.D	^oF							
31	LP TURBINE INLET TEMP.E	^oF							
32	LP TURBINE INLET TEMP.F	^oF							
33	LP TURBINE INLET TEMP G	^oF							
34	LP TURBINE INLET TEMP.H	^oF							
35	LPT DISCH TEMP.ENTR OTSG	^oF							
36	LPT DISCH TEMP.ENTR CO CATAL.	^oF							
37	FLUE GAS TEMP LVG STACK	^oF							
38	LPT DISCH PRESSURE.ENTR OTSG	"H_2O							
39	FLUE GAS PRESSURE ENTR CO CATALYST	"H_2O							
40	ΔP THROUGH CO CATALYST	"H_2O							
41	ΔP THROUGH SCR	"H_2O							
42	TOTAL ΔP THROUGH CO CATALYST & SCR	"H_2O							
43	O_2 ENTERING OTSG	%							
44	O_2 LEAVING STACK	%							
45	NOx @ 15%O_2 ENTERING OTSG	PPM							
46	NOx @ 15%O_2 LEAVING STACK	PPM							
47	NH_3 SLIP @ 15%O_2 LEAVING STACK	PPM							
48	CO @ 15%O_2 ENTERING OTSG	PPM							
49	CO @ 15%O_2 LEAVING STACK	PPM							
50	NOx LEAVING STACK	Lbs/Hr							
51	AQUEOUS NH3 FLOW	Lbs/Hr							
52	GT EXHAUST FLOW ENTERING OTSG	KPPH							
53	GT EXHAUST HEAT ENTERING OTSG	MMBtu/Hr							
54	STACK FLOW (dry)	KDSCFM							
55	VARIABLE INLET GUIDE VANE (VIGV) PSTN	%							
56	VARIABLE STATOR VANE (VSV) PSTN	%							
57	VARIABLE BYPASS VALVE (VBV) PSTN	%							

58	NATURAL GAS HHV	BTU/SCF							
59	TOTAL HEAT INPUT	MMBtu/Hr							
60	HEAT RATE @ 100% LOAD (HHV)	BTU/NetKWh							
61	HEAT RATE @ 100% LOAD (LHV)	BTU/NetKWh							
62	WATER/FUEL RATIO, W_w/W_f	LB_w/LB_f							

APPENDIX C – TECHNICAL DATASHEETS BY CONTRACTOR to be provided during project execution

Item	Description	Units	Technical Data (Contractor to fill in)
1.	**Mechanical Data**		
1.1	Manufacturer and Model Number		
1.2	Power Output at base load at ISO conditions		
	a) fuel gas firing at generator terminals	KW	
	b) Generator rating	MVA	
1.3	Number of similar units in service		
1.4	Year First Similar GTG was placed in service	Yr	
1.5	Compressor Data		
	a) Number of stages		
	b) Blade material		
	c) Rated Speed of all shafts	RPM	
	d) Pressure Ratio		
	e) Type of Inlet Guide Vanes		
	f) 1st Critical Speed	RPM	
	g) 2nd Critical Speed	RPM	
1.6	Turbine Data		
	a) Number of Stages		
	b) Blade Material		
	c) Nozzle Material		
	d) Method of Cooling		
	e) Rated Speed	RPM	
	f) 1st Critical Speed	RPM	
	g) 2nd Critical Speed	RPM	
1.7	Combustors		
	a) Type		
	b) Number		
	c) Material		
	d) Number of fuel nozzles per combustor		
	e) Number and type of fuel igniters		
1.8	Starting System		
	a) Driver Type		
	b) Time interval required between startup attempts	Min	
	c) Starter Motor Rating	KW	
1.9	Lubrication System		
	a) Lubricant Type		
	b) Capacity	Gal	
	c) Flow Rate	GPM	
	d) Consumption, Gal/1000 hrs at base load	Gal	
	e) Recommended Lubricant Change Frequency	Hrs	

Item	Description	Units	Technical Data (Contractor to fill in)
1.10	Lube Oil Pumps		
	a) Main Pump Rating	HP	
	Manufacturer		
	Type		
	Capacity	GPM	
	Discharge Pressure	PSIG	
	Driver Type		
	HP/speed	HP/RPM	/
	b) Auxiliary Pump Rating	KW	
	Manufacturer		
	Type		
	Capacity	GPM	
	Discharge Pressure	PSIG	
	Driver Type		
	HP/speed	HP/RPM	/
	c) Emergency Pump rating	KW	
	Manufacturer		
	Type		
	Capacity	GPM	
	Discharge Pressure	PSIG	
	Driver Type		
	HP/speed	/RPM	/
1.11	Oil Reservoir	Gal	
1.12	Oil Coolers		
	Type (Water or Air Cooled)		
	Single or Dual		
	Duty	Btu/hr	
1.13	Total Utility Requirement		
	a) Electrical Auxiliary Requirements (at site conditions)	KW	Furnish a detailed list separately
	b) Instrument Air Required	SCFM	
	c) Cooling Water Requirement		GPM/ Psig/ ^{0}F
	d) NO_x and Power Enhancement Injection Water		GPM/ Quality
1.14	Inlet Air System		
	a) Air Filter Manufacturer		
	b) Type		
	c) Pressure Loss	In WC	
	d)Silencer Type and Manufacturer		
	e) Ducting Thickness		
1.15	Evaporative Cooler (As required)		
	a) Manufacturer		Not applicable
	b) Type		
	c) Pressure drop	In WC	
	d) Effectiveness		
	e) Quantity of water required	GPM	
	f) Quality of Water Required		

Item	Description	Units	Technical Data (Contractor to fill in)	
1.16	Cooling Water Module			
	Heat Exchanger Design Standard			
	Draft Type		Induced/Forced	
	Number of bays			
	Heat Exchanged	Btu/hr		
	Design Dry Bulb Temperature			
	Tube side water flow rate	GPM		
	Tube side temperature range	Deg F	Inlet / Outlet	
	Tube material			
	Fin material and type			
	Duty of the heat exchanger with one fan out of service	Btu/hr		
	Fan Diameter			
	Blade Material			
	Motor HP			
	Motor Enclosure			
	Overall size of Module			
	Number of Auxiliary Cooling Water (ACW) Pumps			
	Capacity and TDH of ACW pumps			
	Surge water tank capacity on the cooling water module			
1.17	Fire Protection System			
	a) Manufacturer			
	b) Type			
	c) Storage Capacity			
	d) Zones Protected			
	e) Complies with CSFM Requirements	Yes/No		
2.0	**Generator Data**			
2.1	Manufacturer			
2.2	Type			
2.3	Method of Cooling/Rated kVA	/kVA	/	
2.4	KVA Maximum at Low Ambient of 18^0F			
2.5	KW			
2.6	Power factor,% (leading or lagging)			
2.7	Speed	RPM		
2.8	Voltage	kV		
2.9	Stator Amperes at Rated kVA			
2.10	Short Circuit Ratio			
2.11	Field Characteristic at rated Voltage		Amperes	Volts
	a) No Load			
	b) Base Rating, 0.9pf			
	c) Peak rating, 0.9pf			

Item	Description	Units	Technical Data (Contractor to fill in)	
2.12	Total Temperature and Insulation Class		Deg. Fahrenheit	Class
	a) Stator (by detector)			
	b) Rotor (by resistance)			
	c) Hottest Spot (calculated) ….location			
2.13	Reactances	%		
	a) Synchronous, X_d			
	b) Transient, X'_d			
	c) Subtransient, X''_d			
	d) Negative Sequence, X_2			
	e) Zero Sequence, X_0			
	f) Leakage, X_e			
2.14	Time Constants	Sec		
	a) Open Circuit, T'_{do}			
	b) Armature, T_a			
	c) Transient, T'_d			
	d) Subtransient, T''_d			
2.15	Field Resistance, Ω at 75^0C			
2.16	Temperature Coefficient of Field			
2.17	Characteristic Curves to be Furnished			
	a) Capability Vs Air Temperature			
	b) Reactive capability Vs Air Temperature			
	c) Saturation and Synchronous Impedance curves			
	d) Vee curves for various power factors and temperatures			
	e) Negative phase sequence capability curve.			
2.18	Generator Physical Data			
	a) Rotor Weight	lb		
	b) Generator Rotor Inertia WK^2	Lb-ft^2		
	c) Combined turbine-generator stored energy, E, MW-sec			
	d) Maximum possible output (for use in sizing main transformer, including basis for this number such as ambient temperature, peak load operation, etc.)	KW		
2.19	Efficiency, including Windage, Bearing, and Exciter Losses			
	a) Peak Load			
	b) Base Load			
	c) 75% Base Load			
	d) 50% Base Load			
	e) 25% Base Load			
2.20	Cooling Water Quantity	GPM	(if applicable)	

Item	Description	Units	Technical Data (Contractor to fill in)
2.21	Exciter		
	a) Manufacturer		
	b) Type		
	c) Capacity	KW	
	d) Rated Voltage		
	e) Response Ratio		
	f) Ceiling Voltage		
2.22	Voltage Regulator		
	a) Manufacturer		
	b) Type		
	c) Speed of Response		
	d) Line Drop Compensator Provided	Yes/No	
	e) Over Excitation Protection Provided	Yes/No	
3.0	**Control System**		
	a) Microprocessor manufacturer and Model.		
	b) Number of Processors		
	c) Cabinets, Number /Size		
	d) Electrical Generator Control Panels, Number /Size		
	e) Number and type of Interfaces to General Manager's Control Equipment		
	f) CRT Monitors, Number /Size / Manufacturer		
	g) Printers, Number/Type/Model No.		
	Power consumption	kVA	
4.0	**Weights and Dimensions**		
	List weights and dimensions of each separately shipped components.		
	a) Gas turbine Unit		
	b) Electric Generator and Exciter		
	c) Inlet Ducting and Silencer		
	d) Chiller Package		
	e) Control Compartment		
	f) Water Injection Skid		
	g) Fire Protection Package		
5.0	**Tests, Inspections and Quality Assurance Program**		**Indicate below the quality assurance program proposed for each of the systems.**
	BOP Contractor shall recommend the test and inspection points for		
	a) Gas turbine		
	b) Generator and Exciter		
	c) Controls		
	d) Others		

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485311.10

Condensate Pumps

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485311.10
Condensate Pumps

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/11	T. Clark	A
09/09/11	T. Clark	B
12/05/11	T. Clark	C
02/02/12	B. Hritsco	D
09/11/12	T. Clark	E
09/10/2013		F – CONTRACT VERSION

SECTION 485311.10
CONDENSATE PUMPS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 5
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.11 SITE CONDITIONS 5
1.12 WARRANTY ..... 5~~6~~

PART 2 - PRODUCTS 5~~6~~

2.1 MANUFACTURERS 6
2.2 MATERIALS AND WELDING 6
2.3 EQUIPMENT 6
2.4 COMPONENTS 7
2.5 INSTRUMENTATION AND CONTROLS 11
2.6 CIVIL AND STRUCTURAL ..... 12~~13~~
2.7 FABRICATION 13
2.8 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 15

3.1 SPARE PARTS 15
3.2 FIELD QUALITY CONTROL 15
3.3 COMMISSIONING 15

PART 4 - ATTACHMENTS 16~~17~~

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER ..... 16~~17~~
4.2 TECHNICAL DATASHEET BY CONTRACTOR ..... 18~~19~~

SECTION 485311.10
CONDENSATE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of vertical canned pumps for power plant condensate service. It is not the intent to specify completely herein all details of design and construction. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. 2x100% capacity, vertically mounted canned pumps, pump cans, and drivers selected to perform as required for the equipment supplied under Section 481100, Combined Cycle Power Island Equipment.
2. All seals, bearing lubrication systems, couplings, coupling guards, driver motor, baseplates/support systems and other standard accessories or as specified herein
3. Cleaning and finishing prior to shipment
4. Startup spares, special tools and lifting devices required for installation, maintenance, and operation, as required
5. Performance testing at factory and certificates of results
6. Performance data and curves as specified herein
7. Inspection certificates and quality control documentation listed in this Section
8. Drawings and design data to support facility design, construction and maintenance showing all interface requirements, including anchor bolts, foundation loads, foundation outlines, and electrical and instrumentation connections
9. Complete set of component cut sheets
10. Operating, commissioning, installation and maintenance manuals for the supplied equipment
11. Priced list of recommended spare parts for two years of operation
12. Provide pricing for technical assistance during the installation and field testing of pumps
13. Furnish all documentation as outlined in this Section
14. Packing and shipping to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Foundations, grouting and foundation bolts
2. Piping, wiring and conduit to Contractor's connections
3. Instrumentation
4. Receipt, unloading, storage and handling
5. Installation
6. Field inspection and testing
7. Field touch-up painting
8. Suction and discharge piping to and from the pumps.
9. Motor starters
10. Auxiliary cooling water as required
11. Final alignment
12. Pump discharge flow measurement for minimum flow controls.
13. Minimum flow recirculation control

1.4 RELATED SECTIONS

A. Section 260000 - Electrical - Mechanical Equipment

B. Section 262050 - Low Voltage Motors

C. Section 261050 - Medium Voltage Motors

D. Section 480020 - Site Conditions

E. Section 480031 - Combined Cycle Power Island Noise Control Performance

F. Section 480032 - Power Island Performance

G. Section 481100 - Combined Cycle Power Island

H. Section 485413 - Once-Through Heat Recovery Steam Generator (OTSG)

I. Section 485432 - Surface Condenser

1.5 CODES AND STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section:

1. American National Standards Institute (ANSI)

   a. 2.3 - American National Standard for Vertical Pumps Design and Application

2. American Society for Nondestructive Testing (ASNT)

   a. SNT-TC-1A, Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing

3. American Society for Testing and Materials (ASTM)
4. Hydraulic Institute (HI)

    a. ANSI/HI 1.3, Standard for Centrifugal Pumps Design and Application
    b. ANSI/HI 2.3, Standard for Vertical Pumps Design and Application

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. All equipment shall be designed for a thirty (30) year life objective. Components for which this service life cannot be expected shall be identified and those components shall be designed for ease of replacement and maintenance.
2. The pumps shall be suitable for continuous outdoor operation in the ambient conditions as detailed in Section 480020, Site Conditions.
3. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
4. Each pump shall be completely assembled with the electric driving motor prior to shipping from factory. If necessary, the assembly may be disassembled for shipping.
5. When a standby pump is required it shall be designed to start automatically in an emergency situation when the failed operating pump shuts down.
6. The pumps shall also be provided with minimum flow recirculation control arrangement to recirculate condensate back to the condenser hotwell so as to render the pumps safe at low and no load conditions. The minimum recirculation valves shall be sized and selected, including trim and plug design, actuators, valve materials and valve accessories to properly satisfy the operating and design conditions of each condensate pump. The control valves shall be furnished with pneumatic spring opposed diaphragm operators. Valve position transmitters shall be provided and positioner shall be HART type. Any flow restricting orifice plate or back pressure regulators required for the recirculation line shall be provided. Use of ARC valve for minimum flow controls is not acceptable.
7. The pump materials shall be suitable for the feed water quality leaving the condenser hotwell plus any chemical injection or small quantities of phosphate and ammonia (from the breakdown of boiler water treatment chemicals).

8. The two condensate pumps shall be identical in design and component parts shall be interchangeable. It shall be possible to operate two or more pumps together and they shall remain inherently stable when running in parallel while in this mode.
9. The Suction Specific Speed shall not exceed 12,000 or outermost tip on the first stage impeller exceed 65 ft/sec based upon Hydraulic Institute recommendations. Deviation from this recommendation is allowable for special designs if the Contractor can show risk of erosion and cavitation is minimal under normal operating conditions.
10. Pumps shall not produce more than 225 feet of head per stage to avoid damage due to vibration, cavitation, or erosion. More developed head per stage may be allowable if the design is proven by the Contractor.
11. The characteristics of the pumps shall be such that the motors will not exceed the rated capacity and temperature rise under any operating conditions. Under no circumstances shall the service factor of the motor be used to achieve required pump performance.

B. Performance Requirements

1. The design duty of the pumps shall be based on ability to deliver condensate flow corresponding to the maximum output capability of the once-through heat recovery steam generator (OTSG). When operating at maximum flow the condensate pump discharge pressure shall be sufficient to overcome a system resistance equal to the sum of the condensate air extraction system, condensate polishing system, the pressure loss through interconnecting piping up to the feed regulation/control valves, the static pressure difference between the condensate pumps and the boiler feed water pumps, and the net positive suction head requirement of the boiler feed water pumps, minus the net positive suction head of the condensate pumps. The Contractor shall guarantee the following:

    a. Capacity without negative tolerance. Tolerances will be per IST.
    b. TDH without negative tolerance and plus 3% at the design capacity.
    c. $NPSH_{req}$ without positive tolerance minus 10% at design capacity.
    d. Pump efficiency without negative tolerance.
    e. Shutoff head without positive tolerance above guarantee, minus 3%.
    f. Acceptable TDH deviation amongst identical units of 2% at design capacity.
    g. Noise requirements as specified in Section 480031, Combined Cycle Power Island Noise Control Performance
    h. Wire-to-water horsepower input at pump design operating point, corrected to actual fluid temperature within HI tolerances.

2. The characteristics of the pump must be such that the shutoff valve head is approximately 115 to 125% of the pressure at rated output. The Contractor shall state the maximum pump head with discharge valve closed.
3. The pumps shall be suitable for both continuously and intermittent service and shall operate satisfactorily without vibration, cavitation, or distress to any part through an operating range from minimum flow to maximum specified capacity.
4. Pump's point of maximum efficiency shall coincide with the specified design capacity.
5. Pumps are noted as 100% capacity, runout does not apply. A 2 ft NPSH margin is provided at the rated condition.
6. The pump sets (pump, motor and base) shall be designed to avoid occurrence of one-half, first, second, and third harmonic critical speeds in undamped condition resulting in amplified excitation of vibration levels. This includes 20% separation between operating speed and natural harmonic critical speed. A lateral and torsional evaluation shall be conducted to assure the avoidance of critical speed.

7. Contractor shall guarantee that the equipment supplied shall meet the specified noise criteria in Section 480031, Combined Cycle Power Island when tested in accordance with ASME PTC 36.

C. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 SUBMITTALS Refer to Attachment 11 Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

B. Testing

1. Certificates and records of all shop tests shall be submitted to the General Manager for approval at least one week before shipment.
2. Certificates and records shall include, as a minimum:

   a. Mill-test certificates for casing, impellers, and shafting or other components (if required by the governing code).
   b. Pump performance-test reports, including test data and performance curves
   c. Motor test reports
   d. Hydrostatic test reports
   e. “As Built” pump data sheets

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general packaging, delivery, storage, and handling requirements.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply equipment specified within this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the Contractor's Proposal.

1. Not Used

2.2 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.3 EQUIPMENT

A. General Requirements

1. Design of rotating elements shall be such that all critical speeds shall be at least 25% greater than the operating speed.
2. Contractor shall provide all connections for suction, discharge, sealing, flushing, and venting. Piping shall be in accordance with ASME B31.1. All piping furnished by the Contractor shall be provided in ANSI standard sizes in nominal English units (inch sizes) unless otherwise required in Section 480020, Site Conditions. The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Contractor's drawings.
3. Contractor shall be entirely responsible for the pump-to-motor interface including, but not limited to, the following:

    a. Supply of coupling for joining the pump and motor shafts
    b. Coordination of dimensions between the pump and motor
    c. Machining of the motor shaft to accept the coupling

B. Pumps

1. Each pump submitted by Contractor shall be designed for operation using the criteria specified.
2. The pump suction requirements, including submergence NPSHR, and inlet velocity, shall be determined using one pump runout capacity or 120% of design capacity, whichever is greater.
3. The design point total head specified shall use the discharge connection centerline as the reference point. Head losses through the pump, including suction inlet losses, are not included in the total head listed.
4. All pumps shall be identical in design and performance, with all replacement parts being interchangeable.
5. Wetted pump parts shall be suitable for the water handled by pumps for that service.
6. Each pump shall operate satisfactorily when a second, parallel, or standby pump is placed in operation.

7. Pumps shall be designed so that reverse rotation at the runaway speed caused by reverse water flow under maximum head will not cause damage to any of the components of the pump.
8. Pumps shall be designed to pass any foreign object having maximum dimensions indicated in the Datasheets without damage to the pumping equipment.

C. Pump Characteristics

1. Each pump shall be designed with a head-capacity characteristic which rises steadily from the one pump runout capacity to minimum flow.
2. It is preferred that each pump have low shutoff head and maximum efficiency at approximate design capacity and head.
3. Pumps shall be suitable for extended operation over the range from minimum flow to single pump runout at minimum system resistance, without damaging pitting, capitation, excessive noise, or excessive vibration.
4. Pumps shall be designed to have a required NPSH at one pump runout conditions of no more than 75% of the NPSH available. Reliability during all operational conditions is major consideration.

D. Additional Technical Requirements

1. ASME Performance Test Connections – Contractor shall provide the necessary instrumentation connections on the equipment as required for the acceptance tests specified in PTC 8.2.
2. The Contractor shall incorporate into the pump can design any and all provisions necessary to prevent or eliminate the potential for vortexing.
3. The inlet to the condensate pump shall be sized to limit the flow velocity at design conditions to not more than 3 ft/sec and no more than 4 ft/sec in the suction can to minimize potential for reduction in NPSHA due to flow losses.
4. Pump inlet and outlet connections shall be on the same centerline.

2.4 COMPONENTS

A. To minimize equipment failure and damages caused by unproven components, the General Manager intends to install reliable, proven equipment and components which shall perform in accordance with the specifications. The Contractor shall disclose to the General Manager each design manufacturing procedure, component or assembly which does not have at least two (2) years satisfactory operating experience in similar service. Further, the Contractor shall have manufactured at least two pumps of comparable design, power rating, speed, and discharge pressure. The failure to make such disclosures specifically and in writing shall extend the Contractor's warranty to include all direct costs to the General Manager that may result from the Contractor's use of such procedures, components or assemblies.

B. Impellers and Bowls

1. The pump impellers shall be carefully machined and finished, with enclosed construction.
2. The impellers shall fit the shaft accurately and shall be securely keyed and locked in position so as to prevent any movement on the shaft during normal and reverse rotation operation.

3. Collets or taper fits will not be acceptable.
4. The bowls shall be flanged. Screwed in bowls are not acceptable.
5. The wear surface of the bowls and impellers is integrally cast with the components, which include an allowance for future installation of wear rings
6. Full size impellers shall not be used. An allowance for a 5% future TDH increase is included.
7. All impellers shall be statically and dynamically balanced.
8. Pump bowls shall be prepared and coated in accordance with specifications provided in this Section.

C. Pump Column

1. Joints in the pump column shall be flanged and bolted.
2. The pump column shall be designed and constructed to provide accurate alignment automatically when the column is assembled.
3. The pump discharge connection shall be flanged and drilled to match ASME B16.5 requirements. Flanges shall be 150# minimum. Discharge flange top two bolt holes shall straddle flange vertical centerline.
4. The pump shall include provisions designed to resist the discharge thrust developed with the pump operating at shutoff head, the piping weight, and piping thermal expansion.
5. Discharge head skirt shall have through holes drilled with stainless steel bulkhead fittings installed for the through-passage of seal and flushing water supply connections as well as mechanical seal and skirt drain connections.
6. Each column section shall have at least 2 lifting lugs.
7. Pump column section shall be prepared and coated in accordance with specifications provided in this Section.

D. Shaft

1. The pump shaft shall be sized to transmit the power requirements of the pump.
2. The shaft is machined across its entire length and ground and polished at critical areas.
3. A tensioning device shall be provided for each pump with a shaft enclosing tube to assure exclusion of the pumped liquid.
4. If applicable, line shaft and enclosing tube shall be fabricated from316 stainless steel.

E. Shaft Seals

1. The pumps shall be equipped with mechanic seals. The seals shall employ API seal plan 13 or equivalent method to vent non-condensable gases from the seal chamber to the condenser.
2. Mechanical seals shall be specifically designed for the intended service. Seals shall have throttle bushings, vent, drain and flush connections. Plugs for unused seal connections shall be of the same material as the gland.

F. Bearings and Lubrication

1. All radial shaft bearings shall be as recommended by the Contractor for the service and shall be of sufficient number to prevent shaft whip and minimize noise level. Maximum spacing between adjacent line shaft bearings (bushings) shall be in accordance with API 610.

2. The impeller suction and discharge bowl bearings shall be as recommended by the Contractor for the service.
3. All bearings shall be mechanically secured to the bearing housings to prevent bearing rotation or movement during operation.
4. Pump bearings are flushed by the liquid passing through the column.
5. Pump shaft sealing with John Crane or equivalent mechanical seal shall be accessible through openings in the motor support stand shall be provided above the upper bearing.
6. A space coupling is provided to allow the mechanical seal to be removed. Split seals are not utilized.
7. A shaft sleeve shall be provided at the mechanical seal.
8. The space between the motor and the mechanical seal shall be sufficient to permit removal and replacement of the seal without dismantling the pump.
9. Pump axial thrust will be resisted by a thrust bearing in the drive motor through the rigid coupling.

G.Drive Support

1. Each pump shall be provided with a cylindrical fabricated steel support pedestal for mounting the drive motor directly on the pump discharge head. The base shall be designed to support the total weight of the complete pumping unit and all imposed dynamic loads.
2. Reinforcing ribs and braces, if required, shall be on the interior of the support base.
3. Access holes that are sufficiently large, and in sufficient number, shall be provided for dismantling the drive shaft coupling and for maintenance and inspection of the pump seal. Access holes shall have bolted covers.
4. The support pedestal shall be machined and drilled as required to receive and provide for proper alignment and securing of the drive motor to the pedestal.
5. All bolts, nuts, washers, and pins required for securing the motor to the pedestal shall be furnished and shall be constructed with Type 316 stainless steel.
6. Drive motor mountings shall be machined in accordance with dimensions supplied by the motor manufacturer.

H.Baseplate

1. Each pump shall be provided with a heavy structural steel baseplate. The suction can mounting flange acts as the “soleplate”. Base plates shall be made of ASTM A36 carbon steel.
2. Fastening of the base plate to the sole plate shall be accomplished by drilling and tapping soleplate to receive fasteners through the base plate. Fully threaded bolts shall be furnished for this purpose.
3. Edges of base plate attachment holes shall be no closer than 1.5 diameters from the edge of the hole in the soleplate through which the pump column passes. Contractor shall determine fastener size for this connection which meets all local code requirements and furnish required torque value for this connection to achieve design preload.
4. Where base plate and sole plate meet, the mating surfaces shall be machined flat. Contractor shall apply corrosion-resistant treatment to mating surfaces prior to shipment.

I. Shaft Couplings

1. A rigid, adjustable, flanged type coupling shall be provided for connecting the pump to the drive motor.

2. The drive motor coupling shall be specifically designed for vertical pump application, shall provide for vertical adjustment of the impeller, and permit changing the mechanical seal without removal of the motor.
3. The drive motor coupling shall be keyed to both the drive motor and pump line shafts. The shaft coupling shall be sized to transmit the maximum brake horsepower requirements of the driven equipment with a service factor of not less than 2.
4. A permanent corrosion-resistant plate shall be attached with corrosion resistant fasteners to the drive motor support pedestal stating the direction of rotation and coupling gap required for impeller positioning.
5. Line shaft couplings shall be of the sleeve and keyed type to permit ease of maintenance. Threaded couplings are not acceptable.

J. Coupling Guards

1. Safety guards shall be provided for protection of personnel from all exposed moving and/or rotating machine elements in accordance with the requirements of the applicable section of 29 CFR 1910.
2. Each guard shall be fabricated from ASTM A36 steel plate having a minimum thickness of 10 BWG and designed for easy installation and removal.
3. Necessary supports and accessories shall be furnished with each guard.

K.Lifting Lugs

1. Four lifting lugs shall be provided on the pump discharge head to facilitate handling during installation, maintenance and removal. Lugs shall be designed to handle the full weight of the assembled pump and accessories.

L. External Piping Connections

1. Contractor shall provide all connections for suction, discharge, flushing, and venting.
2. Connections shall have flanged ends in accordance with ASME B16.5.
3. Piping shall be in accordance with ASME B31.1.
4. Sizes and design pressures and temperatures of suction and discharge flanges shall be as specified in attached General Manager Datasheet.
5. Suction and discharge connections shall be provided with 1/2-inch NPT pressure gage connections located at the pipe springline.
6. The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Contractor’s drawings.

M. Accessories

1. Miscellaneous trim - All piping and valves required for the mechanical flushing or seal water, air vent valves, oil level indicators, grease lubricators, and other miscellaneous accessories shall be furnished by the pump manufacturer. All wetted parts (valve, tubing, etc.) are to match or exceed the characteristics of the casing materials.

N.Identification

1. A nameplate shall be securely attached to each pump in a visible location. The nameplate shall be made of stainless steel and attached to the pump with stainless steel screws. The following information shall be included on the nameplates:

a. Name of Equipment
b. Manufacturer
c. Serial Number
d. Pump size
e. Model Number
f. Design Capacity (flow and head)
g. Design Pressure
h. Design Temperature
i. Maximum continuous speed
j. General Manager's equipment tag number

O.Drive Motors

1. Drive motors enclosures shall meet requirements of Section 262050, Low Voltage Motors or Section 261050, Medium Voltage Motors.
2. Motors shall be equipped with anti-reverse ratchets to prevent reverse rotation in the stopped condition.

2.5 INSTRUMENTATION AND CONTROLS Not applicable to Contractor scope of supply

A.General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a Contractor-furnished Plant Control System. All control devices furnished by the Contractor shall be capable of interfacing with the plant Control System and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the plant Control System to remotely start and stop all rotating equipment and to allow automatic switch over to the backup unit.
2. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
3. The Contractor shall permanently install a 1-1/4 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified "Instrument Tag Number" to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
4. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required for flame scanners, ignition transformers, etc. shall be provided by the Contractor for installation by the BOP Contractor.
5. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
6. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of

abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.

7. The plant control system is to be designed to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations.
8. Plant systems and equipment are to be monitored and/or controlled through the plant Control System. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant Control System.
9. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
10. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.

B. Instrumentation & Control Devices – Requirements

1. Duplex Type J thermocouples shall be used.
2. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
3. Control valves and pressure regulators shall be by Fisher or General Manager approved equivalent.
4. Electronic transmitters shall be Yokagawa, Endress & Hauser, SMAR smart transmitters or General Manager approved equivalent.

C. Instrumentation to be Supplied by Contractor

1. Pump Minimum Recirculation Controls

   a. The pumps shall be provided with suitable minimum recirculation controls to protect the pump under light load or no load conditions and to maintain a minimum safe flow of condensate through the condensate pumps. When the flow drops to a predetermined minimum value the recirculating valve shall begin to open in a controlled manner. The leak off control shall be such that when the condensate pumps are operating at low load, and in parallel, no hunting is caused by leak off valves opening or closing. The minimum recirculation control valve shall close when the pump flow increases to a predetermined quantity.
   b. The minimum flow recirculation valve for each pump shall be a conventional flow control valve. Leak off flow will be discharged into the condensate intake via separate multi-orifice pressure reducing devices. The condensate pumps shall be capable of running without distress continually with main discharge valves closed. The leak off piping will be provided by Others. However, the minimum flow control valve and the back pressure regulators shall be supplied by the Contractor.
   c. ARC valve type recirculation valves are not acceptable.

2.6 CIVIL AND STRUCTURAL

A. Refer to Section 481100, Combined Cycle Power Island for civil and structural requirements.

2.7 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

B. Shop/Factory Finishing

1. General

a. Steel material furnished under this specification, excluding machined surfaces, surfaces to be bonded to concrete, stainless steel, or "off the shelf" components, shall be blast cleaned and coated as required herein.
b. Priming and finish painting of piping is required. The base plate, coupling guards, and other exposed carbon steel surfaces shall be primed and coated prior to shipment.
c. Surface preparation and priming shall be in accordance with Manufacturer's standards.
d. The coatings shall not be applied until the equipment has been fabricated, hydrostatic tests completed, weld-spatter removed, welds ground smooth, sharp edges and corners ground to a curve, surfaces cleaned with clean mineral spirits, and abrasive blasting performed.
e. Off the shelf components such as control boxes, motors, valves, pipe hangers, etc., shall receive the Contractor's "standard shop finish".
f. Coatings shall be applied in accordance with the requirements of the coating manufacturer.

2.8 SOURCE QUALITY CONTROL

A. Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections

1. Hydrostatic Tests

a. Equipment and vessels shall be subjected to a hydrostatic leak test meeting the requirements of the applicable Code or Standard to verify integrity of the pressure boundary. No leakage is acceptable through the pressure boundary wall or assembly joints.

2. Functional and Performance Tests

a. The equipment shall be subjected to functional and performance tests in the Contractor’s shop to the greatest extent possible to verify the Contractor’s performance guarantees. The performance test for Contract purposes shall be executed at the final installation by the General Manager in accordance with a test procedure developed by the General Manager and approved by the Contractor.

3. Shop Tests

a. Full information shall be submitted describing the Manufacturer's testing facilities. All tests shall be performed in accordance with the requirements of the latest edition of ASME PTC 8.2, except as otherwise required herein. Shop test will not utilize the actual suction can.
b. Each pump shall be performance tested at rated speed to determine the head, capacity, and brake horsepower.
c. Tests shall be conducted in accordance with Hydraulic Institute Standards for Vertical Pumps and as specified herein and/or on the pump data sheet. One pump shall be subject to a witness test. Test data shall be sufficiently comprehensive to produce guaranteed performance curve showing head versus:

    1) Capacity
    2) Efficiency
    3) Net positive suction head required
    4) Brake horsepower

d. A minimum of 7 points shall be tested. One point shall be at shutoff. One point shall be run out. One point shall be the rated point. The remaining points shall be spaced evenly between the rated point and shut-off. The range of test operating points must bracket all design operating points presented on the data sheet. Shop testing shall be conducted with the same driver to be furnished with the equipment specified herein.
e. If the shop tests indicate that the tested pump fails to meet the guarantees stated herein, the other pump(s) for the same service shall be shop tested in accordance with this Section.
f. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.
g. Re-testing and modifications shall be repeated until all performance guarantees are met or until arrangements are made which are acceptable to the General Manager.
h. Certified copies of performance curves resulting from the testing shall be submitted to the General Manager for acceptance before shipment of the equipment. These curves shall indicate actual test pressure, temperature conditions, and the observed test points.
i. Complete documentation regarding the prototype model test conditions and results shall be submitted. Complete documentation verifying the development of the performance curves from the prototype model test curves shall be submitted.
j. Certified copies of performance curves resulting from the prototype model testing shall be submitted to the General Manager for acceptance before shipment of the equipment. These curves shall indicate actual test pressure and temperature conditions and the performance curve points corresponding to the observed prototype model pump test points. The performance curves shall be guaranteed.
k. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed in the General Manager Data Sheet, appropriate correction factors shall be applied to the observed test curve, and a corrected curve shall be indicated. This corrected curve shall then represent expected pump performance with the suction conditions listed in the General Manager Data Sheet.
l. The General Manager reserves the right to witness all pump testing and re-testing.
m. Contractor shall submit certified copies of test and inspection reports within 14 days of completion of the inspection or test.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements.

B. Performance Tests

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Refer to Section 481100 Combined Cycle Power Island for individual equipment baseline performance testing.
2. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.

3.3 COMMISSIONING

A. General

1. Refer to Section 480032, Power Island Performance for general commissioning requirements.

END OF SECTION 485311.10

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER

The detailed technical data will be furnished by the equipment vendor during contract execution. The design will be to manufacturer's standards and will support the power island guarantees and will meet the design life requirements.

Item	Description:	Units	Condensate Pumps
1.1	Pump Tag No.(s)		TBD
1.2	Type:		Canned vertical
1.3	Quantity Required		2
1.4	Capacity,	%	100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Condensate
1.7	Pump Materials:		
	Suction can, column, and discharge head		Fabricated parts: Carbon steel, ASTM A36 or ASTM A283 Grade C Castings: Cast Carbon Steel, ASTM A216 Grade WCB
	Bowls		Cast Carbon Steel ASTM A216 Grade WCB
	Impellers		12-14% Chromium Stainless Steel, ASTM A743 or A217 Grades CA-15 or CA-6NM
	Shaft		11.5-13.5% Chromium Stainless Steel, ASTM A276 Type 410, Condition T
	Shaft Sleeves		11.5-13.5% Chromium Stainless Steel, ASTM A276 Type 410, Condition H
	Shaft Seals		Mechanical Seal - API 610 (John Crane or equivalent)
	Wear Rings		12-14% Chromium Stainless Steel, ASTM A582, Type 416, Condition H
	Bearings		Carbon or Graphalloy
	Bowl Bolting		12% Chromium Stainless Steel, ASTM A193, Type 416
1.8	Screen Opening,	in	Not applicable

1.9	Performance Rating:		
	Fluid Temperature Range (est.)	°F	75-110
	Fluid density (est.)	lb/ft^3	62.0
	Flow (est.)	gpm	234
	Suction head (est.)	ft	-20
	Discharge head (est.)	ft	230
	Net positive suction head available ($NPSH_A$)	ft	TBD
	Pump efficiency at rated point(s)	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	TBD
	Size, discharge	in. NPS	TBD
	Design Pressure	psig	TBD
	Design Temperature	°F	TBD
1.11	Power, volts/ phase/ Hertz		480V or 4160V / 3 ph / 60 Hz
1.12	Shop Test Required, y / n		Y
1.13	Water Analysis:		See 480020, Site Conditions
	Total Hardness	ppm as $CaCO_3$	TBD
	Total Alkalinity	ppm as $CaCO_3$	TBD
	Total Dissolved Solids	ppm	TBD
	Total Suspended Solids	ppm	TBD
	pH		TBD
	Conductivity	µohms/ cm	TBD
	Oxygen	ppb	TBD
	Total Organic Carbon	ppm	TBD

4.2 TECHNICAL DATASHEET BY CONTRACTOR Data to be furnished during project execution

Item	Description	Units	Condensate Pumps
1.0	GENERAL		
1.1	Pump Name		
1.2	Tag No.		
1.3	Number of pumps required		
1.4	Pump type		
1.5	Pump model		
1.6	Manufacturer		
1.7	Point of manufacture		
1.8	Delivery, weeks ARO		
1.9	Max. dimension (pumped solids)		
1.10	Rotation direction (view from driver)		
1.11	Number of stages		
1.12	Suction conn. size/type/rating		
1.13	Discharge conn. size/type/rating		
1.14	Casing design pressure	psig	
1.15	Seal/flush plan		
1.16	Seal water required	gpm	
1.17	Pumped fluid description		
1.18	Pumped fluid chemistry		
2.0	PERFORMANCE @ DESIGN RATING		
2.1	Fluid		
	Temperature	°F	
	Specific gravity		
2.2	Flow,	gpm	
2.3	Total head	ft	
2.4	Pump speed	rpm	
2.5	NPSH required	ft	
2.6	NPSH available	ft	
2.7	Pump efficiency	%	
2.8	Shaft horsepower	hp	
2.9	Motor Nameplate Rating	hp	
3.0	OTHER PERFORMANCE DATA		
3.1	Total head @ shutoff	ft	
3.2	Recommended min. recirculation	gpm	
3.3	NPSH required @ 120% of rated flow	ft	
3.4	Flow @ runout	gpm	
3.5	Total head @ runout	ft	
3.6	NPSH required @ runout	ft	
3.7	Shaft horsepower @ runout	kW	
3.8	For maximum diameter impeller & BEP		
	Flow	gpm	
	Total head	ft	

	Efficiency	%	
3.9	Max. sound level @ 3', (dBA)	dBA	
3.10	Shutoff head	ft	
4.0	DESIGN DATA		
4.1	Min. submergence required	ft	
4.2	Line shaft diameter	in	
4.3	Impeller shaft diameter	in	
4.4	Maximum impeller diameter	in	
4.5	Minimum impeller diameter	in	
4.6	Bearing spans	in	
4.7	Max. temperature rating	°F	
4.8	Pump column outer diameter	in	
4.9	Pump column thickness	in	
4.10	Pump column section length	in	
4.11	Length from bottom of pump baseplate to bottom of suction bell	in	
4.12	Length from CL of first impeller eye to bottom of suction bell	in	
5.0	MATERIALS OF CONSTRUCTION		
5.1	Bowl		
5.2	Casing wear rings (if any)		
5.3	Vent connections		
5.4	Column		
5.5	Baseplate		
5.6	Soleplate		
5.7	Bolting		
5.8	Suction bell		
5.9	Discharge head		
5.10	Shafting		
5.11	Shaft sleeves		
5.12	Impeller		
5.13	Impeller wear rings (if used)		
5.14	Lineshaft bearings		
5.15	Bowl bearings		
6.0	COATING(S) BY ITEM OR SECTION		
6.1	Items(s) or Section		
6.2	Coating		
6.3	Manufacturer & Designation		
6.4	Final thickness	in	
6.5	Surface preparation		
6.6	Item(s) or Section		
6.7	Coating		
6.8	Manufacturer & Designation		
6.9	Final thickness	in	
6.10	Surface preparation		

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485311.20

Boiler Feedwater Pumps

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485311.20
Boiler Feedwater Pumps

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	T. Clark	A
09/09/2011	B. Hritsco	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
05/04/2012	T. Clark	E
06/15/2012	B. Hritsco	F
09/11/2012	T. Clark	G
09/10/2013		H – CONTRACT VERSION

SECTION 485311.20
BOILER FEEDWATER PUMPS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 2
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 5
1.10 DELIVERY, STORAGE, AND HANDLING 5
1.11 SITE CONDITIONS 5
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MANUFACTURERS 5
2.2 MATERIALS AND WELDING 5
2.3 EQUIPMENT 6
2.4 COMPONENTS 7
2.5 INSTRUMENTATION AND CONTROLS 8
2.6 CIVIL AND STRUCTURAL 10
2.7 FABRICATION 10
2.8 SOURCE QUALITY CONTROL 10

PART 3 - EXECUTION 11

3.1 SPARE PARTS 11
3.2 FIELD QUALITY CONTROL 11
3.3 COMMISSIONING 12

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 13

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR 15

SECTION 485311.20
BOILER FEEDWATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of Boiler Feedwater Pumps with electric motors capable of VFD operation - VFD by others.. It is not the intent to specify completely herein all details of design and construction. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. 2x100% multistage centrifugal pumps with electric driver motors.
2. Base plates for each pump and driver
3. Discharge minimum recirculation flow control valves and back pressure regulators for each pump (to be supplied loose)
4. Pump suction strainers for each pump with startup strainer elements and a spare element (to be supplied loose)
5. All oil piping and balance drum leakoff piping on the pump base (or skid)
6. Temperature elements for the pump and motor bearings and motor windings, as specified herein
7. Spare parts for erection and commissioning
8. Priced list of recommended spare parts for two years of operation
9. Performance testing at factory and certificates of results
10. Performance data and curves as specified herein
11. Inspection certificates and quality control documentation listed in this Section
12. Drawings and design data to support facility design, construction and maintenance showing all interface requirements, including anchor bolts, foundation loads, foundation outlines, and electrical and instrumentation connections
13. Complete set of component cut sheets
14. Operating, commissioning, installation and maintenance manuals for the supplied equipment
15. Finish painting
16. Delivery to site
17. Provide pricing for technical assistance during the installation and field testing of pumps
18. Special tools, if required

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Motor starters and power wiring
2. Control wiring from Contractors interface points.
3. Auxiliary cooling water as required
4. Foundations, grouting and foundation bolts
5. Offloading at site and installation
6. Final alignment
7. Field inspection and testing
8. Field touch-up painting
9. Suction and discharge piping to and from the pumps.
10. Pump discharge flow measurement for minimum flow controls.

1.4 RELATED SECTIONS

A. Section 260000, Electrical - Mechanical Equipment

B. Section 261050, Medium Voltage Motors

C. Section 262050, Low Voltage Motors

D. Section 480020, Site Conditions

E. Section 480031, Combined Cycle Power Island Noise Control Performance

F. Section 481100, Combined Cycle Power Island

G. Section 485413, Once-Through Steam Generator

1.5 CODES AND STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section:

1. American Society of Mechanical Engineers (ASME).

a. PTC 8.2 - Power Test Code for Centrifugal Pumps

2. Hydraulic Institute (HI)

B. All interfaces shall be supplied designed to the applicable North American standards.

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. All equipment shall be designed for a thirty (30) year life objective. Components for which this service life cannot be expected shall be identified and those components shall be designed for ease of replacement and maintenance.
2. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
3. The pumps shall be suitable for continuous operation in the ambient conditions as detailed in Section 480020, Site Conditions.
4. Each pump shall be completely assembled, piped and mounted on a common base plate aligned with the electric driving motor.
5. There shall be two 100% capacity feed pumps. One 100% capacity boiler feed pump will be operating while the other is on standby. The standby pump shall be designed to be able to start automatically while the failed pump shuts down.
6. The pumps shall be provided with minimum flow recirculation control arrangement to recirculate water back to the hotwell so as to render the pumps safe at low and no load conditions. The minimum recirculation valves shall be sized and selected, including trim and plug design, actuators, valve materials and valve accessories to properly satisfy the operating and design conditions of each boiler feed pump. The control valves shall be furnished with pneumatic spring opposed diaphragm operators. Valve position transmitters shall be provided and positioner shall be HART type. Recirculation shall be to the hotwell when operating under normal conditions. Any flow restricting orifice plate or back pressure regulators for the recirculation line shall be provided. Use of automatic recirculation control (ARC) valves for minimum flow controls is not acceptable.
7. The pump materials shall be suitable for the feed water quantity leaving the condensate polisher plus any chemical injection or small quantities of phosphate and ammonia (from the breakdown of boiler water treatment chemical additives).
8. Pumps shall be located at ground level. Any special handling equipment necessary for the erection and subsequent maintenance of the pump and motor shall be supplied under this contract.
9. Pumps shall be identical in design and component parts shall be interchangeable. It shall be possible to operate both the pumps together and they shall remain inherently stable when running in parallel while in this mode.

10. The characteristics of the motors shall be such that the pumps will not exceed the rated capacity and temperature rise under any operating conditions.

B. Performance Requirements

1. The design duty of both pumps shall be based on the ability of one pump to deliver a water flow corresponding to the maximum output capability of a heat recovery steam generator plus spray water requirements for superheat attemperation at the steam turbine bypass valve. When operating at this flow the boiler feed pump discharge pressure shall be able to overcome a system resistance equal to the sum of the drum pressure, the pressure loss through the economizer, feed regulation/control valves, feed pipework up to the steam generator inlet piping, and the static pressure difference between the pump and the steam generator inlet piping center line; minus the net positive suction head. The contractor shall guarantee the following:

    a. Capacity without negative tolerance.
    b. TDH without negative tolerance and plus 3% at the design capacity.
    c. $NPSH_{req}$ without positive tolerance minus 10% at design capacity.
    d. Pump efficiency without negative tolerance.
    e. Shutoff head tolerance shall be +/-8% per API 610 requirements.
    f. Acceptable TDH deviation amongst identical units of 2% at design capacity.
    g. Noise requirements as specified herein.
    h. Wire-to-water horsepower input at pump design operating point, corrected to actual fluid temperature within HI tolerances.
2. The characteristics of the pump must be such that the pump shutoff head is 108% of the rated head. The Contractor shall state the maximum pump head with discharge valve closed.
3. Normally one boiler feed water pump will operate. The second pump will be on auto standby available for emergency start. However the feed water pumps shall be capable of operating in parallel over the full duty range.
4. The pumps shall be suitable for both continuously and intermittent service and shall operate satisfactorily without vibration, cavitation, or distress to any part through an operating range from minimum flow to maximum specified capacity.
5. Pump's point of maximum efficiency shall coincide with the specified design capacity.
6. The Net Positive Suction Head Available ($NPSH_{avail}$) is estimate in the attached datasheet. The pump selection shall maintain an $NPSH_{req}/NPSH_{avail}$ ratio of 50% at the runout flow condition. The pump run-out flow shall be defined as no more than 120% of design.
7. The Suction Specific Speed shall not exceed 9,000 based upon Hydraulic Institute definitions.
8. The pump sets (pump, motor and base) shall be designed to avoid occurrence of one-half, first, second, and third harmonic critical speeds in undamped condition resulting in amplified excitation of vibration levels. A lateral and torsional evaluation shall be conducted to assure the avoidance of critical speed.
9. Pumps shall be suitable for continuous operation across the entire sliding pressure operation range of the OTSG without vibration, cavitation, or undue stress to any part of the pumps.

C. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of

causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general delivery storage and handling requirements.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply equipment specified within this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the Contractor's Proposal.

1. Not Used

2.2 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

B. The minimum requirements for pump materials are as follows :

1. Pump materials shall be equivalent to, or shall exceed the strength and corrosion-erosion resistance of the following listed materials.

Component	Material
Casing	ASTM A743, Grade CA-6NM
Casing Studs	ASTM A193, Grade B.7
Casing Wear Rings	ASTM A743, Grade CA-40 H.T.
Throttle Bushing	ASTM A743, Grade CA-40 H.T.
Impellers	ASTM A743, Grade CA-6NM
Impeller Wear Rings	ASTM A473, Type 410
Impeller Hub Rings	ASTM A473, Type 410
Balance Sleeves	ASTM A479, Type 410
Shaft Sleeves	ASTM A479, Type 410
Throat Bushings	ASTM A743, Grade CA-40 HT
Shaft	ASTM A479, Type 410 CL2
Keys – Internal	ASTM A582, TP 416 Cond T
Bearing Housings	ASTM A48, CL30
Baseplate	ASTM A36

2. Contractor's recommendations for pump superior materials will be considered by General Manager. Contractor may bid these superior materials as an alternate in addition to the base bid. As a minimum these materials shall meet the requirements of API-610 Table H-1 Class C-6.
3. The materials in contact with the feedwater shall be a minimum 13% chrome steel. The responsibility for selection of the correct materials for the pumps shall be left with the Contractor.
4. A difference of at least 100 Brinell hardness numbers shall be maintained between stationary and rotating parts.
5. US customary size fasteners shall be used throughout pump assembly.
6. Components operating with close running clearances shall have a minimum hardness of 400 Brinell.
7. Shaft sleeves, high chrome steel, with minimum surface hardness of 500 Brinell.

2.3 EQUIPMENT

A. Boiler Feed Pumps
1. Casing shall be multi-stage ring section pump suitable for frequent and fast start/stops operations. It shall be constructed to reduce the possibility of internal leakage.

2. Each pump shall be of the horizontal, centrifugal, multi-stage diffuser or volute type with impellers arranged in series specially designed for feed water pump services.
3. The suction, and discharge nozzles shall be ANSI class flanges appropriate for the pressure and temperature.
4. Effective sealing devices shall be provided on all bearings to prevent oil and water leakage. Mechanical seals shall be of the pressure balanced cartridge type and designed and materials that have been tested and proven most suitable for the specified service conditions. The seals shall be equipped with all necessary accessories to flush, cool and vent the seal faces, to provide the maximum service of the seal parts. Mechanical seal gland water source shall be from the pumps.
5. Pump shaft sealing with John Crane or equivalent mechanical seals with a closed, filtered cooling water system per API Plan 23, utilizing stainless steel tubing with welded connections shall be provided. Auxiliary cooling water piping shall be designed to meet or exceed the pressure and temperature ratings appropriate for the service. Auxiliary cooling water piping for each pump shall terminate with one supply and one return connection at the Contractor's interface point.
6. Wearing rings, impellers, shaft sleeves, and other parts (either rotating or stationary) forming the pump assembly, shall be securely locked in place and liberally designed and renewable. Internal design clearances shall be rated for the requisite stiffness with API-610 clearances from minimum continuous safe flow to run out flow.
7. Hydraulic axial thrusts are to be compensated by a balance drum device in combination with a thrust bearing of the oil lubricated tilting pad type. Balance water leaking across the balance drum shall be piped back to the pump suction. Thrust bearings shall be of the anti-friction type with ring oil lubrication.
8. The assembled shaft including impellers shall be of robust design with critical speed at least 20% above running speed. The rotating components shall be statically and dynamically balanced to ensure minimum vibration throughout the entire speed and load range.
9. Each pump and motor shall be mounted on a common fabricated steel base, with a drip rim and drains connection. Sound pressure levels for the pump/motor set shall be in accordance with noise specification Section 480031, Combined Cycle Power Island Noise Control Performance.
10. The pump shall be provided with flexible spacer type coupling bored and keyed to match the pump and the motor shafts.

2.4 COMPONENTS

A. Electric Motors

1. The design requirements for electric motors are specified separately in Sections 261050, Medium Voltage Motors and 262050 Low Voltage Motors.
2. Motors shall be equipped with anti-reverse ratchets to prevent reverse rotation in the stopped condition.

B. Lubrication

1. Thrust bearings shall be of the anti-friction type with ring oil lubrication. Pressure gauges shall be installed at the inlet and outlet of the filter and at the oil pump discharge. Thermometers shall be installed at the inlet and outlet of the cooler and on all main bearings and motors.

2. Effective sealing devices shall be provided on all bearings to prevent oil and water leakage. Mechanical shafts shall be of the pressure balanced cartridge type and designed with materials that have been tested and proven most suitable for the specified service conditions. The seals shall be equipped with all necessary accessories to flush, cool and vent the seal faces, to provide the maximum service life of the seal parts. Mechanical seal gland water source shall be from the pumps.

C. Bearings and Balancing

1. Bearings shall be split sleeve type, lined with an approved tin base babbit, pressure lubricated and with cast iron housings. Thrust bearing shall be of the Kingsbury type. This bearing shall not be overloaded under any mode of operation.
2. Axial balancing devices shall be provided, designed to carry the complete axial thrust load of the pump. These devices shall consist of a rotating balancing drum combined with a pressure lubricated thrust bearing.

D. Guards

1. Guards shall be designed and provided in accordance with the manufacturer’s standard and OSHA requirements.

E. Strainers

1. Temporary suction cone-type strainer to be located upstream of each pump, shall be supplied as loose items. The strainer shall be manufactured from ASTM A-216 Grade WCB material and shall be provided with type 316 stainless steel screens and with ANSI flanged end connections.

2.5 INSTRUMENTATION AND CONTROLS

A. General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a Contractor-furnished Plant Control System (PCS). All control devices furnished by the Contractor shall be capable of interfacing with the Plant Control System and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the Plant Control System to remotely start and stop all rotating equipment and to allow automatic switch over to the backup unit.
2. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
3. The Contractor shall permanently install a 1-1/4 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified “Instrument Tag Number” to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
4. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of

non-skid mounted devices. Special cables or termination kits, if required, shall be provided by the Contractor for installation by the BOP Contractor.

5. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
6. The Plant Control System shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.
7. The plant control system is to be designed to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations.
8. Plant systems and equipment are to be monitored and/or controlled through the plant Control System. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant Control System.
9. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
10. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.

B. Instrumentation & Control Devices – Requirements

1. Duplex Type J thermocouples shall be used.
2. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
3. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters.
4. Control valves and pressure regulators shall be manufactured by Fisher or approved equivalent.

C. Instrumentation to be Supplied by Contractor

1. Pump Minimum Recirculation Controls

a. The pumps shall be provided with suitable minimum recirculation controls to protect the pump under light load or no load conditions and to maintain a minimum safe flow of water through the feed water pumps. When the flow drops to a predetermined minimum value the recirculating valve shall begin to open in a controlled manner. The leak off control shall be such that when the feed pumps are operating at low load, and in parallel, no hunting is caused by leak off valves opening or closing. The minimum recirculation control valve will close when the pump flow increases to a predetermined quantity.

b. The minimum flow recirculation valve for each pump shall be a conventional flow control valve. Leak off flow will be discharged into the boiler feedwater tank via separate multi-orifice pressure reducing devices. The feed pumps shall be capable of running without distress continually with main discharge valves closed. The leak off piping will be provided by others. However the minimum flow control valve and the back pressure regulators shall be supplied by the Contractor.

c. Automatic recirculating control (ARC) valve type recirculation valves are not acceptable.

2.6 CIVIL AND STRUCTURAL

A. Refer to Section 481100, Combined Cycle Power Island for general Civil and Structural Requirements.

2.7 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.8 SOURCE QUALITY CONTROL

A. Refer to Section 481100 Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections

1. Hydrostatic Tests

a. Pumps casing shall be hydrostatically tested to a minimum of 1.5 times the design discharge pressure at pump shut-off according to the requirements of the applicable Code or Standard to verify integrity of the pressure boundary. No leakage is acceptable through the pressure boundary wall or assembly joints.

2. Functional and Performance Tests

a. The equipment shall be subjected to functional and performance tests in the Contractor’s shop to the greatest extent possible to verify the Contractor’s performance guarantees. The performance test for Contract purposes shall be executed at the final installation by the General Manager in accordance with a test procedure developed by the General Manager and approved by the Contractor.

3. Shop Tests

a. Pump performance tests shall be performed on each completed pump assembly in the Contractor’s shop to demonstrate the capacity and the head of the pumps. Shop performance tests shall be submitted to General Manager for approval prior to shipment of the pumps. Contractor's standard or generic pump family curves will not be acceptable in lieu of shop testing job-specific pumps. Shop tests shall be performed by a qualified individual who shall certify his or her qualifications as well as the accuracy of the test results. The tests shall demonstrate developed head, efficiency and BHP, at minimum flow, rated flow and runout flow for each pump.

b. The NPSH tests shall be conducted at shutoff flow, and runout flow and five evenly spaced operating points between, for a total of seven test points. The center of these 5 test points shall be the rated flow point

4. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees. Any such repairs, adjustments and or alterations shall be at Contractor's expense. Any and all modifications shall be

documented and submitted for General Manager's approval along with the final "for approval" shop performance testing results.

5. Re-testing and modifications shall be repeated until all performance guarantees are met or until arrangements are made which are acceptable to the General Manager.
6. Certified copies of performance curves resulting from the testing shall be submitted to the General Manager for acceptance before shipment of the equipment. These curves shall indicate actual test pressure, temperature conditions, and the observed test points.
7. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed in the General Manager Datasheet, appropriate correction factors shall be applied to the observed test curve, and a corrected curve shall be indicated. This corrected curve shall then represent expected pump performance with the suction conditions listed in the General Manager Datasheet.
8. The General Manager reserves the right to witness all pump testing and re-testing. Contractor shall notify General Manager within 5 days of pump tests.
9. Contractor shall submit certified copies of test and inspection reports within 14 days of completion of the inspection or test. In no case shall the Contractor ship the pumps without approval of submitted shop performance testing by General Manager.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for general requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements.
2. Following erection/installation of equipment, General Manager or General Manager’s designated BOP Contractor shall test equipment in the installed condition to verify the equipment’s ability to operate under the specified conditions and to meet the specified performance guarantees.
3. The equipment will be tested, at a minimum, at the seven test points reported by Contractor in shop performance test reports.
4. Contractor shall cooperate with General Manager or General Manager's designated BOP Contractor in the preparation for and testing of equipment. Contractor shall provide any and all necessary technical support, in a timely fashion, as may be required during the field testing process.

B. Performance Tests

1. It is the General Manager’s intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Refer to Section 481100 Combined Cycle Power Island for individual equipment baseline performance testing.

2. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.

3.3 COMMISSIONING

A. General

1. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning.
2. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon completion.
3. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

END OF SECTION 485311.20

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

The detailed technical data will be furnished by the equipment vendor during contract execution. The design will be to manufacturer's standards and will support the power island guarantees and will meet the design life requirements.

Item	Description:	Units	Boiler Feedwater Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number		123374
1.1	Pump Tag No.(s)		TBD
1.2	Type:		Multistage Centrifugal suitable for sliding pressure service
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Boiler Water
1.7	Pump Materials:		
	Casing		ASTM A743, Grade CA-6NM
	Shaft		ASTM A479, Type 410 CL2
	Shaft Sleeve		ASTM A479, Type 410
	Impeller Wear Rings		ASTM A473, Type 410
	Impeller		ASTM A743, Grade CA-6NM
	Mechanical Seals		TBD by Contractor
1.8	Speed	RPM	TBD by Contractor
1.9	Design Flow each (est.)	gpm	234
	Suction Pressure (est.)	psia	34
	Design Discharge Pressure (est.)	psia	970
	Design Temperature Range (est.)	°F	75-110
	Density of feed water at design temperature (est.)	lb/ft^3	62.0
	Balance drum leak off flow	gpm	TBD
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	TBD
	Size, discharge	in. NPS	TBD
	Design Pressure	psig	TBD
	Design Temperature	°F	TBD
1.11	Power, volts/ phase/ Hertz		TBD
1.12	Shop Test Required, y / n		Y
1.13	Suction Strainer:		

	Type		Basket or Cone Type, with strainer flow area not less than 4 times the pipe size
	Mesh		50
	Fasteners		Quick Opening
	Material		SS
1.14	Minimum Recirculation Valve		

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR Data to be furnished during project execution

Item	Description	Units	Boiler Feedwater Pumps
1.0	**GENERAL**		
	Pump Name		
	Tag No.		
	Number of pumps required		
	Pump type		
	Pump model		
	Manufacturer		
	Point of manufacture		
	Delivery, weeks ARO		
	Max. dimension (pumped solids)		
	Rotation direction (view from driver)		
	Number of stages		
	Suction conn. size/type/rating		
	Discharge conn. size/type/rating		
	Casing design pressure	psig	
	Seal/flush plan		
	Seal water required	gpm	
	Pumped fluid description		
	Approx. equip. weight	lb	
	Approx. Dimensions, LxWxH	ft	
2.0	**PERFORMANCE @ DESIGN RATING**		
	Fluid		
	Temperature	°F	
	Specific gravity		
	Flow,	gpm	
	Total head	ft	
	Pump speed	rpm	
	NPSH required	ft	
	NPSH available	ft	
	Pump efficiency	%	
	Shaft horsepower	hp	
	Motor Nameplate Rating	hp	
3.0	**OTHER PERFORMANCE DATA**		
	Total head @ shutoff	ft	
	Recommended min. recirculation	gpm	
	NPSH required @ 120% of rated flow	ft	
	Flow @ runout	gpm	
	Total head @ runout	ft	
	NPSH required @ runout	ft	
	Shaft horsepower @ runout	kW	
	For maximum diameter impeller & BEP		
	Flow	gpm	
	Total head	ft	
	Efficiency	%	
	Max. sound level @ 3’, (dBA)	dBA	

Item	Description	Units	Boiler Feedwater Pumps
	Shutoff head	ft	
4.0	**DESIGN DATA**		
	Min. submergence required	ft	
	Line shaft diameter	in	
	Impeller shaft diameter	in	
	Maximum impeller diameter	in	
	Minimum impeller diameter	in	
	Bearing spans	in	
	Max. temperature rating	°F	
5.0	**MATERIALS OF CONSTRUCTION**		
	Casing		
	Shaft		
	Shaft Sleeve - Stationary		
	Shaft Sleeve - Rotating		
	Wear Rings Casing - Stationary		
	Wear Rings Impeller - Rotating		
	Impellers		
	Mechanical Seals		
	Balancing Device - Stationary		
	Balancing Device - Rotating		
	Throttle Bushing		
	Warm-up Orifices, if required		
	Balancing Leakoff Orifices, if required		
	Diffusers		
	Diaphragms		
	Stage Pieces		
	Internal Bolts and Studs		
	Internal Nuts		
	External Bolts and Studs		
	External Nuts		
6.0	**COATING(S) BY ITEM OR SECTION**		
	Items(s) or Section		
	Coating		
	Manufacturer & Designation		
	Final thickness	in	
	Surface preparation		
	Item(s) or Section		
	Coating		
	Manufacturer & Designation		

Item	Description	Units	Boiler Feedwater Pumps
	Final thickness	in	
	Surface preparation		
7.0	**PUMP MINIMUM RECIRCULATION VALVE**		
	Manufacturer		
	Valve Type		
	Flange Size and Rating		
	Valve Characteristics		
	Flow		
	Valve Cv		
	Pressure Drop		
	Valve Cv		
	Recommended installation details		
	Materials of construction		

PASADENA WATER & POWER

Glenarm Plant Unit GT-5
(GT-5 Combined Cycle Installation)

Section 485312
Circulating Water and
Auxiliary Cooling Water Pumps

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485312
Circulating Water and Auxiliary Cooling Water Pumps

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	T. Clark	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
04/14/2012	T. Clark	E
09/10/2013		F – CONTRACT VERSION

SECTION 485312
CIRCULATING WATER PUMPS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 1
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 5
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.11 SITE CONDITIONS 5
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MANUFACTURERS 5
2.2 MATERIALS AND WELDING 5
2.3 EQUIPMENT 6
2.4 COMPONENTS 7
2.5 INSTRUMENTATION AND CONTROLS COMPONENTS 11
2.6 CIVIL & STRUCTURAL 12
2.7 FABRICATION 12
2.8 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 15

3.1 SPARE PARTS 15
3.2 COMMISSIONING 15

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 16

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR18

SECTION 485312
CIRCULATING WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of the circulating water pumps. It is not the intent to specify completely herein all details of design and construction of the circulating water pumps. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager. While this specification is written specifically for the Circulating Water Pumps, it also generally applies to the supply of the Auxiliary Cooling Water Pumps.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. 2x100% capacity vertical circulating water pumps of non-pullout type construction.
2. Two electric drive motors (one speed)
3. All seals, bearing lubrication systems, couplings, and coupling guards.
4. Any special tools and lifting devices required for installation, maintenance, and operation
5. Cleaning and finishing prior to shipment
6. Painting
7. Performance testing at factory and certificates of results
8. Startup spare parts and special tools
9. Fabricated steel support pedestal with fasteners
10. Steel soleplates
11. Review proposed intake dimensions and make a recommendation.
12. Priced list of recommended spare parts for two years of operation
13. Packing and shipping to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Receipt and off loading at site

2. Installation labor and erection at the site
3. Foundation and anchor bolts
4. Grouting
5. Controls and instrumentation external to the equipment
6. Electrical conduit and wiring
7. Motor starters
8. Field touch up painting
9. Initial lubrication from Contractor provided lubrication inventory
10. Field inspection and testing

1.4 RELATED SECTIONS

A. Section 260000, Electrical - Mechanical Equipment

B. Section 261050, Specification for Medium Voltage Motors

C. Section 262050, Specification for Low Voltage Motors

D. Section 480020, Site Conditions

E. Section 480031, Combined Cycle Power Island Noise Control Performance

F. Section 480032, Power Island Performance

G. Section 481100, Combined Cycle Power Island

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American National Standards Institute (ANSI)

a. 2.3 - American National Standard for Vertical Pumps Design and Application

2. American Petroleum Institute (API)

a. 610 - Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries

3. American Society of Mechanical Engineers (ASME)

a. PTC 8.2 Power Test Code for Centrifugal Pumps

4. Hydraulic Institute (HI)

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Refer to Section 481100, Combined Cycle Power Island for cooling system description and requirements.
2. All equipment shall be designed for a thirty (30) year life objective. Components for which this service life cannot be expected shall be identified and those components shall be designed for ease of replacement and maintenance.
3. The pumps shall be suitable for continuous operation in the ambient conditions as detailed in Section 480020, Site Conditions.
4. All equipment shall be designed and assembled to provide suitable access for operation and maintenance of the equipment.
5. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
6. Each pump shall be completely assembled with the electric driving motor prior to shipping from factory. If necessary, the assembly may be disassembled for shipping.
7. The standby pump shall be designed to start automatically in an emergency situation when the failed operating pump shuts down.
8. Each pump shall be provided with a two speed electric motor.
9. The pumps shall also be provided with minimum flow recirculation control arrangement to recirculate water back to the cooling tower basin so as to render the pumps safe at low and no load conditions. The minimum recirculation valves shall be sized and selected, including trim and plug design, actuators, valve materials and valve accessories to properly satisfy the operating and design conditions of each circulating water pump. The control valves shall be furnished with pneumatic spring opposed diaphragm operators. Valve position transmitters shall be provided and positioner shall be HART type. Any flow restricting orifice plate or back pressure regulators required for the recirculation line shall be provided. Use of automatic recirculation control (ARC) valve for minimum flow controls is not acceptable.
10. The two circulating water pumps shall be identical in design and component parts shall be interchangeable. It shall be possible to operate two pumps together and they shall remain inherently stable when running in parallel while in this mode.

11. The Suction Specific Speed shall not exceed 12,000 or eye inlet on the first stage impeller exceed 65 ft/sec based upon Hydraulic Institute recommendations. Deviation from this recommendation is allowable for special designs if the Contractor can show risk of erosion and cavitation is minimal under normal operating conditions.
12. Pumps shall not produce more than 225 feet of head per stage to avoid damage due to vibration, cavitation, or erosion. More developed head per stage may be allowable if the design is proven by the Contractor.
13. The characteristics of the pumps shall be such that the motors will not exceed the rated capacity and temperature rise under any operating conditions. Under no circumstances shall the service factor of the motor be used to achieve required pump performance.

B. Performance Requirements

1. The contractor shall guarantee the following Refer to Attachment 6 for Performance Guarantees:

    a. Capacity without negative tolerance. Tolerances will be per HIS.
    b. TDH without negative tolerance and plus 3% at the design capacity.
    c. NPSHReq without positive tolerance minus 10% at design capacity.
    d. Pump efficiency without negative tolerance.
    e. Shutoff head without positive tolerance above guarantee, minus 3%.
    f. Acceptable TDH deviation amongst identical units of 2% at design capacity.
    g. Noise requirements as specified in Section 480031, Combined Cycle Power Island Noise Control Performance
    h. Wire-to-water horsepower input at pump design operating point, corrected to actual fluid temperature within HI tolerances.

2. Circulating water pumps are non-throttling so the rise to shut off in 6 - 10%. The Contractor shall state the maximum pump head with discharge valve closed.
3. The pumps shall be suitable for both continuously and intermittent service and shall operate satisfactorily without vibration, cavitation, or distress to any part through an operating range from minimum flow to maximum specified capacity.
4. Pump's point of maximum efficiency shall coincide with the specified design capacity.
5. Pumps are noted as 100% capacity, runout does not apply. A 2 ft NPSH margin is provided at the rated condition.
6. The pump sets (pump, motor and base) shall be designed to avoid occurrence of one-half, first, second, and third harmonic critical speeds in undamped condition resulting in amplified excitation of vibration levels. This includes 20% separation between operating speed and natural harmonic critical speed. A lateral and torsional evaluation shall be conducted to assure the avoidance of critical speed.

C. Reliability

1. No single failure of a component or system shall result in damage. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

Testing

1. Certificates and records of all shop tests shall be submitted to the General Manager for approval at least one week before shipment.
2. Certificates and records shall include, as a minimum:
   a. Mill-test certificates for casing, impellers, and shafting or other components (if required by the governing code).
   b. Pump performance-test reports, including test data and performance curves
   c. Motor test reports
   d. Hydrostatic test reports
   e. "As Built" pump data sheets

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general Packaging, Delivery, Storage, and Handling requirements.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply equipment specified within this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the Contractor's Proposal.

1. Not Used

2.2 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.3 EQUIPMENT

A. General Requirements

1. Design of rotating elements shall be such that all critical speeds shall be at least 25% greater than the operating speed.
2. Drive motors enclosures shall be per requirements of Section 262050, Low Voltage Motors or Section 261050, Medium Voltage Motors.
3. Manufacturer shall provide all connections for suction, discharge, sealing, flushing, and venting. Piping shall be in accordance with ASME B31.1. All piping furnished by the Manufacturer shall be provided in ANSI standard sizes in nominal English units (inch sizes) unless otherwise required in Section 480020, Site Conditions. The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.
4. Contractor shall be entirely responsible for the pump-to-motor interface including, but not limited to, the following:

    a. Supply of coupling for joining the pump and motor shafts
    b. Coordination of dimensions between the pump and motor
    c. Machining of the motor shaft to accept the coupling

B. Pumps

1. Each pump submitted by Contractor shall be designed for operation using the criteria specified.
2. The pump suction requirements, including submergence NPSHR, and inlet velocity, shall be determined using one pump runout capacity or 120% of design capacity, whichever is greater.
3. The design point total head specified shall use the discharge connection centerline as the reference point. Head losses through the pump, including suction inlet losses, are not included in the total head listed.
4. All pumps shall be identical in design and performance, with all replacement parts being interchangeable.
5. Wetted pump parts shall be suitable for the water handled by pumps for that service.
6. Each pump shall operate satisfactorily when a second, parallel, or standby pump is placed in operation.
7. Pumps shall be designed so that reverse rotation at the runaway speed caused by reverse water flow under maximum head will not cause damage to any of the components of the pump.
8. Pumps shall be designed to pass any foreign object having maximum dimensions indicated in the Datasheets without damage to the pumping equipment.

C. Pump Characteristics

1. Each pump shall be designed with a head-capacity characteristic which rises steadily from the one pump runout capacity to minimum flow.

2. It is preferred that each pump have low shutoff head and maximum efficiency at approximate design capacity and head.
3. Pumps shall be suitable for extended operation over the range from minimum flow to single pump runout at minimum system resistance, without damaging pitting, cavitation, excessive noise, or excessive vibration.
4. Pumps shall be designed to have a required NPSH at one pump runout conditions of no more than 75% of the NPSH available. Reliability during all operational conditions is major consideration.

D. Additional Technical Requirements

1. ASME Performance Test Connections – Manufacturer shall provide the necessary instrumentation connections on the equipment as required for the acceptance tests specified in PTC 8.2.
2. The Contractor shall incorporate any provisions necessary to prevent or eliminate the potential for vortexing and define installation provisions (i.e. recommended number of intake bell diameters from pit floor).

E. Pump inlet and outlet connections shall be on the same centerline.

2.4 COMPONENTS

A. To minimize equipment failure and damages caused by unproven components, the General Manager intends to install reliable, proven equipment and components which shall perform in accordance with the specifications. The Contractor shall disclose to the General Manager each design manufacturing procedure, component or assembly which does not have at least two (2) years satisfactory operating experience in similar service. Further, the contractor shall have manufactured at least two pumps of comparable design, power rating, speed, and discharge pressure. The failure to make such disclosures specifically and in writing shall extend the Contractor's warranty to include all direct costs to the General Manager that may result from the Contractor's use of such procedures, components or assemblies.

B. Motors

1. The design requirements for electric motors are specified separately in Section 262050 Low Voltage Motors and Section 261050 Medium Voltage Motors.
2. Motors shall be equipped with anti-reverse ratchets to prevent reverse rotation in the stopped condition.

C. Impellers and Bowls

1. The pump impellers shall be carefully machined and finished, with enclosed construction.
2. The impellers shall fit the shaft accurately and shall be securely keyed and locked in position so as to prevent any movement on the shaft during normal and reverse rotation operation.
3. Collets or taper fits will not be acceptable.
4. The bowls shall be flanged. Screwed in bowls will not be accepted.
5. The wear surface of the bowls and impellers is integrally cast with the components, which include an allowance for future installation of wear rings.

6. Full size impellers shall not be used. An allowance for a 5% future TDH increase is included.
7. All impellers shall be statically and dynamically balanced.
8. Pump bowls shall be prepared and coated in accordance with specifications provided in this Section.

D. Pump Column

1. Joints in the pump column shall be flanged and bolted.
2. The pump column shall be designed and constructed to provide accurate alignment automatically when the column is assembled.
3. The pump discharge connection shall be flanged and drilled to match ASME B16.5 requirements. Flanges shall be 150# minimum. Discharge flange top two bolt holes shall straddle flange vertical centerline.
4. The pump shall include provisions designed to resist the discharge thrust developed with the pump operating at shutoff head, the piping weight, and piping thermal expansion.
5. Discharge head skirt shall have through holes drilled with stainless steel bulkhead fittings installed for the through-passage of seal and flushing water supply connections as well as mechanical seal and skirt drain connections.
6. Each column section shall have at least 2 lifting lugs.
7. Pump column section shall be prepared and coated in accordance with specifications provided in this Section.

E. Shaft

1. The pump shaft shall be sized to transmit the power requirements of the pump.
2. The shaft is machined across its entire length and ground and polished at critical areas..
3. A tensioning device shall be provided for each pump with a shaft enclosing tube to assure exclusion of the pumped liquid.
4. Line shaft and enclosing tube, if applicable, shall be fabricated from316 stainless steel.

F. Shaft Seals

1. The pumps shall be equipped with packed box.
2. Mechanical seals shall be specifically designed for the intended service. Seals shall have throttle bushings, vent, drain and flush connections. Plugs for unused seal connections shall be of the same material as the gland.

G. Bearings and Lubrication

1. All radial shaft bearings shall be as recommended by the manufacturer for the service and shall be of sufficient number to prevent shaft whip and minimize noise level. Maximum spacing between adjacent line shaft bearings (bushings) shall be in accordance with API 610.
2. The impeller suction and discharge bowl bearings shall be as recommended by the manufacturer for the service.
3. All bearings shall be mechanically secured to the bearing housings to prevent bearing rotation or movement during operation.

4. Pump bearings are flushed by the liquid passing through the column. Pump shaft sealing with John Crane or equivalent mechanical seal shall be accessible through openings in the motor support stand shall be provided above the upper bearing.
5. The mechanical seal shall be split to facilitate maintenance.
6. A shaft sleeve shall be provided at the mechanical seal.
7. The space between the motor and the mechanical seal shall be sufficient to permit removal and replacement of the seal without dismantling the pump.
8. Pump axial thrust will be resisted by a thrust bearing in the drive motor through the rigid coupling.

H. Drive Support

1. Each pump shall be provided with a cylindrical fabricated steel support pedestal mounting the drive motor directly on the pump discharge head. The base shall be designed to support the total weight of the complete pumping unit and all imposed dynamic loads.
2. Reinforcing ribs and braces, if required, shall be on the interior of the support base.
3. Access holes that are sufficiently large, and in sufficient number, shall be provided for dismantling the drive shaft coupling and for maintenance and inspection of the pump seal. Access holes shall have bolted covers.
4. The support pedestal shall be machined and drilled as required to receive and provide for proper alignment and securing of the drive motor to the pedestal.
5. All bolts, nuts, washers, and pins required for securing the motor to the pedestal and securing the pedestal to the sole plate shall be furnished and shall be constructed with Type 316 stainless steel.
6. Drive motor mountings shall be machined in accordance with dimensions supplied by the motor manufacturer.

I. Baseplate

1. Each pump shall be provided with a heavy structural steel baseplate. Separate heavy steel soleplates, with thickness appropriate to the weight and power of the pump, shall be provided for leveling and grouting and shall be designed to permit removal of the entire pump and baseplate without disturbing the soleplate or grout. Base plates and sole plates shall be made of ASTM A36 carbon steel.
2. Fastening of the base plate to the sole plate shall be accomplished by drilling and tapping soleplate to receive fasteners through the base plate. Fully threaded bolts shall be furnished for this purpose.
3. Edges of base plate attachment holes shall be no closer than 1.5 diameters from the edge of the hole in the soleplate through which the pump column passes. Contractor shall determine fastener size for this connection which meets all local code requirements and furnish required torque value for this connection to achieve design preload.
4. Where base plate and sole plate meet, the mating surfaces shall be machined flat. Contractor shall apply corrosion-resistant treatment to mating surfaces prior to shipment.

J. Shaft Couplings

1. A rigid, adjustable, flanged type coupling shall be provided for connecting the pump to the drive motor.

2. The drive motor coupling shall be specifically designed for vertical pump application, shall provide for vertical adjustment of the impeller, and permit changing the mechanical seal without removal of the motor.
3. The drive motor coupling shall be keyed to both the drive motor and pump line shafts. The shaft coupling shall be sized to transmit the maximum brake horsepower requirements of the driven equipment with a service factor of not less than 2.
4. A permanent corrosion-resistant plate shall be attached with corrosion resistant fasteners to the drive motor support pedestal stating the direction of rotation and coupling gap required for impeller positioning.
5. Line shaft couplings shall be of the sleeve and keyed type to permit ease of maintenance. Threaded couplings are not acceptable.

K. Coupling Guards

1. Safety guards shall be provided for protection of personnel from all exposed moving and/or rotating machine elements in accordance with the requirements of the applicable section of 29 CFR 1910.
2. Each guard shall be fabricated from ASTM A36 steel plate having a minimum thickness of 10 BWG and designed for easy installation and removal.
3. Necessary supports and accessories shall be furnished with each guard.

L. Lifting Lugs

1. Four lifting lugs shall be provided on the pump discharge head to facilitate handling during installation, maintenance and removal. Lugs shall be designed to handle the full weight of the assembled pump and accessories.

M. External Piping Connections

1. Contractor shall provide all connections for suction, discharge, flushing, and venting.
2. Connections shall have flanged ends in accordance with ASME B16.5.
3. Piping shall be in accordance with ASME B31.1.
4. Sizes and design pressures and temperatures of suction and discharge flanges shall be as specified in attached General Manager Datasheet.
5. Discharge connections shall be provided with ½ inch NPT pressure gage connections located at the pipe springline.
6. The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.

N. Accessories

1. Miscellaneous trim - All piping and valves required for mechanical seal flushing or seal water, air vent valves, oil level indicators, grease lubricators, and other miscellaneous accessories shall be furnished by the pump manufacturer. All wetted parts (valve, tubing, etc.) are to match or exceed the characteristics of the casing materials.
2. Lifting lugs shall be provided to facilitate handling during installation, maintenance, and removal.

O. Identification

1. A nameplate shall be securely attached to each pump in a visible location. The nameplate shall be made of stainless steel and attached to the pump with stainless steel screws. The following information shall be included on the nameplates:

   a. Name of Equipment
   b. Manufacturer
   c. Serial Number
   d. Pump size
   e. Model Number
   f. Design Capacity (flow and head)
   g. Design Pressure
   h. Design Temperature
   i. Maximum continuous speed
   j. General Manager's equipment tag number

2.5 INSTRUMENTATION AND CONTROLS COMPONENTS Not applicable to Contractor's scope of supply

A. General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a Contractor-furnished Plant Control System. All control devices furnished by the Contractor shall be capable of interfacing with the plant Control System and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the plant Control System to remotely start and stop all rotating equipment and to allow automatic switch over to the backup unit.
2. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
3. The Contractor shall permanently install a 1-1/4 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified "Instrument Tag Number" to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
4. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required shall be provided by the Contractor for installation by the BOP Contractor.
5. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
6. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.

7. The plant control system is to be designed to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations.
8. Plant systems and equipment are to be monitored and/or controlled through the plant Control System. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant Control System.
9. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
10. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.

B. Instrumentation & Control Devices – Requirements

1. Duplex Type J thermocouples shall be used.
2. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
3. Control valves and pressure regulators shall be by Fisher or General Manager approved equivalent.
4. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters or General Manager approved equivalent.

C. Instrumentation to be Supplied by Contractor

1. Pump Minimum Recirculation Controls

a. The pumps shall be provided with suitable minimum recirculation controls to protect the pump under light load or no load conditions and to maintain a minimum safe flow of water through the circulating water pumps. When the flow drops to a predetermined minimum value the recirculating valve shall begin to open in a controlled manner. The leak off control shall be such that when the circulating water pumps are operating at low load, and in parallel, no hunting is caused by leak off valves opening or closing. The minimum recirculation control valve shall close when the pump flow increases to a predetermined quantity.
b. The minimum flow recirculation valve for each pump shall be a conventional flow control valve. Leak off flow will be discharged into the cooling tower. The circulating water pumps shall be capable of running without distress continually with main discharge valves closed. The leak off piping will be provided by the Others. However, the minimum flow control valve and the back pressure regulators shall be supplied by the Contractor.
c. ARC valve type recirculation valves are not acceptable.

2.6 CIVIL & STRUCTURAL

A. Refer to Section 481100, Combined Cycle Power Island for general Civil and Structural Requirements.

2.7 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

B. Shop/Factory Finishing

1. General

a. Steel material furnished under this specification, excluding machined surfaces, surfaces to be bonded to concrete, stainless steel, or "off the shelf" components, shall be blast cleaned and coated as required herein.
b. Priming and finish painting of piping is required. The base plate, sole plate, coupling guards, and other exposed carbon steel surfaces shall be primed and coated prior to shipment.
c. Surface preparation and priming shall be in accordance with Manufacturer's standard finishing shall apply.
d. The coatings shall not be applied until the equipment has been fabricated, hydrostatic tests completed, weld-spatter removed, welds ground smooth, sharp edges and corners ground to a curve, surfaces cleaned with clean mineral spirits, and abrasive blasting performed.
e. Off the shelf components such as control boxes, motors, valves, pipe hangers, etc., shall receive the Contractor's "standard shop finish".
f. Coatings shall be applied in accordance with the requirements of the coating manufacturer.

2.8 SOURCE QUALITY CONTROL

Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

Tests and Inspections

1. Hydrostatic Tests

a. Equipment and vessels shall be subjected to a hydrostatic leak test meeting the requirements of the applicable Code or Standard to verify integrity of the pressure boundary. No leakage is acceptable through the pressure boundary wall or assembly joints.

2. Functional and Performance Tests

a. The equipment shall be subjected to functional and performance tests in the Contractor’s shop to the greatest extent possible to verify the Contractor’s performance guarantees. The performance test for Contract purposes shall be executed at the final installation by the General Manager in accordance with a test procedure developed by the General Manager and approved by the Contractor.

3. Shop Tests

a. Full information shall be submitted describing the Manufacturer’s testing facilities. All tests shall be performed in accordance with the requirements of the latest edition of ASME PTC 8.2, except as otherwise required herein.
b. Each pump shall be performance tested at rated speed to determine the head, capacity, and brake horsepower.

c. Tests shall be conducted in accordance with Hydraulic Institute Standards for Vertical Pumps and as specified herein and/or on the pump data sheet. One pump shall be subject to a witness test. Test data shall be sufficiently comprehensive to produce guaranteed performance curve showing head versus:

1) Capacity
2) Efficiency
3) Net positive suction head required
4) Brake horsepower

d. A minimum of 7 points shall be tested. One point shall be at shutoff. One point shall be run out. One point shall be the rated point. The remaining points shall be spaced evenly between the rated point and shut-off. The range of test operating points must bracket all design operating points presented on the data sheet. Shop testing shall be conducted with the same driver to be furnished with the equipment specified herein.

e. If the shop tests indicate that the tested pump fails to meet the guarantees stated herein, the other pump(s) for the same service shall be shop tested in accordance with this Section.

f. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.

g. Re-testing and modifications shall be repeated until all performance guarantees are met or until arrangements are made which are acceptable to the General Manager.

h. Certified copies of performance curves resulting from the testing shall be submitted to the General Manager for acceptance before shipment of the equipment. These curves shall indicate actual test pressure, temperature conditions, and the observed test points.

i. Complete documentation regarding the prototype model test conditions and results shall be submitted. Complete documentation verifying the development of the performance curves from the prototype model test curves shall be submitted.

j. Certified copies of performance curves resulting from the prototype model testing shall be submitted to the General Manager for acceptance before shipment of the equipment. These curves shall indicate actual test pressure and temperature conditions and the performance curve points corresponding to the observed prototype model pump test points. The performance curves shall be guaranteed.

k. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed in the General Manager Data Sheet, appropriate correction factors shall be applied to the observed test curve, and a corrected curve shall be indicated. This corrected curve shall then represent expected pump performance with the suction conditions listed in the General Manager Data Sheet.

l. The General Manager reserves the right to witness all pump testing and re-testing.

m. Contractor shall submit certified copies of test and inspection reports within 14 days of completion of the inspection or test.

n. Test and inspection reports within 14 days of completion of the inspection or test.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for general requirements regarding Spare Parts.

3.2 COMMISSIONING

A. General

1. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning.
2. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon completion.
3. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

B. Field Testing

1. Refer to Section 481100, Combined Cycle Power Island for general field acceptance test requirements.

END OF SECTION 485312

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

Item	Description:	Units	Circulating Water Pumps
1.1	Pump Tag No.(s)		TBD
1.2	Type:		Vertical
1.3	Quantity Required		2
1.4	Capacity,	%	100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Cooling Water
1.7	Pump Materials:		
	Column, and discharge head		Carbon steel ASTM A53
	Bowl/Suction Bell		Cast iron ASTM A48
	Impellers		Bronze ASTM B584, A48, C1 25B or 30B
	Shaft		ASTM A276 Type 316
	Shaft Sleeves		ASTM A276 Type 316
	Shaft Seals		Mechanical Seal - API 610 (John Crane or equivalent)
	Wear Rings		Bronze ASTM B584
	Bearings		Bronze backed rubber
	Bowl Bolting		ASTM A276 Type 316
1.8	Screen Opening, (mm.)	in	TBD
1.9	Performance Rating:		
	Fluid Temperature Range (est.)	°F	50-85
	Fluid density (est.)	lb/ft^3	62.0
	Flow (est.)	gpm	10,800
	Suction head (est.)	ft	1
	Discharge head (est.)	ft	90
	Net positive suction. head available ($NPSH_A$)	ft	TBD
	Pump efficiency at rated point(s)	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	TBD
	Size, discharge	in. NPS	TBD
	Design Pressure	psig	TBD
	Design Temperature	°F	TBD
	Piping System Losses (est.)	ft	20
1.11	Power, volts/ phase/ Hertz		480V or 4160V / 3 ph / 60 Hz
1.12	Shop Test Required, y / n		Y

1.13	Water Analysis:		See 480020, Site Conditions
	Total Hardness	ppm as $CaCO_3$	TBD
	Total Alkalinity	ppm as $CaCO_3$	TBD
	Total Dissolved Solids	ppm	TBD
	Total Suspended Solids	ppm	TBD
	pH		TBD
	Conductivity	μohms/ cm	TBD
	Oxygen	ppb	TBD
	Total Organic Carbon	ppm	TBD

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR Data to be furnished during project execution

Item	Description	Units	Circulating Water Pumps
1.0	GENERAL		
1.1	Pump Name		
1.2	Tag No.		
1.3	Number of pumps required		
1.4	Pump type		
1.5	Pump model		
1.6	Manufacturer		
1.7	Point of manufacture		
1.8	Delivery, weeks ARO		
1.9	Max. dimension (pumped solids)		
1.10	Rotation direction (view from driver)		
1.11	Number of stages		
1.12	Suction conn. size/type/rating		
1.13	Discharge conn. size/type/rating		
1.14	Casing design pressure	psig	
1.15	Seal/flush plan		
1.16	Seal water required	gpm	
1.17	Pumped fluid description		
1.18	Pumped fluid chemistry		
2.0	PERFORMANCE @ DESIGN RATING		
2.1	Fluid		
	Temperature	°F	
	Specific gravity		
2.2	Flow,	gpm	
2.3	Total head	ft	
2.4	Pump speed	rpm	
2.5	NPSH required	ft	
2.6	NPSH available	ft	
2.7	Pump efficiency	%	
2.8	Shaft horsepower	hp	
2.9	Motor Nameplate Rating	hp	
3.0	OTHER PERFORMANCE DATA		
3.1	Total head @ shutoff	ft	
3.2	Recommended min. recirculation	gpm	
3.3	NPSH required @ 120% of rated flow	ft	
3.4	Flow @ runout	gpm	
3.5	Total head @ runout	ft	
3.6	NPSH required @ runout	ft	
3.7	Shaft horsepower @ runout	kW	
3.8	For maximum diameter impeller & BEP		
	Flow	gpm	
	Total head	ft	
	Efficiency	%	
3.9	Max. sound level @ 3’, (dBA)	dBA	
3.10	Shutoff head	ft	
4.0	DESIGN DATA		

Item	Description	Units	Circulating Water Pumps
4.1	Min. submergence required	ft	
4.2	Line shaft diameter	in	
4.3	Impeller shaft diameter	in	
4.4	Maximum impeller diameter	in	
4.5	Minimum impeller diameter	in	
4.6	Bearing spans	in	
4.7	Max. temperature rating	°F	
4.8	Pump column outer diameter	in	
4.9	Pump column thickness	in	
4.10	Pump column section length	in	
4.11	Length from bottom of pump baseplate to bottom of suction bell	in	
4.12	Length from CL of first impeller eye to bottom of suction bell	in	
5.0	MATERIALS OF CONSTRUCTION		
5.1	Bowl		
5.2	Casing wear rings (if any)		
5.3	Vent connections		
5.4	Column		
5.5	Baseplate		
5.6	Soleplate		
5.7	Bolting		
5.8	Suction bell		
5.9	Discharge head		
5.10	Shafting		
5.11	Shaft sleeves		
5.12	Impeller		
5.13	Impeller wear rings (if used)		
5.14	Lineshaft bearings		
5.15	Bowl bearings		
6.0	COATING(S) BY ITEM OR SECTION		
6.1	Items(s) or Section		
6.2	Coating		
6.3	Manufacturer & Designation		
6.4	Final thickness	in	
6.5	Surface preparation		
6.6	Item(s) or Section		
6.7	Coating		
6.8	Manufacturer & Designation		
6.9	Final thickness	in	
6.10	Surface preparation		

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485374.21
Compressed Air System

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 485374.21
Compressed Air System

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *BRIAN HRITSCO*

REVISION HISTORY		
DATE	REVISED BY	REVISION
07/05/2011	B. Hritsco	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
05/04/2012	T. Clark	E
06/15/2012	B. Hritsco	F
11/07/2012	T. Clark	G
09/10/2013		H – CONTRACT VERSION

SECTION 485374.21
COMPRESSED AIR SYSTEM

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES & STANDARDS 3
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 4
1.9 QUALITY ASSURANCE 4
1.10 DELIVERY, STORAGE, AND HANDLING 4
1.11 SITE CONDITIONS 4
1.12 WARRANTY 4

PART 2 - PRODUCTS 4

2.1 MATERIALS AND WELDING 4
2.2 EQUIPMENT 4
2.3 COMPONENTS 6
2.4 ELECTRICAL REQUIREMENTS 7
2.5 INSTRUMENTATION & CONTROL REQUIREMENTS 7
2.6 FABRICATION 10
2.7 SOURCE QUALITY CONTROL 10

PART 3 - EXECUTION 11

3.1 SPARE PARTS 11
3.2 FIELD QUALITY CONTROL 11
3.3 COMMISSIONING 11

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 12

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR 14

SECTION 485374.21
COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines the scope and services, responsibilities, and terminal points for design, fabrication, inspection, testing and certification of a compressed air system used to supply instrument air and service air to the plant for operational and maintenance requirements. The system includes air-cooled, oil-free, rotary screw air compressors, regenerative desiccant air dryers, lined carbon steel air receivers, interconnecting stainless steel piping and valves, along with all associated controls.

B. It is not the intent to specify completely herein, all details of design and construction of the equipment/systems. However, the equipment/system shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractors guarantee in a manner acceptable to the General Manager.

C. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

D. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor will be responsible for design, manufacture, shop testing, packaging, shipping, along with technical direction of the installation and field-testing of the plant compressed air system including but not limited to the following:

1. Single skid mounted packaged compressed air system sized by the Contractor for equipment supplied under Section 481100 Combined Cycle Power Island with 15% additional capacity margin for instantaneous demands.
2. 2x100% Air-cooled, oil-free, rotary screw air compressors
3. Dual tower desiccant air dryers
4. Service Air receiver
5. Instrument Air receiver
6. Pre-filter and after-filter
7. Intercooler and after-cooler
8. Interconnecting stainless steel piping and valves
9. Vents, drains, and piping appurtenances
10. All associated controls and instrumentation required to fully automatically operate the compressors and protect compressors from any fault or alarm condition.
11. Supply of motor drives, disconnect switches and motor starters housed in Contractor-furnished control panel rated for outdoor service.
12. Weather proof enclosure.

13. Noise abatement required to meet the project noise specification
14. Startup spares and special tools including at a minimum, two complete sets of particulate and/or coalescing filters.
15. Performance testing at factory and certificates of results
16. Drawings and design data to support facility design, construction and maintenance
17. Inspection certificates and quality control documentation listed in this Section
18. Complete set of component cut sheets
19. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
20. Priced list of recommended spare parts for two years of operation
21. Packing and shipping to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.

B. The compressor system terminal points shall be:

1. Instrument/Service air connection
2. Control signals to the plant control system with a terminal block at the package control panel.
3. Two electrical terminations for the package power supply.
4. Drain connection
5. Air connection for supplementary air supply

C. The requirements of this specification are the minimum for the equipment and are supplemented by the Contractor's own requirements. The compressed air system shall be the primary source for plant instrument and service air.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Foundations, grouting and foundation bolts
2. Unloading, storage, and installation
3. All piping external to the compressed air system
4. Heat tracing of vessels and drain lines, if required
5. Two 480V power supplies to the compressor skid
6. Electrical, instrumentation and controls wiring to the compressor control panel
7. Off-skid instrumentation

1.4 RELATED SECTIONS

A. Section 260000 – Electrical-Mechanical Equipment

B. Section 262050 - Low Voltage Motors

C. Section 480020 – Site Conditions

D. Section 480031 - Combined Cycle Power Island Noise Control Performance

E. Section 480032 - Power Island Performance

F. Section 481100 - Combined Cycle Power Island

1.5 CODES & STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. The compressed air system shall be designed in accordance with these specifications and data provided in the attached data sheets and satisfy the requirements noted within regulations, codes, and standards listed as reference and others which are applicable to the site.
2. Refer to section 480020, Site Conditions for ambient temperature and humidity data.
3. All equipment shall be designed for a thirty (30) year life objective.
4. All equipment shall be designed for continuous 24 hour per day outdoor operation with potential daily cycling from off-line to full load. Motors, compressors and coolers shall be sized to prevent thermal or electric overload during continuous operation.
5. All equipment shall be designed and assembled to provide suitable access for operation and maintenance of the equipment.

B. Performance Requirements

1. The dryers shall be sized for the full flow of each air compressor with a flow limiting valve on the service air system to prevent loss of adequate instrument air pressure for control valve operation when service air is in use.

C. Noise Level – Equipment noise level shall meet the requirements of Section 480031, Combined Cycle Power Island Noise Control Performance

1.8 SUBMITTALS - REFER TO ATTACHMENT 11 -DRAWING SCHEDULE

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general Delivery, Storage, and Handling requirements.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.2 EQUIPMENT

A. Equipment Skid

1. The compressed air system shall consist of the following specified equipment, associated piping and instrumentation, mounted on a single rigid frame skid designed to maintain equipment alignment.
2. Skid shall be furnished with a galvanized corrugated metal canopy for the prevention of damage related to direct exposure to sunlight. Canopy structure shall be designed to comply with all applicable local and national codes.
3. Piping shall be cross-connected between compressors, dryers, and receivers. Cross-connections shall be valved appropriately to allow for isolation and sufficient operational flexibility.
4. The equipment shall be completely assembled, piped, wired and shop-tested and shall enable immediate operation after installation.

B. Compressors

1. The compressors shall be air cooled, oil free, rotary screw type.
2. The compressors shall automatically load, unload and alternate lead/lag assignments (automatic sequencing) independent of the BOP control system.
3. Each compressor shall be furnished complete with drive motors, inlet filter-silencer, inlet valve, baseplate/mounting frame, discharge pressure band control system, air-cooled intercooler and aftercooler (if necessary), speed increaser gears, lubricating oil system with warning/safety system, blowoff vent silencer, blowoff valve, couplings, coupling guards, vibration isolators, and other accessories required for a complete prepackaged installation.

C. Air Dryers

1. The dryers shall also have integrated automatic controls. The compressed air system shall include a separate remote mount Master Controller which interfaces with each of the compressors and dryers to operate completely automatically without need of operator intervention.
2. Each air dryer shall be of the heavy duty type with a dual tower arrangement.
3. The outlet dew point temperature shall follow Instrument Society of America standards for Instrument Air but in no case shall exceed -40 ˚F. In addition, the pressure dew point as measured at the dryer outlet shall be at least 18 ˚F below the minimum temperature to which any part of the instrument air system is exposed. Instrumentation furnished with each dryer shall be mounted and piped, and shall include air-inlet and outlet temperature indicators, a discharge air dew point indicator, and differential pressure gauge across the inlet and outlet of the air dryer.
4. All compressed air system supply shall pass through the dryers.
5. Pressure relief valves shall be provided on each dryer. Pressure relief valves, if not furnished as an integral part of the manufacturer's dryer, shall be set to relieve at no more than 90% of the dryer's maximum rated working pressure.
6. Each dryer shall have a bypass circuit for full-flow bypass of the dryer. Bypass circuit shall comprise 3 valves total and shall be arranged to allow for complete isolation of the dryer for the purpose of servicing and/or removal. For this purpose inlet, outlet and drain connections to the air dryer shall be made with unions, rated for the pressure and temperature service they will be subjected to.

D. Air Receivers

1. The air receiver sizes are indicated in the attached Data Sheets and shall be carbon steel vertical tanks, complete with pressure relief valves. Pressure relief valves shall be provided for the working pressure of the compressor plus 10% but not greater than the receiver design pressure.
2. The air receivers shall be designed for the maximum pressure noted in the attached General Manager Data Sheets, and shall be designed and built in accordance with the requirements of ASME Section VIII Pressure Vessel Code.
3. Each receiver shall be provided with, but not necessarily limited to, the following accessories, openings, and connections:

    a. Inlet and outlet connections with spring loaded check valves on the outlet connections.
    b. Pressure gauge with isolation and test port valves.
    c. Pressure switch with isolation and test port valves and isolated connection for low pressure alarm.

d. The air receiver vessel shall include a minimum corrosion allowance as specified in the attached Data Sheets and interior of the air receiver shall be treated /coated to be corrosion resistant for at least a 30-year life.
e. An automatic condensate trap shall be provided for each receiver. A drain connection and valve.
f. A manhole shall be provided on each receiver sized sufficiently to permit inspection access.
g. Each receiver shall have one spare 3" flanged nozzle, complete with blind flange, bolt-up hardware and gasket.

4. Pressure switch/low pressure alarm connection may be connected to the receiver at the same point as the pressure gauge but shall still have independent isolation and test port valves.
5. The skid shall be designed to permit full access for maintenance and removal of condensate traps.

2.3 COMPONENTS

A. Seals: The compressors shall be provided with stainless steel sealing rings. Shaft seals shall be designed to prevent escaping air or oil from coming into contact with adjacent equipment and personnel. Shaft seals shall positively prevent entry of oil into the air stream. Seal rings shall be free for radial self-adjustment along the rotor shafts.

B. Vents and Drains

1. Compressor cases shall have vents and drains. Drains shall be complete with drain valves and piping. Vents shall be tapped and plugged. Plugs shall be installed with suitable anti-seize agent to ensure future ease of removal.
2. All drains shall be piped to the edge of the skid. While package size is to be kept to a minimum, accessibility for maintenance shall not be sacrificed.

C. Couplings: Couplings shall be rated a minimum of 150 percent of the rated motor horsepower. Protection shall be provided by a strong steel guard complying with all applicable state and federal standards, rigidly fastened to the frame or equipment, and arranged for ease of access to the coupling.

D. Intercoolers, After-Coolers and Moisture Separators: Each after-cooler shall be fitted with a moisture-separator and shall be provided with a relief valve, temperature indicators at air inlet and outlet, and sight flow indicators. Both intercoolers and after-coolers shall have automatic drain traps. The automatic drain traps shall be provided with inlet strainer, bypass and bypass valves, and balancing line connections.

E. Filters

1. Coalescing filters upstream and particulate after filters downstream of the air dryers shall be provided. Coalescing pre-filters shall be rated at 0.3 micron. Coalescing/particulate after filters shall be rated at 3 micron.
2. Filtration efficiency shall be per manufacturer’s recommendation.
3. Each pre-filter and each after filter shall be full capacity. All piping and valves required for isolation and full size bypass of each filter shall be provided.

4. Filters shall be sized so that pressure drops in clean condition shall not exceed the pressure drops specified in attached Data Sheets.
5. The filters shall be provided with disposable, replaceable cartridges. Each filter cartridge shall be capable of withstanding a 50 psi differential pressure. Filter installation shall permit unobstructed removal and replacement of cartridges.
6. The pre-filter shall have adequate sump capacity and be equipped with an automatic drain valve and a bypass valve.
7. A differential pressure gauge shall be provided for each filter.

F. Piping and Valves – Contractor's standard piping and valves may be used, provided they meet established safety standards and are of a quality that will provide the high reliability required in a power plant (i.e., sized appropriately to avoid flow bottlenecks, corrosion resistant to avoid contamination of the instrument air, etc.). All on-skid piping shall be minimum schedule 80 wall thickness. Flanges shall be constructed of materials equivalent to the pipe with which they are used.

G. Sound Attenuated Enclosures: A sound attenuated enclosure shall be provided for the compressor unit if required to meet noise limits described in Section 480031, Combined Cycle Power Island Noise Control Performance. The enclosure shall be constructed of sheet steel, reinforced as required to assure a suitably rigid structure. Quick release panels and/or hinged doors shall be provided as required for ease of access to the equipment for inspection and maintenance.

2.4 ELECTRICAL REQUIREMENTS

A. Motors for auxiliary services shall be 460 Volt, 3 ph, 60 Hz and in compliance with Section 262050, Low Voltage Motors.

B. Electrical Codes and Standards – All electrical devices and materials shall be furnished and installed per the NEC (National Electrical Code, NFPA 70), Electrical Codes and Ordinances and all other applicable electrical codes and standards and shall be listed and labeled.

C. The electrical work for this system shall be in compliance with Section 260000, Electrical Mechanical Equipment.

D. All PLC's and/or controllers to have available connections for UPS power feeds.

2.5 INSTRUMENTATION & CONTROL REQUIREMENTS

A. General

1. Refer to Section 481100, Combined Cycle Power Island for instrument calibration requirements. Contractor is advised that factory instrumentation calibration, especially instrumentation which governs compressor operation, will be required to be furnished prior to acceptance of equipment.

2. A control panel mounted on the baseplate at a convenient height and shall be furnished separately for each compressor and air dryer. The local panels for each compressor shall communicate with each other.

3. All instruments and control devices shall be factory mounted, connected, and wired in a control cabinet meeting the following criteria:

    a. Comply with NEMA 4 or 4X rating, gasketed to resist splashed water and dust infiltration
    b. Shall be adequately sized per NEC to allow for proper termination of cables.
    c. The wiring and cable supports provided shall meet the requirements of the National Electrical Code, and all local rules, regulations, and ordinances.

B. Air Compressor Controls

1. A complete control system shall be furnished for each compressor. The control system shall include all necessary control switches, indicating lights, alarms, primary measuring equipment, control components, and final drive devices for complete and functional control systems.
2. The interlocks and control sequences for each compressor (start-up permissive, load and unload circuitry, malfunction alarms, shutdown, etc.) shall be provided in a local control panel.
3. In the event of a low-pressure condition, the lag compressor(s) shall automatically start to supplement the lead compressor.
4. The compressor loading will vary from zero flow to full rated flow. Changes in demand may be sudden and large. The load and unload control shall operate the compressor between predetermined minimum and maximum pressure settings by opening and closing the blowoff and inlet valves accordingly.
5. Each compressor shall be equipped with a time delay device so that it will be automatically unloaded upon starting until the motor is up to rated speed and lubricating oil is up to operating pressure.
6. Contractor shall furnish a local control panel for each compressor on which shall be mounted an analog oil pressure gauge, analog discharge air pressure gauge, status (running; off; hot standby; cold standby), compressor controls, and all necessary switches, lights, and indicators required for operation.
7. At a minimum the following controls shall be mounted on the local compressor control panel:

    a. Manual-Off-Auto Switch: The manual switch position shall be spring-loaded to return to the Off position.
    b. Constant Run/Stop-Start selector switch
    c. High-air temperature shut down and alarm. Provide local light for control cabinet. Compressor shall automatically shut down on high-air temperature.
    d. Run and stop lights with dry contact outputs for remote indication of run and stop status.
    e. Externally mounted or integrated disconnect switch with interlock that precludes opening the panel door under energized conditions by unauthorized personnel.
    f. Lead/Lag/Alternating Preference selector switch

8. Contractor shall furnish all necessary switches and relays for alarm and automatic shutdown of compressor. Actuation of any shutdown device shall energize a latch type relay located at the compressor. Circuits shall be arranged to permit the compressor to be restarted only after the relay is manually reset. Alarm and shutdown switches for the same function shall be separate and the alarm signal shall be such as to precede the

shutdown signal. As a minimum, the following indicators shall be furnished for each compressor:

a. Compressor Running
b. Compressor Alarm
c. Compressor Loaded

9. Contractor shall provide an air system "master controller" which can monitor, control and sequence the operation of all the air compressors and air dryers. At a minimum, the master controller shall have dry contact outputs, rated at 24VDC, for a general alarm, run status and stop status for each compressor, (6) contacts total.
10. The Contractor shall indicate in his proposal the type of HMI provided, its preferred location, and minimum hardwired signals recommended for plant control system.

C. Air Dryer Controls

1. All electrical components in the air dryer shall be completely factory wired into the control cabinet so that only one field connection is required to place the dryer into complete automatic operation. Power supply circuit and external alarm circuits shall be terminated at the terminals provided in the dryer control cabinet.
2. The control system shall sense and indicate actual moisture conditions, shall alarm on high moisture or other failed performance conditions, and shall indicate locally as well as transmit to the Plant Control System, all hardwired alarms and dew point temperature.
3. At a minimum the following controls shall be mounted on the local air dryer control panel:

a. Control for selection of automatic or manual regeneration
b. Contacts for starting and remote indication and alarms in the main control room for moisture and temperature, as a minimum
c. Inlet and outlet pressure
d. Operating status lights for each tower
e. A moisture indicator, with the capability of monitoring the percent moisture in the effluent air, and at a set high point, it shall annunciate and activate the regeneration cycle on the tower then in operation if the dew point of the air exceeds the set point. This shall not eliminate the timing feature which is provided to perform this operation on a time interval basis.
f. Moisture monitoring and energy saving energy control
g. Alarms to the Plant Control System for differential pressure across the filters high and dryer malfunctions

D. Control Devices

1. All control devices required to perform the control functions indicated, to interlock the functions, annunciate and/or indicate shall be furnished, including components to be mounted on the piping and equipment furnished under separate sections of these contract documents. This shall include, but not be limited to, solenoid air control valves, control valves, pressure switches, level switches, relays, time delays, transducers, controllers, indicating lights, control switches, and push buttons.
2. All control devices shall be installed in the local panels unless the functional requirements for a device make such installation impractical.

3. The controls system shall include separate electrically isolated contacts for remote monitoring of each unit's operational status and alarm condition. These isolated contacts shall be wired to local panel terminals. Contacts shall be normally open, closed on alarm condition.

E. Instrumentation

1. Quantity and types of items furnished shall be as required to meet the specific performance and as otherwise noted.
2. Contractor to supply Ashcroft indicators and Yokagawa, Endress & Hauser, or SMAR transmitters or General Manager approved equivalent where applicable.
3. Where analog gauges are used, gauges shall be glycerin-filled.

2.6 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.7 SOURCE QUALITY CONTROL

A. Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections

1. Inspection and testing shall be in accordance with the codes specified.
2. Instruments shall be protected during hydro testing.
3. Wiring shall be checked for continuity and insulation integrity.
4. Filters shall be removed for hydro test of filter housing.
5. Full information describing the tests which are included in the bid price shall be included with the Proposal.
6. Certified copies of test results shall be submitted for acceptance before shipment of the equipment is made. Test results shall include a tabulation of settings of valves, equipment-protection devices, relays and alarm contact settings for proper operation and/or as left following factory testing.
7. As a minimum, the following tests shall be performed:

    a. Wiring shall be checked for continuity and insulation integrity.
    b. Functional checkout through simulated conditions of all control panel operation and alarm control schemes.
    c. Performance testing sufficient to determine that the subject equipment meets the specified performance criteria in this Section.

C. The General Manager reserves the right to witness shop tests. A minimum of 14 working days advance notice shall be given. Unless General Manager shall advise Contractor not to proceed with the inspection and testing prior to seven days before the date which General Manager has stated in its notice, Contractor may proceed and any inspection and tests shall be deemed to have been made in General Manager presence, and Contractor shall forthwith forward to General Manager duly certified copies of the inspection and test results.

D. The Contractor will establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for general requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements.

B. Performance Tests

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Refer to Section 481100 Combined Cycle Power Island for individual equipment baseline performance testing.
2. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.

3.3 COMMISSIONING

A. General

1. Refer to Section 480032, Power Island Performance for general commissioning requirements.

END OF SECTION 485374.21

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Location	Pasadena, CA
	Project Number	123374
	Equipment Location	Outdoors
1.0	**Compressor**	
	Equipment Name	Air Compressor A/B
	Equipment Tag	TBD
	Number Required	2x100%
	Type	Rotary Screw
	Cooling (Air / Water)	Air
	Lubrication (Oil Injected/Oil Free)	Oil free
	Rated Capacity	TBD SCFM
	Full Load Operating Pressure	TBD PSIG
	Full Load Operating Temperature	TBD °F
2.0	**Dryer**	
	Equipment Name	Air Dryer A/B
	Equipment Tag	TBD
	Number Required	2x100%
	Type	Dual Tower, Desiccant
	Rated Capacity	TBD SCFM
	Outlet Dew Point	-40 °F
	Pre-Filter Requirement	TBD
	Pre-Filter Efficiency	TBD
	After Filter Requirement	3.0 µ
	After Filter Efficiency	99.99%
	Design Pressure	TBD psig
	Total Air Dryer System Pressure Drop	TBD psid
	Design Temperature	TBD °F
3.0	**Receiver**	
	Equipment Name	Service/Instrument Air Receiver
	Equipment Tag	TBD
	Number Required	2
	Working Capacity	TBD gallons

	Operating Pressure	TBD psig
	Design Pressure	TBD psig
	Design Temperature	TBD °F
	Corrosion Allowance	1/16”
	Design Standard	ASME Sec VIII Div 1
4.0	**Accessories**	

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR to be furnished during project execution

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Location	Pasadena, CA
	Project Number	123374
	Equipment Location	Outdoors
1.0	**Compressor**	
	Equipment Name	
	Equipment Tag	
	Number Required	
	Type	
	Cooling (Air / Water)	
	Total Cooling Load	
	Lubrication (Oil Injected/Oil Free)	
	Rated Capacity	
	Full Load Operating Pressure	
	Full Load Operating Temperature	
	Maximum Full Flow Operating Pressure	
	Drive Motor Nameplate Rating	
	Drive Motor Nameplate Nominal Efficiency	
	Fan Motor Nameplate Rating (if applicable)	
	Fan Motor Nameplate Nominal Efficiency	
	Total Package Input Power at Zero Flow	
	Total Package Input Power at Rated Capacity and Full Load Operating Pressure	
	Specific Package Input Power at Rated Capacity and Full Load Operating Pressure	
2.0	**Dryer**	
	Equipment Name	
	Equipment Tag	
	Number Required	
	Type	
	Rated Capacity	
	Outlet Dew Point	
	After Filter Requirement	
	After Filter Efficiency	

	Design Pressure	
	Total Air Dryer System Pressure Drop	
	Design Temperature	
	Desiccant Type	
	Dryer Cycle Time	
	Max Required Purge Flow	
3.0	**Receiver**	
	Equipment Name	
	Equipment Tag	
	Number Required	
	Working Capacity	
	Operating Pressure	
	Design Pressure	
	Design Temperature	
	Design Standard	
	Receiver Material	
	Corrosion Allowance	
	Internal Coating	
4.0	**Accessories**	

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485374.22

Fuel Gas Compressor Specification

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485374.22
Fuel Gas Compressor Specification

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	PREPARED BY	REVISION
6/24/2011	T. Clark	A
9/9/2011	B. Hritsco	B
12/5/2011	T. Clark	C
6/15/2012	G. Harwood	D
9/10/2013		E – CONTRACT VERSION

SECTION 485374
FUEL GAS COMPRESSOR

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 5
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.11 SITE CONDITIONS 5
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 EQUIPMENT 5
2.3 COMPONENTS 7
2.4 ELECTRICAL 11
2.5 INSTRUMENTATION AND CONTROLS 11
2.6 FABRICATION 14
2.7 SOURCE QUALITY CONTROL 14

PART 3 - EXECUTION 15

3.1 SPARE PARTS 15
3.2 FIELD QUALITY CONTROL 15
3.3 COMMISSIONING ..... 16~~15~~

APPENDIX A –TECHNICAL DATASHEETS BY GENERAL MANAGER 17

APPENDIX B – GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET 19

APPENDIX C – TECHNICAL DATASHEETS BY CONTRACTOR 21

SECTION 485374.22
FUEL GAS COMPRESSOR SPECIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This document specifies scope of services, requirements for the design, manufacture, shop testing, packaging, shipping, field support, and supervision of installation and field-testing of a fuel gas compressor package.

B. It is not the intent to specify completely herein all details of design and construction of the equipment/systems. However, the equipment/system shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractors guarantee in a manner acceptable to the General Manager.

C. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. 2x100% capacity skid mounted screw type gas compressors
2. 1x100% common inlet scrubbers
3. Suction pulsation controls
4. 2x100% common discharge coalescing filters
5. 1x100% oil cooler heat exchanger (shell and tube)
6. 1x100% fuel gas discharge heat exchanger (if required)
7. Capacity and header pressure controls
8. Discharge gas receiver (if required)
9. Instrumentation
10. Compressor control panel
11. Noise attenuation
12. Motor drives, disconnect switches
13. Cleaning and finishing prior to shipment
14. Finish painting
15. Factory testing and certificates of results
16. Site specific drawings and design data to support facility design, construction and maintenance
17. Inspection certificates and quality control documentation listed in this Section
18. Complete set of component cut sheets
19. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
20. Provide field support and supervision for installation and field testing of the compressor package.
21. Priced list of recommended spare parts for two years of operation

22. Packing and shipping to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.

1.3 FURNISHED BY OTHERS

A. Supply by Others shall be limited to the following:

1. Foundation and anchor bolts
2. Receipt and off-loading
3. Installation at site
4. DCS configuration and graphics programming
5. Off-skid electrical wiring
6. Electrical, instrumentation and controls wiring
7. Instrumentation
8. All piping to/from Contractor's terminal points
9. Final job site cleanup and touch-up painting

1.4 RELATED SECTIONS

A. Section 260000, Electrical Mechanical Equipment

B. Section 261050, Medium Voltage Motors

C. Section 262050, Low Voltage Motors

D. Section 480020, Site Conditions

E. Section 480031, Combined Cycle Power Island Noise Control Performance

F. Section 480032, Power Island Performance

G. Section 481100, Combined Cycle Power Island

1.5 CODES AND STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American Petroleum Institute (API)

   a. 619 - Rotary Type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries
   b. 660 - Shell-and-Tube Heat Exchangers
   c. 661 - Air-Cooled Heat Exchangers for General Refinery Service

2. Heat Exchanger Institute (HEI)

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. General:

1. The fuel gas rotary screw compressors shall provide required quantity and pressure of natural gas to operate the gas turbine power plant. The gas compressor package design shall be modern, well proven, safe, and economical in capital, operating, and maintenance costs.
2. The gas compressors and auxiliaries shall be designed and selected to ensure high reliability and availability of the complete plant for a 30 year operating life in an outdoor installation.
3. An appropriate level of redundancy shall be included in each system. The equipment shall be designed so that no single auxiliary component failure within gas compressor package shall result in the total loss of the gas turbine unit generating capability. In this context, it is required that with agreed exceptions, all unit auxiliaries shall be provided with at least one installed spare (N+1).
4. The compressor package shall be fully automated and require minimum operator intervention for normal operation.
5. The fuel gas system will interconnect to the plant fuel gas system at the General Manager supplied tie-in to bring the gas line to the project site. The fuel gas will be pressurized and conditioned through gas compressors before supplied to the gas turbine unit.
6. The fuel gas system upstream of gas compressor package will comprise the following equipment supplied by Others:

    a. Fire Safety Emergency Shutoff Valve
    b. Fuel gas spectrophotometer
    c. One fuel gas flow check meter

7. The gas compressor cooling shall be provided by a closed loop auxiliary equipment cooling water system. The gas compressor package shall be skid mounted with all accessories including inlet scrubber, discharge receiver, discharge pressure and capacity control system and compressor controls. A final 2x100% discharge coalescing filter shall be installed to meet the gas turbine manufacturer's specification for liquid droplet and solid particle filtration. Contractor shall be responsible for ascertaining gas turbine

manufacturer's fuel gas inlet requirements and furnishing that information with the filter skid submittal(s) to prove compatibility.

B. Design Requirements:

1. The rotary screw compressor set shall be designed such that the motor and the compressor rotor can be run at full rated RPM over the specified suction pressure and temperature range; discharge pressure; flow rate from 0% through 100% demand; and over the entire ambient temperature range without any destructive effects or overload of the motor, compressor or coolers. Use of the service factor of the motor(s) to obtain 100% demand performance shall not be permitted
2. All equipment provided by Contractor will comply with NEMA and Class-I, Division 2, Group D requirements as a minimum.
3. The compressors will be connected to a regulated gas pipeline with variation in suction pressure and gas flow variation due to gas turbine duty requirements.
4. The steady state supply pressure exiting the discharge receiver shall be regulated to +/- 1% (with peak to peak) for frequencies above 20 Hz. No pulsation is allowed at 20 Hz and below. The gas leaving the gas compressor package shall be filtered to at least 3 microns absolute.
5. The traces of lube/cooling oil leaving the gas compressor package shall not exceed 1.0 ppm.
6. Where conflict appears to occur between fuel gas conditioning requirements described herein or where conditioning requirements are not otherwise specified, the gas turbine manufacturer's fuel gas inlet requirements shall govern. Contractor is responsible for obtaining gas turbine manufacturer's fuel gas requirements and furnishing equipment that is compliant therewith.
7. The fuel gas compressor skids shall be equipped with the appropriate noise attenuation measures to meet the requirements of Section 480031, Combined Cycle Power Island Noise Control Performance. The Sound Attenuation measures shall be provided by the Contractor may include: (1) Acoustical Insulating Blankets / Compressor Motor housings and/or (2) 4 sound attenuating walls around gas compressor skids or (3) Enclosure (4 wall + roof) for each gas compressor skid. In the event that the enclosure is provided, the necessary ventilation, gas detection, and fire-fighting system shall also be provided.

C. Performance Requirements Refer to Attachment 6 – Performance Guarantees:

1. Contractor shall guarantee total auxiliary power consumption per compressor when operating at rated conditions. This includes related off-skid electrical loads such as cooling fans, etc.
2. Near field noise and contribution to far field noise emissions of the plant shall not exceed the limits provided in Section 480031, Combined Cycle Power Island Noise Control Performance.
3. The performance of the complete compressor package shall be in accordance with General Manager’s drawings, specifications, and Data Sheets.
4. The compressor control shall allow continuous control of output over the range from 0% flow to full rated flow at rated pressure.
5. Fuel Gas Compressor discharge pressure and flow variation shall be automatically controlled on the compressor skid by an automatic slide gate valve or with fuel gas recirculation and bypass system, as needed to provide quick response and operation below 25% capacity.

6. The compressor discharge gas temperature shall not exceed the maximum allowable temperature limit as stated on the Technical Datasheets by General Manager or set in the gas turbine manufacturer's fuel gas specification. This maximum temperature limit shall not be exceeded under any operating load condition. Contractor shall furnish a gas cooling system if necessary to meet this requirement.

D. Reliability:

1. The gas compressor package shall provide efficient and reliable service throughout the range of operating conditions. Reliability, ease of operation and a minimum of maintenance attention are primary considerations, and the rating and model size chosen by the Contractor shall reflect this. Only proven equipment and systems shall be offered for this contract.

1.8 SUBMITTALS - Refer to Attachment 11 -Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481100, Combined Cycle Power Island for general delivery, storage, and handling requirements.

1. The gas compressor control panel shall be shipped with copies of all factory functional testing documentation described herein.

1.11 SITE CONDITIONS

A. Reference Section 480020, Site Design Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.2 EQUIPMENT

A. Compressor

1. The compressor unit shall be suitable for outdoor installation.
2. The compressor shall be a screw type, in accordance with API 619.
3. The pressure containing components shall be designed to comply with Section VIII Div-2 of ASME pressure vessel code with appropriate stress intensity factors.
4. The gas compressor pressure protection system shall be furnished and sized as API Recommended Practice 520 (including fire case).
5. The rotor stiffness shall be adequate to prevent contact between the rotor and the casing at the most unfavorable specified conditions. The rotor material shall be proven materials and shall be selected by the manufacturer.
6. The rotor shaft shall be a helical rotor, dynamically balanced to provide vibration free operation.
7. The rotor assembly including thrust disk, balance piston (when applicable) and half key on shaft end shall be dynamically balanced prior to compressor assembly.
8. All materials of construction shall be clearly stated in the proposal with an equivalent ASTM specification. API-619, Table F-1 material selection guide shall be followed.
9. Shaft seals shall be provided to restrict or prevent gas leakage to the atmosphere. The seals operation shall be suitable for specified variations in suction or discharge conditions that may prevail during start-up, shutdown or normal operation. Dual or single seal design with independent seal fluid system is acceptable.
10. The compressor shall be installed on a structural steel frame including provisions for filling in with high strength grout with allowance for motor and coupling alignment. Alignment shall be verified just prior to shipment and at site.
11. Compressor and motor mounting base shall be machined after all welding is completed so that all the machined mounting pads contacting with compressor and motor legs are within a tolerance by manufacturer's standard of each other in parallel when measured on the milling machine.
12. Compressor shall have slide valve to adjust the flow rate due to suction pressure variations and capacity change. The instrumentation shall be provided to indicate the position of the slide valve.
13. The maximum allowable working pressure (MAWP) shall be at least 110% of or 75 psig greater than the maximum operating pressure, whichever is higher.
14. The coupling connecting between compressor and drive motor shall be sized for all operating conditions. The drive coupling assembly shall be protected with a removable, non-sparkling guard.
15. The main pressure casing shall be bolted and main casing split face shall use a metal-to-metal joint (such as O-ring) to avoid gas leakage due to high pressure. Gasket joints are not acceptable.
16. A liquid separator shall be provided at the compressor discharge to limit lube / cooling oil leaving the gas compressor package to 1.0ppm.
17. The compressor package shall accommodate a system trip, utilizing a “measured” response while going into recycle, thereby preventing negative impact to the upstream or downstream equipment.

B. Capacity Control

1. The Contractor shall supply the capacity control system.
2. The control system shall include a manual override (local manual start and control).

3. The capacity control shall provide 0%-100% throughout the range of conditions as specified in data sheet. This criteria is also applicable in the case of multiple compressor installations, with any number of compressors operating.
4. Capacity control shall be done by the combination or either of slide valve built in compressor and spill back valve on bypass line.
5. The compressor control system shall include a recycle/slide gate valve positioner and position transmitter.

C. Compressor Lube Oil System

1. The lube oil system shall be equipped with the alarms, indicators and shutdowns as required.
2. Compressor lube oil system shall include:

    a. Dual flow filter assembly including 10-micron replaceable element and differential pressure indicator and continuous flow transfer valve.
    b. System relief valve for full pressure lubrication to bearings and seals.
    c. Control oil system for hydraulic cylinder for slide valve movement. It shall be a common oil system with the lube oil.
    d. A single cooler for lube oil system shall be provided.
    e. Two sets of motor driven lube oil pumps shall be provided (one for main and another for stand-by). Stand-by pump shall have automatic cut in function when lube oil supply pressure hits low alarm point. No compressor shaft driven pump is allowed in any case. The compressor shall be provided with pre-lube pump.
    f. A water cooled lube oil system shall be provided with temperature indicators for reading directly both the inlet and outlet oil temperatures.
    g. A shell and tube heat exchanger designed to API 660 standards for single pass or double pass with a return water box with cooling water supplied form the auxiliary cooling water system shall be provided. U-tube or plate and frame type heat exchangers are not acceptable. Refer to requirements listed in subpart 2.3A.7 for detail specifications of the lube oil heat exchanger.
    h. If necessary, a compressor oil sump electric immersion heater shall be supplied with electrical connections fully accessible.

2.3 COMPONENTS

A. Compressed Fuel Gas Heat Exchanger

1. Waste heat from gas compression and recycle gas shall be discharged from the system by a shell and tube heat exchanger provided by the Contractor.
2. A 1x100% heat exchanger arrangement shall be provided for each compressor skid.
3. The heat exchanger shall be sized for all operating conditions, not only for compressor full load operation, but also be capable for gas recycle operation with 0% gas flow rate to the gas turbine with minimum slide valve load.
4. The gas cooler discharge shall not exceed the gas turbine fuel gas temperature limit.
5. Noise levels shall be guaranteed and verified in conformance with Section 480031, Combined Cycle Power Island Noise Control Performance.
6. The corrosion allowance of carbon steel components shall be a minimum of 0.063”.
7. Shell and Tube Heat Exchanger

a. Shell and tube heat exchangers shall be design to API 660 standards for single pass or double pass with a return water box with cooling water supplied form the auxiliary cooling water system. U-tube or plate and frame type heat exchangers are not acceptable.
b. Tubes may be either seamed or seamless with a minimum OD of 0.75 inch and a minimum design pressure of 125 psig. Maximum tube side pressure drop shall be 13 psig. An 85% cleanliness factor shall be used in the design calculations to determine the required heat transfer surface area.
c. The fuel gas cooling system shall be provided with inlet and outlet temperature indicators, pressure test connections (inlet and outlet) and a thermal relief valve if required for compliance with the governing design codes.
d. Tubes shall be stainless steel and tubesheets carbon steel. The shell and heads shall be carbon steel with epoxy coating on wetted surfaces.
e. Fluid velocity through the cooler tubes shall be 4-7 ft/sec with a design target velocity of 5 ft/sec.

B. Vessels

1. All pressure vessels shall be sized for the maximum possible system flow rates; and, designed in accordance with ASME Section VIII, Division 1. Each vessel shall be designed per ASME Code and ASME Code stamped. National Board certification is required. Code stamp and vessel information shall be legible.
2. All pressure vessels shall be manufactured from SA-106 Grade B or higher grade seamless pipe; or, from SA-516-70 rolled steel with a single ERW longitudinal weld seam. Heads are to be spun from SA-516-70 steel. All flanges shall be SA-105 forged steel and shall be RFWN or LWN forgings. All pipe fittings shall be SA-234-WPB steel. All couplings to be 3000# or greater.
3. The suction scrubber shall be designed for at least 110% of or 50 psig greater than the maximum operating suction pressure, whichever is higher. and design temperature shall be 200°F. The scrubber design shall include a 0.063 inch minimum corrosion allowance. All flanged connections shall have reinforcing pads, except on heads, where LWN connectors or heavy wall piping may be utilized to preclude the need for the more difficult pad forming.
4. All suction scrubbers and other vessels shall be fabricated fully tested and then painted.
5. Attachment of the vessels that mount on the skid shall be by welding or bolting the vessel skirt to the thick plates, which are specifically arranged as a stiff section of the skid frame members for mounting the vessels.
6. Scrubber “trim” shall include a high level alarm and shut-down switch; a level gauge manual drain with shut-off valve.
7. Discharge Coalescing Filter Separator “trim” shall provide for upper and lower chambers. Trim shall include externally mounted high level alarm switches; level gauges; with shut-off valve; and pressure indicating gauge(s), with local differential pressure indicator and transmitted signal to the gas compressor controller PLC for oil coalescing element; and temperature indicating instruments. Automatic drain level control is not required.
8. The Discharge Coalescing Filter Separator shall be designed for 99.9% filtration of particles, one (1) micron and larger. All possible oil carry-over from the compressor must be filtered, even at the highest possible flow rates. The coalescing filter shall have a quick access fully supported to facilitate change of internal filters. Replacement filters shall be readily available.
9. The Discharge Bulk Oil Separator and Coalescing Filter Separator shall be designed for at least 110% of or 75 psig greater than the maximum operating discharge pressure,

whichever is higher and design temperature shall be 250°F. These vessels shall include a 0.063-inch minimum corrosion allowance.

10. Final oil carry over downstream of the Coalescing Filter Separator shall be less than 0.5 ppmwt as a guarantee, unless otherwise specified.
11. All vessel welds shall have radiographic examination in accordance with the ASME code.
12. Stainless steel 6-inch thick minimum, mesh pad type mist eliminators or high efficiency vane type mist eliminators shall be 316L stainless steel. Either style design shall be fully supported with continuous seal welds inside the scrubber.
13. Special care shall be exercised to assure each vessel's internals are cleaned thoroughly.

C. Drains Tank (by others)

D. Piping

1. The Contractor shall supply all necessary piping, piping supports, isolation valves and fittings for all lines for fuel gas, lube oil, vents, drains, instrument control air and instruments. All piping connections shall terminate with flanged or socket weld connections at the edge of the skid.
2. The material and fabrication of all skid piping and connections to equipment shall conform to ANSI B31.1. Carbon steel fuel gas piping shall be in accordance with ASTM A-106 Grade B seamless. Sizes 2.5" through 12" shall be Schedule 80 minimum and shall have welded or flanged connections. Sizes 2" and smaller shall be Schedule 80 minimum and may be flanged, welded or socket welded.
3. Skid piping shall be designed and fabricated to minimize and eliminate the possibility of gas leakage and provide for individual isolation for instruments and downstream piping without causing a system shutdown in order to isolate a leak or make repairs.
4. A lubricating type threaded joint sealant suitable for gas service shall be used to insure vibration and leak proof joints for all threaded pipe joints and all threaded instrument connections. (No Teflon tape, no copper based pipe thread sealant on oil lines)
5. Equipment breakout pipe unions, when used, shall be located downstream of the first isolation block valve in branch piping or fuel gas headers.
6. Ball valves shall be used for gas piping and forged steel gate and globe valves, 2" and smaller, shall be seal welded bonnet, bar stock type.
7. Suction and discharge gas connections shall be flanged and rated for the design pressure and temperature in accordance with ASME B16.5. In no case shall any flange be of lesser rating than those on the same line or system. Bolt holes for flanged connections shall straddle lines parallel to the main horizontal or vertical centerline of the equipment, and shall be indicated on drawings.
8. Gas piping on the skid shall be sized for a maximum gas velocity of 3600 feet per minute or pressure drop calculations where applicable.
9. All piping furnished by the Contractor shall be installed and supported on the compressor skid. Piping shall provide proper flexibility and easy accessibility for operator maintenance and cleaning. When a system includes standby components, valves shall be provided and installed as required to allow removal of components for maintenance without draining the system or shutting down the compressor.
10. Piping shall be firmly fixed in a neat and orderly arrangement adapted to the contour of the machine and shall not obstruct access openings. Piping, tubing, or conduit shall be supported and protected to prevent damage from vibration, operation, or maintenance. Valved connections 1-1/2" and smaller into gas piping shall be designed to minimize

over-hung weight and gusseted to avoid breakage due to pulsation-induced vibration. Piping shall be free of rust, slag, welding beads, and other foreign materials.

11. Instrument pressure take-off points shall be a minimum of 1/2" and a common pressure take-off connection may be used for pressure gauges and pressure switches or transmitters. Instrument pressure take-off points shall be located at spring line of the pipe. In no case shall instrument pressure connections be located at pipe invert. Each instrument take-off point shall have an isolation valve and all instrument air supply lines to control valves or instrument devices shall have isolation valves. Instrument isolation valves shall be Whitey (or equal) and fittings shall be Swagelok (or equal).
12. All instrument pressure connections, level bridle connection, etc., from a gas pressure vessel or piping header to the first instrument isolation block valve shall be welded or socket welded. Threaded joints with seal welded construction are not permitted. Threaded connections on instrument devices like pressure gauges, switches, transmitters, temperature indicators, etc. shall not be seal welded.
13. Each process connection to a pressure instrument shall feature a 12" drip leg at the point of connection or last horizontal bend before point of connection for the purpose of draining accumulated condensate.
14. Thermowell connections shall be 1" NPT.
15. All control valves shall be flanged. Wafer or lug-wafer style valves shall not be permitted.
16. All Lubricating oil lines shall be made of stainless steel. Stainless steel fittings with stainless steel tubing shall be furnished. Pressure piping downstream of oil filters shall be free of internal obstructions or pockets that could accumulate dirt at pipe joints. Other lube oil piping fittings shall be butt weld type. When butt welds are necessary, such precautions as internal grinding of joints, heliarcing the first weld pass, and other steps shall be taken to prevent weld spatter inside the lines. After fabrication, oil lines shall be thoroughly cleaned.
17. Oil lines from forced-feed lubricators to lubrication points for gas service shall have a minimum wall thickness of 0.049 inch and shall be stainless steel with stainless steel fittings and check valves.
18. Relief valves for all equipment shall meet all Federal, State, and local regulations. The Contractor shall furnish and install all relief valves required on all piping and equipment within his Scope of Supply with settings clearly and indelibly marked on the valve or stamped onto the valve's nameplate. The Contractor shall determine sizes and set pressures for relief valves related to the equipment. The relief valve installations shall be complete by equipment skid manufacturer with all valve vent piping extended to a safe location above the operating deck by others. Vent valves shall be individually routed; ganging of vent lines from multiple compressors shall NOT be permitted.
19. Drain and vent piping 2" and smaller shall be Schedule 80 minimum and not less than 1" O.D. All drains shall be manifolded into a common header per compressor. Drains from multiple compressors shall not be ganged together. Header size shall not be less than 2”. Drains shall be sloped toward the collection point at a minimum of 1%.
20. All drain manifolds, packing and distance piece vent manifolds shall have flanged or plugged couplings on each end of the skid to facilitate the connection of these lines from either end of the skid.
21. The packing and distance piece drains shall be manifolded and piped to skid edge. Supply of the drain collection tank and routing of drain piping to drain tank shall be completed by others.
22. Gas piping shall be radiographed in accordance with applicable code requirements. All skid gas piping that is installed or routed under the skid deck shall be 100% radiographed.

23. All compressor discharge skid piping that operates above 140°F and subject to handling by operating personnel shall be identified in the submittals, for insulation by General Manager.

2.4 ELECTRICAL

A. All motors and electrical equipment shall be in full accordance with all specification requirements of Sections 260000 Electrical Mechanical Equipment, 261050 Medium Voltage Motors, 262050 Low Voltage Motors,

B. Electrical Systems

1. All electrical equipment shall be suitable for installation in NEC Class I, Division 2, Group D hazardous locations.

2.5 INSTRUMENTATION AND CONTROLS

A. General

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Contractor shall accommodate this objective in the design of their equipment and Contractor shall furnish any and all transmitting instrumentation required to observe and record the process conditions listed in Performance Test Datasheet herein. These instruments shall be furnished regardless of whether or not they are required by Contractor's control system for ordinary equipment operation. These instruments shall be furnished and calibrated in accordance with specification section 481100, Combined Cycle Power Island, Instrumentation and Controls. These performance data sheets shall then be completed and submitted as part of the plant performance testing described in section 480032, Power Island Performance Testing.

B. Control Panel and Shutdown System

1. There shall be one common control panel provided that controls all compressors, which shall be designed at a minimum to:

   a. monitor and control all required functions;
   b. indicate and shutdown on any unit malfunction;
   c. have push button MANUAL START,
   d. MANUAL LOADING and UNLOADING capability,
   e. AUTOMATIC SHUTDOWN, actuated either remotely or
   f. AUTOMATIC SHUTDOWN, by panel shutdowns.
   g. Provide for temperature and pressure monitoring and control as required
   h. Provide for discharge pressure control

2. The control system shall include provision to control compressor capacity with a slide gate valve.

3. The control panel shall be designed with internal cooling and heating as required to assure component availability for continuous operation over entire temperature range for the site.
4. The panel shall have a sunscreen to assure readability of panel read-outs.
5. Full length hinged and lockable doors shall be provided on the panel to permit easy access to all panel components.
6. The control panel, tie-in junction box(es), hinges, hinge bolts, nuts, and washers shall all be made of 304 stainless steel.
7. Enclosure shall be rated as NEMA 4X as a minimum but shall meet the requirements of the area electrical classification.
8. Stiffeners as required, shall be used to ensure panel integrity during shipment and jobsite installation.
9. All components protruding through the front or side of the panel shall have the function identified with phenolic nameplates.
10. The panel shall be designed to give a first out indication of process upsets.
11. Control panel shall contain the logic to sequence the operation of the valves for each compressor.
12. Each step of the sequence shall be confirmed to work properly before proceeding to the next successive step. The compressor start sequence shall be automatic. Back-up Auto Start-Stop is required in multiple compressor installations so a "trip" on one unit will cause the automatic start of an alternate compressor as required to sustain gas turbine operation.
13. Each compressor unit shall always start in an "unloaded" mode.
14. The compressor unit shall be designed to automatically blow-down only on ESD, emergency shutdown, if requested. A timed purge cycle must be integrated into the control system for any instance in which the gas compressors is vented and cleared of gas.
15. The main junction box(es) as required for power and controls wiring interfaces on skid shall be located in an accessible area on the edge of the skid. Each skid shall have a remote I/O panel permanently mounted securely on the skid that interfaces to the main PLC control panel to control all functions on that skid. This remote I/O panel may be installed in the junction box.
16. The main PLC control panel may be located off-skid on a foundation by others. This main panel shall be connected to the individual skids remote I/O panel by single communication cable to reduce wiring performed by the General Manager.
17. The gas compressor PLC shall be capable of Ethernet communication to the Plant Control System (PCS) for remote monitoring and supervisory control.
18. The control panel shall have provision for remote start or stop through both the Ethernet communication link with the Plant Control System (PCS) and hardwired points.
19. The control panel shall have a local panel mounted emergency stop (E-stop) as well as a provision for remote hardwired E-stop from the General Manager's control room.

C. Instruments, Indicators, Monitors, Shutdowns

1. Refer to Section 481100, Combined Cycle Power Island for instrument calibration requirements.
2. Contractor shall provide manufacturer's standard vibration monitoring system.
3. Compressor and motor probes shall be mounted in the bearings and wired to a base-mounted NEMA 4 rated proximiter housing. Vibration probes shall be Bently Nevada Series 3300XL proximity probes.

4. Vibration monitor shall be Bently Nevada Series 3500. One common vibration monitor system shall be provided for all the compressor / motor sets. Bently Nevada system shall have provisions to export data via Ethernet ModBus TCP port. ModBus configuration and commissioning support shall be provided. A ModBus point list shall be provided.
5. Indicating instruments and protective devices shall be provided to assure, accurate indication and data transmission under all operating conditions; a safe; and, fully functional system. Each device shall be manufactured by a reputable and proven supplier.
6. All indicating instruments shall be dual scale, reading in English units. All such devices shall have indication in the proper operating range.
7. All required instruments, controls, and control valves shall be furnished and installed on the skid by the Contractor
8. The Contractor shall provide and install all skid-mounted instruments, controls, gauges, and safety devices.
9. The following alarms and control signals shall be provided in the local control panel by the Contractor, for General Manager interconnection to a remote Plant Control System (PCS).

    a. Common dry contact alarm signal from the compressor skid to the General Manager's Plant Control System.
    b. Common shutdown signal from the compressor skid to the General Manager's Plant Control System.
    c. Signal from the compressor skid to the General Manager's Plant Control System panel indicating that the unit is running.
    d. Signal from the compressor skid to the General Manager's Plant Control System panel indicating that the unit is stopped.
    e. Unit shutdown signal from the General Manager's central Plant Control System panel to the compressor control panel. The shutdown shall cause the unit block valves to close.
    f. Ethernet data link for monitoring to the plant control system.
    g. Provision for two (2) remote shutdowns.

10. If the Contractor feels that additional shutdowns are required for the complete protection of the compressor, motor, or other skid components, they shall be specifically noted in the quotation.
11. All shutdowns shall be the lockout type requiring manual reset.
12. No end device shall be allowed to reset automatically.
13. A compressor shutdown shall be fail safe.
14. The shutdown devices are to activate the unit sequential shutdown system.
15. All pressure instruments shall be equipped with test connections in manifold valves, located for ease of calibration and all pressure gauges shall be glycerin filled and equipped with snubbers to prevent gauge damage due to pulsation.
16. Each pressure gauge shall be furnished with a block and bleed needle or manifold valve.
17. All temperature probes shall be inserted in 1" thermo wells connected through ¾" couplings / latrolets in the pressure piping. No thermowell may extend beyond the centerline of the pipe. All thermo wells shall be 316L SS. External projections for thermal devices are to be held to a minimum.
18. Wherever completed control loops are installed within the skid limits, each controller shall be assembled as follows:

    a. Instrument air from header shut-off gate valve shall be piped to each instrument.
    b. Each instrument shall be provided with an isolating block and bleed needle valve.

19. All tubing shall terminate at a bulkhead in the bottom or side of the panel designed for easy tie-in of interconnecting tubing.
20. All tubing and fittings shall be 304L stainless steel.
21. Bulkhead fittings shall have companion fittings and shall be plugged for shipment.
22. All tubing shall be protected, straight neatly arranged, and properly supported.
23. All tubing bends shall be shaped using tube benders.
24. All tubing shall be adequately mounted and protected.
25. Tube bundles shall be utilized where practical.
26. Tubing bundles shall be supported at least every 6 feet or at intervals as recommended by the tubing bundle manufacturer, whichever is closer.
27. Where multiple tubing runs are made along skid frames or vessels, the Contractor shall furnish and install support brackets and tubing gang clamps.
28. All tubing supports and tubing support hardware (nuts, bolts, u-bolts, etc.) shall be 316L stainless steel.

2.6 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

B. Each Compressor and its accessory equipment shall be mounted on an individual skid. Each skid shall be heavy-duty welded steel with full-length longitudinal runners and full depth cross members with sufficient reinforcement to allow a four-point lift of the each complete assembly. Each skid deck shall be covered with checkered plate and fully seal-welded with drainage slope to prevent settling or puddling of rainwater. Jackscrews and foundation bolt holes shall be provided on the outside runner.

C. Each skid shall have a two-inch drip-lip extending around the outer perimeter oil containing areas of the skid for spill containment. The drip lip shall have plugged couplings for drain connections. General Manager shall approve design of the drip lip.

D. Seismic and dynamic analyses shall be utilized in the design of the skid assembly to provide a system, which is free of equipment vibration problems, and foundation and anchor problems during operation.

E. The Contractor shall supply and install two NEMA two-hole grounding pads near diagonally opposite corners of each skid. Grounding pads shall be in accordance with the electrical standard specifications included in this package.

2.7 SOURCE QUALITY CONTROL

A. Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections

1. Contractor shall notify General Manager two weeks in advance of functional testing. General Manager reserves the right to witness functional testing at Contractor's works.

2. The gas compressor control panel and all controls shall be thoroughly tested on the completed unit prior to shipment. This testing shall assure functionality and proper operation / installation of all components. All P&ID items shall be verified and any changes shall be issued as "As-Built" drawings. Also, all BOM items are to be verified on the unit and in the BOM, including the proper scale of measurement utilized for the application.
3. "Functionality" as used in this context includes at a minimum: ringing out of all I/O points and verifying against Contractor's point-to-point drawings, verifying and documenting alarm set points, switch contact developments, calibration of all skid-mounted instrumentation and successful functional checkout of all startup, shutdown and trip operating sequences. Points and alarm conditions may be simulated using jumpers or other similar means in order to verify functionality.
4. Documented results of functional testing, in Contractor's testing format, shall include actual measured values, required values, manufacturer's accepted values where requirements are not specifically identified as part of these specifications, functional step checkout, electrical drawing red lines, equipment and instrument adjustments made shall be submitted to the General Manager prior to shipment.

C. Code Compliance: It is the Contractor's responsibility to obtain copies of all documents referenced in this specification. The referenced documents shall be binding. The Contractor of the fuel gas compression systems shall certify that the components of the system, where applicable, shall be designed, fabricated, tested, and documented in accordance with applicable portions of API Specification 619.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100, Combined Cycle Power Island for general requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 480032, Power Island Performance for general field acceptance test requirements.

B. Performance Tests

1. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Refer to Section 481100 Combined Cycle Power Island for individual equipment baseline performance testing.
2. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.

3.3 COMMISSIONING

A. General

1. Refer to Section 480032, Power Island Performance for general commissioning requirements.

END OF SECTION 485374.22

APPENDIX A –TECHNICAL DATASHEETS BY GENERAL MANAGER

The detailed technical data will be furnished by the equipment vendor during contract execution. The design will be to manufacturer's standards and will support the power island guarantees and will meet the design life requirements.

Description		**Units**	**Comments**
Gas Turbines			
Number of Gas turbines	1		
Expected Fuel Gas Demand per Unit			
Total Plant Fuel Gas Demand			
Fuel Gas Demand Range			
Cooling Medium	Water or Air		
Fuel Gas Supply to Plant at Compressor Suction			
Minimum Pressure	150	psig	
Nominal Pressure Range	150 to 200	psig	
Temperature Range	50 to 75	ºF	
Average Temperature	60	ºF	
Fuel Gas Supply Requirements to Gas Turbine Generator			
Compressor Discharge Pressure, Design Conditions		psig	Refer to Gas Turbine Manufacturer Re-quirements
Compressor Discharge Pressure, Maximum		psig	
Pressure Required at GTG		psig	
Maximum Allowed Discharge Temperature		°F	
Fuel Gas Compressors			
Required Flow Each Compressor		MMSCFD	
Design Standard	API-619		

Parameter	**Definition**
Site Voltage	Refer to Section 260000
Control Voltage	Refer to Section 260000

Instrument Air	Refer to Section 481100
Gas Compressor Duty	Multiple start/stops per day with varying discharge flows
Arrangement	2x100% capacity
Maximum oil carryover	0.5ppmwt
Pulsation Suppression / Silencers Study	Required as per Para 6.9 API-619
Location	Outdoor
Winterization	Required to site minimum temperature
Acoustic Insulation Blanket / Housing	Required

APPENDIX B – GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET

FUEL GAS SCREW COMPRESSOR		**Test #:**				**Date**			
	Reading #:		**1**	**2 3**		**4**	**5**	**6**	**AVG**
	Time:								
	PARAMETER	**UNITS**							
1	GROSS GENERATION GT5	MW							
2	NET GENERATION GT5	MW							
3	FUEL FLOW RATE	SCFM							
4	GC POWER CONSUMPTION 4160 V	MW							
5	BAROMETRIC PRESSURE.	PSIA							
6	AIR TEMP ENTERING LPC, T_2	^oF							
7	LPC INLET STATIC PRESS, P_0	PSIA							
8	LPC INLET PRESSURE LOSS	"H_2O							
9	NG PRESS INSIDE GAS HOUSE, $P_{GH\ in}$	PSI							
10	NG PRESS OUTSIDE GAS HOUSE, $P_{GH\ out}$	PSI							
11	NG PRESS BEFORE SUCTION FILTER, P_S	PSI							
12	NG PRESS ENTERING COMPRESSOR, P_S	PSI							
13	NG DISCHARGE PRESSURE, P_D	PSI							
14	NG COMPRESSION RATIO, P_D/P_S	-							
15	NG GC SUCTION TEMP	^oF							
16	NG TEMP AFTER OIL SEPARATOR, Tg	^oF							
17	OIL TEMP ENTERING L.O. COOLER, $Toil_1$	^oF							
18	OIL TEMP LEAVING L.O. COOLER, $Toil_2$	^oF							
19	OIL PRESSURE ENTERING L.O. FILTER	PSIG							
20	L.O. PUMP SUCTION PRESSURE	PSIG							
21	L.O. PUMP DISCHARGE PRESSURE	PSIG							

SECTION 485374.22
FUEL GAS COMPRESSOR SPECIFICATION

	FUEL GAS SCREW COMPRESSOR	Test #:				Date			
	Reading #:		**1**	**2 3**		**4**	**5**	**6**	**AVG**
	Time:								
22	SCREW GAS COMPRESSOR SPEED	RPM							
23	SCREW GAS COMPRESSOR CAPACITY	KW							
24	SLIDE VALVE POSITION	%							
25	BYPASS VALVE POSITION	%							
26	NG PRESS AFTER GT5 GAS FLOW METER, P_{FM}	PSI							
27	NG TEMP AFTER GT5 GAS FLOW METER, T_{FM}	^{o}F							
28	NG PRESS BEFORE GT3 COMB. NOZZLES, P_{NOZ}	PSI							

APPENDIX C – TECHNICAL DATASHEETS BY CONTRACTOR

1. Contractor shall use API 619 data sheets for furnishing gas compressor technical data.

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485413

Once-Through Heat Recovery Steam Generator

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485413
Once-Through Heat Recovery Steam Generator

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *BRIAN HRITSCO*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	T. Clark	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
02/08/2012	G. Harwood	E
05/04/2012	T. Clark	F
06/15/2012	B. Hritsco	G
09/11/2012	G. Drake	H
09/10/2013		I – CONTRACT VERSION

SECTION 485413
ONCE-THROUGH HEAT RECOVERY STEAM GENERATOR

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 3
1.4 RELATED SECTIONS 4
1.5 CODES AND STANDARDS 4
1.6 DEFINITIONS 5
1.7 SYSTEM DESCRIPTION 5
1.8 SUBMITTALS 8
1.9 QUALITY ASSURANCE 8
1.10 DELIVERY, STORAGE, AND HANDLING 8
1.11 SITE CONDITIONS 9
1.12 WARRANTY 9

PART 2 - PRODUCTS 9

2.1 MATERIALS AND WELDING 9
2.2 MANUFACTURED UNIT 9
2.3 EQUIPMENT 9
2.4 COMPONENTS 11
2.5 ACCESSORIES 16
2.6 INSTRUMENTATION AND CONTROLS 18
2.7 FABRICATION 20
2.8 SOURCE QUALITY CONTROL 20

PART 3 - EXECUTION 21

3.1 INSTALLATION 22
3.2 FIELD QUALITY CONTROL 22
3.3 COMMISSIONING 22
3.4 TRAINING 23

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 24

APPENDIX B – GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET 26

APPENDIX C – TECHNICAL DATASHEET BY CONTRACTOR 28

SECTION 485413
ONCE-THROUGH HEAT RECOVERY STEAM GENERATOR

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of a once-through heat recovery steam generator (OTSG). It is not the intent to specify completely herein all details of design and construction of the OTSG and its related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment for a complete OTSG system, including but not limited to the following:
1. Once-Through Steam Generator with economizer, evaporator, and superheater sections unfired and at a single pressure
2. General Manager Datasheet
3. Inlet transition duct and expansion joint to the OTSG from GTG/OTSG interface
4. Two pressure relief valves, complete with silenced vent stacks
5. Main steam electromatic relief and pneumatic start-up vent valves and mechanical SRVs as per the ASME Sec 1 requirement and silencers (note: silencers must be designed to comply with the noise specifications. Primary start-up operation shall be to bypass to condenser). Silencer supports by OTSG manufacturer.
6. Main feedwater flow devices
7. Main steam outlet desuperheater
8. Steam turbine bypass system
9. Pressure vessel stop valves and check valves
10. Feedwater control valves
11. All required headers for the boiler sections
12. All boiler trim valves (including safety valves equipped with silencers) and trim piping, including all necessary valves to the OTSG scope limit
13. Superheater and steam piping low point automatic drains with valves, conductivity probes, and condensate legs
14. Field instrumentation and control valves
15. Outlet transition ducting and main stack with damper
16. EPA Emissions test ports and SCAQMD test ports
17. Access platforms, one set of full height stairway to the main operating level and handrails

18. Base plates and slide pads
19. Sole plates and shear keys
20. Structural steel supports for the OTSG
21. Double wall insulated steel casing for transition ducts, economizers, evaporators and superheater sections
22. Boiler feedwater control valves and trim (supplied loose for field mounting)
23. Boiler feedwater valve piping stations
24. Interfacing insulation and liner between all ducting and module field joints
25. OTSG drain system for both the casing and water side (piping by Others)
26. CO catalyst system
27. SCR system as indicated
28. 19% Aqueous ammonia vaporization and injection system
29. Tempering air fans
30. Grounding lugs for the General Manager's lightning protection and grounding system
31. Shop finish coat
32. Spare parts list
33. Per diem rates for supervision for unloading, field erection training and commissioning
34. All activities required for completion of the Work including the following:

    a. Design, materials, fabrication and assembly
    b. Shipping preparation, loading and securing on carrier.
    c. Shipment to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.
    d. Submittal of drawings, data and documents.
    e. Expediting of materials, equipment and submittals.
    f. Inspection, examination and testing.
    g. Monitoring and reporting.
    h. Special lifting equipment (i.e. lifting lugs) but not standard lifting equipment such as slings, spreader beams, etc Field technical services including erection advisor, startup advisor and operator training
    i. Coordination during OTSG performance testing
    j. Attendance at a project kickoff meeting and a design review meeting in the General Manager's office.

35. Interconnecting piping, ducts, bolts, nuts and gaskets or other items required for connections between components included in the Work. Drill-in or shot-in concrete anchors required to install the Contractor's components shall be provided. Refer to the M195 Drawing in Attachment 1 – Scope of Supply.
36. The Contractor's scope shall include all items within the following terminal points and as described herein and on the Contractor's conforming P&ID's. Refer to the M195 Drawing in Attachment 1 – Scope of Supply. Terminal elevations shall be as shown. Top terminal points for main steam outlets and bottom terminal inlets for feedwater inlets are preferred. Upper and lower terminals shall extend beyond the HRSG sidewalls. Far side is the side opposite the General Manager's pipe rack. Valves and instruments in terminal piping shall be located above platforms or accessible from grade as specified herein. When auxiliary equipment sections are included in this specification, additional terminal points in those sections also apply:

General Manager/Contractor Terminal Points	
Contractor's Scope Includes	**Terminal Location**
Exhaust Gas	
Downstream of GTG outlet expansion joint	GTG outlet
TEG condensation area drain piping outlets and upstream	At General Manager's grade funnel, both sides
Casing drain caps and upstream	At cap
Stack drain piping outlets and upstream	General Manager's grade funnel, far side
Stack damper drain piping outlet and upstream	General Manager's grade funnel, far side
Stack outlet and upstream	Top of stack
Steam/Water	
Boiler feedwater inlets and downstream	Top, pipe rack side
Superheated steam stop valve/bypass valve piping and upstream	Top or bottom, pipe rack side
Start-up vent silencer outlets and upstream	Top of silencer; Piping from the start up vent valve to the silencer shall be by others.
PSV silencer outlets and upstream	Top of silencer
PSV and startup vent drip pan/silencer drain piping	General Manager's grade funnel, both sides
High point vent valve pigtail outlet and upstream	Safe location
Desuperheater inlet piping and downstream	Top or bottom, pipe rack side
Steam sample piping outlets and upstream	Top or bottom, pipe rack side
FW piping inlet	Top or bottom, pipe rack side
Low point drain outlet terminals and upstream	General Manager's grade funnel, both sides
Electrical	
Weather enclosure fan motor wiring terminals	Top, pipe rack side
Weather enclosure heater wiring terminals	Top, pipe rack side
Aviation light control box terminals	Not Applicable
Off-skid individual actuator and instrument terminals	At actuator or instrument
Ambient Air	
FW preheater re-circulating pump drain outlets and upstream	Not Applicable
Pneumatic	
Off-skid individual actuator and instrument terminals	At actuator or instrument
Nitrogen	
Nitrogen blanketing isolation valve inlet and downstream	Not Applicable

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:
   1. All piping up to the specified terminal points
   2. HP steam flow devices

3. Sample analyzers for steam and water sampling
4. Sample coolers
5. Labor and equipment for unloading, field erection, and storage
6. Electrical and instrument wiring and wiring supports
7. Electronic transmitters for remote control
8. Plant Control System (PCS) and all system integration logic for start up and operation
9. Motor starters (as required for purge/tempering air fans)
10. 19% Aqueous ammonia storage tank
11. Control room instrumentation
12. Concrete Foundations, sole plates, shear keys, imbedded anchor bolts, washers and nuts
13. Flushing during commissioning
14. Grouting
15. Insulation, lagging and heat tracing of piping
16. Piping outside of interface points shown on flow sheet
17. Platform lighting and receptacles
18. Grounding and lightning protection system
19. Lighting
20. Piping beyond ASME BPVC Section 1, Boiler External Piping

1.4 RELATED SECTIONS

A. Section 261050 - Medium Voltage Motors

B. Section 262050 - Low Voltage Motors

C. Section 260000 - Electrical - Mechanical Equipment

D. Section 409413.22 - Continuous Emissions Monitoring System

E. Section 480020 - Site Conditions

F. Section 480031 - Combined Cycle Power Island Noise Control Performance

G. Section 480032 - Power Island Performance

H. Section 485311.20 - Boiler Feedwater Pumps

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.
   1. American Boiler Manufacturers Association (ABMA)
      a. Boiler 402, Boiler Water Quality Requirements and Associated Steam Quality for Industrial/Commercial and Institutional Boilers
   2. American Society of Mechanical Engineers (ASME):
      a. Boiler and Pressure Vessel Code, Section I, Power Boilers

b. Boiler and Pressure Vessel Code, Section II, Parts A and B, Ferrous and Non-Ferrous Materials
c. Boiler and Pressure Vessel Code, Section V, Nondestructive Examination
d. Performance Test Code, PTC 4.4, Gas Turbine Heat Recovery Steam Generators
e. STS-1, Steel Stacks

3. American Society for Testing and Materials (ASTM)
   a. D 1066, Standard Practice for Sampling Steam
4. California Air Resources Board (CARB)
   a. AB 32, GHG Reporting
5. Code of Federal Regulations (CFR)
   a. 40 CFR Part 60, Standards of Performance for New Stationary Sources
   b. 40 CFR Part 75, Continuous Emissions Monitoring
   c. 40 CFR Part 98, GHG Reporting
6. South Coast Air Quality Management District (SCAQMD)
   a. Rule 218, Continuous Emission Stack Monitoring
   b. Rule 218.1, Continuous Emission Monitoring
   c. Rule 2012, Requirements for Monitoring, Reporting, and Recordkeeping for Oxides of Nitrogen (NOx) Emissions

B. The OTSG shall be designed and fabricated in accordance with ASME Section I and upon completion of erection and testing shall receive an ASME Section I "Nameplate", the manufacturers "S" and "PP" symbol stamps and be registered with the National Board of Boiler and Pressure Vessels.

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements
   1. Reference Section 481100 Combined Cycle Power Island for general design requirements and expected operating profile.

2. The OTSG shall be designed, constructed, inspected, tested and stamped in accordance with ASME BPVC Section 1. The Work shall conform to the local authority Boiler Code and Registration requirements. The Contractor shall verify the local requirements. Confirmation of local authority requirements and approvals shall be furnished to the General Manager for any changes from the ASME Code and General Manager specified requirements due to the local requirements. The OTSG shall be registered with the National Board and as required by the local authority. All fabrication documentation necessary for the BOP contractor to complete its pressure vessel certifications (P3's, etc.) shall be supplied with the OTSG.
3. The design shall include a modular assembly for simplicity of field installation and allow for steam blows performed during commissioning of the plant.
4. Material design temperature shall be at least 25°F above the maximum calculated metal temperature for heat transfer surfaces. The Contractor shall define the minimum design metal temperature for projects with low ambient temperatures.
5. The TEG temperature entering the stack shall be per OTSG vendor design practices.
6. All condensate and feedwater piping material supplied between the condenser hotwell to the OTSG feedwater connection shall be 316SS.
7. Structural calculations and drawings shall be stamped by a structural engineer registered in the state of California.
8. Fabrication shall be in approved shops as required by local authorities.
9. Electrical equipment and panel design and approval by local authorities shall be included by the Contractor if required by the authorities.
10. Steam and water pressure parts within ASME BPVC Section I code breaks shall conform to ASME BPVC Section I and ASME B31.1.
11. Steam and water piping systems not within ASME BPVC Section I code breaks and utility piping systems shall conform to ASME B31.1 for OTSG's installed in self-contained power plants.
12. Components that can be exposed to pump shutoff pressure upon valve closure shall be designed for the related pump shutoff pressure in accordance with ASME BPVC Section 1 Boiler External Piping.
13. The Work shall conform to the following additional general requirements. When auxiliary equipment sections are included in this specification, additional general requirements in those sections also apply.

    a. The OTSG site specific design and performance requirements, the basis for the requirements and utility, site and mechanical data shall conform to the attached, "Technical Datasheet by General Manager". The OTSG site specific performance tests and guarantees shall conform to the General Manager's Performance Tests and Guarantees specified in this Section and in Section 481100 Combined Cycle Power Island.
    b. The OTSG equipment layout and tagging shall conform to that shown in the General Manager's general arrangement drawings provided as part of the bid documents and the OTSG/GTG/Foundation Interfaces specified.
    c. Terminal points, piping, instrumentation, controls and trim shall conform to this specification and shall be shown accordingly on the Contractor's Conforming P&ID's.
    d. The OTSG structure, casing, ductwork, stacks, ladders, platforms and stairways shall conform to General Manager's structural requirements.
    e. Induction motors shall conform to the General Manager's induction motor specifications: 260000 Electrical Specification for Mechanical Equipment, 261050 Medium Voltage Motors, and 262050 Low Voltage Motors. Noise limits shall

conform to the General Manager's Noise Limits as stated in Section 480031, Combined Cycle Power Island Noise Control Performance.

f. Unless specified herein, wiring harnesses between Contractor equipment and General Manager's interface too large to be shop assembled are not included under 260000 Electrical - Mechanical Equipment. Hazardous area definitions in this specification shall apply.

g. Motor operated valves shall conform to the General Manager's Standard MOV Interface, External Reversing Starter requirements. Motor operated valves, both open/close and modulating, shall be shop tested and calibrated prior to shipment. Certification of calibration and/or shop testing shall be furnished to General Manager for review for each valve.

h. Instrument, remotely operated valve and relief valve data sheets submitted shall conform to the content in the General Manager's Instrument and Remotely Operated Valve datasheets, or to ISA data sheets.

i. The Contractor's field erection and heavy haul shall conform to the General Manager's Plot Plan, Construction and Lay-Down Plan and Site Plan drawings and the General Manager's Contract

j. Drawing submittals shall conform to the Contractor's drawing and data requirements detailed in this specification.

14. The Work shall be designed for, successfully meet, and withstand all continuous load, operating cycle, part load, GTG transitions, GTG water injection and transitions, GTG inlet chiller, evaporative cooler and fogger transitions, start-up, shut-down, stand-by and idle conditions.
15. Normal operation will be from the PCS. Preparation for start-up will be done remotely by PCS operators.
16. The Work shall accommodate expansions and contractions under all conditions within the range of specified conditions
17. Flow mal-distribution, vibrations, vortex shedding noise, fluid pulsations and acoustic excitations shall be minimized. Their effects shall be incorporated into the design.
18. Permanent local piping, valves, flanges, fittings, bolting, gaskets, instruments, trim, controls and accessories required for operation, control and safeguarding shall be provided by the Contractor unless stated otherwise in this specification. All Code and General Manager specified requirements shall be incorporated.
19. Asbestos materials shall not be used

B. Performance Requirements

1. The OTSG shall be capable of sliding pressure control to the steam turbine.
2. The System shall be mechanically capable of continuous, unrestricted stable operation (up to the GTG mechanical power limitation) over the specified ambient temperature range and from approximately 25% to full load.
3. When the OTSG is supplied with emissions control, the System shall be capable of operating within the specified emissions concentration levels over the specified ambient temperature range and from approximately 25% to full load (with the GTG emission concentrations given in the Data Sheets attached to this specification). The Contractor's proposal shall include complete information regarding part load emissions capabilities for the specified ambient temperature range.
4. When the OTSG is supplied with emissions control, the specified emissions concentration levels shall be met for both combined cycle and OTSG run dry modes of operations.

5. The system shall be capable of operating dry (no water in OTSG) at full rated turbine exhaust pressure and temperature for extended periods as required for extended start-up, emergency trip, and shut-down operations, while meeting all emission requirements.
6. The high pressure (HP) steam system shall be designed to generate the flowrate of HP steam at the pressure and temperature as specified in the Data Sheet at each operating point subject to the GTG exhaust energy given herein. The HP steam conditions are specified at the OTSG outlet piping terminal point. The OTSG shall be able to operate with HP terminal point flows, pressures and temperatures varying as specified in the Datasheet.
7. Performance Correction Curves shall be provided as requested and/or Heat Balance output for all customer-specified cases.

C. Reliability
1. No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

D. Guaranteed Performance Refer to Attachment 6 – Performance Guarantees
1. The OTSG shall be guaranteed to meet the performance listed in Section 481100, Combined Cycle Power Island Equipment.
2. Stack Emission: The emission concentration exiting the OTSG stack shall be guaranteed to not exceed the value listed in the Technical Datasheets by General Manager and/or permit conditions for both combined cycle and OTSG run dry modes of operation.
3. HP Steam Quality and Purity: Steam quality and purity to the steam turbine should follow the requirements of ABMA Boiler 402 (Boiler Water Quality Requirements and Associated Steam Quality for Industrial/Commercial and Institutional Boilers) and EPRI Guidelines as a minimum requirement. Also refer to Section 480020 Site Conditions for boiler water purity requirements.
4. Steam sampling ASTM D-1066 standards or agreed methods may be utilized for sampling. It is recognized that for OTSG, steam purity is directly affected by feed water quality to the OTSG and OTSG manufacturer guidelines for water quality may be stricter than the standards referenced.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping
1. Refer to Section 481100 Combined Cycle Power Island for general packaging and shipping requirements.

2. The System shall be packaged for shipment to allow for outdoor storage as prescribed by Contractor for a period of six months without damage from dust, sun, wind, or rain. Preparation for shipment shall require:

   a. Equipment to be completely free of water prior to packaging for delivery.
   b. Flanges and threaded connections to be coated with rust preventatives and blanked-off or plugged. Blanking flanges shall utilize at least four bolts. Open ends of pipe shall be caps or plugged.
   c. Unpainted surfaces to be protected from weather with weather tight and weatherproof covers. Machined surfaces shall be coated with a heavy grease or similar material before covering.
   d. Lifting and support points shall be clearly identified.
   e. Packages shall be identified with items and serial numbers, purchase order number, and item descriptions. Identifying tags shall be corrosion and weather resistant.
   f. Temporary bracing and covers shall be painted yellow.

1.11 SITE CONDITIONS

A. Refer to Section 480020 Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100 Combined Cycle Power Island for general material and welding requirements.

2.2 MANUFACTURED UNIT

A. Structural Requirements
   1. General

      a. Refer to Section 481100 Combined Cycle Power Island for general structural design requirements.

   2. Materials

      a. Refer to Section 481100, Combined Cycle Power Island for general structural material requirements.

2.3 EQUIPMENT

A. OTSG

1. The HP final steam temperature shall be controlled. During certain load conditions, attemperation may be required as a means to control final steam temperature. The OTSG shall be designed so that attemperation is not necessary when operating at the design point. Desuperheaters shall include internal liners and shall be located for proper mixing, accurate upstream and downstream temperature readings and to prevent water quenching damage to downstream components. The HP steam attemperator shall be provided by the PIE Contractor.
2. Minimum length of straight pipe upstream of the liner shall be three pipe diameters. Length of the liner downstream from the spray nozzle(s) shall be between three and six feet. Location of the temperature sensor downstream of the liner shall be positioned to allow 0.2 seconds of residence time to ensure complete mixing. If the mass flow of the spray water is greater than 15% of the mass flow of the superheated steam, this residence time shall be 0.3 seconds. Spray water control valve trim exit velocity shall be less than 100 ft/sec. to prevent cavitation and erosion damage. Control valve shall be sized appropriately to ensure precise control over the entire spray water flow range, especially at low Cv values. The control system shall be designed such that final steady state temperature of the desuperheated steam is within 5˚F of the setpoint.
3. Desuperheater probes and nozzles shall withstand the cyclical environment to which they are exposed without damage and nozzle tips shall remain in their correct orientation. The temperature of the steam after the desuperheater shall be at least 27°F above the steam saturation temperature at that point.
4. The OTSG shall be designed to prevent any detrimental effects resulting from high combustion turbine exhaust flows and turbulence, or combustion turbine induced vibrations. It is the responsibility of the Contractor to design the inlet duct and liners such that no damage will occur due to gas turbine exhaust turbulence, flow induced vibration, poor velocity distribution, or uneven flow patterns. The design shall meet the requirements of this article while there is no water in the OTSG.
5. The OTSG shall be a modular design. The location of external steam and feedwater connections shall be identical between the units supplied for a project when applicable. Field welding shall be minimized.
6. All components shall be factory assembled and shipped as complete packages when possible in order to minimize field erection. All pieces shall be suitably identified to facilitate installation. All holes shall be pre-drilled. All field welded pipe ends on pipe larger than 2” diameter shall be weld prepped prior to shipment. Steel shot blasting or iron grit blasting of all external steam and feedwater lines in the steam turbine path is required after post weld heat treatment.
7. The Contractor shall be responsible for all piping system stress analysis and pipe supports to the terminal points and shall work closely with the General Manager on the balance-of-plant stress analysis to coordinate overall pipe stress analysis and pipe support design. Steam and feedwater pipe stress analysis shall be by others.
8. Piping shall not be smaller than ¾ inch. The wall thickness for ¾ inch piping shall not be less than schedule 80. Piping shall be designed to provide unobstructed access to valves, instruments, and control devices. All valves shall be readily accessible from platforms or grade for operation and maintenance. Piping over 2” shall be butt-welded construction and piping 2” and under shall be socket welded construction.
9. Crosby, Consolidated, or approved equivalent safety valves shall be furnished. Pressure safety relief valves shall be flanged on both ends. They shall be provided with gags, lifting levers, sleeves, weather protection for outdoor installations, drip ell, drip pan and discharge piping. Drain lines shall be provided for the drip ell, pan and discharge piping. The discharge piping connection to relief valve silencers shall be welded, not bolted

10. The OTSG shall be equipped with water inlet and steam outlet manual stop valves consisting of ASME code required non-return (check) valves and gate valves. Solid wedge gate valves are prohibited. Parallel slide gate valves are required for cycling steam service and flexible wedge gate valves with bypass are required for all others. Boiler drain and blow-off valves shall be provided as required by code. Valves shall be equipped with motor operators.
11. The OTSG shall be equipped with additional spacing in the housing to allow addition of an SCR and CO catalyst.

B. CEMS SAMPLE PORTS

1. The Continuous Emissions Monitoring System (CEMS) hardware, sampling system, instrumentation, datalogger, and related equipment are supplied under Section 409413.22.
2. CEMS sample ports shall be provided in accordance with applicable 40 CFR Part 60 & 75 and SCAQMD rules and source testing guidelines.
3. Ports in the stack at the sampling platform and has provided shared ports in the inlet duct. No provision for ports between the SCR and CO is provided.

C. TEST CONNECTIONS

1. The OTSG ductwork and stack shall be supplied with all connections necessary to perform ASME PTC 4.4, Gas Turbine Heat Recovery Steam Generators. Instruments and controls for performance testing will be the same as supplied for operation.

D. TEMPERING AIR

1. 2x100% tempering air fans shall be provided by the Contractor to protect the SCR unit from high TEG temperatures during GTG operation with an OTSG dry mode.
2. The tempering air system shall include all ducting, air distribution lances, dampers, suction filters, and controls incorporated into the system.
3. For the SCR system to meet NOx emission requirements at all operating conditions, the tempering air system shall be sized and provided by the Contractor to reduce flue gas temperature at the SCR catalyst.
4. The system shall be designed to ensure proper mixing of the dilution air upstream of the NOx catalyst bed.
5. Fan motors shall be 1800 rpm, 480VAC, 60 Hz, 3 phase induction motors per Section 262050, Specification for Low Voltage Motors.
6. The tempering air fans shall be sized appropriately to accommodate maximum firing temperature at all expected load ranges and ambient conditions including dry tube operation with consideration for maximum degraded temperature to account for increased GTG exhaust gas temperature rise over the life of the turbine.

2.4 COMPONENTS

A. Tubes and Headers

1. All tubes shall be seamless and of suitable material for continuous dry running of the OTSG under the conditions described in Section 481100 Power Island Equipment Supply. Considerations must also take into account conditions when metal temperatures are below the TEG water vapor and acid dew points or when flue gas temperatures exceed 750˚F.

2. Headers shall be made of seamless pipe. Contractor shall clearly indicate specific ASTM material designation on shop drawings.
3. Headers shall be self-draining to minimize risk of off-load corrosion and thermal shock in steam circuits. Headers shall be sloped and supported properly to allow for full drainage.
4. Tube headers shall be provided with a vent drain as necessary to facilitate start-up. Vent and drain connections shall be external to the casing. Sizes of all vents and drains shall be clearly indicated on shop drawings.
5. All tubing arrangements shall be fully drainable.
6. Fin density and thickness shall be per the manufacturer's design standards. Fins shall be attached to tubes by high frequency, continuous welding or high temperature brazing. Fins shall be solid or serrated. The minimum fin thickness is the nominal fin thickness before the manufacturing tolerance is applied.
7. Tube fin material shall be per the manufacturer's design standards and meet temperature and corrosion resistance demands.
8. Installation of K type, mineral insulated, 304 stainless steel sheathed surface thermocouples shall be installed on each of the water inlet and superheater outlet tubes for investigation of water and steam maldistribution during startup, shutdown and normal operating conditions of the unit. Thermocouple wiring shall be long enough to terminate each thermocouple at thermocouple junction boxes to be furnished by the contractor and located on the exterior of the unit. Reference Section 260000, Electrical Mechanical Equipment for thermocouple junction box and terminal block requirements.

B. Casings, Liners and Insulation of Casing and Ducts
1. The outer casing shall be gas tight, minimum 1/4 inch thick and shall be designed for a minimum of 20 inches water column. Means shall be provided for draining water from the inside of the OTSG casing after water washing the outside of tubes. Blind flanged nozzles shall be provided underneath the OTSG for water removal ports. Sleeves shall be provided for drains in insulated sections, extending to the internal liner or hot casing. Sleeve material shall be equivalent to the local liner or hot casing material.
2. Casing drains shall be 2 inch minimum. Vertical elbow duct drains shall be 4 inch minimum
3. Spacing between the casing and boiler tube bends shall allow room for inspection of tube leaks and repairs through internal access pathways. Access doors shall be provided for access to those locations between tube bundles not accessible through internal passageways.
4. Insulation and liners in inlet ducts shall withstand GTG discharge characteristics without deformation or insulation loss. Design shall include the impact of GTG discharge temperature variations, turbulence, flow re-circulation and vortices. Floor liners shall support foot traffic and distributed scaffolding weight.
5. The inner liner shall be minimum 11 gauge thickness throughout unless specified otherwise. The inner liner shall be stainless steel. The inlet duct features tighter pin/scallop spacing (11"x11")
6. Internal insulation for inlet ducts and adjacent superheater section insulation shall be 8 lb/ft^3 density, OSHA approved soluble ceramic fiber blanket suitable up to 2300°F. Mineral wool or other non-soluble fiber materials shall not be used for internal insulation.
7. External insulation and lagging shall be provided when required to meet the TEG water and acid dew point criteria specified in the Design Requirements article of this specification.
8. The insulation shall be of such thickness and material to minimize heat loss, but in no case shall the outer casing temperature exceed 140°F at 80°F ambient temperature, 0 mph wind conditions except for localized points at liner pin locations and internal casing

supports. The Contractor shall provide personnel protection as required. Protection shall extend 8 feet above grade or platform floor.

9. All insulation shall be installed in the Contractor's shop to the greatest extent possible. Contractor shall provide internal insulation suitable for the service conditions. Insulation in the inlet duct shall be covered with a 40 mesh SS screen prior to installing panels.
10. The OTSG casing shall be provided standard maintenance door on the module (18"x18"). 18"x24" will be provided in other ducting areas for operation and routine maintenance.
11. If not externally insulated for personnel protection, the stack shall be provided with an expanded metal standoff at the base area up at the EPA test/CEM port platform area.
12. All casing weld joints shall be left as bare metal (no paint or primer) within 3" of a field weld seam.

C. Internal Supports, Guides, Baffles and Flow Distribution Devices

1. Vertical tubes shall be top supported.
2. To meet OTSG performance requirements or maintain components within design limitations, TEG flow distribution devices shall be provided if necessary.
3. To prevent TEG bypassing of heat transfer surfaces and flow-induced vibration mechanical damage due to acoustic resonance, supports, acoustic baffles and other baffles shall be provided. Supports, guides, baffles and distribution devices shall be suitable for 50°F above the maximum local TEG temperature. These shall be removable for pressure part inspection and shall remain securely in place. The arrangement design shall prevent accumulation of TEG deposits and internal components erosion within the OTSG
4. Materials shall withstand the specified plant operating conditions. Carbon steel shall not be used.
5. Tube supports shall not damage fins or tubes during operation or during inspection/outage.

D. Ducts and Expansion Joints

1. The OTSG manufacturer shall provide verification of successful experience with the GTG specified and the inlet duct arrangement proposed. Transitions shall be designed for optimum dynamics. The duct flange shall match the GTG outlet.
2. The casing design shall ensure a uniform gas flow profile at the inlet to the catalyst section. Gas velocity profile entering each catalyst module shall be as required by the catalyst manufacturer.
3. The gas path shall be a pressure tight envelope with internal liner donuts. These shall be secured by z-clips on the TEG side of the liner and penetration seals external to the casing at piping and support penetrations. The latter shall not restrict movement of the penetrating items. Seismic restraints and stops shall be separately provided independent to piping penetrations.
4. Access doors (18"W x 24"H minimum) shall be provided in the inlet and exhaust ducts for the OTSG.
5. The entire inlet duct (up to the first heat transfer modules) for the OTSG shall be at least 1/4" casing through with a stiffener design suitable for the turbulent conditions of the GT. Cold casing duct casing plate thickness shall not be less than ¼ inch.
6. The inlet duct for the OTSG shall be furnished with twelve 3-inch flanged sampling ports with end caps located 180 degrees apart (6 on each side). The sampling ports shall be equally spaced up the sides of the inlet duct.
7. The inlet duct for the OTSG shall be provided with two 1 inch diameter flanged ports located on opposite sides for pressure measurement devices.

8. Expansion joints, if required in the design, shall be manufactured of fabric suitable for the design temperature. Each expansion joint shall be designed for axial, lateral and angular displacements caused by the expansion difference between the internally insulated casing sections. The outer skin of the duct expansion joints (where exhaust-gas temperature is greater than 480°F (250°C) shall be made of non-combustible materials to minimize burning or charring of the expansion joints by the exiting exhaust gas. The internal side of the expansion joints shall be protected to minimize "erosion" of the insulating material.
9. The boiler casing shall be designed to provide an uncooled gas-tight enclosure around the boiler pressure part sections/tube bank modules.
10. Ducts shall have stiffeners, access doors, internal insulation, and cladding to reduce heat loss and provide personnel protection, where necessary.
11. Ducts and duct internals shall be made of gas-tight steel designed for maximum expected temperatures.
12. When required to maintain homogeneous velocity profiles, baffles shall be provided. Baffles are designed to mitigate vibration and provide for expansion with changes in temperature.
13. Heat flow from the OTSG and associated equipment and supports shall not cause foundation concrete temperatures to exceed 150°F. Steel members shall be insulated to protect concrete slabs and foundations if required.

E. Stack

1. The stack shall be integral to the exhaust duct and supported on top of the OTSG. The stack shall be manufactured with internal liner and insulation for dry operation of the OTSG. Stack design shall conform to ASME STS-1 adapted to OTSGs. Stack plate thickness shall not be less than ¼ inch including corrosion allowance
2. The stack shall have an outlet damper located at the top of the stack. For vertical flue gas flow designs, the damper shall seal to keep out rain water to prevent damage to the SCR catalyst. A platform shall be provided to allow 360 degree access to the stack damper.
3. The stack shall be furnished with four 4 inch diameter flanged EPA sampling ports with pipe plugs located 90 degrees apart in accordance with 40 CFR Part 60 Appendix B Spec 2, 8.1.2 CEMS Measurement Location. The measurement locations shall be at least two equivalent diameters downstream from the nearest control device, the point of pollutant generation, or other point at which a change in the pollutant concentration or emission rate may occur and at least a half equivalent diameter upstream from the effluent exhaust or control device. This is consistent with SCAQMD Test Method 1.1 and must also meet SCAQMD Rule 2012 Chapter 2 requirements.
4. If the specified upstream and downstream distance requirements cannot be met per SCAQMD Rule 2012 (B) 14 other locations may be chosen subject to a written approval of the Executive Officer. If an alternate location is chosen which does not conform with District Method 1.1, the absence of flow disturbance shall be demonstrated using the District method in the source Test Manual, Chapter X, Section 1.4 - "Alternative Site Selection Method", or 40 CFR, Part 60, Appendix A, Method 1, Section 2.5 - "Alternative Measurement Site Selection Procedure", and, the absence of stratification shall be demonstrated using the District method in the source Test Manual, Chapter X, Section 13 - "Determination of Gaseous Constituent Stratification". Absence of flow disturbance and stratification can be demonstrated by the following methods:

    a. Each affected piece of equipment shall have sampling locations which meet the "Guidelines for Construction of Sampling and Testing Facilities" in the District Source Test Manual.

b. If an alternate location (not conforming to the criteria of eight duct diameters downstream and two diameters upstream from a flow disturbance) is used, the absence of flow disturbance shall be demonstrated by using the District method in the Source Test Manual, Chapter X, Section 1.4, or 40 CFR, Part 60, Appendix A, Method 1. Section 2.5 and the absence of stratification shall be demonstrated using District method in the Source Test Manual, Chapter X, Section 13.

5. The stack shall be furnished with two 6 inch diameter flanged ports for the CEMS probe as well as four test ports described above.
6. A cantilevered davit (500 lb. capacity) shall be provided to allow hoisting material from grade to the sampling platform.
7. A sampling platform 4 feet wide (minimum) and 5 feet below sample ports shall be provided to allow safe 360˚ access around the stack.
8. If the outlet damper cannot be serviced from the CEMS sample port access platform, a 4 feet wide platform shall be provided at an elevation to facilitate maintenance of the stack damper and actuator motor.
9. The OTSG gas path shall contain at least one 3 inch diameter drain.
10. Stack dampers or cap shall be provided to prevent ingress of rain water during extended outages that may foul the catalyst bed. The stack damper shall be actuated by a single 480 VAC motor with integral motor starter. The motor operator shall be Limitorque model MX or approved equal and furnished with limit and torque switches. In addition, the damper shall also be furnished with shaft mounted limit switches. Local position indication shall be provided. The dampers shall be designed to minimize stack draft when closed. The damper linkage and one of the damper blades shall be configured to automatically open should the combustion turbine generator be started without first opening the full damper. The damper shall be equipped with an auxiliary contact to act as a permissive for the GTG start and tempering air fan start logic. The damper linkages shall be configured for remote greasing of the damper bearings that are accessible from a working platform.
11. The stack shall be provided with a stack silencer appropriately designed to support the overall plant noise limitations specified in Section 480031, Combined Cycle Power Island Noise Control Performance.
12. The stack shall be insulated below the damper elevation to retain heat during shutdown periods.
13. The stack shall be a 10.17 ft inner diameter round stack.
14. OTSG vendor shall provide a square to round transition for the exhaust stack.

F. Drains
1. All OTSG components shall be fully drainable. All drain valves shall be brought out from underneath the OTSG casing.

G. Valves
1. The steam outlet non-return valves (stop checks) shall be manufactured by Edward, Weir (Atwood-Morrill), Pacific, or equivalent.
2. All drains, vents, and instrument sections shall have a double valve arrangement.

H. Control Valves
1. Control valves and pressure regulators shall be manufactured by Fisher or equivalent.
2. Pneumatic actuators shall be designed to provide adequate torque with 60 psig instrument air pressure.

I. Motor Operated Valves

1. Motor operators for MOVs shall be 460 VAC, 60 Hz, 3 phase, and contain an integral starter. A manual override handwheel shall be provided on each MOV. Limitorque Model MX or approved equivalent motor operators are acceptable. Local disconnect switches shall be provided on each MOV. MOVs shall conform to the General Manager's Standard MOV Interface, External Reversing Starter sketch.

J. Startup Vents
1. All start-up vent valves and silencers shall be sized for base load steam production including any external steam flows.
2. The HP start-up vent valve shall be a y-pattern globe valve with pneumatic actuator, positioner, position transmitter, solenoid valve, and local open/close indication. The valve has electromatic functionality as well as modulating pressure control during start-up. The valve inlet shall be buttweld and the outlet shall be flanged.

2.5 ACCESSORIES

A. CO Catalyst
1. CO catalyst will be required to reduce the CO from the combustion turbine for all operating cases to levels specified in the attached datasheets at the stack. CO catalyst shall be as supplied by Engelhard or General Manager approved equal. Reactor housing and catalyst support frame shall be included. The reactor housing shall be located downstream of the HP evaporator and designed to support 2" w.c. pressure drop across the catalyst.
2. The CO catalyst shall be designed for warranted for a 5 yr life (but typically lasts 8 yrs), and is hand-loaded without a rail system.
3. In vertical flue gas flow configurations, catalyst support frame shall include a rail system to an exterior platform on the end of the OTSG to facilitate replacement of the catalyst modules.

B. Selective Catalytic Reduction (SCR) System
1. General

a. Easily accessible, replaceable SCR catalyst shall be incorporated into the design of the OTSG. The catalyst shall be designed to simultaneously achieve the NO_X and NH3 slip concentrations exiting the OTSG stack as specified in the attached datasheets, provided that the combustion turbine generator exit NO_X and NH3 slip are no greater than the levels guaranteed by the gas turbine manufacturer. The stack NO_X and NH3 slip emission levels shall be guaranteed for a minimum of five years without exceeding the NH3 slips specified in the attached datasheets. The guaranteed NH3 slip with "new and clean" catalyst (less than 300 operating hours) shall also be guaranteed for five years. Refer to Attachment 6 – Performance Guarantees. The catalyst shall be located in the proper exhaust gas temperature zone so as to optimize the performance of the catalyst throughout all operating modes of the OTSG.

b. The catalyst shall be replaceable from the top of the unit on horizontal flue gas flow designs. Catalyst removal shall be from the side of the unit on vertical flue gas flow designs with a built in trolley system. Nine (9) of the catalyst cartridges shall be provided with a pre-made core sample. The nine core samples shall be equally spaced transverse and vertically within the catalyst reactor housing (three rows of three) and shall be accessible from internal platforms. Access doors (18"W

x 24"H minimum) shall be provided both upstream and downstream of the catalyst bed. A minimum of twelve 3 inch flanged sampling ports upstream of the ammonia injection grid and twelve 3 inch flanged sampling ports downstream of the catalyst shall be provided. A minimum of six ports shall be provided on each side (180 degrees apart) for both the upstream and downstream sampling ports. The sampling ports shall be equally spaced up the sides of the casing. Additionally, one 6 inch diameter flanged port for a NO_X CEM probe shall be provided immediately upstream of the ammonia injection grid.

c. Catalyst temperature rating shall be selected to accommodate the GTG flue gas maximum temperature taking into account temperature rise due to degradation of the GTG over time.

d. Space shall be reserved behind the catalyst bed to allow adding additional catalyst volume required to increase removal efficiency if required to meet the specified level as specified in the attached datasheets. The contractor shall be responsible for any additional catalyst volume that may be necessary to achieve the specified NO_X removal efficiency.

2. Ammonia Injection Grid (AIG)

a. The AIG shall be designed to provide an even distribution of ammonia to the SCR catalyst. A distribution header and riser system including balancing valves (globe or ball valves) and manometers shall be provided for the OTSG. The AIG shall be sized for the calculated ammonia flow required to reduce combustion turbine outlet NO_X as specified in the attached datasheets.

b. The AIG valves and flow orifices shall all be accessible from grade.

3. Aqueous Ammonia Dilution Skid

a. The aqueous ammonia dilution skid provided shall be a hybrid system using electric heaters for startup operation and hot gas recirculation when the unit is heated and able to maintain emissions compliance. The ammonia dilution skid shall contain all necessary devices to vaporize the 19% aqueous ammonia and meter the mixture to the ammonia injection grid (AIG). 2x100% capacity air diluent blowers shall be provided for each skid and 2x100% hot gas recirculation blowers. Ammonia flow control and measurement devices shall be included. All equipment shall be sized for the calculated ammonia flow required to reduce combustion turbine outlet NO_X as specified in the attached datasheets.

b. The ammonia dilution skid shall be pre-piped and suitable for outdoor installation whether or not the OTSG is indoor or outdoor installation. Contractor shall furnish all piping.

4. Catalyst Support Frame and Housing

a. The reactor housings shall include internal steel frames to support the SCR catalyst modules. The internal support and catalyst module configuration shall be such that no exhaust gas may bypass the active catalyst area. The SCR catalyst framing shall be capable of supporting a 5" w.c. pressure drop across the catalyst bed. The catalyst support system shall be designed and fabricated to accommodate the additional SCR catalyst referenced above in subpart 2.5B.1.d without the need for additional support members.

b. In vertical flue gas flow configurations, catalyst support frame shall include a rail system to an exterior platform on the end of the OTSG to facilitate replacement of the catalyst modules.

C. Platforms and Stairs
1. Refer to Section 481100 Combined Cycle Power Island for general platform and stairs requirements.

D. Heat Trace and Insulation
1. Refer to Section 481100 Combined Cycle Power Island for heat trace and insulation requirements.

E. Water Treatment System
1. Existing demineralized water quality is provided in Section 480020, Site Conditions. If the existing demineralized water quality does not meet the requirements of the OTSG and the Steam Turbine Generator, then the necessary Water Treatment System equipment shall be provided by the Contractor. The Water Treatment system shall be designed to use the existing demineralized water and produce boiler feedwater of sufficient quality to satisfy the requirements of both the OTSG and Steam Turbine Generator.

2.6 INSTRUMENTATION AND CONTROLS

A. General
1. Refer to Section 48110 Combined Cycle Power Island for general instrumentation and controls requirements and shop calibration and documentation requirements.
2. It is the intent of the General Manager to integrate the Contractor's equipment into a plant-wide Distributed Control System (PCS). All control devices furnished by the Contractor shall be capable of interfacing with the PCS and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the PCS to remotely start and stop all rotating equipment and to allow automatic switch over to the backup unit.
3. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
4. The Contractor shall permanently install a 1.25” stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified “Instrument Tag Number” to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
5. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required for flame scanners, ignition transformers, etc. shall be provided by the Contractor for installation by the General Manager.
6. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
7. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.

8. The plant control system is to be designed (by General Manager per 1.2 above) to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations. Once the GTG and steam turbine have been placed in their ready-to-start conditions, balance of plant systems have been filled and vented, and equipment has been placed in automatic mode, normal plant operations can proceed with few operator actions. The operator is required to start each turbine with a single command to bring it to a desired load level. At that point the GTG can be put in plant master mode. The operator can then enter a single plant load setpoint to which total plant output is controlled.
9. Plant systems and equipment are to be monitored and/or controlled through the PCS. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant PCS.
10. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
11. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.
12. It is the General Manager's intention that through equipment commissioning, Contractor shall create baseline performance profiles for each piece of equipment furnished by Contractor for use in future periodic performance testing by General Manager. Contractor shall accommodate this objective in the design of their equipment and Contractor shall furnish any and all transmitting instrumentation required to observe and record the process conditions listed in Performance Test Datasheet herein. These instruments shall be furnished regardless of whether or not they are required by Contractor's control system for ordinary equipment operation. These instruments shall be furnished and calibrated in accordance with specification section 481100, Combined Cycle Power Island, Instrumentation and Controls. These performance data sheets shall then be completed and submitted as part of the plant performance testing described in section 480032, Power Island Performance Testing.

B. Instrumentation & Control Devices – Requirements
   1. Duplex type K thermocouples and 100-ohm platinum RTDs shall be used.
   2. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
   3. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters.
   4. Control valves and pressure regulators shall be manufactured by Fisher.

C. OTSG Controls
   1. The following items shall be included as a minimum:

      a. Steam Temperature Control: The HP steam temperature shall be controlled by attemperation driven by the plant PCS.
      b. The OTSG outlet temperature setpoints are to be established by the ST metal temperature. Once set, the PCS automatically controls spray water flow to achieve the desired setpoint. Since steam turbine metal starting temperatures vary based on duration of shutdown, steam temperatures must be controlled to maintain allowable differentials between steam turbine metal temperatures and inlet steam temperatures.
      c. Each drain valve can operate in automatic or be overridden in manual. In automatic mode the drains stay open until steam piping warm-up is complete. After satisfactory superheat is achieved in the steam piping, drains will operate based upon detecting water in the condensate pots.

D. Instrumentation to be Supplied by Contractor Refer to the M195 Drawing in Attachment 1 – Scope of Supply.
   1. The following instrumentation shall be supplied by the Contractor for the OTSG.

      a. Gas side local pressure gauge on OTSG inlet duct.
      b. Steam local pressure gauges at steam outlets for all pressure levels.
      c. Feedwater local pressure gauges at feedwater inlets.

      d. Gas side thermocouples at:

         1) Four (2 per side) upstream and downstream of each OTSG heat transfer zone (Thermowells only, TC wire not required)
         2) Stack (4 required) RTDs to be equally spaced at CEMS platform elevation (0.5°F accuracy on reading is required)

      e. Feedwater/steam thermocouples and test thermowells at:

         1) Feedwater inlet
         2) Three thermocouples on HP steam outlet (1 test thermowell required)

2.7 FABRICATION

A. Refer to Section 481100 Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.8 SOURCE QUALITY CONTROL

A. Refer to Section 481100 Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspection
   1. Shop Inspections & Testing

      a. The OTSG and accessories shall be factory assembled into major components and inspected as required to establish critical fits, clearances, alignment, weld connections, mating surfaces and bolt hole alignment to minimize field adjustments.
      b. Testing shall be in accordance with Contractor's standard practices. Testing may be witnessed at General Manager's option. Testing shall include the following:

         1) Hydrostatic tests shall be performed per ASME code guidelines for tube assemblies (tube bend welds shall be shop installed and the welds radiograph or ultrasonically inspected). The hydro test shall be in accordance with the applicable Code and as follows-

            a) All air shall be vented from assemblies. Test pressure shall be held for sufficient time to examine the entire assembly for defects.
            b) Water for shop hydro test shall be potable with water quality reports submitted to the General Manager in advance of the hydro test. For

ferritic materials the chloride content shall not exceed 200 ppm and the water temperature shall not be less than 60°F The chloride content of water used for testing austenitic materials with more than 11% chrome shall not exceed 50 ppm unless treated with an inhibitor of 1.5% soda ash and 0.5% sodium nitrate. The chloride content of the soda ash shall not exceed 500 ppm. Required ppm levels are by weight. Contractor shall have hydro test water quality documentation available.

c) Hydro test water shall be drained and module internals shall be dry and capped after the hydro test.

d) The hydro test shall be successfully repeated after any repairs.

2. Extended Surface Inspection and Testing

   a. Extended surface shall be visually inspected to verify materials and dimensions.
   b. Fins shall be perpendicular to the tube within 15 degrees and uniformly spaced. The maximum discontinuity of resistance welds shall be 2-1/2% of the total tube length.

3. Structure, Casing, Duct and Stack Inspection and Testing – General Fabrication Tolerances

   a. Erection tolerances specified in the AISC Code of Standard Practice, Section 7, Erection, apply to the steel fabrication to the extent work affects the final erected outcome.
   b. Plates of flat sections shall be within ½ inch of a straight line, and within 3/8 inch in any 3 foot span.
   c. Framed beam length shall be within 1/16 inch for dimensions to 30 feet and 1/8 inch for dimensions over 30 feet.
   d. The distance from structural support members to the nearest splice or base plate surface shall be within 1/8 inch.
   e. Shop fabricated section overall dimensions shall be within +1/8 inch (3 mm) and -1/4 inch.

4. Model Test

   a. The Contractor shall conduct a flow model test to verify distribution within the OTSG and submit a copy of the model test report to the General Manager.
   b. A physical flow model test shall be conducted to verify that the exhaust flow velocity in the downstream horizontal direction is within +/- 15% of the average velocity in the downstream horizontal direction over 90% of the duct cross section with the GTG exhaust profiles applicable to the operating range of the SCR catalyst. Flow distribution measurements shall be in the plane just upstream of the ammonia injection grid and just upstream of the SCR catalyst. The physical model shall include all components in their actual locations.
   c. The above requirement for a flow model test may be waived by the General Manager if the Contractor can provide flow model test results from operating installations with OTSG design and GTG similar to the equipment specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Painting
1. Refer to Section 481100 Combined Cycle Power Island for general field painting requirements of exposed structural and carbon steel elements.

3.2 FIELD QUALITY CONTROL

A. Tests
1. Refer to Section 481100 Combined Cycle Power Island for general field acceptance test requirements.
2. Hydrostatic Test

a. After field assembly of the OTSG is complete, the Contractor shall perform a hydrostatic test of the pressure components per ASME BPVC Section 1 requirements. The hydro test shall be in accordance with the applicable Code and as follows:

1) All air shall be vented from assemblies. Test pressure shall be held for sufficient time to examine the entire assembly for defects.
2) Water for shop hydro test shall be potable with water quality reports submitted to the General Manager in advance of the hydro test. For ferritic materials the chloride content shall not exceed 200 ppm and the water temperature shall not be less than 60°F The chloride content of water used for testing austenitic materials with more than 11% chrome shall not exceed 50 ppm unless treated with an inhibitor of 1.5% soda ash and 0.5% sodium nitrate. The chloride content of the soda ash shall not exceed 500 ppm. Required ppm levels are by weight. Contractor shall have hydro test water quality documentation available.
3) Hydro test water shall be drained and module internals shall be dry after the hydro test.
4) The hydro test shall be successfully repeated after any repairs.

B. Performance Tests
1. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees. Refer to Section 480032 Power Island Performance for general performance test requirements.
2. The performance test will be carried out to the manufacturer's standards in general accordance with the following internationally recognized standards:

a. ISO 2314: Gas Turbines – Acceptance Tests
b. ASME PTC 4.4: Gas Turbine Heat Recovery
c. ASME PTC 19.1: Test Uncertainty

3.3 COMMISSIONING

A. General
1. Refer to Section 480032, Power Island Performance for general commissioning requirements.

3.4 TRAINING

A. Refer to Section 481100, Combined Cycle Power Island for general training requirements.

END OF SECTION 485413

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Plant Unit GT-5
	Project Number	123374
1.0	**General**	
	Number of OTSGs	One
	Gas Turbine Model	
	GTG Operating Range	Approximately 25% to 100%
	Start/Stop Cycles per Year (each OTSG)	See 481100 Combined Cycle Power Island
	OTSG Type	un-fired, single pressure
	Number of Modules Wide	One
	Installation Location	Outdoors
2.0	**Stack and Emissions**	
	Stack Flue Gas Exit Velocity	86-111 ft/sec
	Main Stack Height (minimum above grade)	125 ft
	Minimum / Maximum Exhaust Temperature	341-377˚F / 378-417˚F And approximately 700 F in dry operation
	Stack ID	10.17 ft
	Stack Damper Required	Yes
	Stack Corrosion Allowance – including breaching through to stack outlet	1/8” on bottom 10 feet, 1/32” on the rest of the stack or coated internally
	Large Bore Interface Location	Right side of OTSG (in the flue gas flow direction) to approx. xx ft elevation
	Maximum Allowable Sound Level at a Distance of 3 Feet From Safety Valve and Start-Up Vent Silencers	Refer to Section 480032
	Maximum Allowable Far Field Sound Level (if applicable)	Refer to Section 480032
	Normal Mode of Operation	Unfired
	SCR System Required	Yes
	CO Catalyst System Required	Yes
3.0	**Supplementary Firing**	
	Duct Burner Fuel	Not Applicable
	Duct Burner Fuel Supply Pres-sure	Not Applicable
	Maximum Heat Release	Not Applicable

4.0	**Misc.**	
	Purge Air System	Required (By GT exhaust)
	Dilution Air System	As needed for SCR requirements
	Electrical Enclosure Type	NEMA 4 for outdoor installation
5.0	**Utilities Supplied by General Manager**	
	19% Aqueous Ammonia	
	Three Phase AC Power	480 V/60 Hz
	Single Phase AC Power	120 V/60 Hz

APPENDIX B – GLENARM GT5 COMBINED CYCLE PERFORMANCE TEST DATASHEET Data to be furnished during project execution

	SINGLE PRESSURE OTSG PERFORMANCE TEST	**Test #**				**Date:**			
	Reading #:		**1**	**2**	**3**	**4**	**5**	**6**	**AVG**
	Time:								
	PARAMETER	**UNITS**							
1	SUPERHEATED STEAM FLOW	KLbs/Hr							
2	FEEDWATER FLOW	KLbs/Hr							
3	SPRAY FLOW	KLbs/Hr							
4	STEAM BYPASS TO CONDENSER	KLbs/Hr							
5	FEEDWATER PRESURE ENTR ECON.	PSIG							
6	STEAM PRESS BEFORE SPRAY	PSIG							
7	STEAM PRESS AFTER SPRAY	PSIG							
8	FW PUMP DISCHARGE PRESSURE	PSIG							
9	FW PRESSURE ENTERING ECONOMIZER	PSIG							
10	STEAM BYPASS PRESS TO CONDENSER	PSIG							
11	STEAM BYPASS TEMP TO CONDENSER	^{o}F							
12	SUPERHEATED STEAM TEMPERATURE	^{o}F							
13	STEAM TEMP. BEFORE SPRAY	^{o}F							
14	STEAM TEMP. AFTER SPRAY	^{o}F							
15	FW TEMPERATURE LEAVING CONDENSER	^{o}F							
16	FW TEMPERATURE ENTERING OTSG	^{o}F							
17	AMBIENT AIR DB TEMPERATURE	^{o}F							
18	AMBIENT AIR WB TEMPERATURE	^{o}F							
19	RELATIVE HUMIDITY	%							
20	GT EXHAUST TEMP ENTERING OTSG	^{o}F							
21	GT EXHAUST TEMP ENTR CO CATALYST	^{o}F							
22	GT EXHAUST TEMP ENTERING SCR	^{o}F							
23	GT EXHAUST TEMP LEAVING OTSG	^{o}F							
24	GT EXHAUST FLOW ENTERING OTSG	KPPH							
25	GT EXHAUST HEAT ENTERING OTSG	MMBtu/Hr							
26	GT EXHAUST GAS PRESS ENTERING OTSG	"H_2O							

SINGLE PRESSURE OTSG PERFORMANCE TEST		**Test #**				**Date:**			
	Reading #:		**1**	**2**	**3** **4**		**5**	**6**	**AVG**
	Time:								
27	EXH GAS PRESSURE.ENTR CO CATALYST	"H_2O							
28	EXH GAS PRESSURE.LEAVING OTSG	"H_2O							
29	BAROMETRIC PRESSURE	PSIA							
30	ECON INLET TUBES METAL TEMP	^oF							
31	ECON INLET TUBES METAL TEMP	^oF							
32	SH OUTLET TUBES METAL TEMP	^oF							
33	SH OUTLET TUBES METAL TEMP	^oF							
34	TOTAL HEAT ABSORPTION OTSG	MMBtu/Hr							

APPENDIX C – TECHNICAL DATASHEET BY CONTRACTOR Data to be furnished during project execution

Item	Description	Units	Data
1.0	**General**		
1.1	Manufacturer		
1.2	Steam Purity: Total dissolved solids in steam (max. expected value) based on feedwater quality	ppm	
2.0	**Superheaters**		
	Total Heating Surface	sq. ft.	
	Design Pressure	psia	
	Design Temperature	°F	
	Tube Material (ASME Designation)		
	Tube Outside Diameter	in.	
	Tube Wall	in.	
	Fin Material		
	Fin Height	in.	
	Fin Thickness	in.	
	Fin Density	fins/in.	
3.0	**Evaporators**		
	Total Heating Surface	sq. ft.	
	Pinch	°F	
	Design Pressure	psia	
	Design Temperature	°F	
	Tube Material (ASME Designation)		
	Tube Outside Diameter	in.	
	Tube Wall	in.	
	Fin Material		
	Fin Height	in.	
	Fin Thickness	in.	
	Fin Density	fins/in.	
4.0	**Economizers**		
	Total Heating Surface	sq. ft.	
	Design Pressure	psia	
	Design Temperature	°F	
	Approach	°F	
	Tube Material (ASME Designation)		
	Tube Outside Diameter	in.	
	Tube Wall	in.	
	Fin Material		
	Fin Height	in.	
	Fin Thickness	in.	
	Fin Density	fins/in.	
5.0	**Feedwater Heater**		**Not Applicable**
	Total Heating Surface	sq. ft.	Not Applicable
	Design Pressure	psia	Not Applicable
	Design Temperature	°F	Not Applicable
	Tube Material (ASME Designation)		Not Applicable
	Tube Outside Diameter	in.	Not Applicable

Item	Description	Units	Data
	Tube Wall	in.	Not Applicable
	Fin Material		Not Applicable
	Fin Height	in.	Not Applicable
	Fin Thickness	in.	Not Applicable
	Fin Density	fins/in.	Not Applicable
6.0	**OTSG Casing**		
	Design Pressure	in. w.c.	
	Inlet Duct Casing (through first heat transfer module) Thickness	in.	
	Balance of Casing Thickness	in.	
7.0	**OTSG Stack**		
	Material		
	Outside Diameter at Exit	ft.	
	Design Pressure	in. w.c.	
	Height	Ft.	
8.0	**Overall Dimensions**		
	Length	ft.	
	Width	ft.	
	Height	ft.	
9.0	**Weights**		
	Total Assembled Weight (Operating)	lb	
	Heaviest Component to be Handled During Erection		
	1) Component		
	2) Weight	lb	
	Shipping Method for Modules and Drums (rail or truck)		
10.0	**Component Source (Factory and Country)**		
	Modules		
	Casing		
	Piping		
	Stack		
11.0	**Construction**		
	No. of Modules		
	Largest Module Height/Width	ft.	
	Est. Erection Time	man hrs	Provide Appendix with detailed breakdown
	Estimated Length of Field Welds	ft.	Provide Appendix with detailed breakdown
12.0	**NOX SCR**		
	Manufacturer		
	Removal Efficiency	%	
	Overall Catalyst Depth	in.	
	Individual Catalyst Block Weight	lb	
	Individual Catalyst Block Dimensions (W x H x D)	in.	

Item	Description	Units	Data
13.0	**CO Catalyst**		
	Manufacturer		
	Removal Efficiency	%	
	Overall Catalyst Depth	in.	
	Individual Catalyst Block Weight	lb	
	Individual Catalyst Block Dimensions (W x H x D)	in.	
	Length of Downstream Space for Future Catalyst Addition	ft.	
14.0			
		scfm	
		hp	
15.0	**Tempering Air Fans**		
	Fan/Motor Manufacturer		
	Fan Size	scfm	
	Fan Motor Rating	hp	
	Fan Speed	**rpm**	
16.0	**Piping**		
	HP Steam Piping Material		
	HP Steam Pipe Wall Thickness	in.	
	HP Steam Outlet Pipe Diameter	in.	

OTSG PERFORMANCE GUARANTEE* Refer to Attachment 6 – Performance Guarantees			
Item	**Description**	**Units**	**Data**
1.0	**Main Steam**		
	Superheated Steam Flow	KPPH	
	Temperature	^{0}F	
	Superheated Steam Pressure after NRV	psia	
2.0	**General**		
	Exhaust Gas Back Pressure	in/wc	
	Stack Gas temperature	^{0}F	
	19% Aqueous ammonia consumption	lb/hr	
3.0	**GTG Exhaust Data**		
	Flow		
	Temperature		
	Composition		
4.0	**Raw Emissions (confirmed by Contractor)**		
	NOx (at 15% O2, 1 hr rolling average)	ppmvd	Refer to 480020 Site Conditions
	CO (at 15% O2, 1 hr rolling average)	ppmvd	Refer to 480020 Site Conditions
	VOC (at 15% O2, 1 hr rolling average)	ppmvd	Refer to 480020 Site Conditions
	SOx (at 15% O2, 1 hr rolling average)	ppm	Refer to 480020 Site Conditions
	PM10 (at 15% O2, 1 hr rolling average)	lb/hr	Refer to 480020 Site Conditions
	CO2 (at 15% O2, 1 hr rolling average)	lb/hr	Refer to 480020 Site Conditions
	NH3Slip (at 15% O2, 1 hr rolling average)	ppmvd	Refer to 480020 Site Conditions
5.0	**Steam Purity**		
	Total dissolved solids in steam, ppm (max. expected value) required by STG	ppm	(carryover – 0.001)

**Contractor to provide values at each gas turbine load condition (25%, 50%, 75%, and 100%)*

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485432

Surface Condenser

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485432
Surface Condenser

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *JOSHUA GUNDERSON*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	T. Clark	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
05/04/2012	T. Clark	E
09/11/2012	T. Clark	F
09/10/2013		G – CONTRACT VERSION

SECTION 485432
SURFACE CONDENSER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 ALTERNATIVES 4
1.9 SUBMITTALS 4
1.10 QUALITY ASSURANCE 4
1.11 DELIVERY, STORAGE, AND HANDLING 5
1.12 SITE CONDITIONS 5
1.13 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 MANUFACTURED UNIT 6
2.3 EQUIPMENT 7
2.4 ACCESSORIES 12
2.5 INSTRUMENTATION AND CONTROLS 14
2.6 FABRICATION 15
2.7 SOURCE QUALITY CONTROL 15

PART 3 - EXECUTION 16

3.1 SPARE PARTS 16
3.2 INSTALLATION 16
3.3 FIELD QUALITY CONTROL 17
3.4 COMMISSIONING 18

APPENDIX A – TECHNICAL DATASHEETS BY GENERAL MANAGER 19

APPENDIX B – TECHNICAL DATASHEETS BY CONTRACTOR 21

SECTION 485432
SURFACE CONDENSER

PART 1 - GENERAL

1.1 SUMMARY

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of a steam surface condenser and accessories. It is not the intent to specify completely herein all details of design and construction of the equipment and its related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Surface condenser (shop-tubed)
2. Water boxes with circulating supply and return water connections on one end
3. Deaerating hotwell
4. Hogging Air Extraction System with 2x100% liquid ring vacuum pumps.
5. Turbine exhaust duct and flange (Condenser neck)
6. Expansion joint between turbine exhaust flange and condenser neck
7. Miscellaneous piping, valves and fittings for attached accessories. Interconnecting piping and valving between condenser and auxiliaries is not included.
8. Condensate drain connections as specified herein
9. Four (4) Waterbox Gauge glasses and one (1) hotwell gauge glass, as specified herein
10. Bolts, nuts and gaskets required for field connecting equipment within Contractor's scope
11. Turbine internal drains flash vessel attached to the condenser
12. One (1) 24 inch diameter manway on the condenser connecting piece, and each waterbox compartment. Two (2) 24 inch diameter manways located in the hotwell
13. One main steam bypass connection with internal wear plates / baffles.
14. One (1) 4 inch DC Motor operated, water sealed vacuum breaker with integral starter
15. Motors for all motor-driven equipment furnished under this specification
16. Rupture Disks
17. Instrumentation as specified herein including four (4) waterbox temperature indicators and two (2) hotwell temperature indicators with thermowells
18. One set of tube installation/removal tool kits (less driver)
19. Spargers for all steam bypass lines

20. Final thermal kit including all required correction curves to verify performance at off-design conditions
21. Drawings, data, Instruction Books, and other information as indicated in the attached "Vendor Data Requirements"
22. Start-up spares consisting of one set of waterbox gaskets and one set of manway gaskets
23. Four (4) automatic air release valves for the condenser waterboxes
24. Special services including on site field support and start-up support as specified herein.
25. Shipment to the Glenarm Plant or a location to be identified by the General Manager either in the city of Pasadena, CA or other nearby city.

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Unloading, storage, and erection of equipment at jobsite
2. Foundations, anchor bolts, and standard concrete embedments
3. Grout
4. Pipe insulation and lagging
5. Finish painting
6. Condensate piping, expansion joints and valves
7. Circulating water piping, expansion joints and valves
8. Piping and automatic on/off valves for condenser curtain spray nozzles
9. Plant control system
10. Instrumentation as specified herein
11. AC motor starters
12. Field wiring
13. Field hydrostatic and performance testing

1.4 RELATED SECTIONS

A. Section 260000, Electrical Mechanical Equipment

B. Section 262050, Low Voltage Motors

C. Section 480020, Site Conditions

D. Section 481100, Combined Cycle Power Island

E. Section 485221, Steam Turbine Generator

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American Society of Mechanical Engineers (ASME)
   a. ASME PTC-12.2 – Steam Condensing Apparatus

b. ASME PTC-24 – Ejectors

2. Heat Exchanger Institute (HEI)
   a. HEI 4A – Performance Standards for Liquid Ring Vacuum Pumps
   b. HEI 2629 – Standards for Steam Surface Condensers

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Reference Section 481100 Combined Cycle Power Island for general design requirements and expected operating profile.

B. Performance Requirements

1. The performance requirements for the steam surface condenser are specified in Section 481100, Combined Cycle Power Island.
2. The steam surface condenser shall be designed with the water chemistry and temperature ranges specified in Section 480020 Site Conditions.
3. The following design performance parameters shall also be met by the surface condenser:

   a. The steam surface condenser and accessories shall be designed for stable operation from zero to maximum heat load and at 100% turbine bypass operation.
   b. The Air Extraction System shall be capable of drawing condenser vacuum necessary to support sustained steam bypass operation within 20 minutes.
   c. The minimum temperature of the condensate leaving the hotwell shall be the saturation temperature corresponding to the shell pressure (no subcooling).

C. Predicted Performance

1. The Contractor shall submit the predicted performance information for the operating cases shown in Section 481100, Combined Cycle Power Island. Additionally, the Contractor shall provide correction curves, or software at General Manager's discretion,

that will permit the General Manager to establish condenser performance when varying either concurrently or individually, the following parameters:

a. Circulating water flow rate
b. Circulating water supply temperature
c. Heat load
d. Demineralized make-up water flow rate

2. The correction curves shall indicate the condenser absolute pressures in inches of mercury on the Y-axis and the condenser duty (MMBTU/hr) from zero to maximum heat load on the X-axis.
3. Performance curves for inlet circulating water temperatures of 60, 70, 80, 90, and 100°F and with flow quantities of 100, 90, 80, and 70% of design flow shall be submitted.
4. A vacuum correction curve or curves shall also be furnished for use with the above performance curves indicating the applicable vacuum correction for tube cleanliness factors varying from 70 to 100%.
5. All curves shall be drawn to a scale adequate to permit readings to an accuracy of plus or minus 0.01 inch of mercury (absolute). The curves submitted will be used in the analysis of field tests to determine if the condenser has met the guaranteed performance.
6. Curves of exhaust steam enthalpy entering the condenser characteristic curves vs. exhaust steam flow at the different vacuum in the condenser (1.5", 2", 2.5" and 3"Hg).

D. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 ALTERNATIVES

A. The Contractor may provide Alternate Bid(s). Any Alternate Bids proposed by the Contractor shall provide equal or better performance at reduced capital cost. The Contractor shall clearly state the technical differences between the Base Bid and any Alternate Bids. Alternate Bids shall be supported with complete technical, performance, and cost data.

B. The Contractor may request alternative materials, equipment, or configurations for consideration provided compliance to requirements of applicable codes is not compromised.

1.9 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

1.10 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping

1. The System shall be packaged for shipment to allow for outdoor storage as prescribed by Contractor for a period of six months without damage from dust, sun, wind, or rain. Preparation for shipment shall require:

a. Equipment to be completely free of water prior to packaging for delivery.
b. Flanges and threaded connections to be coated with rust preventatives and blanked-off or plugged. Blanking flanges shall utilize at least four bolts. Open ends of pipe shall be caps or plugged.
c. Unpainted surfaces to be protected from weather with weather tight and weatherproof covers. Machined surfaces shall be coated with a heavy grease or similar material before covering.
d. Lifting and support points shall be clearly identified.
e. Packages shall be identified with items and serial numbers, purchase order number, and item descriptions. Identifying tags shall be corrosion and weather resistant.
f. Temporary bracing and covers shall be painted yellow.

B. Storage and Protection

1. The steam surface condenser and accessories shall be packaged for shipment to allow storage as prescribed by Contractor for a period of six months without damage from sun, wind, rain, or snow.

1.12 SITE CONDITIONS

A. Refer to Section 480020 Site Conditions.

1.13 WARRANTY

A. Refer to Article 13 in the Contract.

B. Performance Guarantees

1. Contractor shall provide guarantees for thermal performance, tube side pressure drop, acoustical emissions, and oxygen content in accordance with the contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100 Combined Cycle Power Island for general material and welding requirements.

2.2 MANUFACTURED UNIT

A. Structural Requirements

a. Refer to Section 481100 Combined Cycle Power Island for general structural requirements.

2. Materials: All materials shall be new. Structural steel members shall be hot-dipped galvanized, in accordance with ASTM A-123.

a. Structural Steel: ASTM A36 or ASTM A572 Gr. 50
b. Ladder(s): ASTM A36
c. High Strength Steel: ASTM A572, Gr. 50
d. Structural Tubing: ASTM A500 Gr. B
e. High Strength Bolts ASTM A325, Type 1
f. High Strength Nuts/Washers: ASTM A563 Gr. DH/ASTM F436
g. Common Bolts: ASTM A307 Gr. B
h. Pipe Handrail: 1 1/2 in. Schedule 40, ASTM A53 Type E or Type S, Gr. B or ASTM A500 Gr B
i. Safety Chain, 1/4 in. diameter with 1 1/4 in. links: ASTM A413, Class PC.
j. Steel Floor Grating and Stair Treads: ASTM A569
k. Checkered Floor Plate ASTM A786, Pattern No. 4
l. Miscellaneous Structural Steel: Structural steel shall be hot-dipped galvanized

3. High Strength Bolting:

a. Obtain and submit certifications that bolts, nuts, and washers comply with all of appropriate requirements of applicable specifications. Provide complete manufacturer's test reports to document that chemical and mechanical requirements of applicable specifications have been achieved. For acceptance of fasteners, lot numbers must appear on product containers and correspond to lot identification numbers on test reports. Verify manufacturer's symbol and grade markings appear on all bolts and nuts.
b. Complete and submit representative sample tests for bolt tightening per AISC Specification for Structural Joints for approval prior to installing any bolts.
c. High-strength bolting inspections, tests, test and inspection acceptance standards, and remedial procedures for slip-critical type connections: AISC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," except as specified herein.
d. Randomly inspect 10% of all high strength bolted slip-critical type connections for each bolt size as follows:

1) Inspect bolts tightened using the turn of the nut method: Specification 9(b) of AISC Specification for Structural Joints.
2) Bolts tightened using direct tension indicator washers: Feeler gauge to acceptance requirements in ASTM F959.

e. Method of sampling for high-strength bolts: "Production Lot Method", ASTM A 325.

2.3 EQUIPMENT

A. Steam Surface Condenser

1. General

a. The steam surface condenser shall be a double pass design with waterboxes at each end, circulating water connections on one end.
b. The condenser shall be provided with internal non-condensable gas removal sections, a hotwell and all necessary accessories.
c. The condenser shall be equipped with distribution headers located in the condenser neck for 100% steam turbine bypass operation with the gas turbine at full load.
d. The condenser shall be fabricated of all new material. Asbestos material shall not be used for any component. No copper or copper alloys shall be used where there may be contact with the condenser air or condensate.
e. The condenser shall be designed in accordance with HEI standards using the allowable stresses from the ASME Section VIII Code. The shell side and tube side are not required to be code stamped. The condenser shall be fabricated in an ASME Section VIII Code shop. All welding shall be per ASME Section IX.

2. Condenser Shell

a. The shell shall be of all welded carbon steel construction properly fabricated for strength and shall remain airtight at full vacuum. Bolting shall be permitted only at access manholes. The shell shall be shop-assembled to the maximum extent possible with the tubesheets, support plates, thermal sleeves, tubes and impingement protection (dummy tubes, baffles, etc.) in place before shipment. Drawings illustrating the condenser "as-shipped" and fully erected shall be provided with the proposal.
b. The condenser shell wall thickness shall be in accordance with recommendations of the Heat Exchange Institute (HEI) as modified herein. A corrosion allowance of 1/8 inch shall be used on all shell carbon steel pressure parts. The shell shall be properly reinforced to withstand design conditions. Bracing for flat surfaces shall be adequate to prevent excessive deflections.
c. The shell side shall be designed for full vacuum and 15 psig with a design temperature of 250°F.
d. All interior baffles, brackets, and support plates shall be designed so that they will not trap sand or dirt. Convenient access shall be provided to permit easy cleaning of all horizontal surfaces prior to placing the equipment in operation.
e. Suitable means shall be incorporated in the design to provide for the difference in expansion between shell and tubes to avoid undue stress upon the tube to tube sheet joints. A detailed description of expansion provisions and complete information on any special requirements for tube installation shall be submitted with the proposal.

3. Waterboxes

a. The waterboxes shall be fabricated of carbon steel and factory lined.
b. The waterboxes shall be designed for 75 psig maximum allowable working pressure and hydrostatically tested in accordance with HEI Standards. The design temperature shall be 150°F.

c. Waterboxes shall be of good hydraulic design and properly sized to provide low water velocities and optimum entrance conditions to the condenser tubes. The depth of the waterboxes from the tubesheet shall be at least equal to the circulating water pipe diameter at the waterbox inlet unless otherwise approved by General Manager.

d. The inlet and outlet waterboxes connecting to the circulating water piping system shall be bolted to the condenser shell to permit removal and oriented in such a way that it suits the interconnection with the existing CW piping. The thickness of the waterboxes shall be adequate to withstand the specified design pressure, plus a corrosion allowance of 1/8 inch. External waterbox reinforcement shall only be permitted upon review and written approval by the General Manager. External reinforcement, if required and allowed, shall be designed so as not to accumulate water or dirt. Internal stay bolts or ribs shall not be used. Grab bars, ladder brackets, and other internal projecting provisions shall be designed to result in minimum interference with smooth flow.

e. A corrosion allowance of 1/8 inch shall be provided on all carbon steel plates and nozzles.

f. Waterbox instrumentation connections shall be made of stainless steel to avoid the need for coating.

g. Sacrificial zinc or magnesium anodes shall be furnished in the waterboxes for corrosion protection.

h. Each waterbox compartment shall be provided with one 24 inch diameter, quick opening, hinged-type manways as manufactured by Tube Turns, or General Manager-approved equal. Manways shall be on the end of the waterboxes and in line with the tubes so that a tube can be pulled for inspection. Final manway locations shall be approved by the General Manager.

i. The waterboxes shall be provided with permanent lugs for lifting and handling and threaded holes and jackscrews for breaking gasketed joints. All bolts and gaskets shall be furnished. Each waterbox shall be shop leak tested.

j. Waterbox flanges shall be ASME Class 150 forged steel flanges.

k. The design of the waterboxes shall include, but not necessarily be limited to, the following connections:

Inlet / Outlet Box	Two circulating water
	One vent
	One drain
	Two gauge glass
	Two thermowells
	One pressure
Return Box	
	One vent
	One drain
	Two gauge glass
	Two thermowells
	One pressure

l. Vents and drains shall be provided on each compartment of each waterbox to permit complete draining within 15 minutes. An automatic vent valve shall be provided to vent air from each waterbox, in addition to manual vent(s).

4. Tube Support Plates

a. The spacing of the tube support plates shall be determined based on the HEI standard to minimize vibration during operation.
b. The tube support plates shall be carbon steel and shall not be less than 3/4 inch thick. The supports shall be of sufficient number with proper spacing to provide adequate support for the tubes and to prevent deleterious vibration.
c. Holes for the tubes shall be drilled and finished with suitably rounded edges on both sides of the plates to prevent damaging tubes during installation and operation.

5. Tubes

a. All tubes shall be furnished and shop installed in the condenser. Tubes shall be rolled at both ends and flushed on the inlet ends. All condenser tubes shall be arranged for self-drainage.
b. Contractor shall provide a single row of solid carbon steel rods to protect the tube bundle in the turbine bypass impingement zones.
c. The tube side shall be designed for 75 psig with a design temperature of 150°F.
d. Condenser tube OD, minimum thickness and material are specified in the attached data sheets. The tolerances for tube outside diameter, wall thickness and length variation shall be in accordance with the tube material ASTM specified in attached data sheets.
e. After final annealing, each tube shall be leak tested by immersing in water while containing air at 150 psig. If any tube shows leaks during the pressure test, it shall be rejected. Each tube shall be subjected to a full circumferential nondestructive electric test, which will indicate defects in the tube wall and inside and outside tube surfaces. Unacceptable defects shall include dents, seams, pinholes, or unsound metal and shall be cause for rejection. The results of this test shall be provided to the General Manager along with any other required documentation.

6. Tubesheets

a. Tubesheets shall be designed to HEI specifications. Tubesheet material is specified in "Technical Datasheets by General Manager" (see attached). For applications where titanium cladding is specified, the minimum thickness of the cladding shall be 3/16 inch.
b. Tubesheets shall be properly braced to give ample strength to withstand the pressure specified for the waterboxes, plus vacuum load, plus thermal stress. Tubesheet holes shall be rounded and have all burrs removed.
c. Tubesheets shall be attached to the condenser shell independently of the waterboxes to permit removal of the waterboxes without disturbing the tubesheets.
d. Tubesheets shall be the thickness recommended by HEI.
e. The maximum tubesheet bending stress under the higher of either the hydrotest or the maximum transient pressure condition shall be lower than limits defined within HEI.

f. Tubesheets and tube support plates shall be designed to permit the tubes to be installed straight and sloped downward a minimum of 1/16 inch per support plate. Tubesheets shall be designed for rolling of the tubes at both ends. Before tube rolling, tubesheets shall be plane and vertical within 1/16 inch at all points. The edges of the tube holes in the tube support plates shall be deburred to a minimum of 1/64 inch radius to facilitate tube insertion and to prevent scratching tubes during installation.

g. Layouts of the tubesheets and steam lanes shall be submitted to the General Manager for information only to show the adequacy and method of steam distribution in the condenser and the sizes and tolerances of tube holes. The basic shell area between the top and bottom tube rows shall have a tube occupied area of no greater than 35%.

h. The velocity distribution across the tubesheet shall be uniform such that the velocity of the circulating water shall not deviate more than 10% at any tube when compared to the average water velocity as a whole.

7. Hotwell

a. Condensate shall be collected in a hotwell attached to the condenser shell. The hotwell shall be of the same material as the shell. The hotwell bottom shall be provided with a condensate pump suction well to permit direct horizontal piping to the condensate pumps. Condensate pump suction connections shall be provided. The condensate pump suction connections shall be sized so that the pipe velocity does not exceed 1.5 fps at the maximum condensate flow rate with two pumps in operation. The condensate nozzles shall be provided with anti-vortex baffling.

b. Two (2) 24-inch diameter, quick opening hinged type manways shall be provided at suitable locations for condenser and hotwell maintenance and inspection access.

c. The hotwell shall be designed for complete drainage. At least one 3-inch diameter drain connection shall be provided.

d. Baffles shall be provided at the level transmitter connections to minimize water level disturbances.

8. Turbine Exhaust Duct (Condenser Neck)

a. The exhaust duct or condenser neck shall be fabricated from the same material as the condenser shell. The duct shall be designed to ensure even distribution of steam over the entire length of the condenser tubes. The exhaust connection shall be bolted.

b. The Contractor shall streamline struts, piping, and condenser internals to eliminate obstructions and protrusions and to eliminate additional pressure losses imposed on the steam turbine. Suitable means shall be provided to prevent condensate from collecting in the exhaust duct.

c. Internal bracing and miscellaneous structural members shall be designed to permit entrance and access from the condenser shell manways.

d. In steam turbine configurations where the turbine bearing is accessed through the exhaust duct, sufficient working space clearance and welded lifting lugs for bearing removal tools and rigging shall be provided.

9. Piping and Connections

a. All connections shall be flanged or welded as required by the General Manager. Welded connections larger than 2 inches shall have ends weld prepped for butt-welding. Connections 2 inches and smaller shall generally be of the 6,000 lb. socket welded type. Connections smaller than 1 inch shall not be allowed except for instrument connections.
b. Connections shall be provided on the condenser for make-up water, drains, one main steam bypass dump, two (2) condensate pump suction lines, two (2) condensate pump suction can vents, air extraction, instrumentation and any other connections as may be specified or required by the General Manager. The size and location of all nozzles on the condenser shall be arranged to best meet the requirements of the piping layout, and shall be subject to the approval of the General Manager.
c. Contractor shall include provisions to prevent erosion of tubes or shell interior for all connections introducing steam, condensate, and water. Thermal sleeves shall be provided as required.
d. One (1) 3 inch diameter flanged drain connection shall be installed on the bottom of the hotwell.
e. Two (2) 4 inch diameter Schedule 40 butt weld connections and six (6) 2 inch diameter 6,000 lb. socket weld connections with pipe extension and welded cap shall be provided as spares on the shell.
f. The turbine bypass connections shall be located in the condenser neck.
g. The condenser non-condensable gas off-takes shall be internally piped with standard weight 304L grade stainless steel pipe brought to the condenser shell exterior. The off-takes for each tube bundle shall be routed separately to the shell exterior.

10. Bolting

a. External condenser bolting shall be carbon steel. All internal bolting except tube support plate tie rods and spacers shall be Monel.

11. Valves (all accessories)

a. Valves shall be either cast or forged steel. No cast or ductile iron valves are allowed.

12. Baffles

a. All shell connections not requiring perforated distribution pipes shall be fitted with heavy stainless steel baffles, not less than ½ inch thick, within the condenser.
b. Baffles shall be designed to direct the discharge flow away from the condenser wall to prevent localized heating and/or erosion of the wall. The discharge flow shall be directed to minimize impingement upon the hot well water surface or any structural or functional component of the condenser. Baffles shall be designed to withstand the reaction forces resulting from the sudden introduction of the design fluid at maximum conditions.
c. The discharge area of the baffles shall not be less than 1.5 times the internal cross-sectional area of the pipe connections to be baffled.
d. All baffles shall be continuously strength welded to the condenser shell. Full penetration welds shall be used and, where possible, a seal weld shall be included on the impingement sides of the baffle-to-wall connection for weld protection.

Axial and shear forces as well as bending moments due to the impingement force and thermal behavior shall be adequately considered.

13. Piping Sleeves

    a. Piping sleeves, of the number and size required, shall be provided on the condenser shell to allow for penetration of piping where required.

14. Condenser Leak Detection

    a. Provisions shall be made to enable tube leaks to be detected, located and repaired with the unit remaining on load and with minimum disruption to the generated output. A description of the means of isolating a condensing zone for the purpose of carrying out this procedure shall be provided. The Contractor shall also define the loss of generated output during this procedure. A full description of the proposed instrumentation and equipment and the technique for detecting leaks shall be included.
    b. The shell of the condenser shall be provided with tubesheet leak detection troughs. Each trough shall be located directly below the tubesheet area associated with each waterbox. Water collected in each trough shall be routed to a conductivity cell located outside the shell (by Contractor), then returned to the condenser hot well below the operating water level.

15. Coating Systems

    a. The interior wetted surfaces of the surface condenser waterboxes and piping shall be coated with an epoxy-based system for corrosion and erosion protection. The coating system shall be Amercoat 78HB as manufactured by Ameron or General Manager approved equal. The coating system shall not have any solvents at any time in the coating process and shall have a total dry film thickness of 20 to 25 mils. Contractor shall indicate clearly on the exterior of internally coated components “Do Not Weld”.
    b. The waterbox coating shall be shop applied and tested in strict accordance with the manufacturer's recommendations. Additional dry film thickness measurements shall be taken throughout the waterbox to ensure minimum coating thickness. Any damage to the coating during shipment or installation shall be repaired and retested in accordance with the manufacturer's recommendations until no holidays or discontinuities are detected, at the Contractor’s expense. The coating shall cover the face of all flanged connections on the waterbox (not the flange itself).
    c. All metallic surfaces shall be cleaned, prepared, and protected by shop-applied coatings. Internal areas which will be exposed to steam or treated feedwater shall be shot blasted using metal shot only and coated with a water soluble preservative. Shop coatings as specified shall be applied to the exterior surfaces of the waterboxes, piping, condenser shell, exhaust trunks, and domes.

2.4 ACCESSORIES

A. Air Extraction System

1. Type and Arrangement

a. The condenser shall be supplied with a dual 100% liquid ring vacuum pumps with electric motor drivers for air extraction during start up and operation. The system shall be chosen by the Contractor to provide the lowest lifetime cost while meeting the air extraction requirements of the condenser and related equipment.

2. Design

a. The LRVP equipment shall be designed in accordance with HEI Performance Standards for Liquid Ring Vacuum Pumps.

B. Instrumentation

1. The Contractor shall supply the following instrumentation:

a. Waterbox gauge glass level indicators (one for each inlet/outlet waterbox and one for each return waterbox).
b. One hotwell gauge glass level indicator per shell (more than one gauge glass can be provided to cover the vertical height). A Jergeson, Mag Tech or Pemberthy type Mag level gauge glass shall be provided.
c. Waterbox temperature indicators (one for each inlet compartment and one for each outlet compartment).
d. Two hotwell temperature indicators per shell.

2. Connections shall be provided for the following instruments (instruments and isolation valves provided by others):

a. Two full-range level transmitters for hotwell level indication and hotwell make-up system operation; connections to be located on opposite ends.
b. One level switch for hotwell high-high level trip.
c. One level switch for hotwell low-low level trip.
d. One hotwell thermocouple.
e. Waterbox pressure indicators (one for each inlet compartment and one for each outlet compartment).
f. Waterbox sample connections.
g. Four shell pressure transmitters per shell.

C. Vacuum Breaker

1. The Contractor shall supply one minimum 6 inch diameter DC Motor operated vacuum breaker with actuator. The MOV will be operated from General Manager's control system and shall have a means for manually operating. The opening time for the valve shall be less than 5 seconds.

D. Atmospheric Relief

1. Contractor shall provide rupture disc(s) designed for full venting of the steam flows while not exceeding a shell pressure of 10 psig.

2.5 INSTRUMENTATION AND CONTROLS

A. General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a plant-wide control system (PCS). All control devices furnished by the Contractor shall be capable of interfacing with the PCS and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the PCS to remotely start and stop all rotating equipment and to allow automatic switch over to any backup units.
2. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
3. The Contractor shall permanently install a 1-1/4 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified “Instrument Tag Number” to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
4. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required for flame scanners, ignition transformers, etc. shall be provided by the Contractor for installation by the BOP Contractor.
5. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
6. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.
7. The plant control system is to be designed to provide automation to minimize operator actions during normal plant start-up, shutdown, and at-power operations. Once gas turbine and steam turbine have been placed in their ready-to-start conditions, balance of plant systems have been filled and vented, and equipment has been placed in automatic mode, normal plant operations can proceed with few operator actions. The operator is required to start each turbine with a single command to bring it to a desired load level. At that point the gas turbine can be put in plant master mode. The operator can then enter a single plant load setpoint to which total plant output is controlled.
8. Plant systems and equipment are to be monitored and/or controlled through the PCS. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant PCS.
9. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
10. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.

B. Instrumentation & Control Devices – Requirements

1. 3-wire, 100-ohm platinum RTDs shall be used.

2. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
3. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters.
4. Control valves and pressure regulators shall be manufactured by Fisher or equivalent approved manufacturer.

C. Instrument and Control Wiring By Others

1. Wire markers shall be attached on both ends of Contractor-furnished wiring.
2. The Contractor shall furnish and install all wiring from instruments and devices on the steam turbine, generator and accessories to junction boxes, panel boards or control panels to the greatest extent possible. All wiring shall be insulated for the service conditions and temperature (75 C minimum).
3. All wiring shall be separated according to class and instrument channel. All cable connections shall be made to local terminal blocks.
4. All terminal blocks shall have non-metallic terminal marking strips marked with the wire numbers. Contractor's wire numbers shall be used for circuits that interface with General Manager-supplied equipment. Terminal blocks shall be mounted at least 12 inches above the floor.
5. Stranded conductors connecting to screw terminals shall be terminated with full-ring tongue compression type connectors that firmly grip the conductor and have insulated compression sleeves to grip the wire insulation. All wiring terminating on terminal blocks shall be identified with durable and permanent wire markers.
6. Wiring around the turbine requiring frequent disconnection during maintenance and minor repairs shall be provided with locking type quick-disconnect connectors.
7. All thermocouples shall be terminated on thermocouple termination blocks

D. Conduit

1. Conduit shall be either rigid or IMC. All conduits shall be installed in accordance with NEC.

2.6 FABRICATION

A. Refer to Section 481100 Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.7 SOURCE QUALITY CONTROL

A. Refer to Section 481100 Combined Cycle Power Island for general source quality control, test, and inspection requirements.

B. Tests and Inspections
1. As a minimum, the following tests shall be performed (Hydrotest shall be per HEI; condenser tube-side and shell-side shall be hydrotested in the shop.):

a. Factory Hydro Tests

1) Water jackets, coils, coolers, and shop installed piping shall be hydro tested at 1-1/2 times the design pressure.
2) Pressure retaining components shall be subject to the hydrotest requirements of ASME B&PV Code, Section 1, Section VIII, or ASME B31.1, Power Piping Code, as applicable.
3) Parts shall not be primed or painted until hydro testing is successfully completed.

b. Factory Accessory Testing

1) The accessory equipment shall be functionally tested in the factory. Contractor and General Manager shall mutually agree on what will be tested.

2. Control Board and Software Testing

a. Electrical shop tests shall be made on all control boards. These tests shall include high potential tests on power equipment and operating tests to demonstrate that the equipment functions correctly. Electrical tests shall be made in accordance with ANSI C37-20.
b. Control wiring tests shall include those that are necessary to determine that all instruments, meters, relays, instrument transformers, etc. are correctly wired and function in the specified manner when energized. Each circuit shall be continuity tested. Insulation resistance tests shall be conducted on each circuit (except in circuits containing electronic components); the insulation resistance shall be no less than 25 megohms.
c. A Factory Acceptance Test (FAT) shall be performed on the complete software system prior to shipment. Simulated (software) inputs are acceptable during the FAT.
d. Control wiring tests shall include those that are necessary to determine that all instruments, meters, relays, instrument transformers, etc. are correctly wired and function in the specified manner when energized. Each circuit shall be continuity tested. Insulation resistance tests shall be conducted on each circuit (except in circuits containing electronic components); the insulation resistance shall be no less than 25 megohms.
e. A Factory Acceptance Test (FAT) shall be performed (by General Manager selected system integrator) on the complete software system prior to shipment. Simulated (software) inputs are acceptable during the FAT.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100 Combined Cycle Power Island for required spare parts.

3.2 INSTALLATION

A. Painting

1. Structural and Miscellaneous Carbon Steel

    a. The following requirements shall apply for all exposed structural and miscellaneous carbon steel shapes, plates, stiffening or support elements extending through insulation that are not hot-dipped galvanized.
    b. Surfaces shall only be primed. General Manager will apply the finish paint. Surfaces to be primed shall be blast cleaned in accordance with SSPC-SP6, "Commercial Blast Cleaning."
    c. One of the following painting systems, or General Manager approved equivalent, shall be used:

        1) Ameron Dimecote 9HS
        2) Carboline Carbo Zinc 11HS
        3) Tnemec Co., Inc 90E-92 Treme-Zinc

3.3 FIELD QUALITY CONTROL

A. Tests

1. Refer to Section 481100 Combined Cycle Power Island for general field quality control, test, and inspection requirements.
2. The surface condenser shall be hydrostatically field tested by the General Manager after final assembly.

B. Performance Tests

1. A site performance test shall be carried out to establish the performance of the complete unit against specific performance guarantees.
2. The performance test will be carried out to the manufacturer's standards in general accordance with the following internationally recognized standards:
    a. ASME PTC 12.2 - Performance Test Code on Steam Surface Condensers
3. The test will utilize both station instrumentation and any other specialist instrumentation provided for the test.
4. Correction to Guarantee Basis Conditions

    a. The Contractor shall supply to the General Manager, all correction curves and formulae for the equipment performance parameters which may be required to correct the as-run test values to the specified guarantee values.
    b. The tests results recorded during the performance test shall be corrected, as applicable, to those which would have been achieved had the test been carried out at the guarantee basis conditions by using the correction curves and/or formulae.

5. The correction curves and formulae shall be provided in the performance test procedure. A full set of final Correction Curves shall be provided by the Contractor at least 60 days prior to the start of performance testing.

3.4 COMMISSIONING

A. General

1. The Contractor shall provide onsite commissioning and testing support of the equipment.
2. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning.
3. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon completion.
4. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

B. Commissioning Scope

1. The base scope of the installation and commissioning plan shall provide:

a. Advance knowledge of project schedules, completion dates, and key event dates.
b. General definition of manpower and material resources required.
c. A means of verifying that all critical calibrations, both mechanical and electrical, have been checked.
d. In addition to the documentation that makes up the base scope the Contractor shall include the services of an Installation and Commissioning Manager to monitor and continuously update the plan during the installation and commissioning period.

END OF SECTION 485432

APPENDIX A – TECHNICAL DATASHEETS BY GENERAL MANAGER
**Determined by Power Island final design*

The detailed technical data will be furnished by the equipment vendor during contract execution. The design will be to manufacturer's standards and will support the power island guarantees and will meet the design life requirements.

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Plant Unit GT-5
	Project Number	123374
1.0	**General Installation**	
	Number of Condensers	1
	Type	Steam Surface Condenser; Horizontal Shell & Tube
	Installation Location (Indoors/Outdoors)	Indoors
	Steam Turbine Model	*
	Steam Turbine Exhaust Orientation	Axial
	Number of Water Passes	One
	Divided Waterbox (Y/N)	No
	Condensate Pump Connections	*
	Site Design Requirements	See Section 480020 - Site Conditions
	Site Location	See Section 480020 - Site Conditions
	Design Ambient Dry Bulb temperature range (Outdoor/ Indoor)	See Section 480020 - Site Conditions
	Minimum Design Metal Temperature :	See Section 480020 - Site Conditions
	Nominal site elevation (above mean sea level):	See Section 480020 - Site Conditions
	Governing Building Code (UBC, SBC, ASCE, BOCA, etc.)	See Section 480020 - Site Conditions
	Seismic Design Factors:	See Section 480020 - Site Conditions
	Soil Class:	See Section 480020 - Site Conditions
	Wind Design Criteria (wind speed, expo-sure, etc):	See Section 480020 - Site Conditions
	Condenser Design Requirements	
	Shell Side Design Pressure/Temperature	*
	Tube Side Design Pressure/Temperature	*
	Design Circulating Water Temperatures	See Section 480020 - Site Conditions
	Minimum / Maximum Allowable Tube Velocity	4 fps / 8 fps
	Maximum Allowable Tubeside Press. Drop	14-16 ft WC
	Percent Cleanliness, Design	85%
	Max Oxygen in Condensate	*

	Shell Material	Carbon steel
	Waterbox Material	Carbon steel (epoxy lined)
	Tube Material	304L Stainless Steel or Titanium
	Tube O.D.	*
	Minimum Tube Thickness	22 BWG
	Tubesheet Material	Carbon steel (clad with Stainless Steel or Titanium)
	Shell and Water Box Corrosion Allowance	1/8 inch
	Minimum distance from Lowest tube to HHWL - inches	18
	Minimum distance from HHWL and NWL – inches	6
	Minimum Hotwell Storage – NWL to LLWL trip (minutes)	3
	Liquid Ring Vacuum Pump	
	Time to draw vacuum	20 min (for full steam bypass operation)
	Materials of Construction	
	Casing	316SS
	Impeller	316SS
	Shaft	316SS
	Shaft Sleeves	316SS
	Mechanical Seals	Contractor to provide

APPENDIX B – TECHNICAL DATASHEETS BY CONTRACTOR Data to be furnished during project execution

Contractor furnished data and information is included in this specification to describe the general design, interface characteristics and construction features of Contractor furnished equipment. The accuracy of such information and the compatibility of such information with overall performance requirements specified by the General Manager are the sole responsibility of Contractor.

Item	Description	Units	Technical Data (Contractor to fill in)
1.0	**Manufacturer/Model/Type**		
2.0	**Main Condenser Design and Performance Data (each condenser)**		
2.1	Design Heat Rejection	MMBTU /hr	
2.2	Design Circulating Water Flow Rate	gpm	
2.3	Design Temperature Rise	˚F	
2.4	Tube Side Pressure Drop (at Design Circ. Water Flow Rate)	psi	
2.5	Tube Side Design Temperature	˚F	
	Tube Side Design Pressure	psi	
2.6	Tube Velocity (at Design Circ. Water Flow Rate)	fps	
2.7	Number of Water Passes		
2.8	Number of Tubes per pass / Total		
	Tube Material		
2.9	Tube OD	in.	
2.10	Tube Wall, BWG		
2.11	Tube Length (Total / Effective)	ft.	
2.12	Overall Condenser Length	ft.	
2.13	Shell Dimensions	ft.	
2.14	Required Surface Area (Calculated, Clean)	sq. ft.	
2.15	Surface Area Provided (85% Clean)	sq. ft.	
	Water Box Design Pressure	psi	
	Water Box Design Temperature	˚F	
2.16	Water Box Inlet Nozzles	in.	
2.17	Water Box Outlet Nozzles	in.	
2.18	Condenser Total Assembled Weight (Dry)	lb	
2.19	Condenser Total Operating Weight	lb	
2.20	Condenser Total Operating Weight (Flooded)		
2.21	Envelope Dimensions – H X L X W	in.	
	Distance Between Tube Support Plates	in.	
	Hotwell Capacity @ MWL / Max. WL	gal.	
	Distance from Bottom of Hotwell to:		
	-Normal Water Level	in.	
	-Bottom of Tubes	in.	
	Thickness/CA - Shell	in.	
	-Hotwell	in.	

Item	Description	Units	Technical Data (Contractor to fill in)
	-Tubesheet	in.	
	-Tube Support Plates	in.	
	-Waterbox	in.	
	-Waterbox Lining	in.	
	Material -Shell		
	-Hotwell		
	-Tubesheet		
	-Tube Support Plates		
	-Waterbox		
	-Waterbox Lining		
	Connections – Size/ Type / Rating:		
	-Cooling Water Inlet/Outlet		
	-Hot Water Inlet/Outlet		
3.0	**Shipping Weights**		
3.1	Shell	lb	
3.2	Hotwell	lb	
3.3	Other Package	lb	
4.0	**Erection Information**		
4.1	Number of tube bundle modules		
4.2	Estimated field welding	ft.	
4.3	Clearance required for tube removal	Lbs.	
4.4	Clearance required for Shell removal		
	-Flooded		
	CONDENSER PERFORMANCE – When Operating at Design Conditions:		
	Turbine Exhaust - Flow	gpm	
	- Entalpy	Btu/lb	
	Circulating Water-Inlet Temperature	˚F	
	- Outlet Temperature	˚F	
	Tube Velocity @ Design Flow	ft/sec	
	Condensate Temperature	˚F	
	Absolute Pressure @ Turbine Flange	In. HgA	
	Cleanliness Factor		
	Design Heat Rejection	MMBtu/ lb	
	Oxygen in Condensate	ppb	
	Pressure Drop Through Tubes and Water-boxes	ft. H_2O	
5.0	**Non-Condensable Gas Removal Design and Performance Data**	**N/A**	
6.0	**Liquid Ring Vacuum Pump Design and Performance Data**		
6.1	Total Gas Evacuated	lb/hr	
6.2	Inlet Volume Flow Rate	acfm	

Item	Description	Units	Technical Data (Contractor to fill in)			
6.3	Time to draw vacuum	min				
6.4	Cooling Water Supply Requirements		˚F	gpm	psig	
6.5	Materials of Construction					
	Casing					
	Impeller					
	Shaft					
	Shaft Sleeves					
	Mechanical Seals					
6.5	LRVP Electric Requirements	V	A	phases	kW	
7.0	**Intercondenser Design Data**					
7.1	Shell Design Pressure/Temperature	psig/˚F				
7.2	Tube Design Pressure/Temperature	psig/˚F				
7.3	Shell Material					
7.4	Tube Material					
7.5	Tubesheet Material					
7.6	Tube OD	in.				
7.7	Tube Wall	BWG				
7.8	Overall Length	ft.				
7.9	Weight	lb				

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485471

Inlet Air Chiller

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485471
Inlet Air Chiller

prepared for: *PASADENA WATER & POWER*
prepared by: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/31/2011	T. Clark	A
09/09/2011	B. Hritsco	B
12/05/2011	T. Clark	C
05/04/2012	T. Clark	D
09/10/2013		E – CONTRACT VERSION

SECTION 485471
INLET AIR CHILLER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 3
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 4
1.8 SUBMITTALS 4
1.9 QUALITY ASSURANCE 4
1.10 DELIVERY, STORAGE, AND HANDLING 4
1.11 SITE CONDITIONS 4
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MANUFACTURERS 5
2.2 MATERIALS AND WELDING 5
2.3 EQUIPMENT 5
2.4 COMPONENTS 10
2.5 ELECTRICAL 11
2.6 INSTRUMENTATION AND CONTROLS COMPONENTS ..... 12~~11~~
2.7 CIVIL AND STRUCTURAL 15
2.8 ACCESSORIES ..... 16~~15~~
2.9 FABRICATION 16
2.10 SOURCE QUALITY CONTROL 16

PART 3 - EXECUTION 16

3.1 COMMISSIONING 16
3.2 TRAINING 17

APPENDIX A – CONTRACTOR DATA REQUIREMENTS 19

APPENDIX B – TECHNICAL DATASHEET BY GENERAL MANAGER 20

APPENDIX C – TECHNICAL DATASHEET BY CONTRACTOR22

SECTION 485471
INLET AIR CHILLER

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of a mechanical chiller assembled unit for lowering the temperature of inlet air to a gas turbine generator. It is not the intent to specify completely herein all details of design and construction of the inlet air chiller and its' related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Packaged chiller with standard accessories
2. Skid mounted base frame with outdoor weather enclosure including climate conditioned ventilation, lighting, and electrical receptacles
3. Redundant mechanical centrifugal refrigerant chillers complete with electric motors and integral lubrication system
4. Inlet air chiller coil with temperature control, flow measurement, and flow and bypass control at the gas turbine generator (option, see attached datasheets)
5. Inlet air anti-icing system and controls (option, see attached datasheets)
6. Microprocessor based control system with one local and one remote HMI, protocols for bidirectional communication with plant control system (PCS)
7. Redundant capacity chilled water pumps
8. Expansion tanks essential to proper operation of the chiller system, mounted internal to the skid
9. All piping, raceways, and wiring contained within or supported by the skid mounted packaged along with the associated auxiliary systems
10. Switchgear / Starters / MCCs / electrical distribution board to be located in the PDC
11. Initial charge of refrigerant suitable to the project site
12. Cleaning and finishing prior to shipment
13. Finish painting interior and exterior
14. Insulation internal to the package boundaries
15. Noise mitigation measures to achieve requirements defined in Section 480031, Combined Cycle Power Island Noise Control Performance.

16. Performance testing at factory and certificates of results
17. Drawings and design data to support facility design, construction and maintenance
18. Manuals, drawings, and design data to support balance of plant design, installation, operation, and maintenance of the specified equipment
19. Inspection certificates and quality control documentation listed in this Section
20. Field advisory services including field support, installation support, start-up support, commissioning support, and training
21. Priced list of recommended spare parts for two years of operation
22. Packing and shipment FOB to nearest point of receipt to the plant site

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Receipt, off-loading, storing, and erection of equipment at the plant site
2. Foundations, sole plates, anchor bolts/nuts, standard embedments, and grout
3. Plant Control System (PCS)
4. Power and control raceway, wiring, instrument tubing, and pneumatic supply piping external to the chiller package and auxiliary equipment
5. Cooling tower with all structural support, interconnecting piping, instrumentation and controls to meet the operational requirements of the inlet air chiller. Reference Section 485491, Cooling Tower. (Cooling tower is part of the PIE Scope, but not provided by the chiller manufacturer. Cooling water for the chiller will be supplied by the PIE furnished cooling tower)
6. Chilled water piping from package boundaries to inlet air chiller coil
7. Cooling water piping from cooling tower to chiller
8. Insulation external to the package boundaries
9. Cooling water chemical injection and sampling
10. External instrumentation and weather station
11. Field inspection and testing
12. Final job site cleanup and touch-up painting
13. Instrument Air supply to Contractor’s terminal point

1.4 RELATED SECTIONS

A. Section 260000, Electrical Specification for Mechanical Equipment

B. Section 261050, Specification for Medium Voltage Motors

C. Section 262050, Specification for Low Voltage Motors

D. Section 480020, Site Conditions

E. Section 480031, Combined Cycle Power Island Noise Control Performance

F. Section 480032, Power Island Performance

G. Section 481100, Combined Cycle Power Island

H. Section 485222, Gas Turbine Generator (Aeroderivative)

1.5 CODES AND STANDARDS

A. Refer to 481100, Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

550/590 - Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle
580 - Non-Condensable Gas Purge Equipment for Use with Low Pressure Centrifugal Liquid Chillers

2. American Society of Heating, Refrigerating, and Air conditioning Engineers (ASHRAE)

147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

3. Heat Exchanger Institute (HEI)
4. Hydraulic Institute (HI)
5. South Coast Air Quality Management District (SCAQMD)

Rules 1451 & 1415.1 - Reduction of Refrigerant Emissions from Stationary Refrigeration Systems

6. Tubular Exchanger Manufacturers Association (TEMA)

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. All equipment shall be designed for a thirty (30) year life objective.
2. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
3. All equipment shall be designed and assembled to provide suitable access for operation and maintenance of the equipment.

B. Performance Requirements

1. Chiller package shall be designed so as to minimize plant auxiliary power requirements while achieving the required inlet air chilling over the full range of ambient and operating conditions.
2. The chiller load controls shall allow continuous control of chilled water output over the range from 25% flow to full rated flow.
3. The chilled water flow controls shall be achieved with an automatic chilled water recirculation and bypass system.
4. The chiller controls shall provide freeze free operation of the system.
5. The Contractor shall supply the required type and extent of silencing treatment, if any for the package to meet the noise level requirements in accordance with Section 480031, Combined Cycle Power Island Noise Control Performance. The Contractor shall state the expected maximum SPL (Sound Pressure Levels) produced by this equipment in operation and shall state the operating mode at which the maximum levels occur.

C. Reliability

1. No single failure of a component or system shall result in damage. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 SUBMITTALS - Refer to Attachment 11 -Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.10 Delivery, Storage, and Handling

A. Refer to Section 481100, Combined Cycle Power Island for delivery, storage, and handling requirements.

1.11 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply equipment specified within this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the Contractor's Proposal.

1. Not Used

2.2 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.3 EQUIPMENT

A. Inlet Air Chiller Assembled Unit

1. The inlet air chilling system shall be furnished as a complete and operable system to chill the inlet air for a gas turbine generator (GTG) to a temperature suitable for an increase GTG output during high ambient temperature operating.
2. The chiller assembled unit shall be a skid mounted mechanical centrifugal refrigeration chiller.
3. The inlet air chiller shall be capable of continuous operation and shall be designed to accommodate start/stop and partial to full load cycles.
4. All equipment shall be designed to function properly over the entire temperature range specified in the datasheets unless a more severe duty is otherwise specified. Function properly includes starting, operating, and powered stand-by.
5. Chiller shall conform to AHRI 550/590-2003
6. The chiller modules should be chosen to achieve low auxiliary loads and low capital cost while accounting for physical space available.
7. The arrangement of assembled components shall be such that there is safe and suitable clearance for operation and efficient maintenance of the equipment.
8. In view of limited operating experience with R134A refrigerant based in large inlet air cooling systems, the Contractor shall provide back-up guarantees from chiller compressor manufacturer for the system design and auxiliary power guarantees.
9. The chiller compressor and the condenser shall be sourced from a proven supplier. An experience list of similar capacity and refrigerant compressor model shall be submitted with the proposal.

10. In addition to chilling, a system for heating GT inlet air shall be provided. In the inlet air heating mode, a shell & tube heat exchanger is provided. The heat exchanger will utilize extraction steam from the Once Through Steam Generator (OTSG) to heat the fluid contained within the chilled water closed loop. The system will utilize the chilled water pumps and temperature control valve to provide the hot water flow to the GTG inlet coils in order to increase the GTG inlet air temperature. The heat exchanger skid for inlet heating will include:
    - One (1) Carbon Steel Shell & Tube Heat Exchanger designed and constructed to ASME Sec. 8 Div. 1
    - One (1) Temperature Control Valve.
    - One (1) Plate & Frame Heat Exchanger
    - Expansion Tank
    - Condensate Recovery system including tank, level control, with 2 x 100% condensate forwarding pumps.
    - Miscellaneous valves and fittings
    - Painted Carbon steel base frame.

B. Compressor and Motor

1. Compressor

    a. The compressor shall be mechanical centrifugal.
    b. Chiller should be able to unload to 10 percent of design tonnage with constant entering chilled water temperature. The compressors shall have provision for hot gas bypass (if required) to achieve minimum turndown load.
    c. Compressor assembly shall be run-tested at the factory. Vibration shall not exceed 0.15 inches per second. The test data shall be recorded and provided to the General Manager in report form for approval.
    d. A multiple compressor arrangement may be used if economically superior.
    e. The failure of a single compressor, and subsequent repair (opening the refrigeration path), shall not impair the operation of the system by more than 50%. The compressor, condenser and evaporator must have inlet and outlet discharge isolation valves for positive isolation while other equipment and systems are in operation.
    f. Compressor's maximum efficiency shall coincide with the specified design capacity at highest ambient conditions and at annual average ambient conditions listed as the design conditions in Section 480020, Site Conditions.

2. Impeller

    a. The compressor impeller shall be fully shrouded and made of a high strength steel alloy or manufacturers recommended proven material. The responsibility for selection of most reliable materials of construction is left with the Contractor. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

3. Electric Motors

    a. The motor should be sealed and either suction or refrigerant cooled.

b. If an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided. An oil reservoir shall collect any oil and refrigerant that leaks past the seal. A float device shall be provided to open when the reservoir is full, directing the refrigerant / oil mixture back into the compressor housing. Manufacturer shall warrant the shaft seal, reservoir, and float valve system against leakage of oil and refrigerant to the outside of the chiller for a period of 5 years from initial start-up, including parts and labor to replace a defective seal and any refrigerant required to trim the charge to original specifications. Motors shall have temperature sensing for each phase. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
c. Compressor motors shall be single speed, non-reversing, squirrel cage induction type rated at 4,000 volt and with a 1.15 service factor.
d. Hermetic motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized sub-cooled refrigerant in contact with the motor windings.
e. Motor winding temperature sensors shall be provided, at least one per phase. Full load operation of the motor shall not exceed nameplate horsepower rating (i.e. motor shall not operate into the service factor under any mode of chiller operation).
f. Current imbalance detector which monitors 3-phase motor current to provide the following protection:

    1) Phase loss, reversal and imbalance protection
    2) Ground fault protection

g. The electrical motors shall comply with Section 262050, Specification for Low Voltage (NEMA) Motors and Section 261050, Specification for Medium Voltage Motors.

C. Evaporator and Condenser

1. Evaporators and condensers shall be built in accordance with ANSI/ASHRAE 15-1994 Safety Code for Mechanical Refrigeration. Any equipment operating above 15 PSIG shall be built in accordance with ASME Section VIII and provided with National Board registration. The chilled water piping connections with chiller package shall be Victaulic, with bevel preparation for welding.
2. Evaporator and condenser tube material shall be copper or copper/nickel. The minimum tube wall thickness shall be 0.028 inch. Tubes shall be internally or externally enhanced at the discretion of the Contractor.
3. Refrigerant metering devices and thermal expansion valves shall be provided for inspection and periodic adjustment.
4. Multi-stage compressors shall incorporate an interstage flash vessel "economizer". Units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of sub-cooling.
5. Supply and return head water boxes shall be designed for a working pressure of 150 psig and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Skid module design shall allow for annual removal of water boxes for cleaning. Skid enclosure shall include removable wall, access doors, or access panels for water box removal and for tube brushing. Skid layout shall include the “pull space” for this procedure.

6. Water box drain and vent connections shall be provided. All water box drains shall be hard-piped to a common drain location.
7. Insulation shall be 1" and cover all low temperature surfaces to include the evaporator, water boxes, and suction elbow. Economizer and motor cooling lines shall be also insulated.

D. Pumps

1. Pump Selection

a. Pumps shall be adequately sized for the specified duty conditions.
b. Pumps shall be double or single suction, vertical in-line centrifugal pump designed to deliver the flow rate at the specified total dynamic head in feet.
c. Pumps shall not be overloaded throughout the entire range of pump operations.
d. Pumps shall be redundant capacity and the General Manager estimated piping pressure losses as specified in the datasheets (this value to be validated by BOP Contractor) shall be considered in the pump design head.
e. Pumps construction shall allow servicing in all respects without removal of the pump or motor from the skid. Bearings, casing, seals and shaft must be removable without disassembly of the pump from the motor or the attached piping.

2. Centrifugal Pumps

a. Casing

1) Casing for pumps shall accommodate an impeller fifteen (15) percent greater in diameter than the impeller actually selected to meet specified performance.
2) The casing material shall be close-grained cast iron.
3) Casings shall be designed for scheduled working pressure and shall be hydrostatically tested. Suction and discharge flanges shall be drilled to ANSI Standards and be machined raised face.

b. Impeller

1) Full size impellers shall not be used. An impeller diameter that is at least 10 percent larger than the minimum impeller diameter and at least 10 smaller than the maximum diameter for the pump casing is preferred.

c. Wearing Rings

1) Provide bronze, renewable wearing rings on all pumps 1-1/2 inches and larger.
2) Pumps shall be fitted with renewable case wear rings indexed with a dowel pin for fixed positioning or manufacturer’s standard attachment.

d. Shaft

1) Furnish a stainless steel shaft, turned and ground to accurate dimension, of ample size to prevent deflection and key slotted as required.

e. Shaft Sleeves

1) All pumps shall be provided with mechanical shaft seals unless a specific application precludes the use of such seals. Mechanical shaft seals shall be of multiple spring balanced pusher type. If required mechanical shaft seals shall be furnished with a complete flushing system, including interconnecting piping. The flushing system shall utilize the pumped fluid unless otherwise required.

f. Bearing

1) The pump shaft shall be adequately supported by the pump bearings to limit the shaft deflection to 0.002 inches.
2) If pump bearings are used, the pump ball bearings shall be deep groove type with cartridge mounting, locked to shaft with positive locks, of ample size to withstand all axial and radial loads.
3) Each bearing housing shall be bolted to the upper and lower casing halves for a full 360 degree support registered fit to ensure positive alignment.

g. Pump Maintenance Access

1) An overhead monorail, minimum capacity of 1/2 ton or as required to pick the heaviest component, with trolley and chain-fall shall be provided to allow easy maintenance and repair for the pumps.
2) The rail will extend to near the service doors to assist in rigging the pumps or motors out of the module.
3) Provide sufficient pull space around pumps to provide for all operations, maintenance and removal activities.

h. Motor Extension Shaft

1) Machine the end bracket to receive the pump support bracket for rigid bolted assembly to ensure permanent, accurate alignment of the pump and motor.

i. Couplings

1) Provide a flexible mechanical coupling rated for the full rated horsepower of the driving motor at motor speed. Standard rigid, split, aluminum alloy couplings can be alternatively used.

j. Variable Frequency Drive (Contractor shall provide this as optional pricing)

1) The variable speed drives shall convert three-phase, 60 HZ utility power to adjustable voltage and frequency, three-phase, AC power for stepless motor speed control from 40% to 100% of the motor's 60 Hz speed.
2) The VFD power input stage shall convert three-phase AC line power to a fixed DC bus voltage. This will be accomplished with a solid state three-phase full-wave diode rectifier with metal oxide varistor (MOV) three-phase protection. Displacement power factor shall not be less than 0.95

throughout the speed range. Input line inductors (3%) shall be included on the line side of the power input state.

3) The VFD output power shall vary frequency to the motor from 24 to 60 Hz with resultant motor speed varying at the motor nameplate rated speed, with output voltage variation from zero to motor rated voltage for optimum volts per hertz (V/Hz) ratio for fan and pump loads. Output current shall be rated 110% of motor full load amps (FLA) for 1 minute based upon VFD's variable torque FLA rating. The output must be a voltage source type generating a sine waveform utilizing an asynchronous carrier frequency (output transistor switching frequency is to be independent of drive output frequency). This carrier frequency shall be adjustable to minimize harmonically induced noise or vibration.
4) The VFD shall include the following features:

   a) The VFD shall be housed in a NEMA 1 enclosure.

5) The following display/control parameters shall be located on the front of the enclosure:

   a) Hand/Off/Auto selector to start and stop the motor. In the auto position, the drive shall start/stop from a remote contact closure. In the auto position, motor speed shall be determined by the follower signal. In the manual position, motor speed shall be determined by manual adjustment.
   b) Power on indication that the VFD from the power line.
   c) Fault indication that the VFD has tripped on a fault condition.
   d) Display shall indicate load parameters such as load percent, frequency or running load amps.

2.4 COMPONENTS

A. Purge System

1. The refrigeration system shall be provided with a non-condensable gas purge system compliant with SCAQMD rules 1415 and 1415.1 and AHRI 580 and ASHRAE 147 guidelines for system design, performance, and efficiency.
2. At standard room operating conditions and with a condensing refrigerant temperature > 80 ˚F, the purge system shall be rated for no more than .02 lb of refrigerant per 1 lb. non-condensable. The purge efficiency shall not deteriorate over time.
3. Purge exhaust shall be to outdoors.

B. Chiller Package Enclosure

1. The structure shall be designed for both the “lifting” and the operating cases, using STAAD.PRO or equivalent, and designed per ASD-89. Design calculations shall be submitted for General Manager review.
2. Base frame shall be constructed of suitable structural wide flange beams. Joining of skid full-depth members shall be performed using full penetration welds, to a factory-certified ASME/AWS welding procedure with welders qualified to the specific certified procedures.

3. Each skid base shall have four (4) retractable lifting trunnions that maintain the unit within fifteen (15) degrees of horizontal when lifted with a single spreader bar with a single crane hook point. These trunnions shall be designed in accordance with ASME B30.20, latest edition. Where lifting trunnions assemblies penetrate the base beam, large reinforcing plates (ASD-89) shall be incorporated to both sides of the beam for structural integrity. Each outside longitudinal beam shall have at least three (3) jack bolts (provided by others) for leveling skid on concrete slab and making space for grouting. As an alternative, installation contractor may use shim plates for leveling. Provisions for anchor bolts to be supplied by others shall be included in the skid design.
4. Enclosure shall be supplied with thermostatically-controlled ventilation fans with adjustable setpoints from within the enclosure. Vent ducting shall be designed and fabricated with a serviceable means of filtering the intake air.
5. Enclosure floor shall be equipped with adequate drainage and sloped accordingly toward drains.

2.5 ELECTRICAL

1. Packaged System Electrical Requirements

   a. The chiller package will be fed with a single MV and a single LV power feed. These shall feed the main MV and LV MCC busses.
   b. The Electrical systems in the package shall comply with Section 260000, Electrical Specification for Mechanical Equipment.
   c. Electric Motors

      1) Chiller Compressor Motors

         a) Compressor motors shall be totally enclosed.
         b) Compressor motors shall be single speed, non-reversing, squirrel cage induction type rated at 4,000 volt and with a $\leq$1.0 service factor.
         c) Hermetic motors shall be suitable for operation in a refrigerant atmosphere.
         d) Motor winding temperature sensors shall be provided, at least one per phase. Full load operation of the motor shall not exceed nameplate horsepower rating (i.e. motor shall not operate into the service factor under any mode of chiller operation).
            Contractor's standard RTD wiring method applies.

      2) Current imbalance detector which monitors 3-phase motor current to provide the following protection:

         e) Phase loss, reversal and imbalance protection
         f) Ground fault protection

   d. Motor control centers and/or electrical cabinets shall be mounted on appropriate housekeeping pads or other pedestal system which shall be designed and constructed to prevent the intrusion of water into the cabinets. Housekeeping pads shall be a minimum of 4" tall.

2.6 INSTRUMENTATION AND CONTROLS COMPONENTS

1. System Controls

a. The system control panel shall consist of a programmable controller which shall coordinate the chilled water pumping systems, variable speed systems, and the chiller control systems to achieve the desired T2 temperature requirements of the turbine inlet air temperature.
b. PLC type Allen-Bradley Logix family, language is to be determined.
c. The control system panel shall communicate directly with the plant PCS via a network gateway (preferably Ethernet) to enable monitoring of system parameters directly on existing systems.
d. A Human Machine Interface (HMI) shall be included as part of the system control panel to provide the operator with a "Window" to the process. The HMI shall permit changes to the process such as setpoint and manual control functions. The HMI shall also be capable to perform system diagnostics such as alarming, trending, report generation and color graphics to simplify the operation.
e. The packaged control system shall have a built-in an industrial touch screen personal computer running standard off the shelf HMI graphical interface such as Rockwell Automation RSView or approved equal.
f. The packaged control system coordinates the pumping systems with the actions of the chiller system. It also schedules pump rotation to equalize runtime and wear on each pump and chiller system by using different rotation schemes thus providing a more reliable chiller plant by periodically exercising all of its components.
g. Intelligent "smart" motor starters shall be used throughout the system to enable motor control and motor monitoring diagnostics. Motor control system shall be provided with DeviceNet.
h. The packaged control system shall monitor both the supply and return water temperatures to determine system demand. The system shall take into consideration the available on-line chiller capacity in determining the set point of chiller system. In addition, the system shall monitor the flow rate through the chillers to meet the ideal conditions to chill water and maintain desired T2 temperature. Pumps may also be staged on / off to maintain optimal efficiency for the entire TIC system.
i. The packaged control system shall monitor condenser discharge pressure to determine the number of fans required to achieve the optimized condenser refrigerant pressure.
j. Temperature Control Valves shall be used to control and regulate chilled water flow rates through the cooling coils at gas turbine filter house, decrease parasitic loads, and provide the most efficient method of providing chilled water. Contractor shall advise if Temperature Control Valves are shipped loose to be installed in BOP piping.
k. The packaged control system shall use distributed I/O to reduce installation costs and aid in both the start-up and commissioning the control system. With I/O strategically located throughout the plant, such as at the Chiller Plant, TIC Coils, and secondary field devices can be easily added and implemented in the future. Additional diagnostic and performance data gathering can be achieved also.

2. Performance Monitoring Devices

a. Chilled water temperature transmitters at the supply and discharge of cooling coil manifolds at the gas turbine.
b. T1 ambient dry bulb (DB) temperature and humidity meter (capable of reading in wet bulb (WB) temperature), at the gas turbine filter house.
c. Temperature indicating transmitter at the supply and discharge of the chiller water box, chilled water and condenser refrigerant loops.
d. 0.5 % accuracy mass flow meter (mass flow, not volumetric flow) in chiller skid for chill water loops, and at gas turbine coil assembly. For primary / secondary systems, provide secondary flow measurement also.
e. Ammeter, voltmeter, watt-var meters for low and medium voltages feeders. Metering shall be per each module. For primary / secondary systems, provide secondary power monitoring also.
f. 0-100% Valve Position Feedback at the coil control valves.
g. The above points shall be wired back to the central chiller control system for monitoring and control.
h. Control system shall be capable of providing instantaneous capacity (tons), parasitic electrical load (kW), and efficiency (kW/ton) measurements. Control system shall be capable of trending these values.
i. Differential pressure indicating transmitters shall be furnished to monitor differential pressure across the supply and discharge piping of the chiller water box and chilled water. Process connections for the differential pressure instruments shall be positioned at the 3 o'clock or 9 o'clock position in the horizontal piping within 24" of the chiller discharge flange or connection.

3. Performance Monitoring Devices Supplied by Contractor

a. T2 temperature transmitter, utilizing gas turbine CIT.
b. Gas Turbine MW meter each
c. Net plant output MW
d. The above points shall be wired to the central chiller control system for monitoring and control.

4. Refrigerant Monitor

a. Provide a refrigerant monitor for enclosed skid modules per ASHRAE 15.
b. The refrigerant monitor shall have an infrared sensor using either photo acoustic or photo absorptive sensing method. The minimum refrigerant detection level shall be no more than 1 ppm and its specified error over its measurement range shall be no more than +/- 3 ppm for 1 - 50 ppm range and +/- 10% for 51 - 1,000 ppm range.
c. Alarm shall include a signal to the central control system and a visual warning light outside of the enclosure.

5. Remote Monitoring

a. The system shall be capable of remote monitoring by phone line or Internet connection. The Contractor shall have the capability to monitor and troubleshoot the system remotely.

6. Refrigerant Leak Detection System

a. The system shall be equipped with an automatic refrigerant leak detection system in accordance with any and all applicable regulations including, at a minimum, SCAQMD Rules 1415 & 1415.1.

B. Local Chiller Controls

1. The local chiller control panel shall be a stand-alone Direct Digital Control (DDC) System. A dedicated chiller microprocessor control panel shall be supplied with each chiller compressor by the chiller manufacturer.
2. The local chiller control panel shall provide control, operation and monitoring of all chiller sensors, actuators, relays and switches and shall include controls to safely and efficiently operate the chiller.
3. Safeties - the local chiller control panel shall monitor the following safeties: start and running time between compressor/motor starts, low chilled water temperature, low evaporator refrigerant temperature or pressure, high condenser refrigerant pressure, evaporator, low oil pressure, low oil temperature, high oil temperature, high motor winding temperatures, sensor faults, and proper operation of unit controls.
4. All compressor and motor bearings (including high speed, low speed, and thrust bearings), shall have separate factory installed temperature sensors installed in the bearing or the oil return lines of each bearing. If any temperature reaches or exceeds a set value, the chiller control panel shall shut down the chiller, display the diagnostic, and annunciate a common trouble alarm.
5. The local chiller control panel shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:

    a. Phase loss
    b. Phase imbalance
    c. Phase reversal
    d. Under voltage
    e. Motor overload
    f. Motor overload protection incorrectly set
    g. Momentary power loss protection with auto restart consisting of three phase current sensing devices that monitor the status of the current
    h. Starter contactor fault protection
    i. Failure to accelerate

6. Advanced motor protection systems shall be furnished in the associated MCC, for both medium voltage and low voltage motors.
7. The local chiller control panel shall be capable of displaying system data in English or Metric units.
8. The local chiller control panel is to be provided with a start and run time counters.
9. The front of the local chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:

    a. Entering and leaving evaporator water temperatures
    b. Entering and leaving condenser temperatures
    c. Compressor Motor Winding Temperature of each phase A, B, C.
    d. Saturated evaporator and condenser refrigerant temperatures
    e. Evaporator and condenser refrigerant pressure
    f. Oil Temperature
    g. Oil Tank pressure

h. Oil pump discharge pressure
i. Differential oil pressure
j. Compressor motor starts and running hours
k. Compressor motor current, by phase
l. Compressor motor percent RLA
m. Purge compressor suction temperature
n. Purge pump out rate
o. Purge pump out time last or current cycle
p. Total Purge pump out time
q. Total Purge run time
r. Chilled water set point and set point source
s. Electrical current limit set point and set point source
t. Current chiller operating mode
u. Equipment room refrigerant monitor ppm levels
v. Chiller diagnostics including a time and date of occurrence
w. (Minimum 20 historical diagnostics stored in non-volatile chiller panel memory)
x. Differential pressure across chilled water supply and return
y. Differential pressure across chiller water box supply and return

10. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. The control shall take action in response to the actual value of the evaporator refrigerant temperature. A diagnostic message shall be automatically displayed at the front panel whenever this control is in effect, and if the condition exists for more than 20 minutes, a limit warning alarm relay shall energize.
11. The chiller control panel shall provide individual relay outputs to start/stop the evaporator chilled water pumps. The condenser temperature output can be used to enable the condenser temperature controls.
12. The chiller control panel shall provide a relay output that shall energize whenever the compressor is running.
13. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault is detected by the panel.
14. The chiller control panel shall provide a head relief request Alarm to indicate that the chiller is in condenser limit mode.
15. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature or ambient temperature.
16. The chiller control panel shall be capable of supporting a printer. The printer interface shall provide the following printing functions:

    a. Each printed output is stamped with the time and date of printing.
    b. Print on command from the operator interface keypad.
    c. Print based upon each occurrence of a chiller diagnostic.
    d. Print a standard summary report based upon an operator specified timed interval.

17. The chiller control panel shall be capable of providing short cycling protection.

2.7 CIVIL AND STRUCTURAL

A. Refer to Section 481100, Combined Cycle Power Island for general civil and structural requirements.

2.8 ACCESSORIES

A. Insulation

1. Piping, tanks, and equipment shall be insulated if:

Heat loss results in economic loss or negative performance impact of the equipment provided by the Contractor as part of this scope of supply.
Operating temperature exceeds 140˚F or surface temperatures will endanger station personnel.
The equipment and piping must be protected from freezing.

2. Insulation that must be removed for maintenance access shall be provided in modular blankets or sections to facilitate removal for equipment access.
3. Piping and equipment to be insulated for personnel protection shall be insulated up to 8 feet above floors and platforms and 3 feet horizontally of all platforms and walkways.
4. Outdoor insulation shall be weatherproofed and jacketed to prevent degradation due to ambient conditions

B. Heat Tracing

1. All above ground piping containing fluids subject to freezing will be heat traced and insulated. Piping routed in-ground will also be insulated and heat traced down to the frost line.

2.9 FABRICATION

A. Refer to Section 481100, Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

B. The chiller pump room floor shall receive a non-slip coating treatment

2.10 SOURCE QUALITY CONTROL

A. Refer to Section 481100, Combined Cycle Power Island for general source quality control, test, and inspection requirements.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. General

1. The Contractor shall provide onsite commissioning and testing support of the equipment.
2. The Contractor shall allow for training of the General Manager’s personnel appointed to operate the equipment and involved in commissioning.
3. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the

right to remove and take away from site such commissioning and test equipment upon completion.

4. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

B. Commissioning Plan

1. The base scope of the installation and commissioning plan shall provide:

Advance knowledge of project schedules, completion dates, and key event dates.
General definition of manpower and material resources required.
A means of verifying that all critical calibrations, both mechanical and electrical, have been checked.
In addition to the documentation that makes up the base scope the Contractor shall include the services of an Installation and Commissioning Manager to monitor and continuously update the plan during the installation and commissioning period.

C. Installation, Commissioning and Startup (ICS) Manual

1. The ICS Manual shall be an integral part of the Installation and Commissioning plan. Each activity in the ICS manual shall be detailed and documented in the Activities Manual and step-by-step instructions provided for carrying out each activity.
2. Each activity sheet shall identify as a minimum:

The unit on which the activity is to be carried out
Applicable drawings
Engineering standards
Special tools
Torque and alignment specifications
Piping connection information and drawing identification codes
Wiring junction box locations and terminal designations
Switch and control action and set points

3. Log sheets shall be provided where required for recording critical information (alignments, clearances, calibration points achieved etc.) generated during each activity.
4. Each activity sheet shall also provide signature blocks for the Contractor and General Manager to sign off, thereby verifying the activity was completed to both their satisfaction.

3.2 TRAINING

D. Operation and maintenance training shall be provided for up to 10 end user operation and maintenance personnel (not including travel and accommodations) and shall include the following topics:

1. Minor mechanical maintenance
2. Controls and instrumentation
3. Specialist training

E. The training program shall be appropriate for all levels of the end user's staff including Engineers, Supervisors, and Technicians.

F. The training program shall be held at the Contractor's facility and include visit to an operating site with similar equipment.

G. Prior to award of contract, the Contractor shall provide content of the training program for the General Manager's approval.

END OF SECTION 485471

APPENDIX A – Contractor Data Requirements - Refer to Attachment 11 -Drawing Schedule

APPENDIX B – Technical Datasheet by General Manager

	Client Name	Pasadena Water & Power
	Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number	123374
1.0	**Design**	
	Site Conditions	Section 480020, Site Conditions
	Gas Turbine Type	By Gas Turbine Contractor
	Gas Turbine Quantity	1
	GTG Minimum Inlet Air Temperature	By Gas Turbine Contractor
	Total Inlet Air Chilling Load	By Gas Turbine Contractor
	Power (MV/LV/Freq)	4160V/480V/60Hz
2.0	**Air Chilling Coil Design**	By Gas Turbine Contractor
	Maximum Face Velocity	
	Maximum Allowable Air Side Pressure Drop	
	Water Side Pressure Drop	
	Number of Coil Tube Rows	
	Number of Tube Passes	
	Coil Tube O.D	
	Coil Tube Wall Thickness	
	Coil Tube Material	
	Coil Fin Density	
	Coil Entering Water Temperature	
	Coil Leaving Water Temperature	
	Chilled Water Flow Rate	
	Temperature Control	
	Flow Measurement	
	Flow and Bypass Control	
6.0	**Auxiliary Systems**	
	Cooling Tower	By BOP Contractor
	Auxiliary Cooling Water Pumps	By BOP Contractor
	Inlet Air Anti-Icing System and Controls	By Contractor as Required by Gas Turbine Contractor and Site Ambient Conditions
	Chilled Water Pumps	By Contractor
	Chilled Water System Expansion Tank	By Contractor
	Chilled Water System Air Separation Vessel	By Contractor
	Chemical Pot Feeder	By Contractor

	Chiller Controls	By Contractor
	Weather Station	By BOP Contractor
	Chiller Pre-wired, Pre-piped Package Enclosure Details	By Contractor

APPENDIX C – Technical Datasheet by contractor to be furnished during project execution

Item	Description	Units	Technical Data (Contractor to fill in)
1.	**Operating Guarantees**		
1.1	Chiller Package Start Up Time		
	a) Cold Standstill to Full Capacity Normal / Fast	min	/
1.2	Vibrations		
	a) Normal Vibration Level		
	b) Alarm Level		
1.3	Monthly Refrigerant Charge Makeup		
1.4	Noise Guarantees @ 3 ft		
	a) A - Weighted Scale, Leq	dB	
2.	**Performance Guarantees**		Note 4
3.	**Compressor Data**		
3.1	Type		
3.2	Model/Make		
3.3	Quantity		
3.4	Inlet Conditions		
	a) Pressure	psia	
	b) Temperature	˚F	
	c) Compressibility Factor		
	d) Inlet Flow	lb/hr	
3.5	Outlet Conditions		
	a) Pressure	psia	
	b) Temperature	˚F	
	c) Compressibility Factor		
3.6	BHP Required	hp	
3.7	Speed	rpm	
3.8	Turndown	%	
3.9	Polytropic Efficiency	%	
3.10	Certified Point Performance Curve		
3.11	Compressor Flow Controls		
3.12	Casing Details		
	a) Casing Split		
	b) Material		
	c) Maximum Allowable Pressure	psig	
3.13	Diaphragms		
	a) Material		
3.14	Guide Vanes		
	a) Material		
	b) Number of Adjustable Rows		
3.15	Impellers		
	a) Diameter	in	
	b) Type (Open or Enclosed)		

Item	Description	Units	Technical Data (Contractor to fill in)
	c) Type of Fabrication		
	d) Material		
	e) Brinell hardness		
3.16	Shaft		
	a) Material		
3.17	Shaft Seals		
	a) Manufacturer		
3.18	Bearing and Bearing Housings		
	a) Radial Bearing Type		
	b) Thrust Bearing Type		
	c) Bearing Temperature Detectors		
	d) Vibration Detectors		
3.19	Coupling and Guards		
	a) Material		
	b) Manufacturer		
3.20	Driver Details		
	a) Driver Nameplate Rating	hp	
	b) Enclosure type		
	c) Frame No.		
	d) Efficiency	%	
	e) Current	Amps	
	f) Power Factor	%	
	g) kW Losses		
	h) Locked-Rotor Torque		
	i) Breakdown Torque		
	j) Pull-Up Torque		
	k) Locked-Rotor Current		
	l) LR kVA Code Letter		
3.21	Shop Inspection and Tests		
	a) Hydrostatic		
	b) Impeller Overspeed		
	c) Mechanical Run		
	d) Gas Leak Test		
4.	**Evaporator Data**		
4.1	Leaving Chilled Water Temp	˚F	
4.2	Entering Chilled Water Temp	˚F	
4.3	Chilled Water Flow	gpm	
4.4	Delta T	˚F	
4.5	Fluid Type		
4.6	Percentage of Fluid		
4.7	Number of Passes		
4.8	Fouling Factor	$hr\text{-}ft^2\text{-}F$ / BTU	
4.9	Tube Material		
4.10	Tube Wall Thickness	in	
4.11	Max Water Pressure Drop	psi	

Item	Description	Units	Technical Data (Contractor to fill in)
4.12	Fluid Volume in the System	gal	
5.	**Condenser Data**		
5.1	Condenser Mounting		
5.2	Design Ambient	˚F	
5.3	Altitude	ft	
5.4	Low Ambient Control	˚F	
5.5	Tube Material		
5.6	Tube Wall Thickness	in	
5.7	Total Surface Area	ft^2	
5.8	Any Spare Condenser Modules?		
6.	**Chilled Water Pumps**		
6.1	Number of Chilled Water Pumps (Total / Operating)		/
6.2	Pump TDH	ft	
6.3	Pump Capacity	gpm	
6.4	Pump Type		
6.5	Pump RPM	rpm	
6.6	Pump Motor Nameplate Rating	hp	
6.7	Pump Casing and Impeller Materials		
6.8	Flow Controls		
7.	**Cooling Water Pumps**		
7.1	Number of Cooling Water Pumps (Total / Operating)		/
7.2	Pump TDH	ft	
7.3	Pump Capacity	gpm	
7.4	Pump Type		
7.5	Pump RPM	rpm	
7.6	Pump Motor Nameplate Rating	hp	
7.7	Pump Casing and Impeller Materials		
7.8	Flow Controls		
8.	**Chiller Package**		
8.1	Number of Modules		
8.2	Manufacturer / Model No.		/
8.3	Capacity	Ton	
8.4	Length of Each Module	ft	
8.5	Width of Each Module	ft	
8.6	Shipping Weight	lb	
8.7	Refrigerant Type		
8.8	Total Refrigerant Charge	lb	

Notes:

Contractor shall complete datasheets with all missing information.

1. Chiller flow needs revalidation with GTG Coil Design data.
2. The chilled water piping between the chiller package and GTG units will be supplied by the BOP Contractor. For sizing the chiller package the following margins may be assumed in the design:

   Pressure drop in the inter-connecting piping (chilled water supply, coil pressure drops, flow control valves and return water piping) about 150ft of water column.

   Temperature gain in the chilled water supply piping: 0.2 ˚F

   Temperature gain in chilled water return piping: 0.2 ˚F

Chiller Performance Guarantees (with zero tolerance) below are to be filled in by Contractor.

See Section 480020, Site Conditions for defined ambient conditions.

Ambient Conditions	Capacity (Tons)	Total Auxiliary Power (kW)	Electrical Utilization Factor (kW/Ton)	Chilled Water Flow and Temp Difference (gpm)/ΔT ^{0}F
Maximum				
Summer Design				
Average Annual Design				
Winter Design				
Minimum				

Part Load Performance at AHRI Standard Conditions below to be filled in by Contractor.

% Chiller Capacity	Capacity (Tons)	Total Auxiliary Power (kW)	Coefficient of Performance (COP)
100			
75			
50			
25			

Chiller Loads for Gas Turbine below are to be filled in by Contractor during project execution.

See Section 480020, Site Conditions for defined ambient conditions.

Table 1 Chiller Load (See Notes 2 and 3)					
Ambient Conditions	Chilled Water Return Temp (F)	Chilled Water Outlet Temp (F)	Chilled Water Flow (gpm)	Chiller Load per Gas Turbine (tons of refrigeration)	Total Chiller Load (tons of refrigeration)
Maximum					
Summer Design					
Average Annual Design					
Winter Design					
Minimum					

Inlet Air heater load table:

Ambient Design Point Dry Bulb Temperature			32 ^{o}F
T2 GT inlet air Temperature			140 ^{o}F
Heated Fluid Coil data	Dynalene –HC10	Coil Entering Fluid Temp	145 ^{o}F
		Coil Leaving Fluid Temp	128.3 ^{o}F
		Fluid Flow rate	2500 GPM
	25% PG	Coil Entering Fluid Temp	145 ^{o}F
		Coil Leaving Fluid Temp	128.7 ^{o}F
		Fluid Flow rate	2500 GPM
Heat Exchanger Supply steam properties		Pressure	167.7 psia
		Temperature	570 ^{o}F
		Mass flow rate	17.37 KPPH

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485491
Cooling Tower

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

Section 485491
Cooling Tower

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TYSON DIETZ*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	T. Clark	A
09/09/2011	T. Clark	B
12/05/2011	T. Clark	C
05/04/2012	T. Clark	D
06/15/2012	B. Hritsco	E
09/10/2013		F – CONTRACT VERSION

SECTION 485491
COOLING TOWER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 4
1.9 QUALITY ASSURANCE 4
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 4
1.11 SITE CONDITIONS 5
1.12 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 MANUFACTURED UNIT 5
2.3 EQUIPMENT 5
2.4 COMPONENTS 6
2.5 ACCESSORIES 12
2.6 FABRICATION 12
2.7 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 13

3.1 COMMISSIONING 13
3.2 TRAINING 13

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER 15

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR 16

SECTION 485491
COOLING TOWER

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of the fiberglass (FRP) structure, wet induced draft counterflow, film fill, field constructed cooling tower. It is not the intent to specify completely herein all details of design and construction of the cooling tower and its' related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict between referenced standards, codes and the documents included in this specification, or an apparent conflict with the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. One complete wet induced draft FRP fire retardant cooling tower including tower hardware, film fill material and supports, drift eliminators, casing, supports and circulating water distribution system and all other equipment and materials necessary to erect a complete operating system.
2. Fan assemblies, two-speed motors, motor vibration switches, gears, coupling, fan stacks, steel mounting structure and shafting
3. One FRP stairway and one hot dip galvanized steel ladder in accordance with OSHA and CALOSHA standards on the ends of the cooling tower.
4. Platforms, handrails, access walkways and stairways for all plant items supplied.
5. FRP cable tray routed off the fan deck and within each cooling tower cell to the motors.
6. Inlet riser sway braces and mounting bracket to laterally support the inlet water risers.
7. Splash type oil lubrication
8. Electric motors for all motor driven equipment
9. Shims, soleplates with leveling screws, keys, restraining blocks and any other non-embedded foundation components
10. Lighting system
11. Piping internal to cooling tower package boundaries
12. Startup, commissioning, and thermal test support
13. Special tools required for maintenance
14. Spare parts for two (2) years of operation

1.3 FURNISHED BY OTHERS

A. The supply by Others shall be limited to the following:

1. Unloading and storage of equipment
2. Field erection of cooling tower support structure and installation of equipment at jobsite
3. Concrete basing with integral pump pit
4. Foundations, foundation bolts, nuts, washers, sleeves and standard shims. Anchor/jacking/pull-down plates, bearing pads, expansion anchors, Nelson studs, headed studs, spacer blocks, support plates and any other embedments required by the Contractor's equipment and identified on Contractor's drawings.
5. Grout
6. Power source and associated MCC starters
7. Lightning protection
8. Field wiring, cable and conduit connecting Contractor supplied components
9. Initial fill of all lubrication and control oils, gases, and water
10. Finish painting of acoustical/weather enclosure
11. Field thermal performance testing

1.4 RELATED SECTIONS

A. Section 260000 - Electrical Mechanical Equipment

B. Section 262050 - Low Voltage Motors

C. Section 480020 - Site Conditions

D. Section 480031- Combined Cycle Power Island Noise Control Performance

E. Section 480032 - Power Island Performance

F. Section 481100 - Combined Cycle Power Island

G. Section 485122.11 – Steam Turbine Bypass Valves

H. Section 485221 - Steam Turbine and TEWAC Generator

I. Section 485432 - Surface Condenser

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
2. American National Standards Institute (ANSI)

    a. S1.4 - Sound Level Meters

b. S1.6 - Preferred Frequencies and Band Numbers for Acoustical Measurements
c. S1.11 - Octave, Half-Octave, and Third Octave Band Filter Set

3. American Society for Mechanical Engineers (ASME)

a. PTC 23 - Atmospheric Water Cooling Equipment

4. Cooling Technology Institute (CTI)

a. ATC-105 - Acceptance Test Code for Water Cooling Towers
b. ATC-107R - Characteristic Curve for use with ATC-105
c. ATC-128 - Code for Measurement of Sound from Water Cooling Towers
d. STD-111 - Gear Speed Reducers
e. STD-131 - Fiberglass Reinforced Plastic Panels for Applications on Industrial Water Cooling Towers
f. STD-136 - PVC Materials Used for Film Fill, Splash Fill, Louvers, and Drift Eliminators
g. STD-137 - Fiberglass Pultruded Structural Products for use in Cooling Towers
h. STD-152 - Structural Design of FRP Components
i. STD-201 - Certification Standard

5. National Fire Protection Association (NFPA)

a. 214 - Standards on Water Cooling Towers
b. 255 - Method of Test of Surface Burning Characteristics of Building Materials
c. 780 - Standards for the Installation of Lightning Protection Systems

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Reference Section 481100 Combined Cycle Power Island for general design requirements and expected operating profile.

B. Performance Requirements

1. The design ambient wet bulb temperature shall be as specified on the datasheets. The cooling tower shall be designed to operate at full capacity over the range of ambient wet bulb temperatures.
2. The tower design shall ensure adequate performance despite recirculation or interference that may occur due to the proximity of other buildings and/or as a result of wind conditions.
3. The Contractor shall provide equipment performance curves over the entire range of expected operating conditions. Contractor shall include cooling tower performance characteristic curves with tower design point and heat transfer materials in conjunction with KaV/L vs. L/G curve for a counterflow tower.
4. The Contractor shall guarantee that the cooling tower supplied will meet the specified performance conditions when the tower is installed according to plans. If, because of a suspected thermal performance deficiency, the General Manager may choose to conduct an onsite thermal performance test in the presence of the contractor, and under the supervision of a qualified, disinterested third party in accordance with CTI ATC-105 standards during the full year of operation. If the cooling tower fails to perform within the limits of test tolerance, then the Contractor shall make alterations as it deems necessary to overcome indicated deficiency.
5. Contractor shall design and size the cooling tower such that it is capable of simultaneously rejecting the sum total of heat loads, plus a 10% margin, from the following sources:

    a. The steam turbine steam cycle, at 100% turbine load, full steam bypass to the condenser and all operating points in between.
    b. All auxiliary equipment provided by Contractor which requires cooling including but not limited to turbine lubricating oil system, STG TEWAC system and fuel gas compressor lubricating oil heat exchanger and discharge gas heat exchanger.
    c. Mechanical chiller condenser system if used for combustion turbine inlet cooling.

1.8 SUBMITTALS Refer to Attachment 11 – Drawing Schedule

1.9 QUALITY ASSURANCE

A. Refer to Section 481100 Combined Cycle Power Island for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping

1. Refer to Section 481100 Combined Cycle Power Island for general packaging and shipping requirements.
2. The system shall be packaged for shipment to allow for outdoor storage as prescribed by Contractor for a period of six months without damage from dust, sun, wind, or rain.

1.11 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481100 Combined Cycle Power Island for general material and welding requirements.

2.2 MANUFACTURED UNIT

A. Structural Requirements

1. General

a. Refer to Section 481100 Combined Cycle Power Island for general structural design requirements.
b. All wetted structural members of the cooling tower shall be either FRP or 316 stainless steel. All wetted fasteners and washers shall be 316 stainless steel.
c. The cooling tower shall remain operative after being subjected to the design seismic event without loss of performance or structural integrity.
d. The Contractor shall perform a seismic and wind analysis of the cooling tower using the information provided in Section 480020, Site Conditions. The seismic and wind analysis with complete frame-work loading diagrams shall be submitted for approval by General Manager.

2. Platforms and Stairs

a. Refer to Section 481100 Combined Cycle Power Island for general platform and stairs design requirements.

2.3 EQUIPMENT

A. Cooling Tower

1. The cooling tower shall be a multi-cell counterflow wet mechanical induced draft design employing low-clog film fill. The air path shall be designed to minimize air pressure drop, water drift, and splash.
2. The cooling tower will be located in a concrete basing with an integral pump pit.

3. The cooling tower shall be comprised of multiple cells modularized such that one complete cell can be taken out of service for cleaning or maintenance while the balance of the cells remain in operation. The cooling tower will be required to support the loads associated with the circulating water riser and distribution headers being attached to the structure.
4. The cooling tower shall be designed and will be tested in accordance with the Cooling Technology Institute (CTI) standards.

2.4 COMPONENTS

A. Fill Design and Material

1. The cooling tower shall be designed to utilize film fill type. The low-clog film type shall be fabricated in single sheets for the full depth of the fill pack. The fill material shall be fire retardant plastic, with a minimum thickness of 17 mils. It shall have a maximum temperature limit that is compatible with all operating conditions of the plant, including dry shut down and subject to solar heat gain.
2. Fill shall be supported by girts and joists on centers as required to accommodate operational loads, as well as the specified live load. The support grids shall be installed so as to provide adequate and proper support for the fill material and to prevent any possibility of sagging of the fill occurring during the service life of the cooling tower.

B. Drift Eliminators

1. The cooling tower shall include drift eliminators which hold drift losses to less than 0.0005 percent of the inlet water flow. Contractor shall provide a statement of warranty for the drift efficiency
2. Drift eliminators shall be thermoformed of 17 mil or heavier PVC. They shall be cellular type, triple pass. They shall be factory assembled into easily handled packs that nest together to form a continuous plane of drift eliminators throughout the plan area of each tower cell. They shall be easily removed from inside the tower for cleaning. Eliminators shall be supported by through bolted 2” x 4” (nominal) or larger, girts on no greater than 6’-0” centers. They shall also be designed to be completely self draining and to shed water back to the cold water basin.

C. Fan Deck

1. Material used for decking, sheathing, stairways (e.g. fan decks, hot well covers, hand rails, access stairs, etc.) and other areas normally exposed to the weather shall be made from pultruded fiberglass with a non-skid treatment applied to the deck surface and other walk surfaces with a top surface at least 3/16” thick. The material shall have a flame spread rating of 25 or less per ASTM E-84. The fan deck shall be constructed of rigid fiberglass panels utilizing ribbed stiffeners and supported on maximum spacing of 2 ft centers. The deck shall be designed to prevent sagging, buckling and warping. Foam core decking material will not be accepted.
2. The fan deck shall be designed as part of the tower structure such that it will transmit all live, wind and other loads uniformly to the tower framing. It shall be designed for a minimum live load of 105 psf in addition to any concentrated or live loads from usual tower construction, operation and maintenance provisions. The fan deck shall be capable of

supporting fan components, driving motor, gearing and shafting during overhaul. It shall also provide adequate support for the fan stacks and access to the fan mechanical drive gear and water distribution system of each cell.

3. Fiberglass safety guard-rails of adequate and substantial construction shall be provided around the perimeter of the fan deck and around any area of potential danger to personnel. Handrails, knee rails and toe-boards shall also be provided. All such safety rails shall be bolted to rigid support structures. All necessary internal access ways and ladders shall be provided where required for access to plant and equipment.

D. Corrosion Resistance

1. All wetted surface materials shall be capable of withstanding circulating water pH of 3.0 minimum.
2. All non-metallic cooling tower components and equipment shall be resistant to deterioration from ultra-violet light and water chemistry.
3. Combinations of different materials which may result in electrolytic corrosion shall not be used unless suitably protected and or isolated.

E. Fire Resistance and Tower Wetting

1. Cell partitions, end walls and louvers shall be fire retardant. The fan deck shall have a fire retardant coating. The following tower components shall be composed of non-combustible, or fire resistant materials with a flame spread classification of less than 25, as described in NFPA standard No. 255:

    a. Fill
    b. Drift eliminators
    c. Siding
    d. Structural members

F. Water Distribution System

1. Nozzles shall be threaded to permit easy removal for cleaning of the nozzles and the distribution pipework. Cleanout provisions shall be made at the end of all headers and distribution pipework.
2. The design of the water distribution system shall allow for 90% of the plan area of the cell to receive a water flow within 5% of the average flow. The water flow to no portion of the plan area shall deviate by more than 10% from the average.
3. Joints in the FRP piping shall be located away from support points. The Contractor shall furnish sway bracing for hot water riser (by BOP Contractor). Inlet water risers shall be supported by lateral sway bracing. Bracing shall transmit lateral loads to cooling tower structure and 316L stainless steel. All necessary nuts, bolts and washers for use with the connectors shall be provided and shall be Grade 316 stainless steel. Bracing clamp shall be two piece clamp type with 3" minimum bar width and 1/4” neoprene liner.
4. Water distribution shall be effected by non-clogging nozzles manufactured from corrosion and erosion resistant polypropylene. Contractor shall be responsible for sizing nozzles in accordance with the performance specifications herein. The water distribution shall be even and shall completely cover the whole area of the tower fill material.

G. Axial Fans

1. Fan blades shall be compression molded, fiberglass reinforced polyester with aerofoil profile. All blades shall be uniform in weight, shape and balance and have provision for manually adjusting the pitch angle. The number of blades on each fan impeller shall be selected to ensure that no pulsation of air will occur when the fan is rotating. Each fan shall be statically balanced to a master standard and be randomly interchangeable. Support and attached structures shall be designed to avoid blade passing frequency harmonic excitation. The leading edge of the blades shall incorporate features to provide protection against erosion.
2. Hubs shall be fabricated of hot-dip galvanized steel and ductile cast iron, assembled with 316L stainless steel hardware. Galvanized steel components shall be epoxy coated after galvanizing to a dry film thickness of 12 mils. Hubs shall be statically balanced at the factory. Contractor shall ensure that the operating speed is well clear of any critical speeds associated with the whole assembly or any part thereof.
3. The complete mechanical assembly of each cell shall be supported by a rigid, unitized, torque-tube type support that prevents misalignment between the motor and the gear reducer. Support and any associated structural members shall be epoxy coated mild steel, to which heavy plate platforms for the motor and gear reducer have been welded. The support base for the gear box and motor shall be a machined base. The torque tube shall have structural outriggers to provide structural stability and transmit loads into the tower structure. Provision shall be made in the design of the support for the fitting of demountable lifting gear for maintenance purposes at both the gearbox and drive motor ends. All parts of the fan assembly support shall be effectively protected against the corrosive and erosive environment in which it will be located

H. Fan Motors

1. Two-speed motors shall be located outside the fan cylinders and shall be connected to the speed reducer by tubular, extended, full floating driveshafts. Driveshaft tubes shall be carbon fiber/glass/epoxy composite.
2. Flanges shall be manufactured of 316L stainless steel, attached to the tube by type 316L stainless steel compression rings. Couplings shall be cast 316 stainless, joined to the driveshaft by flexible neoprene bushings and type 316 stainless steel inserts. Connecting hardware shall be 316 stainless steel.
3. Driveshaft assemblies shall be dynamically balanced at the factory at full motor speed.
4. Two type 316 stainless steel driveshaft guards anchored to the mechanical equipment support shall surround the driveshaft for containment in the event of failure. Protective guards shall be provided for the shafts at the end with the electric motor.
5. Cooling tower fan motors and their terminal boxes shall be rated IP55.
6. The maximum power consumption of the tower fan motors shall not exceed the value indicated on the data sheets.
7. Additional fan motor requirements may be found in Section 262050 Low Voltage Motors.

I. Drive Shafts

1. Hollow rotating components shall be either sealed to prevent water ingress or be effectively drained to prevent accumulated water from impairing the balance. All shafts shall be prevented from major displacement by suitable retaining straps situated just clear of the shafts.
2. Belt drives are not acceptable.

J. Gear Drives

1. Gear reduction units shall be double reduction, right-angle type, utilizing helical and/or spiral bevel matched gear sets. Cases shall be epoxy coated, ASTM Class 20, gray cast iron. Bearings shall be tapered roller type. Gears and bearings shall be splash-lubricated in a bath of turbine type mineral oil. Gear reducers shall meet or exceed the requirements of CTI STD-111 and AGMA STD 420.4. Gear boxes shall have a minimum AGMA service factor of 2.0 and be designed for the life of the plant. Bearings shall be designed for a minimum L_{10} life of 100,000 hours when the shaft is subjected to a bending moment of three (3) times the normal torque at the fan. Gear Reducers shall be run-in under load and adjusted at the factory. Interior surfaces shall be coated with a rust-proofing oil prior to shipment.
2. Gear boxes shall have an oil level sight glass, fill line, vent line, drain line, a low level switch and grease fittings connections all located outside the fan stack for convenient maintenance access. Adequate lubrication shall be automatically provided for windmilling. All oil lines and components shall be 316 stainless steel. External oil pumps will not be acceptable. Double oil seals shall be employed throughout to eliminate as far as possible the risk of oil leakage or the ingress of moisture. The lubrication system shall ensure that all gearing is totally immersed when the unit is at standstill to protect against corrosion and shall also ensure that adequate lubrication is provided to all elements requiring lubrication when operating.
3. Each cell shall be equipped with an external stainless steel oil level gauge and gear reducer drain line, terminating at a sight glass and plug located outside the fan cylinder near the motor. Lubricating oil fill and drain pipes shall be extended to a convenient point outside the fan stack and, if required, an appropriate air vent should be provided for use during the addition of oil. Oil level indication, which shall be gradated to show, recommended standing and running oil levels. All low level switches shall be completely weatherproof and of corrosion proof construction, SPDT, in a NEMA 4X or greater housing. Switches shall be conveniently located external to the fan stacks and easily accessible for inspection. Each speed reducer shall be equipped with a magnetic cap for protection against burrs present in the lubricating oil.

K. Vibration Monitoring

1. Individual vibration monitoring transducers (Bently-Nevada) shall be provided for each gearbox assembly and shall consist of analog vibration sensing devices for monitoring and trending vibration, and providing alarm and shutdown signals as required. Each group of four (4) cells shall have one Bently-Nevada 1900/65 series vibration monitoring rack located on the fan deck. Each rack shall transmit the analog vibration data to the plant control system using hard-wired 4-20mA signals. Contractor shall supply definite 4-20mA ranges and alarm and trip set points and indicate which standard or criteria were used in selection of the set point. Transducers and monitors shall be mounted in IP66 enclosures.
2. Individual vibration cut-out switches shall be provided for each fan motor which will effectively and safely disconnect the electrical supply to the drive motor in the event of any abnormal vibration of the mechanical equipment. The switches shall be of the manual reset type, which requires resetting before the drive motor can be restarted following its operation and subsequent to clearing the fault. It shall incorporate means of adjusting the response level to allow for normal slight vibrations, which may occur during starting and stopping of the fans. The switches shall be conveniently located external to the fan stacks

and easily accessible for inspection or resetting. All switches shall be completely weatherproof and of corrosion proof construction, Metrix or equivalent, SPDT, in a NEMA 4X or greater housing, with optional remote electrical reset.

L. Fan Stacks

1. The fan stacks shall consist of factory molded FRP segments joined by vibration proof fittings and be self-supporting. Stiffeners, external supports or cables are not permitted. Reinforcing ribs shall be incorporated in the segment moldings external to the airstream surface to provide adequate design strength and rigidity against live loads and mechanical vibrations. Each fan cylinder segment shall be through-bolted to both the fan deck and a primary fan deck framing member. Anchorage by lag screws into the fan deck alone will not be permitted. Fan cylinder connection and anchorage hardware shall be 316L stainless steel. Each stack must have a removable access through which maintenance can be performed on the inside mechanical equipment. A sight glass shall be provided for each fan stack.
2. The fan stacks shall incorporate entrance flares (velocity recovery) flares with extended approach to the fan. Fan cylinders shall be with eased inlets to promote airflow at blade tips. The smooth operating plane of the fan shall be at a level above the fan deck of at least 15% of the overall fan diameter. Fan tip clearance shall not exceed 0.5% of the fan diameter. Velocity recovery fan cylinders shall have a maximum flare angle of 12 degrees, with a maximum assumed velocity recovery of 75% of the difference in average velocity pressure and have an extended diffuser section to aid the above gas diffusion and reduce recirculation. The minimum exit air velocity shall be 30 ft/s at maximum fan speed.

M. Endwalls

1. The endwalls of the tower as well as the sidewalls above the air inlet elevation shall be cased with 8 oz/ft^2 corrugated FRP panels attached to tower columns with 316L stainless steel screw shank fasteners and self sealing washers. Panels shall be installed with corrugations horizontal and shall be lapped to shed water inward to the tower. Joints shall be lapped and sealed watertight. Casing ends at tower corners shall be covered with 12 oz/ft^2 FRP 90 degree corner rolls. To reduce windage losses at the tower corners, the endwalls shall extend around the corners of the tower to cover the beginning 3 ft of the air inlet opening.

2. The casing wall sheeting shall be lapped so as to shed water within the tower confines and shall be opaque to inhibit the growth of algae. The casing walls shall be completely air-tight and effectively prevent air by-passing the designed air entrance.

N. Partition Walls

1. The tower shall be partitioned such that the fan of each cell can be operated and cycled independently of the remaining cells and shall be designed so that each cell can be isolated from water flow during operation and maintenance. Full width, full height, watertight, corrugated FRP panels shall extend from casing to casing across the tower, and from the top of the lowest basin water level upward to the underneath side of the fan deck floor. Each partition shall be rated for minimum fire separation per NFPA 214, with a half hour

fire rating and shall effectively prevent air leakage between adjacent cells, during operation and maintenance. The partitions shall be constructed from minimum 12oz/ft^2 fire retardant fiberglass corrugated panels. Fiberglass panels shall be firmly fixed to the tower structure with 316 stainless steel drive screws or bolts and washers. Nailing shall not be permitted. Cell dividers shall be provided so that the cells shall be totally independent. All divisions must extend a minimum of 20" below top of curb. The partition walls shall be not less than 2".

O. Windwalls

1. A full-length, full height, watertight, corrugated FRP panel partition shall also extend from endwall to endwall along the approximate centerline of the tower, rising from the basin level girt line to the underneath of the fill. Wind walls shall extend inward at an approximate 45 degree angle from the corner columns of the end cells to meet the longitudinal partition. All divisions must extend a minimum of 20" below top of curb.

P. Piping and Valves

1. All piping shall conform to design, installation, testing and inspection requirements of ASME B31.1. Valves shall be appropriate for the pressures and temperatures of each specific application. Contractor shall provide an adequate pipe anchoring system to allow pipe expansion, contraction and resistance to appropriate seismic and operating loads.
2. Flanges for piping 24 inch and smaller shall be in accordance with ASME B16.5. Flanges for piping larger than 24 inch shall be in accordance ASME B16.47 Series A. All FRP flanges, and flanges for connection to the General Managers non-metallic piping, shall be flat faced.
3. FRP piping shall be of the reinforced thermosetting resin type manufactured by the filament wound process using a thermosetting polyester resin reinforced with fiberglass, generally to ASTM D2310 designation NTDD105 and AWWA Standard C950.
4. Where above ground pipework is FRP material, it shall be suitably supported in accordance with manufacturer's requirements and protected from damage from impact or other accidental causes. Pipe joints shall be made only by suitably qualified and experienced tradesmen to a procedure to be approved by the General Manager.
5. Joining and repair procedures for FRP piping shall be developed by the Contractor and included in the plant maintenance manuals. Special tools for the repair of the piping during the life of the cooling tower shall be supplied by the Contractor.

Q. Access and Safety

1. An HDG steel ladder with safety cage fire escape ladder meeting OSHA requirements shall be provided one end of the cooling tower and a FRP stairway. Contractor shall provide handrails and toe boards on the stairway and fan deck to comply with all applicable regulations. Lighting shall be provided on the stairway, ladder, fan deck, and around the tower by Contractor.
2. Each cell shall have a lift-off access hatch in the fan deck floor and a ladder leading down to a landing at the drift eliminator level. Each landing shall have a lift-off hatch for entry to the top of the fill and water distribution level. There shall be a minimum 3 foot crawl space between the top of fill and drift eliminator for access to water nozzles.
3. Fan cylinders shall have easily removable external hatches of sufficient size to permit removal of all mechanical equipment and components. A removable access catwalk shall be provided.

4. All doors providing access into the cooling tower shall be designed to be easily opened from the inside of the tower and shall open outwards. Bolts, locks, catches etc. on such access doors shall be such that they cannot accidentally become fastened, and the door frame shall be designed to avoid future warpage. A device to compensate for the pressure difference when operating shall be fitted to the door. Partition doors shall be fire rated equal to the partition wall fire resistance rating. All means of access to the tower shall be suitably designed to comply with all applicable regulations and shall be adequately lit and guarded.

R. Noise

1. Noise limits shall conform to the Section 480031, Combined Cycle Power Island Noise Control Performance.

S. Lightning Protection

1. Lightning protection per NFPA 780 shall be provided by the BOP Contractor. Pigtails shall be terminated on NEMA 2 hole ground pads 6" above grade. Under no circumstances shall the lightning protection system be comprised of any bare copper or copper alloys; it shall be comprised of either stainless steel or aluminum.

T. Lighting

1. Contractor shall provide a tower lighting system for the fan deck, stairway, and ladder. Lighting shall have a minimum 100 lumen coverage. Light fixtures shall have IP 65 enclosures.
2. Lighting shall not be attached to cooling tower handrails.

U. Instrumentation

1. Refer to Section 481100, Combined Cycle Power Island for instrument calibration requirements.

2.5 ACCESSORIES

A. Insulation

1. Refer to Section 481100 Combined Cycle Power Island for insulation requirements.

B. Equipment Removal System

1. Contractor shall furnish equipment removal system capable of handling the largest single piece of electrical or mechanical equipment.

2.6 FABRICATION

A. Refer to Section 481100 Combined Cycle Power Island for general fabrication, cleaning, finishing, and painting requirements.

2.7 SOURCE QUALITY CONTROL

A. Refer to Section 481100 Combined Cycle Power Island for general source quality control, test, and inspection requirements.

PART 3 - EXECUTION

3.1 COMMISSIONING

A. General

1. The Contractor shall provide onsite commissioning and testing support of the equipment.
2. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning.
3. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon completion.
4. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

B. Commissioning Scope

1. The base scope of the installation and commissioning plan shall provide:

a. Advance knowledge of project schedules, completion dates, and key event dates.
b. General definition of manpower and material resources required.
c. A means of verifying that all critical calibrations, both mechanical and electrical, have been checked.
d. In addition to the documentation that makes up the base scope the Contractor shall include the services of an Installation and Commissioning Manager to monitor and continuously update the plan during the installation and commissioning period.

3.2 TRAINING

A. Refer to Section 481100, Combined Cycle Power Island for general personnel training requirements.

B. Operation and maintenance training shall be provided for up to 10 end user operation and maintenance personnel (not including travel and accommodations) and shall include the following topics:

1. Minor mechanical maintenance
2. Controls and instrumentation
3. Water treatment

C. Prior to award of contract, the Contractor shall provide content of the training program for the General Manager's approval.

END OF SECTION 485491

APPENDIX A – TECHNICAL DATASHEET BY GENERAL MANAGER

Item	Description	Units	Technical Data
1.0	**General**		
	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number		123374
2.0	**Design**		
	Crossflow/Counterflow		Counterflow
	Construction		Fiberglass
	Field Constructed	Yes/No	Yes
	Fan Type		Induced Draft
	Fill Type		Low-clog film fill
	Circulating Water Flow (est.)	gpm	12,300*
	Hot (Inlet) Water Temperature	˚F	107*
	Cold (Outlet) Water Temperature	˚F	83*
	Design Ambient Wet Bulb Temperature	˚F	See 480020, Site Conditions
	Elevation Above Sea Level	ft	See 480020, Site Conditions

*To be determined by Power Island final design

APPENDIX B – TECHNICAL DATASHEET BY CONTRACTOR Data to be furnished during project execution

Item	Description	Units	Technical Data (Contractor to fill in)
1.0	**General**		
	Manufacturer		
	Model No.		
	Number of Towers Required		
	Arrangement (In Line, Back to Back)		
	Cooling Tower Type		
	Design Standard		
	Fill Type		
	Number of Cells per Tower		
2.0	**Performance**		
	Circulating Water Flow	gpm	
	Hot (Inlet) Water Temperature	˚F	
	Cold (Outlet) Water Temperature	˚F	
	Design Ambient Wet Bulb Temperature	˚F	
	Approach (Based on Design Wet Bulb)	˚F	
	Range	˚F	
	Total Dry Air Flow	lb/h	
	Total Flow at Fans	ft^3/min	
	Air Temperature at Outlet	˚F	
	Makeup Water Temperature	˚F	
	Evaporation Loss	gpm	
	Blowdown	gpm	
	Drift Loss (% of Water Flow)	%	(< 0.0005%)
	Design Ambient Relative Humidity	%	
	Relative Humidity at Outlet	%	
	Maximum Ambient Temperature	˚F	
	Design Ambient Dry Bulb Temperature	˚F	
	Tower Site (Ground Level, Roof, Etc.)		Ground Level
	Fill Type		
	Fill Height	ft	
	Fill Volume	ft^3	
	Length of Air Travel	ft	
	Weight Per Tower - Dry / Operating	lb	/
	Access to Tower		
	Number of Ladders		
	Pump Head Above Basin Curb	ft	
	Static Head Above Basin Curb	ft	
	Number Water Inlets per Tower		
	Water Inlet Diameter	in	
	Water Inlet Flange Rating		
	Design Pressure - Headers	psi	
	Water Inlet Height Above Basin Curb	ft	
	Tower Dimensions		
	a) Length	ft	

Item	Description	Units	Technical Data (Contractor to fill in)
	b) Width	ft	
	c) Height	ft	
	Basin Dimensions		
	a) Length	ft	
	b) Width	ft	
	Overall Tower Height	ft	
	Fan Stack Height	ft	
	Water Level Below Curb	ft	
	Depth of Basin Below Curb	ft	
	Column Extensions		
	Basin Floor Sloped		
	Perimeter Below Curb	ft	
	Internal Below Curb	ft	
	Circulating Water Quality		See 480020, Site Conditions
	Wind Rose		See 480020, Site Conditions
3.0	**Materials of Construction**		
	Cooling Tower Structure		
	Water Inlet Headers		
	Framework Member		
	Casing		
	Casing Color		
	Fill		
	Fill Description and Arrangement		
	Fill Supports		
	Drift Eliminators		
	Fan Stack		
	Louvers		
	Fan Deck		
	Cell Partitions - Material		
	a) Standard and Grade		
	b) Treatment and Retention		
	c) Fire Rating	min	
	Distribution System		
	Spray Nozzles		
	Ladders		
	Stairways		
	Structural Connectors		
	Bolts, Nuts, Washers		
	Connectors		
	Valves		
	Anchor Connections		
	Shear Pucks		
	Screws		
	Anchor Bolts		
	Water Basin		Concrete Construction by Others
4.0	**Fans**		
	Manufacturer		

Item	Description	Units	Technical Data (Contractor to fill in)
	Model		
	Number of Fans		
	Number of Fans / Service		
	Fan Type		
	Diameter of Fan	ft	
	Number of Blades per Fan		
	Fan Speed	rpm	
	Tip Speed	ft/s	
	Design Air Flow - Fan	ft^3/s	
	Bhp/Fan @ Design	hp	
	Total Bhp/Service @ Design	hp	
	Static Pressure	in H_2O	
	Velocity Pressure	in H_2O	
	Total Pressure	in H_2O	
	Pitch Angle		
	Pitch		
	Manual Adjustment	Yes/No	
	Automatic Adjustment	Yes/No	
	Blade Material		
	Hub Material		
	Power Source (Volts/Phase/Cycles)		
	Mechanical Efficiency at Design	%	
	Maximum Power Consumption	hp	
5.0	**Speed Reducer**		
	Manufacturer		
	Model		
	Type		
	Gear Ratio		
	Lubrication System		
	Rating	hp	
	Input Shaft Speed	rpm	
	Output Shaft Speed	rpm	
	Service Factor at Driver Rated HP		
	Lubricating Oil Grade		
	Gearbox Casing Material		
	Input / Output Shaft Material		
	Protective Coatings	Yes/No	
	Vibration Monitoring Device		One Per Cell
	a) Manufacturer		
	b) Model		
	c) Supply Voltage		
	d) Protective Coating / Enclosure	Yes/No	
	Vibration Cutout Switches		
	a) Manufacturer		
	b) Model		
6.0	**Drive Shaft**		
	Manufacturer		

Item	Description	Units	Technical Data (Contractor to fill in)
	Model		
	Type		
	Drive Shaft Material		
	Coupling Manufacturer		
	Coupling Material		
	Driveshaft Brake or Anti-Reverse Rotation Device	Yes/No	Yes
	a) Type		

Notes:

1) Contractor to complete all missing information.

2) Exposed FRP or PVC materials shall be UV protected.

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485952

Condensate Polisher

PROJECT NUMBER:
123374

PROJECT CONTACT:
STEVE HARRIS
EMAIL:
STEVE.HARRIS@POWERENG.COM
PHONE:
208-288-6408

POWER ENGINEERS

Section 485952
Condensate Polisher

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *BRIAN HRITSCO*

REVISION HISTORY		
DATE	REVISED BY	REVISION
05/27/2011	B. Hritsco	A
09/09/2011	B. Hritsco	B
12/05/2011	T. Clark	C
02/02/2012	B. Hritsco	D
04/14/2012	T. Clark	E
08/24/2012	G. Drake	F
09/10/2013		G – CONTRACT VERSION

SECTION 485952
CONDENSATE POLISHER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY CONTRACTOR 1
1.3 BY OTHERS 1
1.4 RELATED SECTIONS 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 2
1.7 SYSTEM DESCRIPTION 3
1.8 ALTERNATIVES 3
1.9 SUBMITTALS 4
1.10 QUALITY ASSURANCE 4
1.11 DELIVERY, STORAGE, AND HANDLING 4
1.12 SITE CONDITIONS 4
1.13 WARRANTY 4

PART 2 - PRODUCTS 4

2.1 MANUFACTURERS 4
2.2 MATERIALS AND WELDING 5
2.3 EQUIPMENT 5
2.4 COMPONENTS 5
2.5 ACCESSORIES 6
2.6 CIVIL AND STRUCTURAL 6
2.7 INSTRUMENTATION AND CONTROLS 6

PART 3 - EXECUTION 7

3.1 SPARE PARTS 7
3.2 COMMISSIONING 8

PART 4 - ATTACHMENTS 9

4.1 CONTRACTOR DATA REQUIREMENTS 9
4.2 TECHNICAL DATASHEET BY GENERAL MANAGER 10
4.3 TECHNICAL DATASHEET BY CONTRACTOR 11

SECTION 485952
CONDENSATE POLISHER

PART 1 - GENERAL

1.1 SUMMARY Refer to Attachment 1 – Scope of Supply, Attachment 1 Scope of Supply, Mechanical and Fluid.doc

A. This specification details the minimum technical requirements for the design, manufacture, testing, and furnishing of a condensate polisher skid to treat condensate water flows prior to entering a heat recovery steam generator. The scope includes initial charge of resin, piping, valves, and instrumentation. It is not the intent to specify completely herein all details of design and construction of the equipment and its related auxiliary systems. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantee in a manner acceptable to the General Manager.

B. The Contractor shall have single source responsibility for all equipment furnished under this specification. No departure shall be made from this specification and the referenced standards and codes unless specific requirements are waived or amended in writing by the General Manager.

C. In the event of a perceived conflict among referenced standards, codes and the documents included in this specification, or a perceived conflict between the technical requirements of the specification and the Contractor's ability to meet the performance requirements contained herein, the Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY CONTRACTOR

A. The Contractor shall design, fabricate and test the specified equipment, including but not limited to the following:

1. Packed bed Cation Exchangers including initial charge of resin, piping, valves, and instrumentation.
2. Packed bed Anion Exchangers including initial charge of resin, piping, valves, and instrumentation.
3. brine system
4. Mixed Bed Polishers including initial charge of resin, piping, valves, and instrumentation.
5. Control System to automate operations
6. All instrumentation necessary for control
7. Piping and valves
8. Conduit
9. Pipe and conduit supports
10. Wiring, both power and control
11. Loop checks, instrument calibrations
12. Startup and performance testing
13. Operator training

1.3 BY OTHERS

A. The supply by Others shall be limited to the following:

1. Foundations
2. Power
3. Support foundations for system skid
4. Tie-in of piping, electrical power, and control wiring at system interfaces

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481100, Combined Cycle Power Island

C. Section 261050, Medium Voltage Motors

D. Section 262050, Low Voltage Motors

1.5 CODES AND STANDARDS

A. Refer to 481100 Combined Cycle Power Island for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. American Institute of Steel Construction (AISC)
    a. 341 - Seismic Provisions for Steel Construction
    b. 360 - Steel Construction Manual
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
    a. B1.1 - Unified Inch Screw Threads
    b. B16.34 - Valves-Flanged, Threaded, and Welding End
    c. B16.5 - Steel Pipe Flanges and Flanged Fittings
    d. B16.9 - Factory - Made Wrought Steel Butt Welding Fittings
    e. B16.21 - Non-metallic Flat Gaskets for Pipe Flanges
    f. B31.1 - Power Piping
    g. B31.3 - Process Piping
    h. PTC 19 - Instruments and Apparatus
    i. PTC 36 - Measurement of Industrial Sound
4. American Society for Testing and Materials (ASTM)
    a. A105 - Carbon Steel Forgings for Piping Applications
    b. A312 - Specification for Seamless and Welded Austenitic Stainless Steel Pipe
5. Hydraulic Institute (HI)

1.6 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party employed by the City to oversee construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. Contractor: The Contractor, or individual, partnership, corporation, joint venture, or other legal entity having a Contract with the City to perform the Work specified directly or by reference in Section 481100, Combined Cycle Power Island Equipment.

D. General Manager: The General Manager of the Water and Power Department, or his/her properly authorized agent, representative, or engineer, acting within the scope of the particular duties and authorities delegated to them.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. The System shall be the Contractor's design, modified as required, to comply with this specification. Major equipment shall be of proven design with a minimum of 2 years of successful operation in equal or more severe design and operating conditions as outlined in Technical Datasheet by Contractor.
2. The System shall be designed to provide trouble-free operation during startup, shutdown, and system operating modes.
3. The complete System shall be furnished on a skid mounted assembly. Components on a skid assembly shall be installed properly and completely pre-piped and prewired. Electrical interface connections shall be brought out to junction boxes at the edge of the skid. Contractor/General Manager piping interface connections shall terminate at the skid boundary. Piping shall be supported from skid or equipment.
4. The design of equipment, arrangement of components, and routing of piping and electrical conduit shall consider operation and maintenance accessibility of components. Equipment, piping, and conduit shall be arranged so that when installed, components requiring manipulation, observation, or maintenance will be readily accessible and safe to operating and maintenance personnel.
5. Pneumatic tubing shall be preassembled on skids and run to a common point, and supported adequately with structural steel angles or channels to provide straight runs.

B. Performance Requirements

1. The Contractor shall guarantee that the System will meet the effluent pressure, volumetric flow rate, and quality as specified on the Technical Datasheet by Contractor.

C. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The Contractor shall provide adequate redundancy to meet this requirement. Contractor shall clearly identify which non redundant components or systems are capable of causing a forced outage of the unit in the event of a failure. Contractor shall provide additives for redundancy for these systems and components.

1.8 ALTERNATIVES Contractor will furnish an alternative technology as described in Attachment 1 – Scope of Supply, Attachment 1 Scope of Supply, Mechanical and Fluid.doc

A. The Contractor may provide Alternate Bid(s). Any Alternate Bids proposed by the Contractor shall provide a clear benefit/advantage to the General Manager. The contractor shall state this benefit/advantage in their proposal. The Contractor shall clearly state the technical differences between the Base Bid and any Alternate Bids. Alternate Bids shall be supported with complete technical, performance, and cost data.

B. The Contractor may request alternative materials, equipment, or configurations for consideration provided compliance to requirements of applicable codes is not compromised.

1.9 SUBMITTALS

A. Refer to Attachment 11 – Drawing Schedule

1.10 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping

1. Refer to Section 481100, Combined Cycle Power Island for general packaging and shipping requirements.

1.12 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.13 WARRANTY

A. Refer to Article 13 in the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply equipment specified within this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the Contractor's Proposal.

1. Not Used

2.2 MATERIALS AND WELDING

A. Refer to Section 481100, Combined Cycle Power Island for general material and welding requirements.

2.3 EQUIPMENT

A. Condensate Polisher Skid

1. Condensate Polisher Skid shall contain 2x100% process trains with bypass capability. The skid layout shall be designed to facilitate offsite regeneration of the ion exchange resin vessels.
2. The bypass should be used only to continue to supply feedwater in the event of a malfunction of the condensate polishing system.
3. Condensate polishers shall be equipped with recycle systems to be used when placing vessels in service or prior to startup. The recycle flow will compact the bed and prepare it for condensate flow as well as allow monitoring of each bed's effluent quality as a final quality check.

2.4 COMPONENTS

1. Service Vessels

   a. Service vessels should be constructed according to the ASME Section VIII Code for Unfired Pressure Vessels.
   b. The design pressure for the vessels shall be the highest pressure the vessel can be exposed to, generally the condensate pump shutoff head.
   c. Cylindrical vessels shall be supplied with flanged and dished heads, according to the ASME Code. All connections to service vessels should be with flanged nozzles. Use of pad type flanges should be limited to sight ports only.
   d. Carbon steel vessels shall contain an interior lining to prevent corrosion. Contractor shall provide at least 5 year warranties for their standard linings.
   e. Service vessels shall be equipped with at least two sight glasses, one in the top to confirm resin levels and one at the bottom to allow inspection of the underdrains and to ensure that resin removal is complete.

2. Influent Water Distribution

   a. Inlet distributors shall provide uniform water flow across the surface area of the resin bed and thus uniform flow throughout the resin volume. Condensate flows of approximately 50 gpm/ft^2 through the bed must be maintained to prevent jets and eddies that will fluidize the resin.

3. Underdrains

   a. The vessel underdrain design must provide for uniform flow through the resin bed, allow complete removal of exhausted resin, protect against resin leakage, and provide sufficient support to withstand expected weight and hydraulic forces.

4. Sight Glasses

   a. Sight glasses are required to permit observation of the key steps in the condensate polisher operation. Sight glass installation should assure that a smooth surface is maintained inside the service vessel to prevent resin getting trapped in the sight glass housing.
   b. Sight glasses should be easily accessed and located away from interferences by valves, piping, pumps etc.

5. Resin Traps

   a. Resin traps should be designed to prevent gross ingress of resin into the feedwater system in the event of polisher vessel underdrain damage or failure. Generally, they should not be designed to retain resin fines.
   b. Clean resin trap differential pressure at rated flow rate shall be less than 2 psi.
   c. Trap strainer element capable of withstanding a differential pressure equal to system operating pressure to prevent strainer rupture and release of collected resin and corrosion products.
   d. Backwash and drain connections shall be provided for “in situ” strainer element cleaning.
   e. Resin traps shall be designed for easy removal of strainer element for cleaning or replacement.

6. Service Vessel Piping

   a. Polishing influent and effluent piping materials should be carbon steel or alloy steel, consistent with the piping used for the remainder of the condensate system.

2.5 ACCESSORIES

A. Not Used

2.6 CIVIL AND STRUCTURAL

A. Refer to Section 481100, Combined Cycle Power Island for civil and structural requirements

2.7 INSTRUMENTATION AND CONTROLS

A. General

1. It is the intent of the General Manager to integrate the Contractor's equipment into a Contractor-furnished plant control system (PCS). All control devices furnished by the Contractor shall be capable of interfacing with the plant control system and provide it with sufficient data and status information required for system control and performance monitoring. This includes all data from process sensors furnished by the Contractor. Equipment and controls furnished by the Contractor shall allow the plant control system to remotely start and stop all rotating equipment and to allow automatic switch over to any backup units.

2. Instrumentation and controls plan shall be designed such that no single instrument fault will cause a trip of the plant.
3. The Contractor shall permanently install a 1-1/4 inch stainless steel identification tag in a conspicuous location on each instrument and control device. The tag shall bear General Manager's specified “Instrument Tag Number” to be provided later. The Contractor shall use this tag number when reference is made to any tagged device in correspondence, engineering documentation, or any other communication with General Manager.
4. All skid mounted control and instrument wiring shall be provided with cable identification tags on the main cable trunk and individual conductors shall be uniquely identified and tagged at both termination points. Provisions shall be made for wiring of non-skid mounted devices. Special cables or termination kits if required for flame scanners, ignition transformers, etc. shall be provided by the Contractor for installation by the BOP Contractor.
5. The control philosophy shall provide a high level of plant automation. Sufficient operator interface devices are to be provided to enable safe start-up, operation, and shutdown. Roving operators place some auxiliary equipment into operation manually at the equipment location or at a motor control center to establish ready-to-start status.
6. The control system shall provide protective features to enable safe operation. The system shall have built-in logic and circuitry to alarm, annunciate, and trip as a result of abnormal operating conditions. Logic is to be designed to provide interlocks to improve plant availability and guidance to the operator about design limits.
7. Plant systems and equipment are to be monitored and/or controlled through the plant control system. Packaged systems with self-contained controllers are only to have high-level monitoring and starting interfaces to the plant control system.
8. All instrument tubing shall be stainless steel and fittings shall be Swagelok or equivalent.
9. All pneumatic and motor operated on/off valves shall have control room indication of open and closed status via two DPDT position limit switches or proximity switches, unless noted otherwise.
10. Contractors control system shall utilize a control platform that integrates well with the General Managers Plant Control System which will be Rockwell’s RSLogix 5000.

B. Instrumentation & Control Devices – Requirements

1. 3-wire, 100-ohm platinum RTDs shall be used.
2. Should thermocouples be used, appropriate junction devices shall be supplied for use with thermocouple conductors where necessary to avoid cold junction signal distortion.
3. Thermowells shall be a minimum of 3/4 inch diameter drilled solid bar type with taper. Thermowell body shall be long enough to clear General Manager furnished insulation.
4. Electronic transmitters shall be Yokagawa, Endress & Hauser, or SMAR smart transmitters.
5. Control valves and pressure regulators shall be manufactured by Fisher.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481100 Combined Cycle Power Island for spare parts requirements.

3.2 COMMISSIONING

A. General

1. The Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning.
2. The Contractor shall arrange and supply any test or additional instrumentation required for all commissioning or performance testing, but shall retain ownership of and have the right to remove and take away from site such commissioning and test equipment upon completion.
3. The Contractor shall submit a detailed and comprehensive plan which describes the commissioning and testing of the plant and equipment that is within the scope of supply in accordance with the timetable that is specified by the contract program but not later than 3 months prior to the commencement of site testing.

B. Field Acceptance Tests

1. Refer to Section 481100 Combined Cycle Power Island for general field acceptance test requirements.

END OF SECTION 485952

PART 4 - ATTACHMENTS

4.1 CONTRACTOR DATA REQUIREMENTS - Data to be furnished during project execution

4.2 TECHNICAL DATASHEET BY GENERAL MANAGER

Item	Description	Units	Technical Data
1.0	**General**		
	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number		123374
2.0	**Performance Guarantees**		
2.1	Condensate Flow Rate (est.)	gpm	240
	Pressure Drop	psid	By Contractor
	Design Pressure Range (est.)	psia	100 to 125
	Design Temperature Range (est.)	°F	75 to 110
2.2	**Water/Condensate Quality (The Stricter of the OTSG Manufacturer's Requirements or Below)***		

Parameter	City Raw Water	On Site Treated Demin Water	Polisher Product Requirement
pH	7.6 to 8.2	6 to 8	9.3 to 9.6
Specific Conductivity	**704 µS/cm**	**2.5 µS/cm**	< 0.15 µS/cm
ORP	**511 mV**	**349 mV**	0 to +100 mV
TOC	**2,800 ppb**	**1100 ppb**	< 100 ppb
TSS	nil	**nil**	nil
TDS	**451,000 ppb**	**2,000 ppb**	N/A
Dissolved O_2	N/A	N/A	< 7 ppb
Hydrazine	N/A	N/A	0 to 10 ppb
Sodium	**56,900 ppb**	**56 ppb**	< 6 ppb
Chloride	**79,600 ppb**	**nil**	< 6 ppb
Sulfate	**113,000 ppb**	**1,210 ppb**	< 6 ppb
Silica	**12000 ppb**	**nil**	< 20 ppb
Iron	**147 ppb**	**nil**	< 10 ppb
Copper	**nil**	**nil**	< 2 ppb
Hardness	**182,000 ppb**	**5,000 ppb**	< 1 ppb

* Updated with Demin Water analysis from American Scientific Laboratories, LLC dated 05/03/2012, sent to Art Silva of Pasadena Water and Power

4.3 TECHNICAL DATASHEET BY CONTRACTOR

Item	Description	Units	Data
1.0	**General**		
	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
	Project Number		123374
1.1	**Polisher**		
	Polisher Type		
	Vessel Quantity		
	Vessel Diameter		
	Vessel Height		
	Materials of Construction		
	ASME Code Stamp		
	Internal Lining		
	External Coating		
1.2	**Accessories:**		
	Pressure Indicator		
	Thermal Relief Valve		
	Differential Pressure Switch		
	Flow Transmitter		
2.0	**Performance Guarantees**		
2.1	**Design Conditions**		
	Design Flow Rate	gpm	
	Design Pressure Range	psia	
	Design Temperature Range	°F	
	Pressure Drop @ Design	psid	
2.2	**Polisher Effluent Achievable**		
	Parameter		
	pH		
	Conductivity	µS/cm	
	ORP	mV	
	TOC	ppb	
	TSS	ppb	
	TDS	ppb	
	Dissolved O_2	ppb	
	Hydrazine	ppb	
	Sodium	ppb	
	Chloride	ppb	
	Sulfate	ppb	
	Silica	ppb	
	Iron	ppb	
	Copper	ppb	
	Hardness	ppb	

CleaverBrooks®

LOW EMISSIONS, COMPACT, QUIET

INSTANTANEOUS ELECTRIC RESISTANCE BOILER



Models: S, CR, WB, HSB & IWH

Steam and Hot Water

12-3375 kW • 208-600V

Electric Boilers

Features

Compact, economical units that deliver maximum output with minimum space requirements. Ideal for new boiler applications or as a replacement unit to upgrade existing installations.

Steam boiler models S, CR & HSB along with hot water boiler model WB take up less floor area and fits through smaller openings than large conventional units. The instantaneous hot water boilers, IWH Model, are also designed with a compact floor plan.

The Electric boiler is one of the many products Cleaver-Brooks offers to meet your boiler room needs. Performance and reliability in a small package.

Why an Electric Boiler?

Cleaver-Brooks Electric Boilers are designed for heavy duty commercial and industrial heating needs. They serve as either a primary or supplementary source of both hot water and steam. These immersion element boilers are quiet, flame-free and compact. Electric boilers completely eliminate the need for stacks and emission control. C-B electric water boilers use resistance elements as a source of heat while keeping water volume as low as possible to allow close control and rapid response.

Advantages

Compact Design

The smaller footprint reduces the overall boiler room space requirement.

No Stack or Fuel Requirements

The unit can be located anywhere in the building and the exterior of the building is not compromised with an unsightly stack, particularly helpful in tall or high rise buildings.

Typical Applications



Universities and Schools



Hospitals and Clinics



Commercial Buildings

Emissions

Electric boilers are 100% local emission free. This is beneficial in meeting the total emissions of a given project site, or in areas where fuel combustion emissions are limited.

Quiet Operation

Elimination of combustion noise and minimal moving parts results in extremely quiet operation.

High Efficiency

The electric boiler will provide nearly 100% efficiency at all operating points.

Ease of Maintenance

The absence of higher maintenance combustion equipment and the use of solid state control devices reduce the complexity and number of moving parts. Electric elements are very accessible and easily replaceable, either individually or in flange mounted groups.

Lower Operating Cost

For areas affected by allocations or interruptions of natural gas and costly oil supplies, electric boilers provide a dependable source of steam or hot water. Electric boilers offer a clean, alternative to fossil fuels allowing users to take advantage of lower energy rates during daily or seasonal off-peak periods.

Quality Construction

ISO 9001:2001 certified manufacturing processes ensure the highest compliance with manufacturing standards.

Each unit is tested and certified in accordance with UL or cUL and a label is affixed attesting to meeting the latest requirements for packaged electric boilers.

Progressive Sequencing Modulation

By individually controlling the heating elements with solid-state digital step controllers only the amount of electrical energy required in response to the system demand is used. In addition virtually a full range of input control is available with optional solid-state analog current controllers that reduce on/off cycling while providing unprecedented load tracking, and thus reduced operating costs.

Standard Features

Boiler:

- ASME Code Vessel
- UL Listed
- Integral Steel Frame
- Incoloy 800 Heating Elements
- Fiberglass Insulation
- ASME Pressure Relief Valves

Trim:

- Proportional Pressure (Temperature on WB & IWH) Control on most sizes
- Manual Reset High Pressure (Temperature on WB & IWH) Control
- Auxiliary Low Water Cut-off (Low Water Cut-Off on WB & IWH)
- Auxiliary Auto High Water Cut-off
- Pilot Light: Control Power On, Low Water, High Pressure (Temperature on WB & IWH)

Electrical Equipment:

- 200,000 AIC Rated Fuses
- Contactors rated at 500,000 Cycles
- Control Circuit Step-Down Transformer
- Customer Connection Terminal Strip
- Primary Lugs Connection Lugs



Model-WB Boiler



Simple to use Interface



Control Panel

TECHNICAL DATA

Product Type	Model	Vessel Diameter (inches)	Output (KW)	Design Pressure (PSIG)
Hot Water Boilers	WB	12	12-288	160, 200 & 250
		20	300-576	
		24	570-1200	
		36	1224-2160	
		42	1830-3360	
Vertical Steam Boilers	S	12	12-48	15,150, 200 & 250
		16	15-141	
		20	135-281	
		24	210-480	
		30	440-720	
		36	750-1031	
		42	1020-1688	
		48	1380-2250	
Vertical Steam Boilers with Condensate Return Tank & Pump	CR	12	12-56	15, 150, 200 & 250
		16	15-164	
		20	135-281	
		24	210-563	
Horizontal Steam Boilers	HSB	42	1560-3375	15, 150, 200 & 250
Instantaneous Water Heater	IWH	6	15-30	160
		8	45-240	
		10	210-360	

ELECTRIC BOILER VESSEL DIAGRAMS



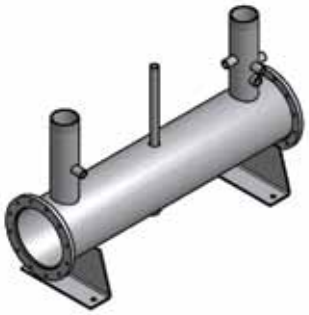
Model WB



Model S and CR



Model HSB



Model IWH

CleaverBrooks®

221 Law Street · Thomasville, GA 31792
414-359-0600 · 800-250-5883
info@cleaverbrooks.com · cleaverbrooks.com

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ELECTRIC BOILER SPECIFICATIONS

CAPACITIES B4-2
STORAGE TANK HEATER CAPACITY B4-2
BOILER B4-2
HEATING ELEMENTS B4-2
TRIM AND CONTROLS B4-3
WARRANTY B4-3

SAMPLE SPECIFICATIONS

The following sample specifications are provided by Cleaver-Brooks to assist you in meeting your customer's specific needs and application.

PART 1 GENERAL

1.1 CAPACITIES

A. Boiler Capacity - Hot Water

1. The _____ gallon _____ capacity hot water boiler shall be Cleaver-Brooks Model _____ rated _____ kW at _____ V, _____ ph, 60 Hz, _____ MBtu/hr. Unit shall be suitable to operate under the following conditions: system flow rate _____ gpm; outlet water temperature _____ °F; return water temperature _____ °F; system operating pressure _____ psig.

B. Boiler Capacity - Steam

1. The _____ gallon _____ capacity steam boiler shall be Cleaver-Brooks Model _____ rated _____ kW at _____ V, _____ ph, 60 Hz. Unit shall produce _____ lbs steam/hr (from and at 212 °F) at a nominal pressure of _____ psig.

C. Water Heater Capacity - Instantaneous

D. The horizontal circulation water heater shall be Cleaver-Brooks Model IWH _____ rated _____ kW at _____ V, _____ ph, 60 Hz.

1.2 STORAGE TANK HEATER CAPACITY

The _____ gallon capacity (horizontal or vertical) shall be Cleaver-Brooks Model _____ rated kW at _____ V, _____ ph, 60 Hz, and shall recover _____ gpm at 100 °F rise.

PART 2 PRODUCTS

2.1 BOILER

A. The vessel shall be constructed in accordance with ASME Boiler Code.

B. The vessel shall be designed for _____ psig.

C. The relief valve shall be per ASME Code, set at _____ psig.

D. The vessel shall be insulated with a double wrap of 2-inch fiber blanket insulation having 1-1/2 PCF density.

E. The boiler shall be UL listed, and bear the Underwriters Laboratories' label.

F. The boiler shall be of the packaged type, factory assembled, wired, and tested.

G. The boiler shall be mounted on a full size structural steel base.

H. The boiler enclosure shall be 16-gauge steel.

I. The entire enclosure shall be finished in light blue enamel paint.

J. The overall dimensions of the boiler shall be _____ inches long, _____ inches wide, and _____ inches high.

K. For CR Models, the boiler shall include built-in condensate receiver and feed pump, with make-up valve mounted on common base with boiler, factory wired and piped, and enclosed in boiler casing.

2.2 HEATING ELEMENTS

A. The heating elements shall be individually mounted, rod type, and field replaceable with standard tools.

B. The heating watt density shall not exceed _____ (50 or 75) W/sq-in.

C. The heating elements shall be (copper or Incoloy) sheathed.

2.3 TRIM AND CONTROLS

A. The units shall be complete with the following:

1. Main lugs for supply circuits.
2. Supplemental internal branch circuit fuses, current limiting, rated at 200,000 amps interrupting capacity.
3. Fused 120 V control circuit transformer.
4. Magnetic contactors rated at 500,000 cycles.
5. Integral high temperature limit (hot water boilers).
6. High pressure limit (steam boilers).
7. Low water cutoff (float-type with gauge glass for steam) on all models except IWH which is supplied with a flow switch.
8. Pressure-temperature gauge (hot water boilers).
9. Pressure gauge (steam boilers).
10. Pilot switch.
11. Pilot lights for power on, low water, high temperature or pressure.
12. Relief valve.
13. Drain valve (hot water boilers).
14. Bottom and water column blowdown valves (steam boilers).
15. Feedwater stop and check valves (steam boilers).
16. All models except IWH shall be supplied with modulating step controls to gradually apply the load in _____ steps.
17. All models except IWH shall be supplied with proportioning temperature (hot water units) or pressure (steam units) control to balance power input to match system demand.
18. Temperature control on IWH is one of the following methods (select a. or b. or c. below).
    a. Thermostats - The heating elements shall be staged by control thermostats. (Standard for one and two step heaters).
    b. Sequencer - The heating elements shall be staged by a time delay sequencer, to energize heating elements in _____ stages with an adjustable 1 to 15 second time delay between stages. (Standard for 3 or 4 step heaters.)
    c. Modulating Step Control - (Standard for heaters above 4 steps).

PART 3 EXECUTION

3.1 WARRANTY

A. The Cleaver-Brooks unit shall be warranted against defective workmanship and materials for a period of one year from the date of start- up or 18 months from shipment.

NOTES

ELECTRIC RESISTANCE BOILERS
STEAM OR HOT WATER



c UL us

CONTENTS

FEATURES AND BENEFITS B37-3
PRODUCT OFFERING B37-4
Standard Equipment - Steam Boilers B37-4
Standard Equipment - Water Boilers B37-6
Optional Equipment B37-8
DIMENSIONS AND RATINGS B37-9
PERFORMANCE DATA B37-31
ENGINEERING DATA B37-32
SAMPLE SPECIFICATIONS B37-39

ILLUSTRATIONS

Figure B4-1. Model WB Dimensions B37-10
Figure B4-2. Model S Dimensions B37-11
Figure B4-3. Model CR Dimensions B37-12
Figure B4-4. Model HSB Dimensions B37-13
Figure B4-5. Model IWH Dimensions B37-14

TABLES

Table B4-1. Standard product offering B37-9
Table B4-2. Model WB Ratings 208V, 240V Supplies B37-15
Table B4-3. Model WB Ratings 380V, 415V Supplies B37-16
Table B4-4. Model WB Ratings 480V, 600V Supplies B37-18
Table B4-5. Model S/CR Ratings 208V, 240V Supplies B37-21
Table B4-6. Model S/CR Ratings 380V, 415V Supplies B37-22
Table B4-7. Model S/CR Ratings 480V Supplies B37-24
Table B4-8. Model S/CR Ratings 600V Supply B37-26
Table B4-9. Model HSB Ratings 380V, 415V Supply B37-28
Table B4-10. Model HSB Ratings 480V Supply B37-28
Table B4-11. Model HSB Ratings 600V Supply B37-29
Table B4-12. Model IWH Ratings 208V, 240V Supplies B37-30
Table B4-13. Model IWH Ratings 380V, 415V Supplies B37-30
Table B4-14. Model IWH Ratings 480V, 600V Supplies B37-31
Table B4-15. Model WB Max Flow Ratings B37-33
Table B4-16. Model WB Minimum Over Pressure Requirements B37-35
Table B4-17. kW per pound of steam B37-36
Table B4-18. Electric Boilers Required Water Quality Parameters B37-37

This section contains information on the complete line of Cleaver-Brooks electric boilers with kilowatt output ratings from 12 to 3,375 kW. Electric boilers are typically utilized for applications where stringent environmental regulations and boiler space requirements are critical.

FEATURES AND BENEFITS

In applications where electric power is more economically available than fossil fuels, or where fossil fuel combustion and the handling of combustion by-products are unacceptable, electric boilers offer a viable alternative.

Compact Design

Electric boilers are typically one-quarter to one-half the size of fuel fired boilers with similar BTU per hour output. The smaller footprint reduces the overall boiler room space.

No Stack Requirements

With no products of combustion to contend with, installation costs are reduced by the elimination of stack requirements. This means the unit can be located anywhere in the building and the exterior of the building is not compromised with an unsightly stack, particularly helpful in tall or high rise buildings.

Emissions

Because there is no combustion, electric boilers are 100% emission free. This is beneficial in meeting total emissions of the project site or in areas where fuel combustion emissions are not tolerated.

Quiet Operation

Elimination of combustion noise and minimal moving parts results in extremely quiet operation, virtually no noise emissions. Very beneficial in applications such as hospitals, nursing homes, schools, and the like.

High Efficiency

With minimum radiation losses and not having the losses associated with combustion equipment the electric boiler will provide nearly 100% efficiency at all operating points.

Ease of Maintenance

The absence of high maintenance combustion equipment and the use of solid state control devices reduce the complexity and number of moving parts.

Electric elements are easily accessible and replaceable either individually or in flange mounted groups.

Pressure vessel components are not subjected to thermal stresses induced by high temperature differentials and cycling encountered with fossil fuel combustion.

Quality Construction

ISO 9001:2001 certified manufacturing process ensures the highest degree of manufacturing standards are always followed.

ASME Code construction ensures high quality design, safety, third party inspection, and reliability, and stamped accordingly.

Each unit is tested and certified in accordance with UL or cUL and the Label is affixed attesting to meeting the latest UL requirements for packaged electric boilers.

Progressive Sequencing Modulation

By individually controlling the heating the heating elements with solid state digital step controllers, only the amount of heat required in response to the system demand is achievable. Virtually unlimited input control is available with optional solid state analog current controllers, which reduces on/off cycling, excellent load tracking, and reduced operating costs.

Designed For Heating Applications

Electric boilers are able to withstand virtually any return water temperature. With combustion by-products and high temperature differentials eliminated, condensation and thermal shock do not limit return water temperatures.

Because of the design characteristics, the electric boiler is well suited for applications utilizing indoor/outdoor reset controls, radiant floor heating, snow melt systems, and ground source heat pump systems

For potable water applications, the IWH can be used with the optional epoxy lining or with the optional stainless steel trim.

PRODUCT OFFERING

Information in this section applies to electric resistance steam or hot water boiler sizes ranging from 12 kW through 3375 kW for operation on 208, 240, 380, 480, 575 or 600 volts, thee phase power supplies. Installation is for indoor use only.

The complete package has been tested and certified in accordance with U.L. and is approved, listed, and bears the U.L label (U.S.A. and Canada) for electric resistance boilers. For Canada, each vessel is registered in each Province and the relative CRN number is attached to the boiler.

Dimensions, ratings, and product information may change to meet current market requirements and product improvements. Therefore, use this information as a guide.

Refer to Table B4-1 as a quick reference guide to the boiler models and sizes provided.

Standard Equipment – Steam Boilers

Equipment described below is for the standard steam electric boilers offering:

A. Model CR and S Boiler

1. Each boiler is designed and constructed in accordance with the A.S.M.E. Code; UL listed, and are mounted on an integral steel frame. Fiberglass insulation (2" thickness) is covered with a preformed, sectional steel painted jacket, factory installed.
2. Trim and Controls:
   a. Manual Reset High Pressure Cutoff.
   b. Probe Aux. Low Water Cutoff, MR.
   c. Aux. Auto High Pressure Cutoff.
   d. For S/CR-120 through 161:
      - 1-Step (1) on/off pressure switch.
      - 2-Step (2) on/off pressure switch.
   e. For Models S/CR 162 and greater:
      - Solid state electronic proportional pressure control with progressive step control with adjustable span and inter-stage time delay.
   f. Primary Low Water Cutoff and On/Off Pump Controller.
   g. Bottom and Water Column Blowdown Valves.
   h. Feedwater Stop and Check Valves.

i. A.S.M.E Pressure Relief Valve(s).

j. Steam Pressure Gauge w/test cock.

k. Sight Gauge with drain and guards.

3. Model CR Boilers include an integral Feedwater Tank and Feedwater Pump Assembly piped and wired.

4. Electric Equipment

   a. Main Control Panel. Panel door key lock is standard on all S Models 422 and 480.

   b. Lugs for the primary power supply, top of panel ingress as standard.

   c. Fuses for each contactor, 200,000 Amps interrupting capacity (AIC).

   d. Contactors duty rated @ 500,000 cycles.

   e. Pilot lights for "Control Power On", "High Pressure", "Low Water", and "Steps".

   f. 67 watts per square inch (WSI) or 78 WSI @ 600V Incoloy 800 heating elements.

   g. Control Circuit Step-down Transformer with primary and secondary fuses and secondary control power switch.

   h. Terminal strip for control wiring and external customer connections.

5. Vessel Inspection Openings:

   - S/CR120 to S/CR 162: Element Flange.
   - S/CR200 to S/CR302: 3" Half Coupling.
   - S361 and larger: 12" x 16" Manway.

B. Model HSB Boiler

1. Each boiler is designed and constructed in accordance with the A.S.M.E. Code; UL listed, and are mounted on an integral steel frame. Fiberglass insulation (2" thickness) is covered with a preformed, sectional steel painted jacket, factory installed.

2. Trim and Controls:

   a. Manual Reset High Pressure Cutoff.

   b. Probe Aux. Low Water Cutoff, MR.

   c. Aux. Auto High Pressure Cutoff.

   d. Solid state electronic proportional pressure control with progressive step control with adjustable span and inter-stage time delay.

   e. Primary Low Water Cutoff and On/Off Pump Controller.

   f. Bottom and Water Column Blowdown Valves.

   g. Feedwater Stop and Check Valves.

   h. A.S.M.E Pressure Relief Valve(s).

   i. Steam Pressure Gauge w/test cock.

   j. Sight Gauge with drain and guards.

3. Electric Equipment

   a. Main Control Panel with panel door key lock.

b. Lugs for the primary power supply, top of panel ingress as standard.

c. Fuses for each contactor, 200,000 Amps interrupting capacity (AIC).

d. Contactors duty rated @ 500,000 cycles.

e. Pilot lights for "Control Power On", "High Pressure", "Low Water", and "Steps".

f. 75 watts per square inch (WSI) "Incoloy-800" heating elements.

g. Control Circuit Step-down Transformer with primary and secondary fuses and secondary control power switch.

h. Terminal strip for control wiring and external customer connections.

4. Vessel Inspection Openings:

- HSB-301 to HSB-302: 3" Half Coupling.
- HSB-361 and larger: 12" x 16" Manway.

Standard Equipment – Water Boilers

Equipment described below is for the standard hot water electric boilers offering:

A. Model WB Boiler

1. The Model WB boiler is designed and constructed in accordance with the A.S.M.E. Code; UL listed, and are mounted on an integral steel frame. Fiberglass insulation (2" thickness) is covered with a preformed, sectional steel painted jacket, factory installed.

2. Trim and Controls:

a. Manual Reset High Temperature Cutoff.

b. Probe Low Water Cutoff, auto reset.

c. Aux. Auto High Temperature Cutoff.

d. For WB-120:

- 1-Step (1) on/off temperature switch.
- 2-Step (2) on/off temperature switch.
- 3-Step (1) 3-stage electronic temperature control.
- 4-Step (1) 4-stage electronic temperature control.

e. For Models WB 121 and above:

- Solid state electronic proportional temperature control with progressive step control with adjustable span and inter-stage time delay.

f. Bottom drain valve.

g. A.S.M.E Pressure Relief Valve(s).

h. WB120: Separate Pressure and temperature gauge.

i. WB-121 and above: Separate Pressure Gauge and Digital Temperature Readout.

3. Electric Equipment

a. Main Control Panel. Panel door key lock is standard on WB Models > 930kW.

b. Lugs for the primary power supply, top of panel ingress as standard.

c. Fuses for each contactor, 200,000 Amps interrupting capacity (AIC).

d. Contactors duty rated @ 500,000 cycles.

e. Pilot lights for "Control Power On", "High Temperature", "Low Water", and "Steps".

f. 75 watts per square inch (WSI) "Incoloy-800" heating elements.

g. Control Circuit Step-down Transformer with primary and secondary fuses and secondary control power switch.

h. Terminal strip for control wiring and external customer connections.

4. Vessel Inspection Openings:

WB-120 to WB-200: Element Flange.

WB-201 to WB-243: 3” Half Coupling.

WB-361 and larger: 12" x 16" Manway.

B. Model IWH Heater

1. The Model IWH water heater is designed and constructed in accordance with the A.S.M.E. Code; UL listed, and are mounted on an integral steel frame. Fiberglass insulation (2" thickness) is covered with a preformed, sectional steel painted jacket, factory installed.

2. Trim and Controls:

a. Manual Reset High Temperature Cutoff.

b. Water Flow Switch - shipped loose.

c. Aux. Auto High Temperature Cutoff.

d. Stage Controls for 15 - 240 kW:

1-Step (1) on/off temperature switch.
2-Step (2) on/off temperature switch.
3-Step (1) 3-stage electronic temperature control.
4-Step (1) 4-stage electronic temperature control.

1) For 270 kW and greater:

Solid state electronic proportional temperature control with progressive step control with adjustable span and inter-stage time delay.

e. Bottom drain valve.

f. A.S.M.E Pressure Relief Valve(s).

g. Pressure and Temperature gauges.

3. Electric Equipment

a. Lugs for the primary power supply, top of panel ingress as standard.

b. Fuses for each contactor, 200,000 Amps interrupting capacity (AIC).

c. Contactors duty rated @ 500,000 cycles.

d. Pilot lights for "Control Power On", "High Temperature", "Low Water", and "Steps".

e. 75 watts per square inch (WSI) "Incoloy-800" heating elements.

f. Control Circuit Step-down Transformer with primary and secondary fuses and secondary control power switch.

g. Terminal strip for control wiring and external customer connections.

4. Vessel Inspection Openings:

   Element Flange.

Optional Equipment

For option details, contact the local authorized Cleaver-Brooks representative. In summary, here are the options that can be provided with the boiler:

- Output step enable/disable toggle switches.
- Additional Pilot Lights.
- Alarm relays for remote annunciation.
- Alarm Horn with silence switch.
- Safety Door Interlock.
- Outdoor reset control.
- Time Clock.
- Ammeter.
- Voltmeter.
- Kilowatt hour meter.
- Ground Fault Detection.
- Pneumatic control interface (3-15 or 6 - 30 psig to 0 - 145 ohms.)
- Load limiting module.
- Auxiliary Low Water Cutoff.
- Preheat Switch for elements.
- Manual Disconnect Switches.
- Shunt Trip for disconnect switches.
- Main Power Door Interlock (standard with switchgear below 600 AMPS).
- Blowdown Separators.
- Water Softener.
- Chemical Feed Systems.
- SCR controls
- Local/Remote control
- BMS interface
- Return water baffle
- Conductivity control

Optional choices also available for nozzles, inspection hand holes, and valves.

Table B4-1. Standard product offering

Product Type	Boiler Model	Output (kW)	Element Density (W/sq in)	Water Content (gallons)	Design Pressure (psig)	Notes
Hot water boilers	WB	12 - 3360	75	16 - 500	160, 200, 250	1
Steam boilers	S	12 - 2250	67 or 78@600V	16 - 595	15, 150, 200, 250	1
	CR	12 - 563	67 or 78@600V	16 - 115	15, 150, 200, 250	1, 2
	HSB	1560 - 3375	75	180 - 790	15, 150, 200, 250	1
Instantaneous Water Heaters	IWH	15 - 360	75	135 - 360*	160	1

Notes: 1. Heating elements are of Incolloy-800 construction
2. Model CR identical to Model S but has integral condensate return tank and pump.

A. 'Water content' not applicable. Flow rate in GPM is listed.

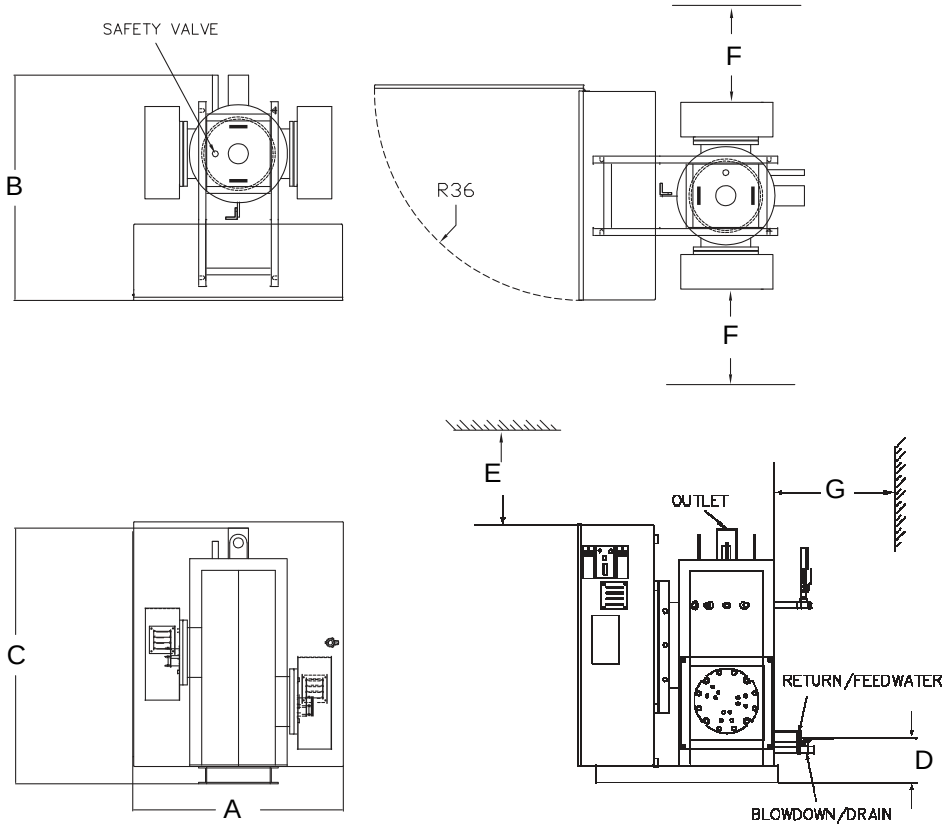
DIMENSIONS AND RATINGS

For layout purposes, the overall dimensions for the Electric Boilers are shown in **Figures B4-1 through B4-5** including the various pipe connections sizes for supply and return water, drain, and steam supply.

Specific ratings of each model are noted in **Tables B4-2 through B4-14**. These tables provide the ampacity at the various supply voltages, element ratings, and contactors employed in the standard models.

Altitude

Because the electric boiler does not require combustion air, installation of the boiler at any elevation is possible without derating or providing special devices for altitude correction normally associated with fuel combustion. Thus the ratings shown are for all elevations.



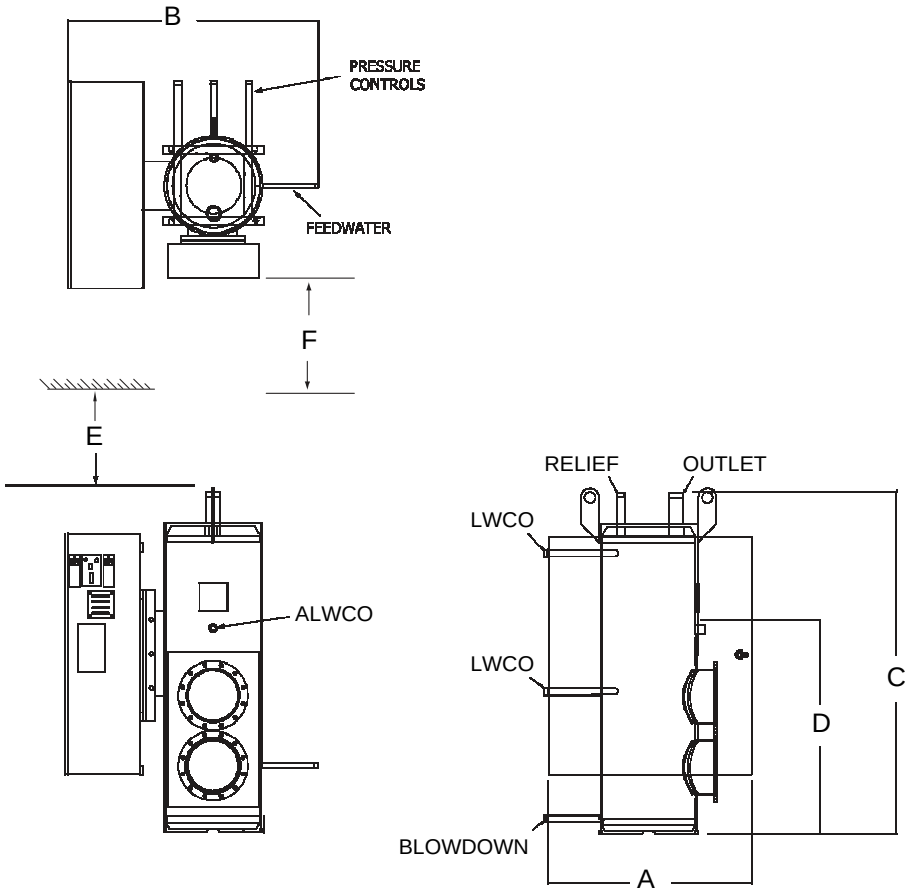
MODEL NO	CONNECTION SIZE (NPT)			DIMENSIONS (IN.)				CLEARANCES			APPROXIMATE WEIGHTS (LBS.)	
				WIDTH	DEPTH	HEIGHT	INLET	TOP	SIDES	REAR	SHIPPING	OPERATING
	SUPPLY	RETURN	DRAIN	A	B	C	D	E	F	G		
WB-120	2	2	3/4	25	36	45	8	12	16	12	450	580
WB-121	3	3	3/4	32	36	45	8	12	16	12	500	630
WB-122	3	3	3/4	32	36	61	8	12	16	12	800	1005
WB-201	4 *	4 *	1-1/4	38	44	71	19	18	16	18	1400	2040
WB-202	4 *	4 *	1-1/4	38	48	71	19	18	16	18	1500	2140
WB-241	6 *	6 *	1-1/2	44	54	75	21	18	25	18	2200	3200
WB-242	6 *	6 *	1-1/2	48	60	75	21	18	25	18	2400	3400
WB-243	6 *	6 *	1-1/2	48	60	83	21	18	25	18	2800	3980
WB-361	6 *	6 *	1-1/2	56	74	75	24	24	30	24	3300	5260
WB-362	8 *	8 *	1-1/2	60	74	92	24	24	30	24	3600	6220
WB-363	8 *	8 *	2	72	76	104	24	24	30	36	4200	7280
WB-421[A]	10 *	10 *	2	76	76	104	24	24	33	36	5800	9300
WB-422[A]	10 *	10 *	2	76	95	111	24	24	33	36	6500	10500

NOTES: Dimensional heights are for the boiler only. Control panel size varies based on the number of steps and optional equipment.

A. These models normally supplied with 2 control cabinets for 2 power supplies.

*These are flange connections; 150# ANSI.

Figure B4-1. Model WB Dimensions

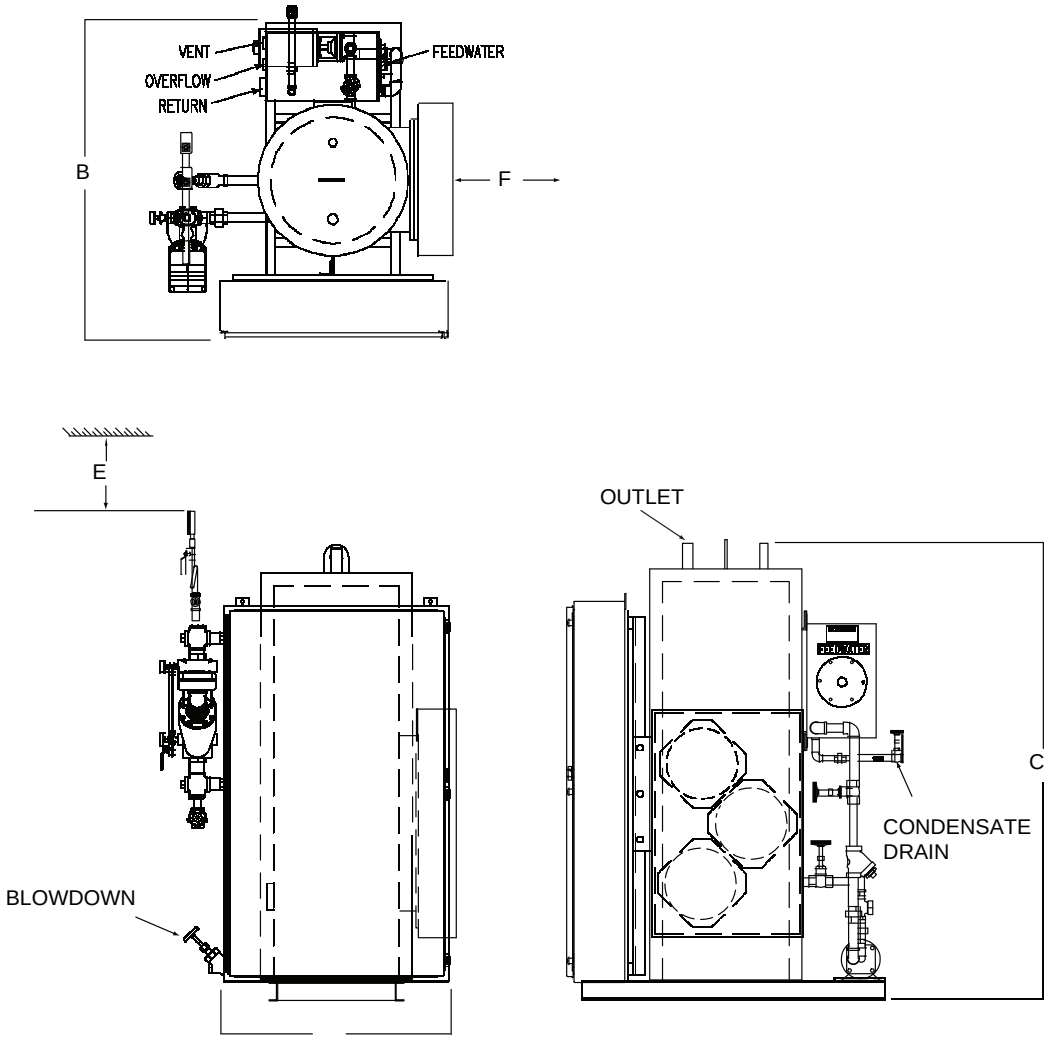


MODEL NO	CONNECTION SIZE (NPT)					DIMENSIONS (IN.)				CLEARANCES		APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET*		FEED-WATER	WIDTH	DEPTH	HEIGHT	LWCO	TOP	SIDES	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG		A	B	C	D	E	F		
S-120	3/4	3/4	1-1/2	1-1/4	1/2	38	38	58	18	12	16	600	675
S-161	3/4	3/4	2	1-1/4	1/2	44	42	69	35	12	20	750	880
S-162	3/4	3/4	2	2	1/2	44	42	69	35	12	20	800	930
S-200	1	1	3 flg	2	3/4	46	47	76	42	12	20	1150	1480
S-241	1-1/4	1	4 flg	2	3/4	43	58	78	42	12	20	1400	1900
S-242	1-1/4	1	4 flg	2	3/4	43	58	78	42	12	20	1600	2000
S-301	1-1/2	1	6 flg	3 flg	3/4	49	62	94	50	15	20	2100	3000
S-302	1-1/2	1	6 flg	3 flg	3/4	49	66	94	50	15	20	2200	3300
S-361	1-1/2	1	8 flg	4 flg	3/4	56	72	79	41	18	36	2900	4000
S-362	1-1/2	1	8 flg	4 flg	3/4	56	78	94	52	18	36	3200	4800
S-421	1-1/2	1	8 flg	4 flg	1	62	84	82	44	18	36	4150	5800
S-422	1-1/2	1	8 flg	4 flg	1	62	84	94	52	18	36	4500	6700
S-480	2	1-1/4	10 flg	6 flg	1	72	90	104	52	18	36	5450	8000

NOTES: Dimensional heights are for the boiler only. Control Panel size varies based on the number of steps and optional equipment.

* Steam Outlet is MPT connection unless otherwise noted.

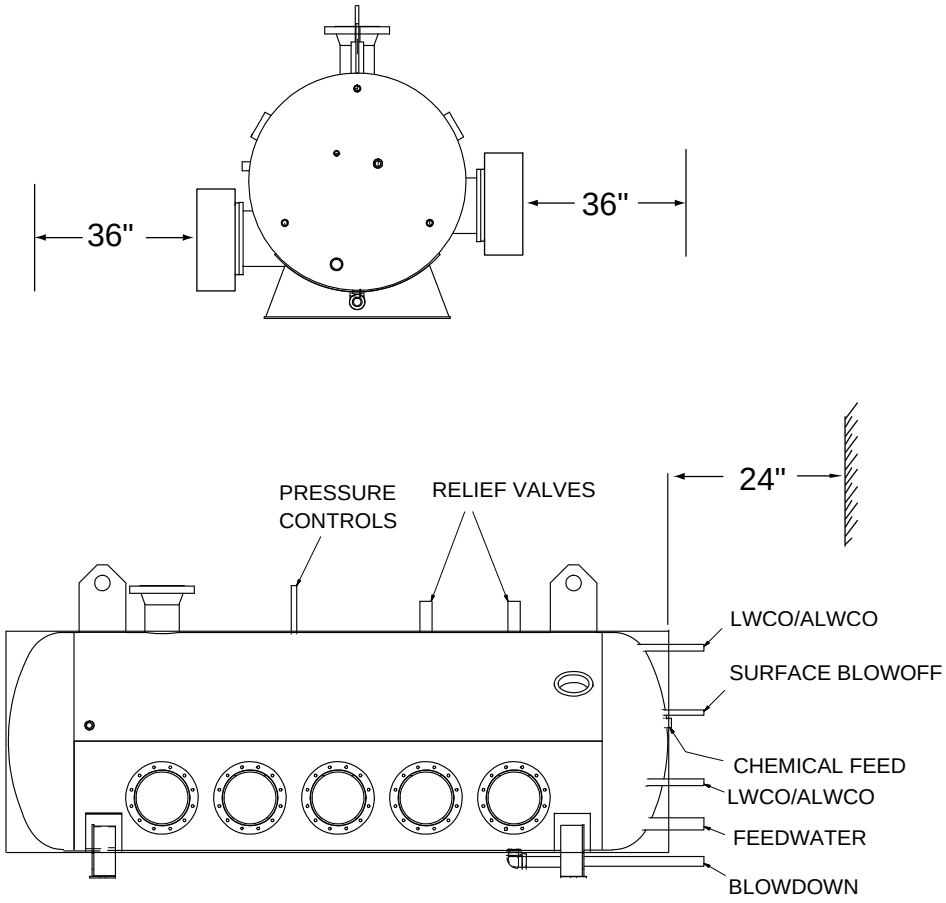
Figure B4-2. Model S Dimensions



MODEL NO	CONNECTION SIZE (NPT)						DIMENSIONS (IN.)				CLEARANCES		APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET*		COND. RETURN	OVER-FLOW	WIDTH	DEPTH	HEIGHT	LWCO	TOP	SIDES	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG			A	B	C	D	E	F		
CR-120	3/4	3/4	1-1/2	1-1/4	3/4	3/4	40	46	58	18	12	16	850	950
CR-161	3/4	3/4	2	1-1/4	1	1	44	50	69	35	12	20	1050	1200
CR-162	3/4	3/4	2	2	1	1	44	50	69	35	12	20	1150	1280
CR-200	1	1	3 flg	2	1-1/4	1-1/4	48	54	76	42	12	20	1650	2030
CR-241	1-1/4	1	4 flg	2	1-1/2	1-1/2	43	58	78	42	12	20	2000	2600
CR-242	1-1/4	1	4 flg	2	1-1/2	1-1/2	43	58	78	42	12	20	2200	2700

* Steam Nozzle connection is MPT unless noted otherwise

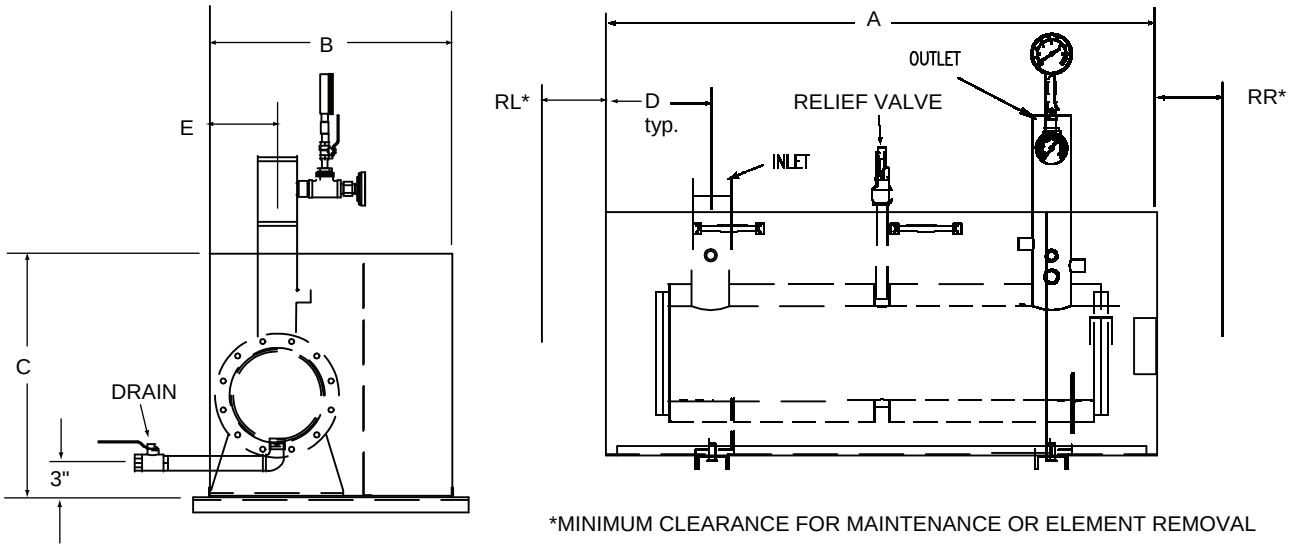
Figure B4-3. Model CR Dimensions



MODEL NO	CONNECTION SIZE (NPT)*					DIMENSIONS (IN.)				CLEARANCES		APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET*		FEED-WATER	WIDTH	DEPTH	HEIGHT	LWCO	TOP	SIDES	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG		A	B	C	D	E	F		
HSB-423	2	1-1/2	10	4	1	155	70	72	34	24	36	5700	8000
HSB-424	2	1-1/2	10	6	1	172	72	72	34	24	36	6400	9300
HSB-425	2	1-1/2	10	6	1	189	72	72	34	24	36	7100	10600

NOTES: Dimensional heights are for the boiler only. Control Panel size varies based on the number of steps and optional equipment.
* Steam Outlet is 150# ANSI Flange connection unless otherwise noted.

Figure B4-4. Model HSB Dimensions



*MINIMUM CLEARANCE FOR MAINTENANCE OR ELEMENT REMOVAL

MODEL NO	CONNECTION SIZE (NPT)			DIMENSIONS (IN.)					CLEARANCES			APPROXIMATE WEIGHTS (LBS.)	
				WIDTH	DEPTH	HEIGHT	INLET	INLET	LEFT	RIGHT	FRONT	SHIPPING	OPERATING
	SUPPLY	RETURN	DRAIN	A	B	C	D	E	RL	RR			
IWH-611	2	2	3/4	30	30	36	11	12	14	14	36	250	295
IWH-811	3	3	3/4	30	32	38	11	12	14	14	36	450	525
IWH-812	3	3	3/4	60	32	38	11	12	14	14	36	450	525
IWH-822	3	3	3/4	60	32	38	11	12	25	25	36	500	630
IWH-022	3 *	3 *	3/4	60	34	40	11	12	25	25	36	600	810

NOTES: Dimensional heights are for the boiler only. Control panel size varies based on the number of steps and optional equipment.
*For flow rates above 240 gpm, specify 4" flanged connections.

Figure B4-5. Model IWH Dimensions

Table B4-2. Model WB Ratings 208V, 240V Supplies

MODEL	Vessel Capacity (gallons)	Rated kW	MBTU/HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	208/240 V	208/240 V	208 V	240 V
WB-120	16	12	41	3	4	1	1@12	34	30
		18	61	3	6	1	1@18	51	44
		24	82	6	4	2	1@24	68	59
		30	102	6	5	2	1@30	84	73
		36	123	6	6	2	1@36	101	87
		45	154	9	5	3	1@30,1@15	126	109
		54	184	9	6	3	1@36,1@18	151	131
		60	205	12	5	4	2@30	167	145
		72	246	12	6	4	2@36	201	174
WB-121	16	90	307	15	6	5	2@36,1@18	251	217
		108	368	18	6	6	3@36	301	261
		126	430	21	6	7	3@36,1@18	351	304
		144	491	24	6	8	4@36	401	347
		162	553	27	6	9	4@36,1@18	451	391
WB-122	25	180	614	30	6	10	5@36	501	434
		198	676	33	6	11	5@36,1@18	551	477
		216	737	36	6	12	6@36	601	521
		234	798	39	6	13	6@36,1@18	651	564
		252	860	42	6	14	7@36	701	607
		270	921	45	6	15	7@36,1@18	751	651
		288	983	48	6	16	8@36	801	694
B-201	78	324	1105	54	6	18	6@54	901	781
		360	1228	60	6	20	4@54,4@36	1001	868
		396	1350	66	6	22	6@54,2@36	1101	954
		432	1474	72	6	24	8@54	1201	1041

Table B4-3. Model WB Ratings 380V, 415V Supplies

MODEL	Vessel Capacity (gallons)	Rated kW	MBTU/ HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	380/415 V	380/415 V	380 V	415 V
WB-120	16	**15**	51	3	5	1	1@15	23	21
		30	102	6	5	1	1@30	46	42
		45	154	9	5	2	1@15, 1@30	68	63
		60	205	12	5	2	2@30	91	83
		75	256	15	5	3	1@15, 2@30	114	104
WB-121	16	**90**	307	18	5	3	3@30	137	125
		105	358	21	5	4	1@15, 3@30	160	146
		120	409	24	5	4	4@30	182	167
		135	461	27	5	5	1@15, 4@30	205	188
		150	512	30	5	5	5@30	228	209
		165	563	33	5	6	1@15, 5@30	251	230
WB-122	25	**180**	614	36	5	6	6@30	273	250
		195	665	39	5	7	1@15, 6@30	296	271
		210	717	42	5	7	7@30	319	292
		225	768	45	5	8	1@15, 7@30	342	313
		240	819	48	5	8	8@30	365	334
		270	921	54	5	9	7@30, 1@60	410	376
WB-201	78	**300**	1024	60	5	10	6@30, 2@60	456	417
		330	1126	66	5	11	5@30, 3@60	501	459
		360	1228	72	5	12	4@30, 4@60	547	501
		390	1331	78	5	13	3@30, 7@60	593	543
WB-202	78	**420**	1433	84	5	14	2@30, 6@60	638	584
		450	1535	90	5	15	1@30, 7@60	684	626
		480	1638	96	5	16	8@60	729	668
		510	1740	51	10	17	3@30, 7@60	775	710
		540	1842	54	10	18	2@30, 8@60	820	751
WB-241	122	**570**	1945	57	10	19	1@30, 9@60	866	793
		600	2047	60	10	20	10@60	912	835
		630	2150	63	10	21	3@30, 9@60	957	876
		660	2252	66	10	22	2@30, 10@60	1003	918
		690	2354	69	10	23	1@30, 11@60	1048	960
		720	2457	72	10	24	12@60	1094	1002
		750	2559	75	10	25	11@60, 1@90	1140	1043
		780	2661	78	10	26	10@60, 2@90	1185	1085
		810	2764	81	10	27	9@60, 3@90	1231	1127
WB-242	122	**840**	2866	84	10	28	8@60, 4@90	1276	1169
		870	2968	87	10	29	7@60, 5@90	1322	1210
		900	3071	90	10	30	6@60, 6@90	1367	1252
		930	3173	93	10	31	5@60, 7@90	1413	1294
		960	3276	96	10	32	4@60, 8@90	1459	1336

Table B4-3. Model WB Ratings 380V, 415V Supplies (Continued)

MODEL	Vessel Capacity (gallons)	Rated kW	MBTU/ HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	380/415 V	380/415 V	380 V	415 V
WB-243	142	**990**	3378	99	10	33	3@60, 9@90	1504	1377
		1020	3480	102	10	34	2@60, 10@90	1550	1419
		1050	3583	105	10	35	1@60, 11@90	1595	1461
		1080	3685	108	10	36	12@90	1641	1503
		1110	3787	111	10	37	5@60, 9@90	1687	1544
		1140	3890	114	10	38	4@60, 10@90	1732	1586
		1170	3992	117	10	39	3@60, 11@90	1778	1628
		1200	4094	120	10	40	2@60, 12@90	1823	1669
WB-362	315	**1230**	4197	123	10	41	1@60, 13@90	1869	1711
		1260	4299	126	10	42	14@90	1914	1753
		1290	4401	129	10	43	5@60, 11@90	1960	1795
		1320	4504	132	10	44	4@60, 12@90	2006	1836
		1350	4606	135	10	45	3@60, 13@90	2051	1878
		1380	4709	138	10	46	2@60, 14@90	2097	1920
		1410	4811	141	10	47	1@60, 15@90	2142	1962
		1440	4913	144	10	48	16@90	2188	2003
WB-363	370	**1470**	5016	147	10	49	5@60, 13@90	2233	2045
		1500	5118	150	10	50	4@60, 14@90	2279	2087
		1530	5220	153	10	51	3@60, 15@90	2325	2141
		1560	5323	156	10	52	2@60, 16@90	2370	2170
		1590	5425	159	10	53	1@60, 17@90	2416	2212
		1620	5527	162	10	54	18@90	2461	2254
		1650	5630	165	10	55	17@90, 1@120	2507	2296
		1680	5732	168	10	56	16@90, 2@120	2553	2337
		1710	5835	171	10	57	15@90, 3@120	2598	2379
		1740	5967	174	10	58	14@90, 4@120	2644	2421
		1770	6039	177	10	59	13@90, 5@120	2689	2463
		1800	6142	180	10	60	12@90, 6@120	2735	2504
WB-421	425	**1830**	6244	183	10	61	11@90, 7@120	2780	2546
		1860	6346	186	10	62	10@90, 8@120	2826	2588
		1890	6449	189	10	63	9@90, 9@120	2872	2629
		1920	6551	192	10	64	8@90, 10@120	2917	2671
		1950	6653	195	10	65	7@90, 11@120	2963	2713
		1980	6756	198	10	66	6@90,12@120	3008	2755

Table B4-3. Model WB Ratings 380V, 415V Supplies (Continued)

MODEL	Vessel Capacity (gallons)	Rated kW	MBTU/ HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	380/415 V	380/415 V	380 V	415 V
WB-422	500	**2010**	6858	201	10	67	5@90, 13@120	3054	2796
		2040	6960	204	10	68	4@90, 14@120	3100	2838
		2070	7063	207	10	69	6@90, 15@120	3145	2880
		2100	7165	210	10	70	2@90, 16@120	3191	2922
		2130	7268	213	10	71	1@90, 17@120	3236	2963
		2160	7370	216	10	72	18@120	3282	3005
		2190	7472	219	10	73	23@90, 1@120	3327	3047
		2220	7575	222	10	74	22@90, 2@120	3373	3089
		2250	7677	225	10	75	21@90, 3@120	3419	3130
		2280	7779	228	10	76	20@90, 4@120	3464	3172
		2310	7882	231	10	77	19@90, 5@120	3510	3214
		2340	7984	234	10	78	18@90, 6@120	3555	3256
		2370	8086	237	10	79	17@90, 7@120	3601	3297
		2400	8189	240	10	80	16@90, 8@120	3647	3339
		2430	8291	243	10	81	15@90, 9@120	3692	3381
		2460	8394	246	10	82	14@90, 10@120	3738	3422
		2490	8496	249	10	83	13@90, 11@120	3783	3464
		2520	8598	252	10	84	12@90, 12@120	3829	3506

Table B4-4. Model WB Ratings 480V, 600V Supplies **Model**	Vessel Capacity (gallons)	Rated kW	MBTU/HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	480/600 V	480/600 V	480 V	600 V
WB-120	16	12	41	3	4	1	1 @ 12	15	13
		18	61	3	6	1	1 @ 18	22	18
		24	82	6	4	1	1 @ 24	30	24
		30	102	6	5	1	1 @ 30	37	29
		36	123	6	6	1	1 @ 36	44	35
		45	154	9	5	2	1 @ 45	55	44
		54	184	9	6	2	1 @ 54	66	53
		60	205	12	5	2	2 @ 30	73	58
		72	246	12	6	2	2 @ 36	87	70
WB-121	16	90	307	15	6	3	2 @ 36, 1 @18	109	87
		108	368	18	6	3	3 @ 36	131	105
		126	430	21	6	4	3 @36, 1 @18	152	122
		144	491	24	6	4	4 @ 36	174	139
		162	553	27	6	5	3 @36, 1 @54	196	157
		180	614	30	6	5	5 @ 36	212	174
		198	676	33	6	6	5 @36, 1@18	239	191
		216	737	36	6	6	6 @ 36	261	209
		234	798	39	6	7	6 @36, 1 @18	282	226
		252	860	42	6	7	7 @ 36	304	243

		270	921	45	6	8	7 @36, 1 @18	326	261
		288	983	48	6	8	8 @ 36	347	278
WB-201	78	324	1105	54	6	9	3 @72, 3 @36	391	313
		360	1228	60	6	10	2 @72, 6 @36	434	347
		396	1350	66	6	11	3 @72, 5 @36	477	382
		432	1474	72	6	12	4 @72, 4 @36	521	417
WB-202	78	468	1597	78	6	13	5 @72, 3 @36	564	451
		504	1720	84	6	14	6 @72, 2 @36	607	486
		540	1842	90	6	15	7 @72, 1 @36	651	521
		576	1965	96	6	16	8 @72	694	555
WB-241	122	600	2047	60	10	20	10 @ 60	723	579
		630	2150	63	10	21	3 @30, 9 @60	759	607
		660	2252	66	10	22	2 @30, 10 @60	795	636
		690	2354	69	10	23	1@30, 11 @60	831	665
		720	2457	72	10	24	12 @60	868	694
WB-242	122	750	2559	75	10	25	5 @90, 5 @60	904	723
		780	2661	78	10	26	6 @90, 4 @60	940	752
		810	2764	81	10	27	7 @90, 3 @60	976	781
		840	2866	84	10	28	8 @90, 2 @60	1012	810
		870	2968	87	10	29	9 @90, 1 @60	1048	838
		900	3071	90	10	30	10 @ 90	1084	868
		930	3173	93	10	31	7 @90, 5 @60	1120	896
		960	3276	96	10	32	8 @90, 4 @60	1157	925
WB-243	142	990	3378	99	10	33	9 @90, 3 @60	1193	954
		1020	3480	102	10	34	10 @90, 2 @60	1229	983
		1050	3583	105	10	35	11 @90, 1 @60	1265	1012
		1080	3685	108	10	36	12 @ 90	1301	1041
		1110	3787	111	10	37	9@90, 5@60	1337	1070
		1140	3890	114	10	38	10 @90, 4 @60	1373	1099
		1170	3992	117	10	39	11 @90, 3 @60	1409	1128
		1200	4094	120	10	40	12 @90, 2 @60	1446	1157

Table B4-4. Model WB Ratings 480V, 600V Supplies (Continued)

Model	Vessel Capacity (gallons)	Rated kW	MBTU/HR	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty	kW	480/600 V	480/600 V	480 V	600 V
WB-361	235	1224	4176	102	12	34	10 @108, 2 @72	1474	1180
		1260	4299	105	12	35	11 @108, 1 @72	1518	1214
		1296	4422	108	12	36	12 @ 108	1561	1249
WB-362	315	1332	4545	111	12	37	9 @108, 5 @72	1605	1284
		1368	4668	114	12	38	10 @108, 4 @72	1648	1318
		1404	4790	117	12	39	11 @108, 3 @72	1691	1353
		1440	4913	120	12	40	12 @108, 2 @72	1735	1388
		1476	5036	123	12	41	13 @108, 1 @72	1778	1422
		1512	5159	126	12	42	14 @ 108	1821	1457
		1548	5282	129	12	43	11 @108, 5 @72	1865	1492
		1584	5405	132	12	44	12 @108, 4 @72	1908	1527
		1620	5527	135	12	45	13 @108, 3 @72	1951	1561
		1656	5650	138	12	46	14 @108, 2 @72	1995	1596
		1692	5773	141	12	47	15 @108, 1 @72	2038	1631
		1728	5896	144	12	48	16 @ 108	2081	1665
WB-363	370	1764	6019	147	12	49	13 @108, 5 @ 72	2125	1700
		1800	6142	150	12	50	14 @108, 4 @ 72	2168	1735
		1836	6264	153	12	51	15 @108, 3 @ 72	2211	1769
		1872	6387	156	12	52	16 @108, 2 @ 72	2255	1804
		1908	6510	159	12	53	17 @108, 1 @ 72	2298	1839
		1944	6633	162	12	54	18 @ 108	2342	1873
		1980	6756	165	12	55	15 @108, 5 @ 72	2385	1908
		2016	6879	168	12	56	16 @108, 4 @ 72	2428	1943
		2052	7001	171	12	57	17 @108, 3 @ 72	2472	1977
		2088	7124	174	12	58	18 @108, 2 @ 72	2515	2012
		2160	7370	180	12	60	20 @ 108	2602	2081
WB-421	425	2240	7643	168	13.3	56	16 @120, 4 @ 80	2698	2158
		2320	7916	174	13.3	58	18 @ 120, 2 @ 80	2794	2236
		2400	8189	180	13.3	60	20 @ 120	2891	2313
		2480	8462	186	13.3	62	2 @160, 18 @120	2987	2390
		2560	8735	192	13.3	64	4 @160, 16 @120	3083	2467
		2640	9008	198	13.3	66	6 @160, 14 @120	3180	2544
WB-422	500	2720	9281	204	13.3	68	8 @160, 12 @120	3276	2621
		2800	9554	210	13.3	70	10 @160, 10 @120	3372	2698
		2880	9827	216	13.3	72	12 @160, 8 @120	3469	2775
		3000	10236	225	13.3	75	15 @160, 5 @120	3613	2891
		3040	10372	228	13.3	76	16 @160, 4 @120	3661	2929
		3120	10509	234	13.3	78	18 @160, 2 @120	3758	3006
		3200	10645	240	13.3	80	20 @ 160	3854	3083
		3280	11191	246	13.3	82	2 @200, 18 @160	3950	3160
		3360	11464	252	13.3	84	4 @200, 16 @160	4047	3237

Table B4-5. Model S/CR Ratings 208V, 240V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS	# of CONTACTORS		NUMBER and kW of STEPS	3-PHASE AMPERES	
					Qty	kW	208/240 V	208/240 V	208 V	240 V
S-120 or CR-120	9	7	12	42	3	4	1	1 @ 12	34	30
			24	84	6	4	2	1 @ 24	68	59
			36	126	9	4	3	1 @ 36	101	88
			48	168	12	4	4	2 @ 24	134	116
S-161 or CR-161	23	16	60	210	9	6.7	3	1 @40, 1 @20	168	145
			80	280	12	6.7	4	2 @ 40	223	193
S-162 or CR-162	23	16	100	350	15	6.7	5	2 @40, 1 @20	279	242
			120	420	18	6.7	6	3 @ 40	334	290
			140	490	21	6.7	7	3 @ 40, 1 @ 20	390	338
S-200 or CR-200	48	26	160	560	24	6.7	8	4 @ 40	445	386
			180	630	27	6.7	9	4 @40, 1 @20	501	434
			200	700	30	6.7	10	5 @ 40	556	482
			220	770	33	6.7	11	5 @40, 1 @ 20	612	530
			240	840	36	6.7	12	6 @ 40	667	578
S-241 or CR-241	62	53	260	910	39	6.7	13	6 @40, 1 @ 20	723	626
			280	980	42	6.7	14	7 @ 40	778	675
			300	1050	45	6.7	15	7 @ 40, 1 @ 20	834	723
			320	1120	48	6.7	16	8 @ 40	889	771
S-242 or CR-242	62	53	340	1190	51	6.7	17	8 @ 40, 1 @ 20	945	819
			360	1260	54	6.7	18	2 @ 60, 6 @ 40	1000	867
			380	1330	57	6.7	19	3 @ 60, 5 @ 40	1056	915
			400	1400	60	6.7	20	4 @ 60, 4 @ 40	1111	963

Table B4-6. Model S/CR Ratings 380V, 415V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212°F	No. of Elements Qty @ kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
								380 V	415 V
S-161 or CR-161	23	16	15	51	3 @ 5	1	1 @ 15	**23**	**21**
			30	102	6 @ 5	1	1@30	46	42
			45	154	9 @ 5	2	1@15, 1@30	68	63
			60	205	12 @ 5	2	2@30	91	83
S-162 or CR-162	23	16	75	256	15 @ 5	3	1@15, 2@30	114	104
			90	307	18 @ 5	3	3@30	137	125
			105	358	21 @ 5	4	1@15, 3@30	160	146
			120	409	24 @ 5	4	4@30	182	167
S-200 or CR-200	48	26	135	461	27 @ 5	5	1@15, 4@30	205	188
			150	512	30 @ 5	5	5@30	228	209
			165	563	33 @ 5	6	1@15, 5@30	251	230
			180	614	36 @ 5	6	6@30	273	250
S-241 or CR-241	62	53	210	717	21 @ 10	7	7@30	319	292
			240	819	24 @ 10	8	8@30	365	334
S-242 or CR-242	62	53	270	921	27 @ 10	9	7@30, 1@60	410	376
			300	1024	30 @ 10	10	6@30, 2@60	456	417
			330	1126	33 @ 10	11	5@30, 3@60	501	459
			360	1228	36 @ 10	12	4@30, 4@60	547	501
			390	1331	39 @ 10	13	3@30, 5@60	593	543
			420	1433	42 @ 10	14	2@30, 6@60	638	584
			450	1535	45 @ 10	15	1@30, 7@60	684	626
			480	1638	48 @ 10	16	8@60	729	668
S-301	110	53	510	1740	51 @ 10	17	3@30, 7@60	775	710
			540	1842	54 @ 10	18	2@30, 8@60	821	752
			570	1945	57 @ 10	19	1@30, 9@60	867	793
			600	2047	60 @ 10	20	10@60	912	835
			630	2150	63 @ 10	21	3@30, 9@60	958	877
			660	2252	66 @ 10	22	2@30, 10@60	1003	919
			690	2354	69 @ 10	23	1@30, 11@60	1049	960
			720	2457	72 @ 10	24	12@60	1094	1002
S-362	200	130	750	2559	75 @ 10	25	11@60, 1@90	1140	1044
			780	2661	78 @ 10	26	10@60, 2@90	1186	1086
			810	2764	81 @ 10	27	9@60, 3@90	1231	1127
			840	2866	84 @ 10	28	8@60, 4@90	1277	1169
			870	2968	87 @ 10	29	7@60, 5@90	1322	1211
			900	3071	90 @ 10	30	6@60, 6@90	1368	1253
			930	3173	93 @ 10	31	5@60, 7@90	1413	1294
			960	3276	96 @ 10	32	4@60, 8@90	1459	1336
			990	3378	99 @ 10	33	3@60, 9@90	1505	1378
S-421	210	180	1020	3480	102 @ 10	34	2@60, 10@90	1550	1420
			1050	3583	105 @ 10	35	1@60, 11@90	1596	1461
			1080	3686	108 @ 10	36	12@90	1641	1503

Table B4-6. Model S/CR Ratings 380V, 415V Supplies (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212°F	No. of Elements Qty @ kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
								380 V	415 V
S-422	270	180	1110	3787	111 @ 10	37	5@60, 9@90	1687	1545
			1140	3890	114 @ 10	38	4@60, 10@90	1733	1586
			1170	3992	117 @ 10	39	3@60, 11@90	1778	1628
			1200	4094	120 @ 10	40	2@60, 12@90	1824	1670
			1230	4197	123 @ 10	41	1@60, 13@90	1869	1712
			1260	4299	126 @ 10	42	14@90	1915	1753
			1290	4401	129 @ 10	43	5@60, 11@90	1960	1795
			1320	4504	132 @ 10	44	4@60, 12@90	2006	1837
			1350	4606	135 @ 10	45	3@60, 13@90	2052	1879
S-480	360	235	1380	4709	138 @ 10	46	2@60, 14@90	2097	1920
			1410	4811	141 @ 10	47	1@60, 15@90	2142	1962
			1440	4913	144 @ 10	48	16@90	2188	2003
			1470	5016	147 @ 10	49	5@60, 13@90	2233	2045
			1500	5118	150 @ 10	50	4@60, 14@90	2279	2087
			1530	5220	153 @ 10	51	3@60, 15@90	2325	2129
			1560	5323	156 @ 10	52	2@60, 16@90	2370	2170
			1590	5425	159 @ 10	53	1@60, 17@90	2416	2212
			1620	5527	162 @ 10	54	18@90	2461	2254

Table B4-7. Model S/CR Ratings 480V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of Contactors	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	480 V	480 V	480 V
S-120 or CR-120	9	7	12	42	3	4	1	1 @ 12	15
			24	84	6	4	1	1 @ 24	29
			36	126	9	4	1	1 @ 36	44
			48	168	12	4	2	2 @ 24	58
S-161 or CR-161	23	16	60	210	9	6.7	2	1 @40, 1 @20	73
			80	280	12	6.7	2	2 @ 40	97
S-162 or CR-162	23	16	100	350	15	6.7	3	2 @40, 1 @20	121
			120	420	18	6.7	3	3 @ 40	145
			140	490	21	6.7	4	3 @40, 1 @20	169
S-200 or CR-200	48	26	160	560	24	6.7	4	4 @ 40	193
			180	630	27	6.7	5	4 @40, 1 @20	217
			200	700	30	6.7	5	5 @ 40	241
			220	770	33	6.7	6	5 @40, 1 @20	265
			240	840	36	6.7	6	6 @ 40	289
S-241 or CR-241	62	53	260	910	39	6.7	7	6 @40, 1 @20	314
			280	980	42	6.7	7	7 @ 40	338
			300	1050	45	6.7	8	7 @40, 1 @20	362
			320	1120	48	6.7	8	8 @ 40	386
S-242 or CR-242	62	53	340	1190	51	6.7	9	8 @40, 1 @20	410
			360	1260	54	6.7	9	1 @80, 7 @40	434
			380	1330	57	6.7	10	1@80,6@40,1@60	458
			400	1400	60	6.7	10	2 @80, 6 @40	482
			420	1470	63	6.7	11	2@80,5@40,1@60	506
CR-242	62	53	440	1540	66	6.7	11	3 @80, 5 @40	530
			460	1610	69	6.7	12	3@80,4@40,1@60	554
			480	1680	72	6.7	12	4 @80, 4 @40	578
S-301	110	70	440	1540	66	6.7	11	3 @80, 5 @40	530
			460	1610	69	6.7	12	3@80,4@40,1@60	554
			480	1680	72	6.7	12	4 @80, 4 @40	578
S-302	140	90	500	1750	75	6.7	13	4 @80, 3 @40, 1@60	603
			520	1820	78	6.7	13	5 @80, 3 @40	627
			540	1890	81	6.7	14	5 @80, 2 @40, 1@60	651
			560	1960	84	6.7	14	6 @80, 2 @40	675
			580	2030	87	6.7	15	6 @80, 1 @40, 1@60	699
			600	2100	90	6.7	15	7 @80, 1 @40	723
			620	2170	93	6.7	16	7 @80, 1 @60	747
			640	2240	96	6.7	16	8 @ 80	771
			660	2310	99	6.7	17	6 @80, 3 @40, 1@60	795
			680	2380	102	6.7	17	7 @80, 3 @40	819
			700	2450	105	6.7	18	7 @80, 2 @40, 1@60	843
			720	2520	108	6.7	18	8 @ 80, 2 @40	867

Table B4-7. Model S/CR Ratings 480V Supplies (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of Contactors	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	480 V	480 V	480 V
S-361	150	100	756	2646	63	12	21	9 @72, 3 @36	911
			792	2772	66	12	22	10 @72, 2 @36	954
			828	2898	69	12	23	11 @72, 1 @36	998
			864	3024	72	12	24	12 @ 72	1041
S-362	200	130	900	3276	75	12	25	12 @72, 1 @36	1084
			936	3402	78	12	26	13 @ 72	1128
			972	3528	81	12	27	13 @72, 1 @36	1171
			1008	3780	84	12	28	14 @ 72	1214
S-421	210	140	1044	3654	87	12	29	14 @72, 1 @36	1258
			1080	3780	90	12	30	15 @ 72	1301
			1116	3906	93	12	31	15 @72, 1 @36	1344
			1152	4032	96	12	32	16 @ 72	1388
			1188	4158	99	12	33	16 @72, 1 @36	1431
			1224	4284	102	12	34	17 @ 72	1474
			1260	4410	105	12	35	17 @72, 1 @36	1518
			1296	4536	108	12	36	18 @ 72	1560
S-422	270	180	1332	4662	111	12	37	18 @ 72, 1 @36	1605
			1368	4788	114	12	38	19 @ 72	1648
			1404	4914	117	12	39	19 @ 72, 1 @36	1691
S-480	360	235	1440	5040	120	12	40	20 @ 72	1735
			1476	5166	123	12	41	9 @108, 7 @72	1778
			1512	5290	126	12	42	10 @108, 6 @72	1821
			1548	5418	129	12	43	11 @108, 5 @72	1864
			1584	5540	132	12	44	12 @108, 4 @72	1908
			1620	5670	135	12	45	13 @108, 3 @72	1951
			1656	5790	138	12	46	14 @108, 2 @72	1995
			1692	5922	141	12	47	15 @108, 1 @72	2038
			1728	6050	144	12	48	16 @ 108	2081
			1764	6174	147	12	49	13@108, 5@72	2125
			1800	6300	150	12	50	14@108, 4@72	2168
			1836	6426	153	12	51	15@108, 3@72	2211
			1872	6552	156	12	52	16@108, 2@72	2254
			1908	6678	159	12	53	17@108, 1@72	2298
			1944	6804	162	12	54	18@108	2341

Table B4-8. Model S/CR Ratings 600V Supply

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	600 V	600 V	600 V
S-120 or CR-120	9	7	19	66	3	6.3	1	1 @ 19	19
			38	131	6	6.3	1	1 @ 37	37
CR-120	9	7	56	197	9	6.3	2	1 @37, 1 @19	54
S-161	23	16	56	197	9	6.3	2	1 @37, 1 @19	54
			70	246	9	7.8	2	1 @47, 1 @23	68
			75	263	12	6.3	2	2 @ 37	73
			94	328	12	7.8	2	2 @ 47	91
CR-161	23	16	70	246	9	7.8	2	1 @47, 1 @23	68
			94	328	12	7.8	2	2 @ 47	91
S-162	23	16	117	410	15	7.8	3	2 @47, 1 @23	113
			141	492	18	7.8	3	3 @ 47	136
CR-162	23	16	164	574	21	7.8	4	3 @47, 1 @23	158
S-200	48	26	164	574	21	7.8	4	3 @47, 1 @23	158
S-200 or CR-200	48	26	188	656	24	7.8	4	4 @ 47	182
			211	738	27	7.8	5	4 @47, 1 @23	204
			234	820	30	7.8	5	5 @ 47	226
			258	902	33	7.8	6	5 @47, 1 @23	249
			281	984	36	7.8	6	6 @ 47	271
S-241 or CR-241	62	53	305	1066	39	7.8	7	6 @47, 1 @23	294
			328	1148	42	7.8	7	7 @ 47	316
			352	1230	45	7.8	8	7 @47, 1 @23	340
			375	1313	48	7.8	8	8 @ 47	362
S-242 or CR-242	62	53	398	1395	51	7.8	9	7 @47, 1 @70	384
			422	1477	54	7.8	9	1 @94, 7 @47	407
			445	1559	57	7.8	10	1 @94, 6 @47, 1@70	429
CR-242	62	53	469	1641	60	7.8	10	2 @94, 6 @47	452
			492	1724	63	7.8	10	2 @94, 5 @47, 1@70	474
			516	1805	66	7.8	11	3 @94, 5 @47	498
			539	1889	69	7.8	11	3 @94, 4 @47, 1@70	520
			563	1969	72	7.8	12	4 @94, 4 @47	543
S-301	110	70	469	1641	60	7.8	10	2 @94, 6 @47	452
			492	1724	63	7.8	10	2 @94, 5 @47, 1@70	474
			516	1805	66	7.8	11	3 @94, 5 @47	498
			539	1889	69	7.8	11	3 @94, 4 @47, 1@70	520
			563	1969	72	7.8	12	4 @94, 4 @47	543

Table B4-8. Model S/CR Ratings 600V Supply (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	600 V	600 V	600 V
S-302	140	90	586	2054	75	7.8	12	4 @94, 3 @47, 1@70	565
			609	2133	78	7.8	13	5 @94, 3 @47	587
			633	2218	81	7.8	13	5 @94, 2 @47, 1@70	610
			656	2297	84	7.8	14	6 @94, 2 @47	632
			672	2355	87	7.8	14	6 @94, 1 @47, 1@70	648
			703	2461	90	7.8	15	7 @94, 1 @47	678
S-361	150	100	750	2625	48	15.6	16	6 @94, 4 @47	723
			797	2789	51	15.6	17	7 @94, 3 @47	768
			844	2953	54	15.6	18	8 @94, 2 @47	814
			891	3117	57	15.6	19	9 @94, 1 @47	859
			938	3281	60	15.6	20	10 @ 94	904
			984	3445	63	15.6	21	9 @94 3 @47	948
			1031	3609	66	15.6	22	10 @94, 2 @47	994
S-421	210	140	1078	3773	69	15.6	23	11 @94, 1 @47	1039
			1125	3938	72	15.6	24	12 @ 94	1084
			1172	4102	75	15.6	25	12 @94, 1 @47	1129
			1219	4266	78	15.6	26	13 @ 94	1175
			1266	4430	81	15.6	27	13 @94, 1 @47	1220
			1313	4594	84	15.6	28	14 @ 94	1265
			1359	4758	87	15.6	29	14 @94, 1 @47	1310
			1406	4922	90	15.6	30	15 @ 94	1355
			1453*	5086	93	15.6	31	15 @94, 1 @47	1400
			1500*	5250	96	15.6	32	16 @ 94	1445
			1547*	5414	99	15.6	33	16 @94, 1 @47	1491
			1594*	5578	102	15.6	34	17 @ 94	1536
			1641*	5742	105	15.6	35	17 @94, 1 @47	1581
			1688*	5906	108	15.6	36	18 @ 94	1627
S-480	360	235	1734	6070	111	15.6	37	17 @94, 3 @47	1671
			1781	6234	114	15.6	38	18 @94, 2 @47	1716
			1828	6398	117	15.6	39	19 @94, 1 @47	1761
			1875	6563	120	15.6	40	20 @ 94	1807
			1922*	6727	123	15.6	41	9 @ 141, 7 @94	1852
			1969*	6891	126	15.6	42	10 @141, 6 @94	1897
			2016*	7055	129	15.6	43	11 @141, 5 @94	1943
			2063*	7219	132	15.6	44	12 @141, 4 @94	1988
			2109*	7383	135	15.6	45	13 @141, 3 @94	2032
			2156*	7547	138	15.6	46	14 @141, 2 @94	2077
			2203*	7711	141	15.6	47	15 @141, 1 @94	2123
			2250*	7875	144	15.6	48	16 @ 141	2168

* High pressure only

Table B4-9. Model HSB Ratings 380V, 415V Supply

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212°F	No. of Elements Qty @ kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
								380 V	415 V
HSB-424	385	260	1650	5630	165 @ 10	55	5@60, 15@90	2507	2296
			1680	5732	168 @ 10	56	4@60, 16@90	2553	2337
			1710	5835	171 @ 10	57	3@60, 17@90	2598	2379
			1740	5937	174 @ 10	58	2@60, 18@90	2644	2421
			1770	6039	177 @ 10	59	1@60, 19@90	2689	2463
			1800	6142	180 @ 10	60	20@90	2735	2504

Table B4-10. Model HSB Ratings 480V Supply

MODEL #	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	Steam lb./hr @ 212°F	ELEMENTS		# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES
					Qty	kW			
HSB-423	300	200	1560	5460	117	13.3	39	7 @120, 9 @80	1879
			1600	5600	120	13.3	40	8 @120, 8 @80	1927
			1640	5740	123	13.3	41	9 @120, 7 @80	1975
			1680	5880	126	13.3	42	10 @120, 6 @80	2025
			1720	6020	129	13.3	43	11 @120, 5 @80	2072
			1760	6160	132	13.3	44	12 @120, 4 @80	2120
			1800	6300	135	13.3	45	13 @120, 3 @80	2168
			1840	6440	138	13.3	46	14 @120. 2 @80	2216
			1880	6580	141	13.3	47	15 @120, 1 @80	2264
			1920	6720	144	13.3	48	16 @ 120	2313
HSB-424	385	260	1960	6860	147	13.3	49	1 @160, 15 @120	2361
			2000	7000	150	13.3	50	2 @160. 14 @120	2409
			2040	7140	153	13.3	51	3 @160. 13 @120	2457
			2080	7280	156	13.3	52	4 @160, 12 @120	2505
			2120	7420	159	13.3	53	5 @160, 11 @120	2553
			2160	7560	162	13.3	54	6 @160. 10 @120	2602
			2200	7700	165	13.3	55	7 @160. 9 @120	2650
			2240	7840	168	13.3	56	8 @160, 8 @120	2698
			2280	7980	171	13.3	57	9 @160, 7 @120	2746
			2320	8120	174	13.3	58	10 @160, 6 @120	2794
			2360	8260	177	13.3	59	11 @160, 5 @120	2843
			2400	8400	180	13.3	60	12 @160, 4 @120	2891
HSB-425	470	320	2440	8540	183	13.3	61	13 @160, 3 @120	2939
			2480	8680	186	13.3	62	14 @160, 2 @120	2987
			2520	8820	189	13.3	63	15 @160, 1 @120	3035
			2560	8960	192	13.3	64	16 @ 160	3083
			2600	9100	195	13.3	65	11 @160, 7 @120	3132
			2640	9240	198	13.3	66	12 @160, 6 @120	3180
			2680	9380	201	13.3	67	13 @160, 5 @120	3228
			2720	9520	204	13.3	68	14 @160, 4 @120	3276
			2760	9660	207	13.3	69	15 @160, 3 @120	3324
			2800	9800	210	13.3	70	16 @160, 2 @120	3372
			2840	9940	213	13.3	71	17 @160, 1 @120	3421
			2880	10080	216	13.3	72	18 @ 160	3469

Table B4-11. Model HSB Ratings 600V Supply

MODEL #	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	Steam lb./ hr @ 212°F	ELEMENTS		# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES
					Qty	kW			
HSB-423	300	200	1734	6070	111	15.6	37	17 @94, 3 @47	1671
			1781	6234	114	15.6	38	18 @94, 2 @47	1716
			1828	6398	117	15.6	39	19 @94, 1 @47	1762
			1875	6563	120	15.6	40	20 @ 94	1807
			1922	6727	123	15.6	41	9 @141, 7 @94	1852
			1969	6891	126	15.6	42	10 @141, 6 @94	1897
			2016	7055	129	15.6	43	11 @141, 5 @94	1943
			2063	7219	132	15.6	44	12 @141, 4 @94	1988
			2109	7383	135	15.6	45	13 @141, 3 @94	2032
			2156	7547	138	15.6	46	14 @141, 2 @94	2078
			2203	7711	141	15.6	47	15 @141, 1 @94	2123
			2250	7875	144	15.6	48	16 @ 141	2168
HSB-424	385	260	2297	8039	147	15.6	49	13 @141, 5 @94	2213
			2344	8203	150	15.6	50	14 @141, 4 @94	2259
			2391	8367	153	15.6	51	15 @141, 3 @94	2304
			2438	8531	156	15.6	52	16 @141, 2 @94	2349
			2484	8695	159	15.6	53	17 @141, 1 @94	2394
			2531	8859	162	15.6	54	18 @ 141	2439
			2578	9023	165	15.6	55	15 @141, 5 @94	2484
			2625	9188	168	15.6	56	16 @141, 4 @94	2529
			2672	9352	171	15.6	57	17 @141, 3 @94	2575
			2719	9516	174	15.6	58	18 @141, 2 @94	2620
			2766	9680	177	15.6	59	19 @141, 1 @94	2665
			2813	9844	180	15.6	60	20 @ 141	2710
HSB-425	470	320	2859	10008	183	15.6	61	17 @141, 5 @94	2755
			2906	10172	186	15.6	62	18 @141, 4 @94	2800
			2953	10336	189	15.6	63	19 @141, 3 @94	2845
			3000	10500	192	15.6	64	20 @141, 2 @94	2891
			3047	10664	195	15.6	65	21 @141, 1 @94	2936
			3094	10828	198	15.6	66	22 @ 141	2981
			3141	10992	201	15.6	67	19 @141, 5 @94	3027
			3188	11156	204	15.6	68	20 @141, 4 @94	3072
			3234	11320	207	15.6	69	21 @141, 3 @94	3116
			3281	11484	210	15.6	70	22 @141, 2 @94	3161
			3328	11648	213	15.6	71	23 @141, 1 @94	3207
			3375	11813	216	15.6	72	24 @ 141	3252

Table B4-12. Model IWH Ratings 208V, 240V Supplies

Model	Maximum Flow (GPM) *	MBTU/Hr	Rated kW	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty.	kW	208/240 V	208/240 V	208 V	240 V
IWH-611	135	51	15	3	5	1	1 @ 15	42	37
		102	30	6	5	2	1 @ 30	84	73
IWH-811	240	154	45	9	5	3	1 @ 45	125	109
		205	60	12	5	4	2 @ 30	167	145
		256	75	15	5	5	1 @ 30, 1 @ 45	209	181
IWH-812	240	307	90	18	5	6	2 @ 45	251	217
		358	105	21	5	7	1 @ 15, 3 @ 30	292	253
		409	120	24	5	8	4 @ 30	334	290

* Maximum flow rate based on a maximum velocity of 1.5 fps (feet per second) through the heater. Minimum flow rate should not be less than 10% of the maximum flow rate listed.

Table B4-13. Model IWH Ratings 380V, 415V Supplies

Model	Maximum Flow (GPM) *	MBTU/Hr	Rating kW	Elements		# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
				Qty	kW	380/415 V	380/415 V	380 V	415 V
IWH-611	135	51	15	3	5	1	1@15	23	21
		102	30	6	5	1	1@30	46	42
IWH-811	240	154	45	9	5	2	1@45	68	63
		205	60	12	5	2	2@30	91	83
IWH-812	240	256	75	15	5	3	1@30, 1@45	114	104
		307	90	18	5	3	3@30	137	125
		358	105	21	5	4	2@30, 1@45	160	146
		409	120	24	5	4	4 @ 30	182	167
IWH-822	240	512	150	15	10	5	3@30, 1@60	228	209
		614	180	18	10	6	2@30, 2@60	273	250
		717	210	21	10	7	1@30, 3@60	319	292
		819	240	24	10	8	4@60	365	334
IWH-022	360	921	270	27	10	9	3@30, 3@60	410	376
		1024	300	30	10	10	2@30, 4@60	456	417
		1126	330	33	10	11	1@30, 5@60	501	459
		1228	360	36	10	12	6@60	547	501

* Maximum flow rate based on a maximum velocity of 1.5 fps (feet per second) through the heater. Minimum flow rate should not be less than 10% of the maximum flow rate listed.

Table B4-14. Model IWH Ratings 480V, 600V Supplies

Model #	Maximum Flow (GPM) *	MBTU/Hr	Rated kW	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
				Qty.	kW	480/600 V	480/600 V	480 V	600 V
IWH-611	135	51	15	3	5	1	1 @ 15	19	15
		102	30	6	5	1	1 @ 30	37	29
IWH-811	240	154	45	9	5	2	1 @ 45	55	44
		205	60	12	5	2	2 @ 30	73	58
IWH-812	240	256	75	15	5	3	1 @ 30, 1 @ 45	91	73
		307	90	18	5	3	3 @ 30	109	87
		358	105	21	5	4	2 @ 30, 1 @ 45	127	102
		409	120	24	5	4	4 @ 30	145	116
IWH-822	240	512	150	15	10	5	3 @ 30, 1 @ 60	181	145
		614	180	18	10	6	2 @ 30, 2 @ 60	217	174
IWH-022	360	717	210	21	10	7	1 @ 30, 3 @ 60	253	203
		819	240	24	10	8	4 @ 60	290	232
		921	270	27	10	9	3 @ 30, 3 @ 60	325	261
		1024	300	30	10	10	2 @ 30, 4 @ 60	362	290
		1126	330	33	10	11	1 @ 30, 5 @ 60	398	318
		1228	360	36	10	12	6 @ 60	434	347

* Maximum flow rate based on a maximum velocity of 1.5 fps (feet per second) through the heater. Minimum flow rate should not be less than 10% of the maximum flow rate listed.

PERFORMANCE DATA

Efficiency

Electric boilers are void of losses normally associated with fuel fired equipment such as stack loss, combustion loss, excess air loss, etc. Therefore electric boilers are nearly 100% efficient at all operating points. For hot water boilers, the only loss from 100% is the radiation loss from the vessel which is ½%. For steam units, in addition to the radiation loss, blowdown losses should be factored in.

Emissions

Since electric boilers are void of fuel combustion, no emissions occur. Therefore, electric boilers are well suited for installations that must meet stringent emissions requirements.

Noise Level

With no moving parts, the electric boiler is nearly noiseless and thus, is well suited for installations sensitive to noise emissions from mechanical equipment. Installations such as hospitals, nursing homes, schools, research laboratories, and the like are ideal for an electric boiler application.

Regardless of output from minimum to maximum, noise emissions are almost undetectable.

ENGINEERING DATA

Boiler Information – Hot Water

Cleaver-Brooks electric hot water boilers are designed for service in any closed hydronic system and can be used to augment any hot water system. They can be put into operation as a single stand-alone unit with high turndown or in multiple units for larger turndown and capacity.

C-B electric hot water boilers may be utilized in water heating systems with temperatures from 400°F (4.4°C) to 245°F (118.3°C); ideal for ground water source heat pump applications, etc. Because the WB is an electric boiler, low water temperature (below the dewpoint) restrictions do not apply.

Variable temperature differentials can be designed to make use of changing outdoor conditions and thus, the WB is not restrictive to a nominal 200°F (10°C) differential. The boiler is designed to withstand thermal stresses with supply and return temperature differences of 100°F (55°C) and greater. However, when the elements are on, water flow through the boiler must be ensured and a flow switch to prove water flow is established is recommended.

Flow Rates and Pressure Drops

To maintain rated capacity of the boiler, recommended flow rates should not be exceeded as the flow will remove the heat beyond the capacity of the boiler. Table B4-15 can be used to determine the full boiler output relative to system temperature drop and the maximum recommended system pump flow.

The pressure drop through the boiler is < 1 psig.

Table B4-15. Model WB Max Flow Ratings Sheet 1 of 2

Model #	Rated kW	System Temperature Drop °F							
		10	20	30	40	50	60	70	80
		Maximum Flow Rate in GPM							
WB-120	12	8.2	4.5	3	2	1.75	1.5	1.25	1
	18	12.4	6.5	4.5	3.2	2.6	2	1.75	1.6
	24	16.5	8	5.5	4.1	3.2	2.75	2.3	2.1
	30	20.5	10.3	6.75	5.1	4.1	3.4	3	2.6
	36	24.5	12.25	8.2	6.2	4.9	4.1	3.5	3.1
	45	30.9	15.7	10.3	7.7	6.3	5.1	4.4	3.9
	54	37	18.4	12.3	9.2	7.4	6.1	5.3	4.6
	60	41	20.5	13.5	10.3	8.2	6.8	5.8	5.1
	72	49.5	24.2	16.5	12.3	9.8	8.2	7	6.1
WB-121	90	61.5	30.5	20.5	15.4	12.3	10.3	8.8	7.7
	108	73.6	37	24.7	18.5	14.8	12.3	10.6	9.2
	126	86	43	28.7	21.6	17.3	14.4	12.3	10.8
	144	98	49.2	32.9	24.6	19.7	16.5	14.1	12.3
WB-122	162	110.5	55.5	37	27.7	22.2	18.5	15.9	13.7
	180	122.6	61.5	41	30.8	24.6	20.5	17.6	15.4
	198	135.5	67.5	45	33.9	27.1	22.6	19.4	16.9
	216	148	74	49.3	37	29.6	24.6	21.1	18.5
	234	160	80	53.4	40	32	26.7	22.9	20
	252	172	86	57.5	43.1	34.5	28.8	24.6	21.6
	270	184.3	92.4	61.6	46.2	37	30.8	26.4	23.2
	288	196	98.5	65.7	49.3	39.5	32.9	28.2	24.6
WB-201	324	222	111	74	55.5	44.4	37	31.7	27.7
	360	246.5	123	82.2	61.6	49.3	41.1	35.2	30.8
	396	271	135.5	90.4	67.8	54.2	45.2	38.7	33.9
	432	296	148	98.6	74	59.2	49.3	42.3	37
WB-202	468	320	160.3	106.8	80.1	64.1	53.4	45.8	40
	504	345	172.5	115	86.3	69	57.5	49.3	43.2
	540	370	185	123.3	92.5	74	61.6	52.8	46.2
	576	394	197	131.5	98.6	79	65.7	56.4	49.3
WB-241	600	411	205.5	137	102.7	82.2	68.5	58.7	51.4
	630	431	215.5	143.8	107.9	86.3	71.9	61.6	53.9
	660	452	226	150.7	113	90.4	75.3	64.6	56.5
	690	472	236	157.5	118.2	94.5	78.8	67.5	59.1
	720	493	246.4	164.4	123.3	98.6	82.2	70.5	61.6
B-242	750	514	257	171.2	128.4	102.7	85.6	73.4	64.2
	780	534	267	178.1	133.6	106.8	89	76.3	66.8
	810	555	277.5	185	138.7	110.9	92.5	79.2	69.3
	840	575	287.5	191.8	143.8	115.1	95.9	82.2	71.9
	870	596	298	198.6	150	119.2	99.3	85.1	74.5
	900	615	308	205.5	154.1	123.3	102.7	88.1	77
	930	637	318.5	212.3	159.2	127.4	106.2	91	79.6
	960	657	328.5	219.2	164.4	131.5	109.6	93.9	82.2

Table B4-15. Model WB Max Flow Ratings Sheet 2 of 2

Model #	Rated kW	System Temperature Drop °F							
		10	20	30	40	50	60	70	80
		Maximum Flow Rate in GPM							
WB-243	990	678	339	226	169.5	135.6	113	96.9	84.8
	1020	698	349	232.9	174.6	139.7	116.4	99.8	87.3
	1050	719	359.5	239.7	179.8	143.8	119.9	102.7	89.9
	1080	740	370	246.6	184.9	150	123.3	105.7	92.5
	1110	760	380	253.4	190	152.1	126.7	108.6	95
	1140	781	390.5	260.3	195.2	156.2	130.1	111.5	97.6
	1170	801	400.5	267.1	200.3	160.3	133.6	114.5	100.2
	1200	822	411	274	205.5	164.4	137	117.4	102.7
WB-361	1224	838	419	279.5	209.6	167.7	139.7	119.8	104.8
	1260	863	431.5	287.7	215.7	172.6	143.8	123.3	107.9
	1296	888	444	296	221.9	177.5	147.9	126.8	110.9
WB-362	1332	912	456	304.1	228.1	182.5	150.9	130.3	114
	1368	937	468.5	312.3	234.2	187.4	156.2	133.8	117.1
	1404	962	481	320.5	240.4	192.3	160.3	137.4	120.2
	1440	986	493	328.8	246.6	197.3	164.4	140.9	123.3
	1476	1011	505.5	337	252.7	202.2	168.5	144.4	126.4
	1512	1035	517.5	322.4	258.9	207.1	172.6	147.9	129.5
	1548	1060	530	353.4	265.1	212.1	176.7	151.5	132.5
	1584	1085	542.5	361.6	271.2	217	180.8	155	135.6
	1620	1109	554.5	370	277.4	221.9	184.9	158.5	138.7
	1656	1134	567	378	283.6	226.8	189	162	141.8
	1692	1159	579.5	386.3	289.7	231.8	193.1	165.5	144.9
	1728	1183	591.5	394.5	295.9	236.7	197.3	169.1	147.9
WB-363	1764	1208	604	402.7	302.2	241.6	201.4	172.6	151
	1800	1233	616.5	411	308.2	246.6	205.5	176.1	154.1
	1836	1257	628.5	419.2	314.4	251.5	209.6	179.6	157.2
	1872	1282	641	427.4	320.5	256.4	213.7	183.2	160.3
	1908	1307	653.5	435.6	326.7	261.4	217.8	186.7	163.4
	1944	1332	665.5	443.8	332.9	266.3	221.9	190.2	166.4
	1980	1356	678	452	339	271.2	226	193.7	169.5
	2016	1381	690.5	460.3	345.2	276.2	230.1	197.3	172.6
	2052	1405	702.5	468.5	240.6	281.1	234.2	200.8	175.7
	2088	1430	715	476.7	357.5	286	238.4	204.3	178.8
	2160	1480	740	493.2	369.9	295.9	246.6	211.3	184.9
WB-421	2240	1534	767	511.4	383.6	306.8	255.7	219.2	191.8
	2320	1589	794.5	529.7	397.3	317.8	264.8	227	198.6
	2400	1644	822	548	411	328.8	274	234.8	205.5
	2480	1699	849.5	566.2	424.6	339.7	283.1	242.7	212.3
	2560	1754	877	584.5	438.3	350.7	292.2	250.5	219.2
	2640	1808	904	602.7	452.1	361.6	301.4	258.3	226
WB-422	2720	1863	931.5	621	465.7	372.6	310.5	266.1	232.9
	2800	1918	959	639.3	479.5	383.6	319.6	274	239.7
	2880	1973	98.5	657.5	493.1	394.5	328.8	281.8	246.6
	3000	2055	1027.5	685	513.7	411	342.5	293.5	256.8
	3040	2082	1041	694	520.5	416.4	347	297.5	260.3
	3120	2137	1068.5	712.3	534.2	427.4	356.2	305.2	267.1
	3200	2192	1096	730.5	547.9	438.4	365.3	313.1	274
	3280	2247	1123	748.8	561.6	449.3	374.4	320.9	280.8
	3360	2302	1151	767.1	575.3	460.3	383.6	328.8	287.7

System Operating Parameters

To prevent water flashing to steam within the boiler or system, hot water boilers must operate with proper over pressure. System over pressure requirements are shown in Table B4 – 16.

While proper overpressure is required, a means to relieve excess pressure at or beyond the design pressure of the boiler must be provided. As boiler water is heated, expansion occurs. And this expansion must be accounted for either with an expansion tank (air filled) or with a bladder type tank. These devices permit the water pressure to expand outside of the boiler and not impact the pressure vessel or pressure relieving device. But, in accordance with Code, each boiler is equipped with an ASME approved safety relieving device should pressure build-up occur.

Table B4-16. Model WB Minimum Over Pressure Requirements

Outlet Water Temperature °F (°C)	Minimum System Pressure PSIG (Bar)
80 - 180 (27 - 82)	12 (0.83)
181 - 185 (83 - 85)	15 (1.03)
186 - 195 (86 - 91)	18 (1.24)

Rule of Thumb Calculations

The following formula can be used to size a hot water boiler:

kW = gph (gallons per hour) x delta T (as expressed in °F) divided by 410

Or

kW = 1 lph (liter per hour) x delta T (as expressed in °C) divided by 862. Where:

- kW is the boiler output rating.
- lph (liters per hour) or gph (gallons per hour) is the hot water flow rate.
- "delta T" is the temperature rise of water.

As an example:

kW= gph x delta T/410

kW = 5000 x 20/410

kW = 100000/410

kW = 244

Boiler Information – Steam

Models CR, S, and HSB are designed for steam service and are built in accordance with the ASME Code for either low pressure steam applications (less than 15 psig operation) or for high pressure steam applications (above 15 psig).

For approximate conversion of pounds of steam to kW, the following can be used:

10 kW = 34 lbs. steam/hr = 1.02 boiler horsepower from and at 212° F.

It is important to know what the operating pressure will be and the feedwater makeup temperature, to properly size the steam boiler. From Table B4-17, one can obtain the pound of steam value for the operating pressure and corresponding feedwater makeup temperature. Based on this, the proper assumption can be made as to the required kW size of the electric boiler.

For example: Steam load required of 2000 pounds per hour of steam at an operating pressure of 100 psig and feedwater temperature of 170 degrees F. Referring to Table B4-17, we find the value of 0.3077 kW per pound of steam. We multiply the required pounds of steam by this value (2000 x 0.3077) and obtain 615. The required boiler would be 615 kW or the Model S-301-620, 150# design.

Table B4-17. kW per pound of steam

Feedwater Temperature (°F)	Boiler Operating Pressure (PSIG)				
	0	15	50	100	150
50	0.3318	0.3359	0.3401	0.3429	0.3441
70	0.3259	0.3300	0.3343	0.3370	0.3382
100	0.3171	0.3212	0.3255	0.3283	0.3294
120	0.3112	0.3154	0.3196	0.3224	0.3236
150	0.3025	0.3066	0.3108	0.3136	0.3148
170	0.2966	0.3001	0.3050	0.3077	0.3089
200	0.2878	0.2919	0.2962	0.2978	0.3001
212	0.2857	0.2898	0.2941	0.2957	0.2980
227	0.2836	0.2877	0.2920	0.2936	0.2967

Water Treatment

Even though hot water systems are “closed”, some amount of make-up water (up to 10%) will be introduced, usually due to pump seal leaks or other minimal leaks from valves etc., that go unnoticed. Therefore, proper water chemistry of a hot water boiler is necessary for good operation and longevity, particularly to ensure that free oxygen is removed to prevent waterside corrosion.

For steam boilers, proper blowdown (surface and bottom) is a required maintenance procedure. This water loss and associated steam use or loss must be made up. Any make-up water should be properly treated prior to introduction into the boiler via water softener, chemical feed, etc. Proper water chemistry in a steam boiler is mandatory for effective operation and longevity.

See **Table B4-18** for water quality requirements.

Table B4-18. Electric Boilers Required Water Quality Parameters

Parameter	Hot Water Boilers Water Limit	Steam Boilers Water Limit
pH	8.3 - 9.5	8.3 - 10.5
Iron	0.1 ppm	0.1 ppm
Alkalinity	< 300 ppm	< 600 ppm
Chlorides	30 mg/liter	30 mg/liter
Oxygen	0.1 mg/liter	0.1 mg/liter
Specific Conductivity	3500 umho/cm	4500 umho/cm
Total Hardness	< 3 ppm	< 3 ppm

Boiler Room Information

The boiler must be installed on a level non-combustible surface. If the surface is not level, piers or a raised pad (slightly larger than the length and width of the boiler base dimensions) will make boiler leveling possible. Installing the boiler on a raised pad or piers will make boiler drain connections more accessible and will keep water from splashing onto the boiler when the boiler room floor is washed. NOTE: The pad or piers must be of sufficient load bearing strength to safely support the operating weight of the boiler and any additional equipment installed with it. Approximate operating weights are shown in Dimensions and Ratings.

Clearances

The boiler must be installed so that all components remain accessible, especially be free of side mounted piping so the element flanges may be opened. Refer to Dimension Sheets **Figure B4 – 1 through B4 - 5**.

Hot Water Piping

Primary/Secondary Pumps are not necessary with the electric hot water boilers, although they can be used. As its design is such that thermal shock is not a concern, some flow is required whenever the boiler elements are on. Therefore, whether primary/secondary or system pump, an interlock such as a flow switch should be employed to ensure that water flow is established before the boiler elements are allowed on.

Electrical

Voltage requirements for the electric boilers are as noted in the ratings sheets including the relative ampacity. Switchgear above 600 amps will not be furnished by Cleaver-Brooks due to the overall size of the equipment and NEC Code requirement for switchgear wiring. The larger switchgear wiring requirements exceed the UL certification of the package boiler.

NOTES

ELECTRIC BOILER SPECIFICATIONS

CAPACITIES B37-40
STORAGE TANK HEATER CAPACITY B37-40
BOILER B37-40
HEATING ELEMENTS B37-40
TRIM AND CONTROLS B37-41
WARRANTY B37-41

SAMPLE SPECIFICATIONS

The following sample specifications are provided by Cleaver-Brooks to assist you in meeting your customer's specific needs and application.

PART 1 GENERAL

1.1 CAPACITIES

A. Boiler Capacity - Hot Water

1. The _____ gallon _____ capacity hot water boiler shall be Cleaver-Brooks Model _____ rated _____ kW at _____ V, _____ ph, 60 Hz, _____ MBtu/hr. Unit shall be suitable to operate under the following conditions: system flow rate _____ gpm; outlet water temperature _____ °F; return water temperature _____ °F; system operating pressure _____ psig.

B. Boiler Capacity - Steam

1. The _____ gallon _____ capacity steam boiler shall be Cleaver-Brooks Model _____ rated _____ kW at _____ V, _____ ph, 60 Hz. Unit shall produce _____ lbs steam/hr (from and at 212 °F) at a nominal pressure of _____ psig.

C. Water Heater Capacity - Instantaneous

D. The horizontal circulation water heater shall be Cleaver-Brooks Model IWH _____ rated _____ kW at _____ V, _____ ph, 60 Hz.

1.2 STORAGE TANK HEATER CAPACITY

The _____ gallon capacity (horizontal or vertical) shall be Cleaver-Brooks Model _____ rated kW at _____ V, _____ ph, 60 Hz, and shall recover _____ gpm at 100 °F rise.

PART 2 PRODUCTS

2.1 BOILER

A. The vessel shall be constructed in accordance with ASME Boiler Code.

B. The vessel shall be designed for _____ psig.

C. The relief valve shall be per ASME Code, set at _____ psig.

D. The vessel shall be insulated with a double wrap of 2-inch fiber blanket insulation having 1-1/2 PCF density.

E. The boiler shall be UL listed, and bear the Underwriters Laboratories' label.

F. The boiler shall be of the packaged type, factory assembled, wired, and tested.

G. The boiler shall be mounted on a full size structural steel base.

H. The boiler enclosure shall be 16-gauge steel.

I. The entire enclosure shall be finished in light blue enamel paint.

J. The overall dimensions of the boiler shall be _____ inches long, _____ inches wide, and _____ inches high.

K. For CR Models, the boiler shall include built-in condensate receiver and feed pump, with make-up valve mounted on common base with boiler, factory wired and piped, and enclosed in boiler casing.

2.2 HEATING ELEMENTS

A. The heating elements shall be individually mounted, rod type, and field replaceable with standard tools.

B. The heating watt density shall not exceed _____ (50 or 75) W/sq-in.

C. The heating elements shall be (copper or Incoloy) sheathed.

2.3 TRIM AND CONTROLS

A. The units shall be complete with the following:

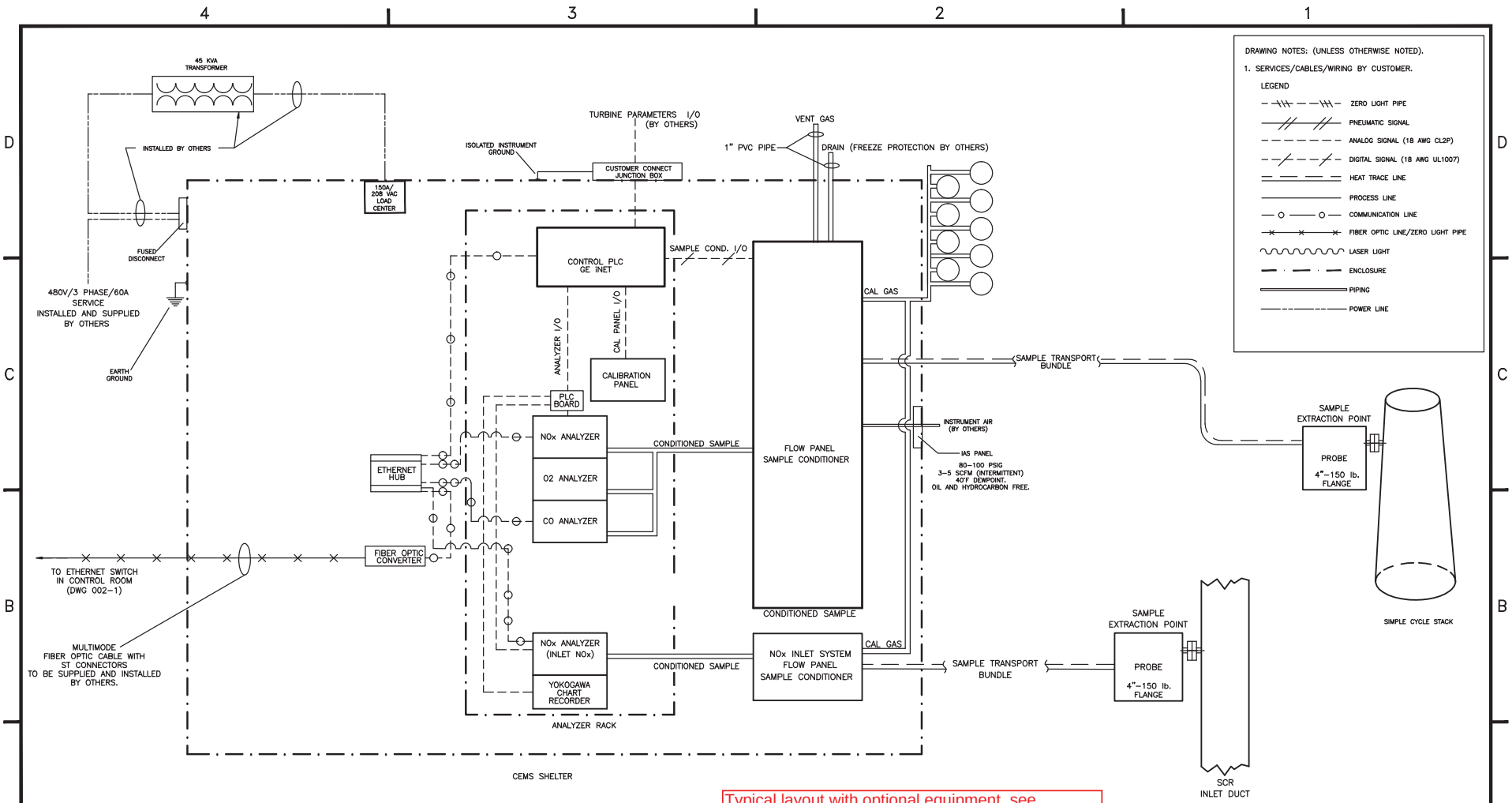
1. Main lugs for supply circuits.
2. Supplemental internal branch circuit fuses, current limiting, rated at 200,000 amps interrupting capacity.
3. Fused 120 V control circuit transformer.
4. Magnetic contactors rated at 500,000 cycles.
5. Integral high temperature limit (hot water boilers).
6. High pressure limit (steam boilers).
7. Low water cutoff (float-type with gauge glass for steam) on all models except IWH which is supplied with a flow switch.
8. Pressure-temperature gauge (hot water boilers).
9. Pressure gauge (steam boilers).
10. Pilot switch.
11. Pilot lights for power on, low water, high temperature or pressure.
12. Relief valve.
13. Drain valve (hot water boilers).
14. Bottom and water column blowdown valves (steam boilers).
15. Feedwater stop and check valves (steam boilers).
16. All models except IWH shall be supplied with modulating step controls to gradually apply the load in _____ steps.
17. All models except IWH shall be supplied with proportioning temperature (hot water units) or pressure (steam units) control to balance power input to match system demand.
18. Temperature control on IWH is one of the following methods (select a. or b. or c. below).
    a. Thermostats - The heating elements shall be staged by control thermostats. (Standard for one and two step heaters).
    b. Sequencer - The heating elements shall be staged by a time delay sequencer, to energize heating elements in _____ stages with an adjustable 1 to 15 second time delay between stages. (Standard for 3 or 4 step heaters.)
    c. Modulating Step Control - (Standard for heaters above 4 steps).

PART 3 EXECUTION

3.1 WARRANTY

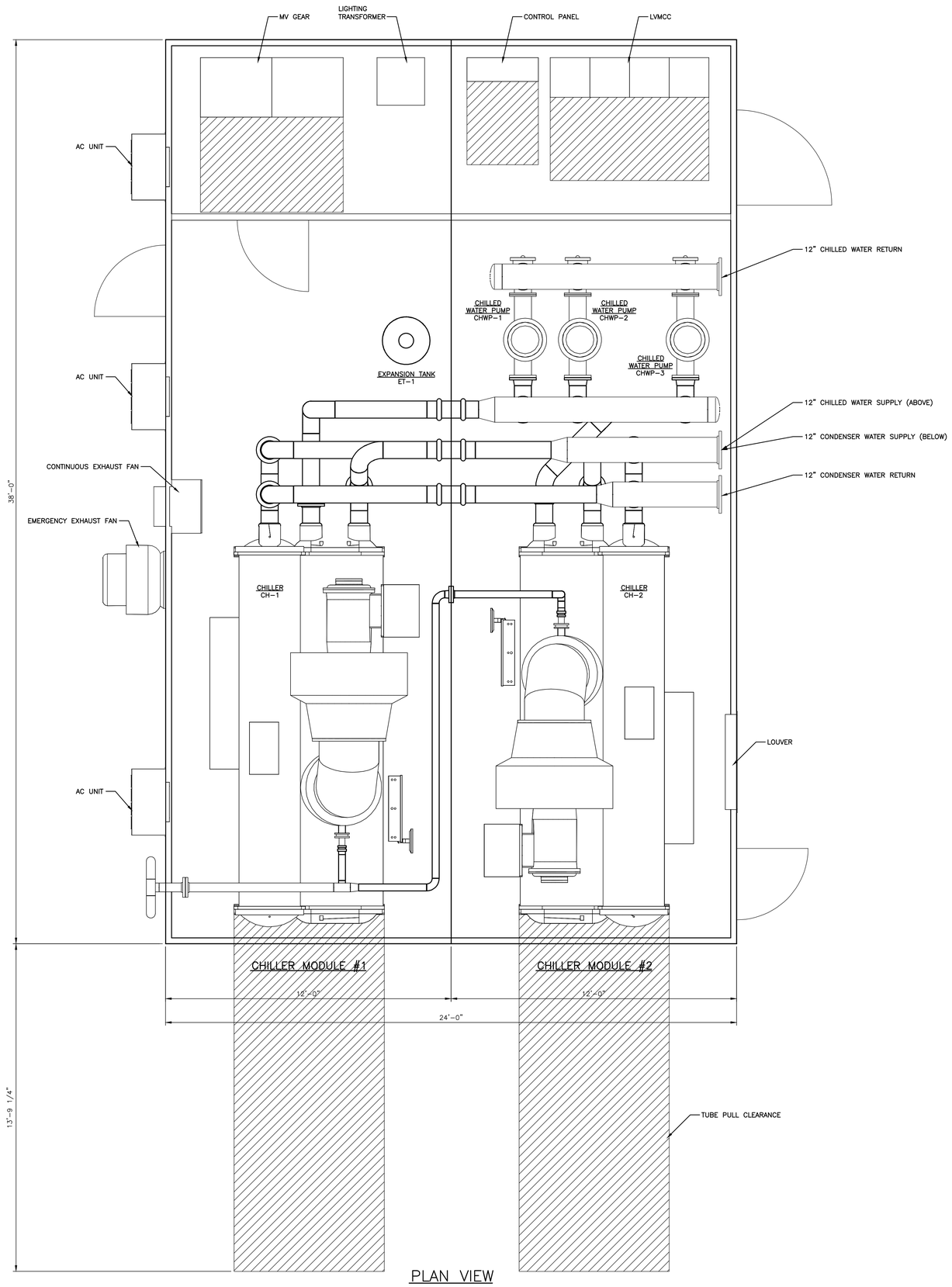
A. The Cleaver-Brooks unit shall be warranted against defective workmanship and materials for a period of one year from the date of start- up or 18 months from shipment.

NOTES



Typical layout with optional equipment, see proposal for actual equipment

P 879		SIGNATURES DATE DWN CHKD ENGR APVD	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: x. – REF. NOT APPLICABLE .x ± .1 .xx ± .02 .xxx ± .01 ANGLES ± 1/4° DO NOT SCALE DRAWING	B&W PROPRIETARY AND CONFIDENTIAL Copyright 2012 Babcock & Wilcox Power Generation Group, Inc. All rights reserved 7	TITLE: CEMS SYSTEM OVERVIEW STACK & NOx INLET SYSTEM DWG NO: ! REV C SCALE: NONE CAD FILE: 511-001 SHEET: 1 OF 1



PLAN VIEW

SCALE: 1/2" = 1'-0"

0 1' 2' 4'

CHILLER MODULE GENERAL ARRANGEMENT

stellarenergy
2500 HARTLEY ROAD
JACKSONVILLE, FLORIDA
32257
(904) 260-2500
WWW.STELLAR-ENERGY.NET

GE LM 6000 PLANT
MODULAR CHILLED WATER PLANT
PASADENA, CA

CHILLER MODULE GENERAL ARRANGEMENT

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REV.	DATE	BY	DESCRIPTION
A	21 SEP 12	TFC	PRELIMINARY

JOB NO.

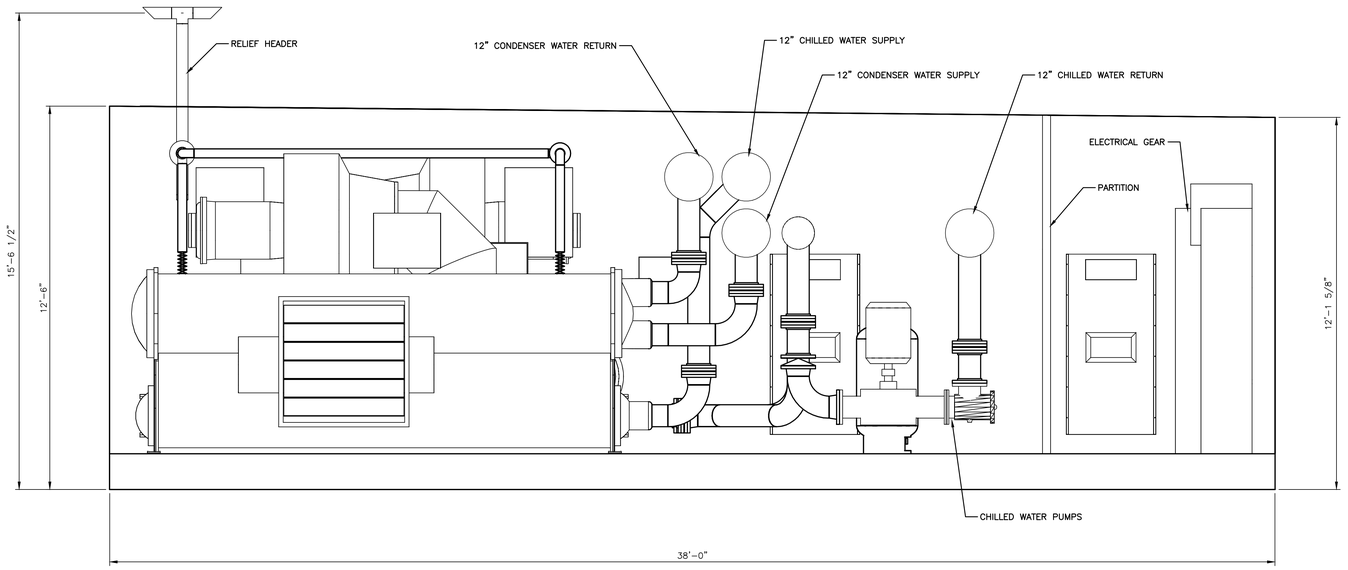
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CHECKED: JMM

SCALE: AS NOTED

M101
DRAWING NO.

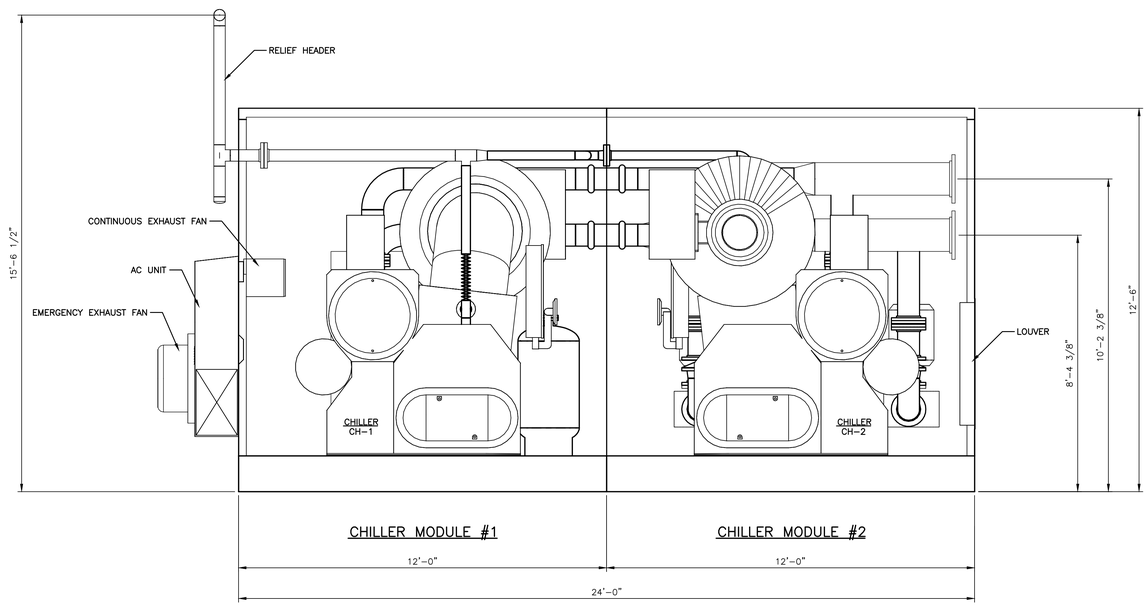
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ELEVATION

SCALE: 1/2" = 1'-0"

0 1' 2' 4'



ELEVATION

SCALE: 1/2" = 1'-0"

0 1' 2' 4'

CHILLER MODULE ELEVATIONS

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JACKSONVILLE, FLORIDA
32257
(904) 260-2500
WWW.STELLAR-ENERGY.NET

GE LM 6000 PLANT
MODULAR CHILLED WATER PLANT
PASADENA, CA

CHILLER MODULE ELEVATIONS

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REV.	DATE	BY	DESCRIPTION
A	21 SEP 12	TFC	PRELIMINARY

JOB NO.

DRAWN: TFC

CHECKED: JMM

SCALE: AS NOTED

M201
DRAWING NO.

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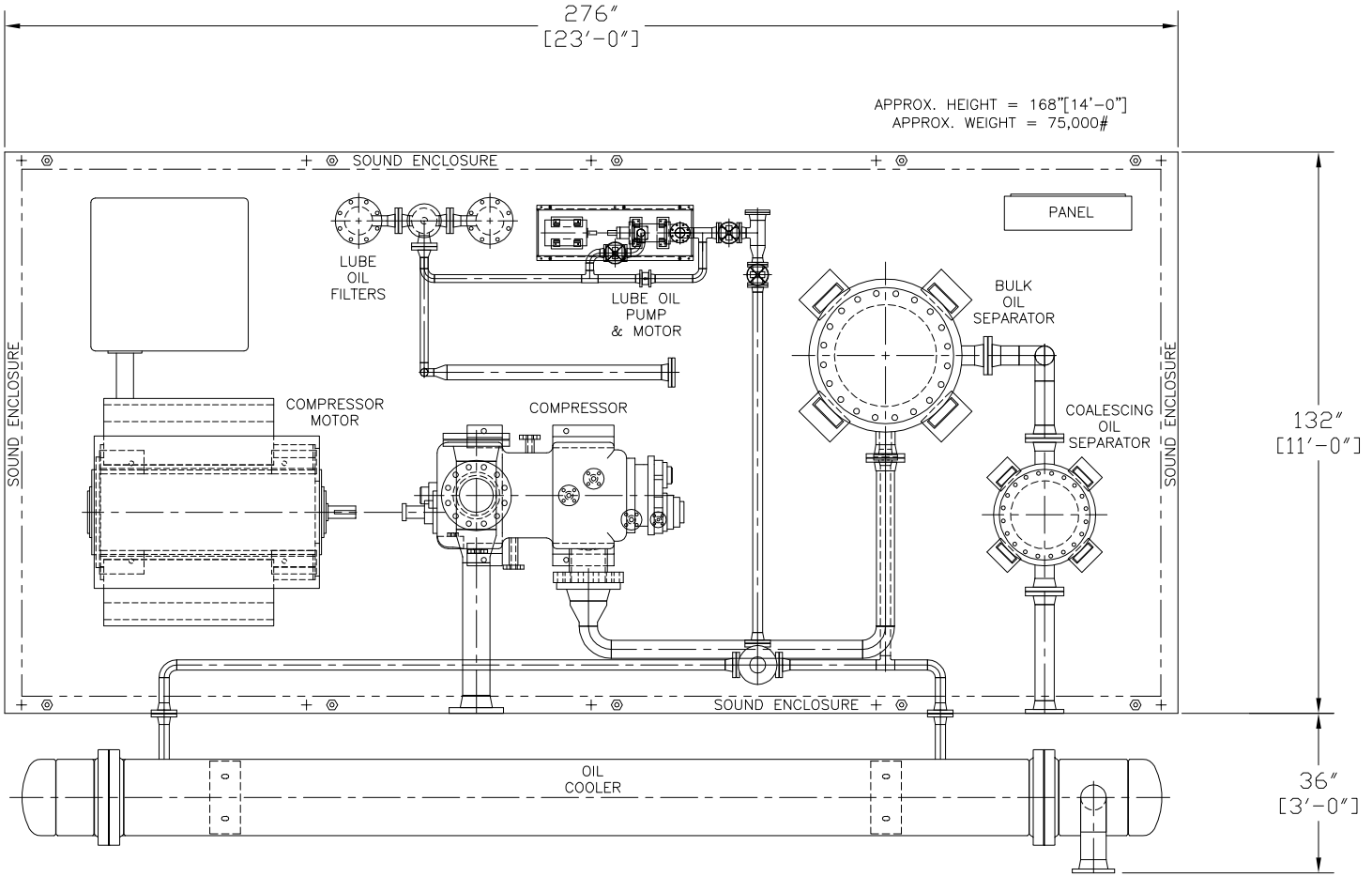
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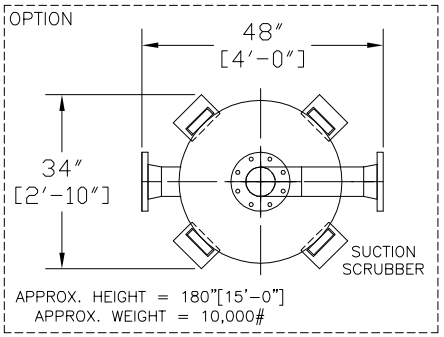
Scheduled Major Component RTS and Delivery Dates*

Reference	Equipment Description	Scheduled RTS Date	Guaranteed Delivery Date
B.1	Gas Turbine Generator	23 Jan 2015	Week of 2 Mar 2015
B.2	Once-Through Steam Generator	20 Feb 2015	Week of 30 Mar 2015
B.3	Steam Turbine Generator	27 Feb 2015	Week of 6 Apr 2015
B.4	Surface Condenser	21 Jan 2015	4 Mar 2015
B.5	Cooling Tower	6 Mar 2015 ~~23 Jan 2015~~	17 Apr 2015 ~~6 Mar 2015~~
B.6	Gas Turbine Inlet Chiller	17 Dec 2014	28 Jan 2015
B.7	Condensate Pumps	4 Mar 2015 ~~10 Dec 2014~~	15 Apr 2015 ~~21 Jan 2015~~
B.8	Boiler Feedwater Pumps	4 Mar 2015 ~~10 Dec 2014~~	15 Apr 2015 ~~21 Jan 2015~~
B.9	Circulating Water Pumps	4 Mar 2015 ~~10 Dec 2014~~	15 Apr 2015 ~~21 Jan 2015~~
B.10	Steam Turbine Bypass Valve	4 Mar 2015 ~~10 Dec 2014~~	15 Apr 2015 ~~21 Jan 2015~~
B.11	Condensate Polisher	27 Feb 2015 ~~19 Dec 2014~~	10 Apr 2015 ~~30 Jan 2015~~
B.12	Continuous Emissions Monitoring System	30 Jan 2015 ~~19 Dec 2014~~	13 Mar 2015 ~~30 Jan 2015~~
B.13	Generator Step Up Transformer	30 Jan 2015 ~~19 Dec 2014~~	20 Mar 2015 ~~6 Feb 2015~~

B.14	Compressed Air System Skid	27 Mar 2015 ~~5 Dec 2014~~	8 May 2015 ~~16 Jan 2015~~
B.15	Fuel Gas Compressor	9 Feb 2015	23 Mar 2015
G.8	Auxiliary Boiler and Pump	25 Feb 2015	8 Apr 2015
G.10	Auxiliary Seal Steam Superheater	25 Feb 2015	8 Apr 2015

*These schedule dates are based on a NTP of 27 September 2013. If the NTP date changes, the scheduled deliveries shall be adjusted as provided in Article 2(a) of the Contract.





KOBELCO

KOBELCO COMPRESSORS AMERICA, INC.
1450 W. RIncon St., Corona, CA 92880-9205
Phone. (951) 739-3030 Fax. (951) 739-3029
www.kobelcocompressors.com

QUOTE NO.: Q-210071B2

PRELIMINARY

NOTE:
1. DIMENSIONS AND LAYOUT ARE PRELIMINARY AND SUBJECT TO CHANGE IN DETAIL ENGNINEERING PHASE

TITLE: MACHINERY ARRANGEMENT
FEED GAS COMPRESSOR SYSTEM

ENG.:	DRAWN:	DATE:	DRAWING NO.	REV:
L.D.	L.C.	11/20/13	Q-210071B-011	A
SCALE: NTS	SHEET: 1 OF 1	CAD FILE: 210071B0111		

MID-TD-0000-1
September 2009



GE Energy

Process Specification
Fuel Gases For Combustion In AeroDerivative Gas Turbines

These instructions do not purport to cover all details or variations in equipment or to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred to the GE Company.

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TABLE OF CONTENTS

1 GENERAL 1

2 FUEL GAS CLASSIFICATION 5
2.1 Natural Gas, Liquefied Natural Gas (LNG), Medium BTU Gas, and Liquefied Petroleum Gas (LPG) 6
2.2 Gasification Fuels 6
2.3 Process Gases 6

3 FUEL PROPERTIES 7
3.1 Heating Values 7
3.2 Modified Wobbe Index Range 7
3.3 Superheat Requirement 8
3.4 Gas Constituent Limits 8
3.5 Gas Fuel Supply Pressure 8

4 CONTAMINANTS 8
4.1 Particulate 9
4.2 Liquids 9
4.3 Sulfur 9
4.4 Siloxanes 11

Appendix 1 DEFINITIONS 12

LIST OF TABLES

Table 1. Fuel Classification 1
Table 2a. Fuel Gas Composition Limits for DLE Configuration 2
Table 2b. Fuel Gas Composition Limits for SAC Configuration 3
Table 3. Test methods for gaseous fuels 4

1 GENERAL

GE AeroDerivative gas turbines have the ability to burn a wide range of gaseous fuels as shown in Table 1. These gases present a broad spectrum of properties due to both active and inert components. This specification is designed to define guidelines that must be followed in order to burn these fuels in an efficient, trouble-free manner, while protecting the gas turbine and supporting hardware.

Table 1. Fuel Classification

Fuel	**LHV Btu/scf**	**Major Components**
Pipeline Natural Gas and Liquefied Natural Gas	800 - 1200	Methane
Liquefied Petroleum Gas	2300 – 3200	Propane, Butane
Gasification Gases - Air Blown - Oxygen Blown	 100 - 150 200 - 400	 Carbon Monoxide, Hydrogen, Nitrogen, Water Vapor Carbon Monoxide, Hydrogen, Water Vapor
Process Gases	300 - 3000	Methane, Hydrogen, Carbon Monoxide, Ethane, Ethene, Propane, Propene, Carbon Dioxide, Nitrogen

Table 2a identifies the fuel composition limits for aeroderivative gas turbines with Dry Low Emission (DLE) combustion systems and Table 2b identifies the fuel composition limits for aeroderivative gas turbines with Standard (Single Annular Combustor (SAC)) combustion systems.

Table 2a. Fuel Gas Composition Limits for DLE Configuration.

Parameter	**Requirement – DLE Configuration**	
	Minimum	Maximum
Modified Wobbe Index (1)	40 (2)	60
Methane (CH4)	50% vol	100% vol
Ethane (C2+ paraffins)		
LM1600	0	35% vol
LM2500 / LM2000	0	35% vol
LM2500+G4	0	30% vol
LM6000 / LMS100	0	24% vol
Hydrogen (H2)	0	5% Vol (2)
Diolefins (i.e. Butadiene, propadiene)	0	None allowed
Other combustibles (3)	0	Consult GE

Notes:
1. MWI at max limits C2+.
2. Other levels may be possible. Consult GE.
3. Other combustibles - CO, olefin hydrocarbons. etc.

Table 2b. Fuel Gas Composition Limits for SAC Configuration.

Parameter	**Requirement – SAC Configuration**	
	Minimum	Maximum
Modified Wobbe Index (1)		
LMS100 Low MWI Nozzles	35	44
LMS100 Standard MWI Nozzles	45	60
All Other LM	40	60
Hydrogen + ½ CO (H2 + ½ CO) (2)		
LM2500 / LM2000	0	85% Vol
LM2500+/+G4/LM1600/LM5000	0	75% Vol
LM6000 / LMS100	0	35% Vol
Diolefins (i.e. Butadiene, propadiene)	0	See Note 3
Olefins	0	15% Vol (4)
Other combustibles (5)	0	Consult GE

Notes:
1. Expanded values may be possible with fuel nozzle modifications. Consult GE
2. High hydrogen and carbon monoxide content fuels have large rich to lean flammability limits. These types of fuels often require inert gas purging of the gas turbine gas fuel system upon unit shutdown or a transfer to a more conventional fuel. When process gas fuels have extreme flammability limits such that the fuel will auto ignite at turbine exhaust conditions, a more "conventional" start–up fuel, such as methane, is required.
3. The presence of even trace amounts of butadiene in the gas fuel may cause fuel system fouling. Additional fuel system maintenance may be required when using fuels containing butadiene.
4. Olefins in the gas fuel at moderate levels (<15%) are not expected to present problems as long as the fuel temperature is kept below 176°F (80°C). With a higher level of olefins or with a higher gas fuel temperature, fuel system fouling may be an issue
5. Other combustibles - CO, hydrocarbons. etc.

Notes for Table 1, 2a, and 2b:

1. When considering the use of alternate fuels, provide details of the fuel constituents, fuel pressure, fuel temperature, and expected engine usage conditions and operating characteristics to GE for evaluation and recommendations.

2. Values and limits apply at the inlet of the gas fuel control module.

3. Heating value ranges shown are provided as guidelines. Specific fuel analysis must be furnished to GE for evaluation. The standard configured single annular combustor (SAC) gas turbines require a fuel with a LHV no less than of 6500 BTU/pound. The Dry Low Emissions (DLE) combustion system requires a minimum LHV of 18000 BTU/pound. (Reference Section 3.1)

4. The fuel gas supply shall be 100% free of liquids. Admission of liquids can result in combustion and/or hot gas path component damage. (Reference Section 3.3)

5. Modified Wobbe Number Index (MWI), is described in Section 3.2

Table 3 identifies the acceptable test methods to be used in determining gas fuel properties.

TABLE 3
TEST METHODS FOR GASEOUS FUELS

PROPERTY	ACCEPTABLE METHODS
Gas Composition	ASTM D1945 - Standard method for constituents of gases by gas chromatography, or ISO 6974 - Natural gas -- Determination of composition from C1 to C8 with defined uncertainty by gas chromatography ISO 6975 - Natural gas -- Determination of hydrocarbons from butane (C4) to hexadecane (C16) -- Gas chromatographic method
Heating Value Specific Gravity Compressibility Factor	ASTM D3588 - Procedure for calculating calorific value and specific gravity of gaseous fuels, or ISO 6976 - Natural gas -- Calculation of calorific values, density, relative density and Wobbe index from composition GPA 2172 - Calculation of Gross Heating Value, Relative Density and Compressibility Factor for Natural Gas Mixtures From Compositional Analysis
Dew Point (see note 1)	ASTM D1142 - Water vapor content of gaseous fuels by measurement of dew point temperature
Sulfur	ASTM D1072 - Total Sulfur in Fuel Gases by Combustion and Barium Chloride Titration, or ASTM D3246 - Sulfur in Petroleum Gas by Oxidative Microcoulometry (see note 2) ASTM D5504 - Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence ASTM D6667 - Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence ASTM D6968 - Simultaneous Measurement of Sulfur Compounds and Minor Hydrocarbons in Natural Gas and Gaseous Fuels by Gas Chromatography and Atomic Emission Detection ISO 4260 - Petroleum Products and Hydrocarbons - Determination of Sulfur Content - Wickbold Combustion Method ISO 6326 - Natural gas -- Determination of sulfur compounds

	ISO 19739 - Natural gas -- Determination of sulfur compounds using gas chromatography IP 243 - Petroleum Products and Hydrocarbons - Determination of Sulfur Content - Wickbold Combustion Method
Chemical Composition	ASTM D2650 - Chemical composition of gases by mass spectrography
ASTM – ASTM International ISO - International Organization for Standardization GPA - Gas Processors Association IP – Institute of Petroleum UK	

Notes:

1. Hydrocarbon and water dew points shall be determined by direct dew point measurement (Chilled Mirror Device). If dew point cannot be measured, an extended gas analysis, which identifies hydrocarbon components from C1 through C14, shall be performed. This analysis must be accurate within 10ppmv. A standard gas analysis to C6+ is normally not acceptable for dew point calculation unless it is known that heavier hydrocarbons are not present, as is most often the case with liquefied natural gases.

2. This test method will *not* detect the presence of condensable sulfur vapor. Specialized filtration equipment is required to measure sulfur at concentrations present in vapor form. Contact GE for more information.

2 FUEL GAS CLASSIFICATION

2.1 Natural Gas, Liquefied Natural Gas (LNG), Medium BTU Natural Gas, and Liquefied Petroleum Gas (LPG)

Natural gases are predominantly methane with much smaller quantities of the slightly heavier hydrocarbons such as ethane, propane and butane. Liquefied petroleum gas is propane and/or butane with traces of heavier hydrocarbons.

2.1.1 Pipeline Natural Gas

Natural gases normally fall within the calorific heating value range of 800 to 1200 BTU/SCF (LHV). Actual calorific heating values are dependent on the percentages of hydrocarbons and inert gases contained in the gas. Natural gases are found in and extracted from underground reservoirs. These “raw gases” may contain varying degrees of nitrogen, carbon dioxide, hydrogen sulfide, and contaminants such as salt water, sand and dirt. Processing by the gas supplier normally reduces and/or removes these constituents and contaminants prior to distribution. A gas analysis must be performed to ensure that the fuel supply to the gas turbine meets the requirements of this specification.

2.1.2 Liquefied Natural Gas

Liquefied natural gas is produced by drying, compressing, cooling and expanding natural gas to approximately -260° F at 14.7 psia. The product is transported as a liquid and delivered as a gas after pressurizing and heating to ambient temperature. The composition is free of inerts and moisture and can be treated as a high quality natural gas. LNG can pick up moisture that is present in the pipeline but it is not a source of the moisture.

2.1.3 Medium BTU Natural Gas

Natural gases are found in and extracted from underground reservoirs. These "raw gases" may contain varying degrees of nitrogen, carbon dioxide, hydrogen sulfide, and contain contaminants such as salt water, sand and dirt. The heating values of medium BTU natural gas normally fall between 400 and 800 BTU/SCF (LHV) Processing by the gas supplier normally reduces and/or removes these constituents and contaminants prior to use in the gas turbine. A gas analysis must be performed to ensure that the fuel supply to the gas turbine meets the requirements of this specification.

2.1.4 Liquefied Petroleum Gases

The heating values of Liquefied Petroleum Gases (LPGs) normally fall between 2300 and 3200 Btu/SCF (LHV). Based on their high commercial value, these fuels are normally utilized as a back–up fuel to the primary gas fuel for gas turbines. Since LPGs are normally stored in a liquid state, it is critical that the vaporization process and gas supply system maintains the fuel at a temperature above the minimum required superheat value. Fuel heating and heat tracing is required to ensure this.

2.2 Gasification Fuels

Other gases that may be utilized as gas turbine fuel are those formed by the gasification of coal, petroleum coke or heavy liquids. In general, the heating values of gasification fuel are substantially lower than other fuel gases. These lower heating value fuels require that the fuel nozzle gas flow passages be larger than those utilized for fuels of higher heating values. Gasification fuels are produced by either an Oxygen Blown or Air Blown gasification process.

2.2.1 Oxygen Blown Gasification

The heating values of gases produced by oxygen blown gasification fall in the range of 200 to 400 Btu/SCF (7876-15752 kJ/NM^3). The Hydrogen (H_2) content of these fuels is normally above 30% by volume and have H_2/CO mole ratio between 0.5 to 0.8. Oxygen blown gasification fuels are often mixed with steam for thermal NOx control, cycle efficiency improvement and/or power augmentation. When utilized, the steam is injected into the combustor by an independent passage. Due to high hydrogen content of these fuels, oxygen blown gasification fuels are normally not suitable for Dry Low Emissions (DLE) applications**.**

2.2.2 Air Blown Gasification

Gases produced by air blown gasification normally have heating values between 150 and 200 BTU/ SCF (5907 - 7876 kJ/NM^3) LHV. The Hydrogen (H_2) content of these fuels can range from 8% to 20% by volume and have a H_2/CO mole ratio 0.3 to 3:1. The use and treatment of these fuels are similar to that identified for oxygen blown gasification.

For Gasification fuels a significant part of the total turbine flow comes from the fuel. In addition, for oxygen blown fuels there is a diluent addition for NOx control. Careful integration of the gas turbine with the gasification plant is required to assure an operable system. Due to the low volumetric heating value of both oxygen an air blown gases, special fuel system and fuel nozzles are required.

2.3 Process Gases

Many chemical processes generate surplus gases that may be utilized as fuel for gas turbines. (i.e. tail or refinery gases). These gases often consisting of methane, hydrogen, carbon monoxide, and carbon dioxide that are normally byproducts of petrochemical processes. Due to the hydrogen and carbon monoxide content, these fuels have large rich to lean flammability limits. These types of fuels often require inert gas purging of the gas turbine gas fuel system upon unit shutdown or a transfer to a more conventional fuel. When process gas fuels have extreme flammability limits such that the fuel will auto ignite at turbine exhaust conditions, a more "conventional" start–up fuel, such as methane, is required.

Additional process gases utilized as gas turbine fuels are those that are byproducts of steel production. These are:

2.3.1 Blast Furnace Gases (BFGs)

Blast Furnace Gases (BFGs), alone, have heating values below minimal allowable limits. These gases must be blended with other fuel to raise the heating value to above the required limit. Coke Oven and/or Natural Gases or hydrocarbons such as propane or butane can be utilized to accomplish this.

2.3.2 Coke Oven Gases

Coke oven gases are high in H_2 and CH_4 and may be used as fuel for single annular combustion (SAC) systems, but are not suitable for Dry Low Emissions (DLE) combustion applications. These fuels often contain trace amounts of heavy hydrocarbons, which when burned could lead to carbon buildup on the fuel nozzles. The heavy hydrocarbons must be "scrubbed" or removed from the fuel prior to delivery to the gas turbine or maintained in the gaseous state.

2.3.3 Flare Gases

Flare gases are produced by a number of associated gas activities including oil wells or oil rigs, refineries, chemical plants and landfills. Associated gases from oil production and refineries is normally flared, but can also be a good fuel source for power production. These associated gases can be high in methane and C2+ gases and must be evalauated on a case by case basis by GE. Refinery gases are also known to contain butadienes which must be removed prior to use. Gases produced from chemical plants are usually the result of a chemical reaction and will vary in heating value depending on the composition and process. In landfills, gas which results from the decomposition of materials buried in the landfill can also be a source fuel for power production. These types of gases are usually in the low to medium heating value range (300-450 btu/scf) and normally contain siloxanes.

3. FUEL PROPERTIES

3.1 Heating Value

A fuel's heat of combustion, or heating value, is the amount of energy, expressed in BTU (British Thermal Unit), generated by the complete combustion, or oxidation, of a unit weight of fuel. The amount of heat generated by complete combustion is a constant for a given combination of combustible elements and compounds.

For most gaseous fuels, the heating value is determined by using a constant pressure, continuous type calorimeter. This is the industry standard. In these units, combustible substances are burned with oxygen under essentially constant pressure conditions. In all fuels that contain hydrogen, water vapor is a product of combustion, which impacts the heating value. In a bomb calorimeter, the products of combustion are cooled to the initial temperature and all of the water vapor formed during combustion is condensed. The result is the HHV, or higher heating value, which includes the heat of vaporization of water. The LHV, or lower heating value, assumes all products of combustion including water remain in the gaseous state, and the water heat of vaporization is not available. It is a common practice in the gas turbine industry to utilize the LHV when calculating the overall cycle thermal efficiency.

3.2 Modified Wobbe Index Range

While gas turbines can operate with gases having a very wide range of heating values, the amount of variation that a single specific fuel system can accommodate is much less. Variation in heating value as it affects gas turbine operation is expressed in a term identified as modified Wobbe Index (Natural Gas, E. N. Tiratsoo, Scientific Press Ltd., Beaconsfield, England, 1972). This term is a measurement of volumetric energy and is calculated using the Lower Heating Value (LHV) of the fuel, specific gravity of the fuel with respect to air at ISO conditions, and the fuel temperature, as delivered to the gas turbine. The mathematical definition is as follows:

Modified Wobbe Index $= LHV/(SG_{gas} \times T_{gas})^{1/2}$

This is equivalent to:

Modified Wobbe Index $= LHV/[(MW_{gas}/28.96) \times T_{gas}]^{1/2}$

Where:

- LHV = Lower Heating Value of the Gas Fuel (Btu/scf)
- SG_{gas} = Specific Gravity of the Gas Fuel relative to Air
- MW_{gas} = Molecular Weight of the Gas Fuel
- T_{gas} = Absolute Temperature of the Gas Fuel (Rankine)
- 28.96 = Molecular Weight of Dry Air

The allowable modified Wobbe Index range between 40 and 60 is established to ensure that required fuel nozzle pressure ratios be maintained during all combustion/turbine modes of operation for standard fuel system configurations. An accurate analysis of all gas fuels, along with fuel gas temperature profiles shall be submitted to GE for proper evaluation.

3.3 Superheat Requirement

The superheat requirement is established to ensure that the fuel gas supplied to the gas turbine is 100% free of liquids. Dependent on its constituents, gas entrained liquids could cause degradation of gas fuel nozzles, and for DLE applications, premixed flame flashbacks or re-ignitions. A minimum of 50°F (28°C) of superheat is required and is specified to provide enough margin to compensate for temperature reduction due to pressure drop across the gas fuel control valves. A minimum of 20°F (11°C) of superheat is required at the gas turbine fuel manifold inlet connection.

3.4 Gas Constituent Limits

Gas constituents are not specifically limited except to the extent described above. These limitations are set forth to assure stable combustion through all gas turbine loads and modes of operation. Limitations are more stringent for DLE combustion systems where “premixed” combustion is utilized. A detailed gas analysis shall be furnished to GE for proper evaluation.

3.5 Gas Fuel Supply Pressure

Gas fuel supply pressure requirements are dependent on the gas turbine model and combustion design, the fuel gas analysis and unit specific site conditions. Minimum and maximum supply pressure requirements can be determined by GE for specific applications.

4. CONTAMINANTS

Dependent on the type of fuel gas, the geographical location and the forwarding means there is the potential for the “raw” gas supply to contain one or more of the following contaminants:

1. Tar, lamp black, coke
2. Water, salt water
3. Sand, clay
4. Rust
5. Iron sulfide
6. Scrubber oil or liquid
7. Compressor Lube oil
8. Naphthalene
9. Gas Hydrates
10. Siloxanes

It is critical that the fuel gas is properly conditioned prior to being utilized as gas turbine fuel. This conditioning can be performed by a variety of methods. These include but are not limited to media filtration, inertial separation, coalescing and fuel heating. Trace metal, particulate and liquid contamination limits are given below. These limits are given in parts per million by weight (ppmw) corrected to the actual heating value of the fuel. It is critical that fuel gas conditioning equipment be designed and sized so that these limits are not exceeded.

4.1 Particulate

Contamination limits for particulates are established to prevent fouling and excessive erosion of hot gas path parts, erosion and plugging of combustion fuel nozzles and erosion of the gas fuel system control valves. The utilization of gas filtration or inertial separation is required. The filtration level should be a beta ratio of 200 minimum (efficiency of 99.5%) at 5μ or less. The total particulate should not exceed 30 ppm by weight. GE requires the use of stainless steel piping downstream of this last level of filtration.

4.2 Liquids

No liquids are allowed in the gas turbine fuel gas supply. Liquids contained in the fuel can result in nuisance and/or hardware damaging conditions. These include rapid excursions in firing temperature and gas turbine load, primary zone re-ignition and flashback of premixed flames, and when liquids carry over past the combustion system, melting of hot gas path components. When liquids are identified in the gas supply, separation and heating is employed to achieve the required superheat level.

Gas at the wellhead is typically produced in a wet saturated condition and is treated to remove water and heavy hydrocarbon liquids. Depending on the degree of treatment and the supply pressure, the gas may be delivered in a dry condition. After pressure reduction it is possible for condensates to form as the gas cools during expansion. The condensates may be either water or hydrocarbons or both. Carry over of lubricating oil from compressor stations is another source of liquids.

4.3 Sulfur

Sulfur can sometimes be found in natural gas in the compounds “H2S” and/or “COS”. It is produced with the natural gas. Typically the gas supplier will limit H2S to a concentration of less than approximately 20 ppmv by removing sulfur in a treatment system. Sulfur may also be present in very low concentrations (< 100 ppbv) in the form of elemental sulfur vapor.

There is no specific limit on natural gas fuel sulfur content if the engine is used in an application where both the fuel and environment are free of alkali metals, including sulfur compounds. There are several concerns relative to the levels of sulfur contained in the fuel gas supply. Many of these are not directly related to the gas turbine but to associated equipment and emissions requirements.

These concerns include but are not limited to:

4.3.1 Hot Gas Path Corrosion

Typically, use of sulfur bearing fuels will not be limited by concerns for corrosion in the turbine hot gas path unless alkali metals are present. Sodium, potassium and other alkali metals are not normally found in natural gas fuels, but are typically found to be introduced in the compressor inlet air in marine environments, as well as in certain adverse industrial environments. The total amount of sulfur and alkali metals from all sources shall be limited to form the equivalent of 0.6 ppm of alkali metal sulfates in the fuel. Unless sulfur levels are extremely low, alkali levels are usually limiting in determining hot corrosion of hot gas path materials. For low Btu gases, the fuel contribution of alkali metals at the turbine inlet is increased over that for natural gas and the alkali limit in the fuel is therefore decreased. The total amount of alkali metals [(a)] in gas fuels used with engines having marinized (corrosion-resistant) coatings on the high pressure turbine blading shall not exceed 0.2 ppm [(b)].

(a) Sodium, potassium, and lithium. Experience has shown that sodium is by far the preponderant alkali metal, if any, found in gaseous fuels.

(b) This limit assumes zero alkali metals in the inlet air or injected water or steam. When actual levels are above zero, the maximum allowable sodium content of the fuel must be reduced in accordance with the following relationship:

ppm sodium inlet air x Air/Fuel Ratio	=
ppm sodium in water or steam x $\frac{\text{Water or Steam}}{\text{Fuel}}$ ratio	=
ppm sodium in fuel	=
Total fuel equivalence for sodium from all sources not to exceed	0.2 ppm

4.3.2 HRSG Corrosion

If heat recovery equipment is used, the concentration of sulfur in the fuel gas must be known so that the appropriate design for the equipment can be specified. Severe corrosion from condensed sulfuric acid results if a heat recovery steam generator (HRSG) has metal temperatures below the sulfuric acid dew point. Contact the HSRG supplier for additional information.

4.3.3 Selective Catalytic Reduction (SCR) Deposition

Units utilizing ammonia injection downstream of the gas turbine for NOx control can experience the formation of deposits containing ammonium sulfate and bisulfate on low temperature evaporator and economizer tubes. Such deposits are quite acidic and therefore corrosive. These deposits, and the corrosion that they cause, may also decrease HRSG performance and increase backpressure on the gas turbine. Deposition rates of ammonium sulfate and bisulfate are determined by the sulfur content of the fuel, ammonia content in the exhaust gas, tube temperature and boiler design. Fuels having sulfur levels above those used as odorants for natural gas should be reported to GE . In addition, the presence of minute quantities of chlorides in the inlet air may result in cracking of AISI 300 series stainless steels in the hot gas path. Contact the SCR supplier for additional information.

4.3.4 Exhaust Emissions

Sulfur burns mostly to sulfur dioxide, but 5% to 10% oxidizes to sulfur trioxide. The latter can result in sulfate formation, and may be counted as particulate matter in some jurisdictions. The remainder will be discharged as sulfur dioxide. To limit the discharge of acid gas, some localities may restrict the allowable concentration of sulfur in the fuel.

4.3.5 Elemental Sulfur Deposition

Solid elemental sulfur deposits can occur in gas fuel systems downstream of pressure reducing stations or gas control valves under certain conditions. Power reduction has been observed for DLE applications due to elemental sulfur. These conditions may be present if the gas fuel contains elemental sulfur vapor, even when the concentration of the vapor is a few parts per billion by weight. Concentrations of this magnitude cannot be measured by commercially available instrumentation and deposition cannot therefore be anticipated based on a standard gas analysis. Should deposition take place, fuel heating will be required to maintain the sulfur in vapor phase and avoid deposition. A gas temperature of 130°F (54°C) or higher may be required at the inlet to the gas control valves to avoid deposition, depending on the sulfur vapor concentration. The sulfur vapor concentration can be measured by specialized filtering equipment. If required, GE can provide further information on this subject.

4.4 Siloxanes

Siloxanes are sometimes found in non-traditional gas fuels such as obtained from landfills. Siloxanes should be removed with current technology so that the content is as low as possible, but not to exceed 50 ppb by weight in the fuel gas. If the application includes wet NOx controls, the silica limit for the water or steam is reduced to 50 ppb by weight. Gas sampling and analysis is required and should include either an impinger or sorbent collection method and have a laboratory with Gas chromatography coupled with Mass Spectrometer (GC-MS) capability to analyze the samples collected.

APPENDIX 1 – DEFINITIONS

Dew Point

This is the temperature at which the first liquid droplet will form as the gas temperature is reduced. Common liquids found in gas fuel are hydrocarbons, water and glycol. Each has a separate and measurable dew point. The dew point varies considerably with pressure and both temperature and pressure must be stated to properly define the gas property. Typically, the hydrocarbon dew point will peak in the 300 to 600 psia (2068 to 4137 kPa) range.

Dry Saturated Conditions

The gas temperature is at, but not below or above, the dew point temperature. No free liquids are present

Gas Hydrates

Gas hydrates are semi–solid materials that can cause deposits that plug instrumentation lines, control valves and filters. They are formed when free water combines with one or more of the C1 through C4 hydrocarbons. Typically the formation will take place downstream of a pressure reducing station where the temperature drop is sufficient to cause moisture condensation in a region of high turbulence. Because hydrates can cause major problems in the gas distribution network, the moisture content is usually controlled upstream at a dehydration process station.

Gas Hydrate Formation Line

This is similar to the dew point line except the temperature variation with pressure is much less. The hydrate line is always below or at the moisture dew point line as free water must exist in order for hydrates to form. Maintaining 50°F of superheat above the moisture dew point will eliminate hydrate formation problems.

Glycol

Glycol is not a natural constituent of natural gas but is introduced during the dehydration process. Various forms of glycol are used, diethylene and triethylene glycol being two most common. In some cases glycol is injected into the pipeline as a preservative. In most cases, glycol may only be a problem during commissioning of a new pipeline or if an upset has taken place at an upstream dehydration station.

Odorant

Odorants are injected into natural and LP gas to make leaks readily detectable. The odorant commonly used for natural gas is tertiary butyl mercaptan, while ethyl mercaptan is used for LP gas.

Superheat

This is defined as the difference between the gas temperature minus the liquid dew point. The difference is always positive or zero. A negative value implies that the value is being measured at two differing states of pressure and temperature and is not valid. A measured gas temperature below the theoretical dew point means that the gas is in a wet saturated state with free liquids present.

Saturation Line

This is the same as the dew point line.

Wet Saturated Conditions

A point where a mixture consists of both vapor and liquids.

Requirements for Water and Steam Purity for Injection in Aero Derivative Gas Turbines

1.1 Scope

This document establishes the purity requirements for water for NOx suppression and *SPRINT*® injection into gas turbine engines and for Steam for injected into the gas turbine whether for NOx suppression or power augmentation.

1.2 Definitions

For the purpose of this specification, the following definitions shall apply:

NOx Suppression Water - Water introduced into the engine combustor for the purpose of suppressing the oxides of nitrogen (NOx) in the engine exhaust gases. This does not include any boiler feed or make up water for steam generation.

SPRINT® Water – Water introduced into the engine inlet or into the high pressure compressor inlet for purpose of power enhancement.

Steam – Steam that is injected into the combustor for NOx suppression or injected into the compressor rear frame or LP Turbine for power augmentation on certain LM models.

2. Applicable Documents

2.1 American Society of Testing and Materials

Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA. (http://www.astm.org)

ASTM D1066	Standard Practice for Sampling Steam
ASTM D3370	Standard Practices for Sampling Water from closed Conduits
ASTM D4327	Anions in Water by Chemically Suppressed Ion Chromatography
ASTM D5391	Electrical Conductivity and Resistively of a Flowing High-Purity Sample
ASTM D5464	Standard Test Method for pH of Water with Low Conductivity
ASTM D5542	Trace Anions in High-Purity Water by Ion Chromatography
ASTM D5907	Standard Test Method for Filterable and Non-Filterable Matter in Water

2.2 Environmental Protection Agency (EPA) Test Methods

EPA 150.1	pH Electrometric
EPA 200.7	Metals & Trace Elements
EPA 300.0	Determination of Inorganic Anions By Ion Chromatography

3.0 Water Requirements

3.1 Water Sampling Requirements

The sampling shall be in accordance with ASTM D3370. A minimum of one (1) gallon or four (4) liters shall be supplied.

3.2 Water Purity Requirements

The water shall meet the following requirements when tested in accordance with the designated test method:

	Limit	Test Method
Total Suspended Solids and Total Dissolved Solids, mg/L, max	5 5	ASTM D5907(1), EPA 160.1(1), EPA 160.2(1)
pH(2)	6.0 - 8.0	ASTM D5464 or EPA 150.1
Conductivity(2), μS/cm at 25°C	< 1.0	ASTM D5391(3)
Sodium + potassium, ppm, max	See 3.3	EPA 200.7
Silica (SiO_2), mg/L, max.	0.1(4)	EPA 200.7
Chlorides, mg/L, max	0.5	ASTM D5542, ASTM D4327, or EPA 300.0
Sulfates, mg/L, max	0.5	ASTM D5542, ASTM D4327 or EPA 300.0

(1) Use twice the recommended volume of sample
(2) pH and Conductivity shall be measured when water is free of carbon dioxide
(3) Flowing Sample Method B.
(4) If gas fuel utilized contains Siloxanes, limit is 0.05 mg/l (Ref MID-TD-0000-1)

3.3 Sodium & Potassium Limits in Water or Steam

The maximum amount of NA + K allowed in the water or steam injected into the engine depends upon the total NA + K contamination from all sources; i.e., from the fuel, air, water and steam. The maximum Na + K allowed is determined from the equation:

(ppmFuel) + (ppmAir)*A/F + (ppmWater)*W/F + (ppmSteam)*S/F = 0.2 ppm

Where:

ppmFuel	=	Parts per million Na + K in fuel
ppmAir	=	Parts per million Na + K in Air
ppmWater	=	Parts per million Na + K in water
ppmSteam	=	Parts per million Na + K in steam
A/F	=	Air/Fuel Ratio (Wt. Basis)
W/F	=	Water/Fuel Ratio (Wt. Basis)
S/F	=	Steam/Fuel Ratio (Wt. Basis)

3.4 Water Filtration Requirements

Filtration is most commonly expressed by filter beta ratio (β) at a specified particle diameter. The standard of beta ratio at a particle size is β = (total number particle at diameter or greater into filter) / particles at diameter or greater through filter). Thus, for a given particle size, efficiency in terms of beta ratio is [$\varepsilon = (1 - 1/ \beta) \times 100\%$]. The filtration level shall be a beta ratio of 200 minimum (efficiency of 99.5%) at 20μ or less.

4.0 Steam Requirements

4.1 Steam Purity

The Steam shall meet the following requirements when tested in accordance with the designated test method:

- **Sodium + Potassium (Na +K)** – See paragraph 3.3
- **Total Conductivity (Cation + Anion)**

  Normal: <1.5 μS/cm (95% of operation time)
  Abnormal: < 2.0 μS/cm (5% of operating time)

- **Total Solids**

  The maximum total solids depends on the steam/fuel weight ratios at which the gas turbine is to operate in the specific application. The value is determined form Figure 1. Contaminant size shall not exceed 250 microns. With the exception of silica, there is no differentiation between types of solids as long as other limitations of this section are met.

  Interpretation of Figure 1 should be made as follows:

  a. Calculate maximum steam-to-fuel ratio by dividing total (CDP & fuel nozzle) high pressure steam flow by fuel flow (WF36) for site operating conditions. Where steam flow may vary widely, operating condition with highest steam-to-fuel ratio should be used.

  b. From curve, determine maximum solids permissible and apply this limit to steam supplied to gas turbine.

  Silica in the steam is limited to 20 ppb.

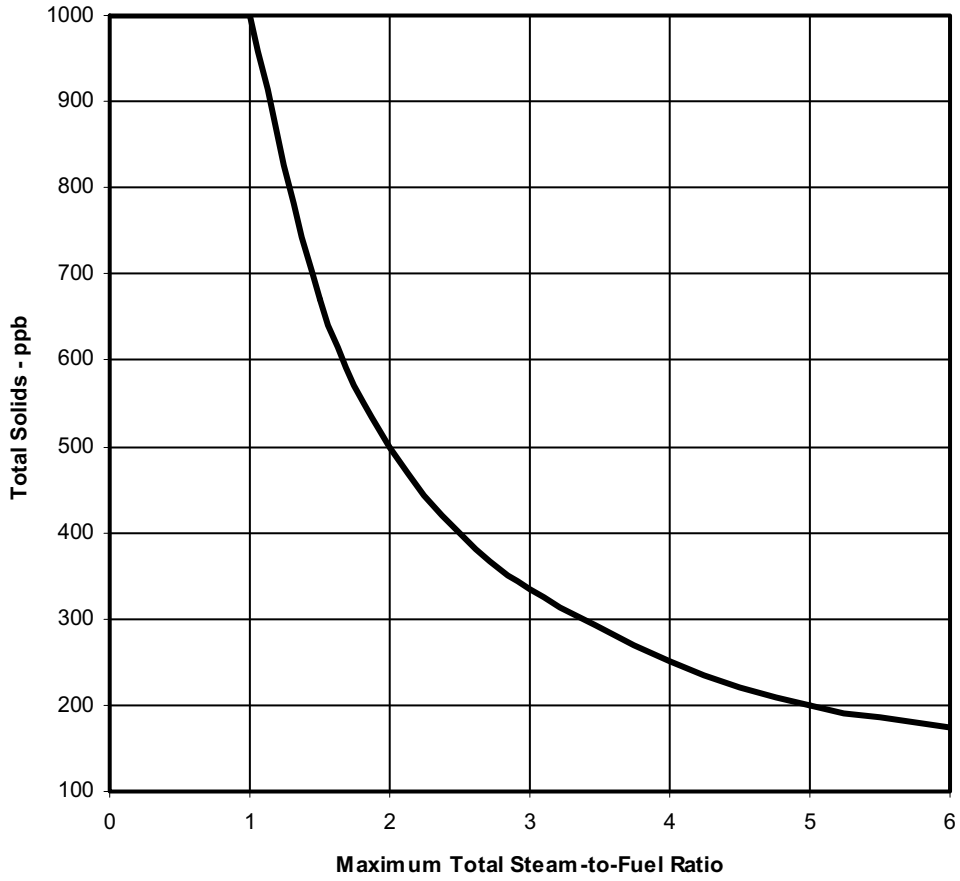


Figure 1. Steam Contamination Maximum Solids

4.2 Steam Sampling

Steam samples should be taken in accordance with ASTM D1066.

Compressor Cleaning Water Purity Requirements for GE Aircraft Derivative Gas Turbines

1.1 Scope

This specification establishes the requirements for purified water for use in cleaning the compressor of gas turbine engines where the intent is to restore performance by removing the build up of deposits on compressor components. The water quality defined in this specification applies to water used in both on–line compressor cleaning and crank–soak compressor cleaning.

1.2 Definitions

For the purpose of this specification, the following definitions shall apply:

On–line Compressor Cleaning - A method of removing the build up of deposits on compressor components while the engine is operating. On–line cleaning as accomplished by spraying cleaning solution into the inlet of the engine while the engine is operating.

Crank–Soak Compressor Cleaning - A method of removing the buildup of deposits on compressor components while the engine is motored by the starter. Crank–soak cleaning is accomplished by spraying cleaning solution into the inlet of the engine while the engine is operating unfired at crank speed.

Liquid Detergent - A concentrated solution of water soluble surface active agents and emulsifiable solvents.

Cleaning Solution - A solution of emulsion of liquid detergent and water or a water and antifreeze mixture for direct engine application. The recommended dilution of liquid detergent and water shall be specified by the liquid detergent manufacturer.

2.0 Applicable Documents

The following documents shall form a part of this specification to the extent specified herein. Unless a specific issue is specified, the latest revision shall apply.

2.1 American Society of Testing and Materials

Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA. (http://www.astm.org)

ASTM D1293 Tests for pH of Water

ASTM D3370 Practices for Sampling Water

ASTM D4191 Tests for Sodium in Water by atomic Absorbtion Spectography

ASTM D4192 Tests for Potassium in Water by Atomic Absorbtion Spectography

ASTM D5907 Tests for Filterable and Non-Filterable Matter in Water

2.2 Environmental Protection Agency (EPA) Test Methods

EPA 160.3 Residue, Non-Filterable and Total Suspended Solids

EPA 150.1 pH Electrometric

EPA 200.7 Metals & Trace Elements

3.0 Requirements

3.1 Sampling Requirements

The sampling shall be in accordance with ASTM D3370. A minimum sample of one (1) gallon or four (4) liters shall be supplied.

3.2 Chemical Requirements

The water shall meet the following requirements when tested in accordance with the designated test method.

3.3 Filtration Requirements

Filtration is most commonly expressed by filter beta ratio (β) at a specified particle diameter. The standard of beta ratio at a particle size is β = (total number particle at diameter or greater into filter) / particles at diameter or greater through filter). Thus, for a given particle size, efficiency in terms of beta ratio is [ε = (1 – 1/ β) x 100%]. The filtration level shall be a beta ratio of 200 minimum (efficiency of 99.5%) at 100μ or less.

	Limit	Test Method
Total matter, ppm, max	100	ASTM D5907 or EPA 160.3
pH	6.5 - 8.5(1)	ASTM D1293 or EPA 150.1
Sodium + potassium, ppm max	25	ASTM D4191 & ASTM D4192 or EPA 200.7

Note (1): pH of 6.5 – 8.5 is desired, 6.0 – 8.5 is permitted.

Liquid Detergent for Compressor Cleaning for GE Aircraft Derivative Gas Turbines

This specification establishes the requirements for liquid detergent products used to prepare cleaning solutions for cleaning the compressors of gas turbine engines, where the intent is to restore performance by removing the build–up of deposits on compressor components. Such deposits include salt, soils or oils that may be ingested from the atmosphere.

The cleaning process shall be carried out by spraying the cleaning solution into the bellmouth of the engine while the engine is running at power (on–line cleaning) or while the engine is being cranked (crank soak cleaning).

For the purposes of this specification, the following definitions shall apply:

Liquid Detergent - A concentrated solution of water soluble surface active agents and emulsifiable solvents.

Cleaning Solution - A solution or emulsion of liquid detergent in water or a water and antifreeze mixture for direct engine application. The recommended dilution of liquid detergent and water shall be determined by the liquid detergent manufacturer.

1. Applicable Documents

The following documents shall form a part of this specification to the extent specified herein. Unless a specific issue is specified, the latest revision shall apply.

ASTM D88 Standard Test Method For Saybolt Viscosity

ASTM D445 Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids

ISO 3104 Determination of Kinematic viscosity and calculation of dynamic viscosity

ARP 1795 Stress–Corrosion of Titanium Alloys, Effect of Cleaning Agents on Aircraft Engine Materials

AMS 1424 Deicing/Anti-icing Fluid, Aircraft (Newtonian-SAE Type 1)

2. Detergent Properties

2.1 Composition

The chemical composition of the detergent is not limited, other than as specified herein.

2.2 Biodegradability

Use of the liquid detergent/cleaning solution shall conform to local regulations for water pollution. Use of biodegradable ingredients is recommended.

2.3 Toxicity

Use of the liquid detergent/cleaning solution shall conform to local regulations for industrial hygiene and air pollution. Use of nontoxic ingredients is recommended.

2.4 Health and Safety Information

The liquid detergent manufacturer shall make available health and safety information for the liquid detergent as required by applicable local, state and federal regulations.

2.5 Solids

The liquid detergent shall contain no particles larger than 20 micron.

2.6 Physical and Chemical Properties

The liquid detergent shall meet the test requirements.

3. Test Requirements

3.1 Liquid Detergent

3.1.1 Residue or Ash Content

Residue or ash content shall not exceed 0.01 percent when tested in accordance with paragraph 4.1.

3.1.2 Low Temperature Stability

The liquid detergent shall show no evidence of separation of component parts when maintained at 40°F ± 3 (5°C ± 2). It is highly desirable although not mandatory that the fluid shall remain liquid below 32°F (0°C).

3.1.3 Cold Weather Solution Compatibility

The liquid detergent shall show no separation, layering or precipitation when mixed to the liquid detergent manufacturer's recommended dilution in one or more of the following antifreeze solutions after 2 hours at 10°F ± 3 (-12°C ± 2):

- Isopropyl Alcohol
- Monopropylene glycol (PG)
- Acetone

See paragraph 6.1 for more information regarding liquid detergent and antifreeze mixtures.

3.1.4 Hard Water Compatibility

The liquid detergent shall show no separation or layering when mixed with synthetic hard water prepared in accordance with paragraph 4.2.

3.1.5 Acid and Alkali Acceptance

The liquid detergent shall show no separation, layering or precipitation when tested in acidic or alkali media in accordance with paragraph 4.3.

3.1.6 Salt Water Tolerance

The liquid detergent shall show no separation or gelling when mixed with 3.5 percent salt water in accordance with paragraph 4.4.

3.1.7 Viscosity

The liquid detergent shall have a viscosity of 50 to 200 SUS at 77°F (25°C) when tested in accordance with ASTM D88, or 7.4 to 43.3 cSt when measured per ASTM 445 or ISO 3104.

3.1.8 pH

The pH of the liquid detergent as received shall be from 6.5 to 8.5 when measured with a suitable pH meter employing a glass electrode.

3.2 Cleaning Solution

3.2.1 Corrosive Elements

Maximum levels of elements in the cleaning solution which may promote various types of corrosion, shall be no greater than as shown in Table 1, when analyzed by methods in paragraph 4.5.

Table 1. Maximum Corrosives Limit

Total alkali metals (sodium + potassium + lithium, etc.)	25 ppm max.
Magnesium + calcium	5 ppm max.
Vanadium	0.1 ppm max.
Lead	0.1 ppm max.
Tin + Copper	10 ppm max.
Sulfur	50 ppm max.
Chlorine	40 ppm max.

3.2.2 pH

The pH of the cleaning solution shall be from 6.5 to 8.5 when measured with a suitable pH meter employing a glass electrode.

4. Test Methods

4.1 Residue or Ash Content

Weigh 10 ± 0.1 gram sample of liquid detergent in a weighed 30 ml porcelain crucible. Heat gently to volatilize any water or solvents. (Crucible may be placed in air oven at 105°C ± 2 for 24 hours, followed by 240°C ± 2 for 24 hours to insure all volatile matter is evaporated.) Finally, ignite contents over Bunsen Burner, first at low temperature under good oxidizing conditions until all ignitable material is consumed, then place a crucible in a muffle furnace at 1040 to 1100°C for 2 hours. Cool in desiccator, and weigh.

Percent residue or ash = (100 x A)/W

Where: A = grams of residue
W = grams of sample

4.2 Hard Water Compatibility

4.2.1 Preparation of Synthetic Hard Water

A hard water solution is prepared by dissolving the following in one liter of just boiled and cooled distilled water:

a. 0.20±0.005 gram Calcium Acetate, reagent grade $Ca(C_2H_3O_2)_2 \bullet H_2O$

b. 0.15±0.005 gram Magnesium Sulfate, reagent grade $MgSO_4 \bullet 7 H_2O$

4.2.2 Hard Water Test

5 ml of liquid detergent shall be added to a clean 50 ml cylinder. 45 ml of synthetic hard water shall be added and mixed well. The solution shall be examined for compatibility after 16 hours at 77°F ± 5 (25°C ± 3).

4.3 Acid and Alkali Acceptance

The liquid detergent shall be mixed with distilled water in accordance with the liquid detergent manufacturer's recommended dilution. To 50 ml of the solution, add 1 ml of 75 percent phosphoric acid. To another 50 ml of the solution, add 5 ml of 75 percent phosphoric acid. To another 50 ml of the solution, add 1 ml of 50 percent potassium hydroxide. Let all three mixtures stand for one hour at 77°F ± 5 (25°C ± 3), and then examine for acid or alkali acceptance.

4.4 Salt Water Tolerance

Prepare a 3.5 percent by weight solution of sodium chloride in distilled water. Add 15 ml of salt solution to 35 ml of liquid detergent and let stand for 1 hour at 77°F ± 5 (25°C ± 3). Examine for salt water tolerance.

4.5 Elemental Content

Elemental content shall be determined using the following methods:

Element	Method
Sulfur, Phosphorous	Inductivity Coupled Plasma Spectroscopy - Atomic Emission Spectroscopy (ICP-AES)
Chlorine	Microcoulometric filtration
Sodium, Potassium	Atomic Absorption (AA)
Other metals	ICP-AES or AA

5. Material Compatibility

5.1 Compatibility with Engine Materials

Use of the detergent gas turbine cleaner shall not have adverse effects on engine system materials such as titanium stress corrosion, hot corrosion of turbine components or damage to lubrication system components.

5.2 Titanium Stress Corrosion

A titanium stress corrosion test in accordance with ARP 1795 or equivalent may be run on the liquid detergent at the discretion of GE.

6.1 Cold Weather Usage

In cold weather, liquid detergent must be added to antifreeze mixture rather than to water alone. At present, the only acceptable antifreeze solutions are:

- Isopropyl Alcohol
- Monopropylene glycol (PG)
- Acetone

Monopropylene glycol (PG) must be per AMS 1424 and may be used down to 20°F (-7°C)

Antifreeze mixtures are shown in Table 2. The liquid detergent manufacturer must specify which, if any, of the antifreezes specified above is not compatible with the liquid detergent.

The use of non-isopropyl alcohol, ethylene glycol or additives containing chlorine, sodium or potassium are not permitted since they may attack the titanium and other metals in the gas turbine.

It is extremely important that the liquid detergent and antifreeze solution be a homogeneous mixture when sprayed into the bellmouth of the gas turbine. If after 2 hours the liquid detergent and antifreeze solution separates, (see paragraph 3.1.3) agitation of the mixture in the wash water tank is permissible. However, the liquid detergent manufacturer shall specify that agitation is required.

Table 2. Water Wash Antifreeze Mixtures.

Compressor Washing Antifreeze Mixtures						
Outside Air Temp, °F (°C)	**Monopropylene glycol (PG) % Vol**	**H2O % Vol**	**Acetone % Vol**	**H2O % Vol**	**Isopropyl Alcohol % Vol**	**H2O % Vol**
+20 to +50 (-7 to 10)	21	79	25	75	22	78
+10 to +20 (-12 to –7)	N/A	N/A	40	60	34	66
0 to +10 (-18 to –12)	N/A	N/A	53	47	47	53
-10 to 0 (-23 to –18)	N/A	N/A	63	37	72	28
-20 to –10 (-29 to –23)	N/A	N/A	69	31	88	12
-30 to –20 (-34 to –29)	N/A	N/A	75	25	97	3
Compressor Rinsing Antifreeze Mixtures						
Outside Air Temp, °F (°C)	**Monopropylene glycol (PG) % Vol**	**H2O % Vol**	**Acetone % Vol**	**H2O % Vol**	**Isopropyl Alcohol % Vol**	**H2O % Vol**
+20 to +50 (-7 to 10)	14	86	20	80	18	82
+10 to +20 (-12 to -7)	N/A	N/A	33	67	27	73
0 to +10 (-18 to -12)	N/A	N/A	43	57	39	61
-10 to 0 (-23 to -18)	N/A	N/A	50	50	58	42
-20 to -10 (-29 to -23)	N/A	N/A	55	45	70	30
-30 to -20 (-34 to -29)	N/A	N/A	60	40	77	23

Lubricating Oil Specification for GE Aircraft Derivative Gas Turbines

This document provides the requirements and application guidelines for selection of lubricating oils which can be satisfactorily utilized in GE Marine and Industrial Aeroderivative Applications. It is recommended that the lubricating oil selected be reviewed with GE prior to its use.

1.0 Oil Specifications

Oils conforming to the US Department of Defense (DoD) Specifications shown in paragraph 2.1 are acceptable for use in GE Aircraft Derivative gas turbines, provided they are listed on the Qualified Product List (QPL) for the specific Specification.

1.1 Commercial Specifications

Commercially available synthetic based lubricating oils, per the Supplier's Specification, are acceptable for use in GE Aircraft Derivative gas turbines, provided they are listed in Section 4 of this document. Such oils largely conform to the primary requirements of the oils in Section 1.0, but certain variations have been approved. Such oils have been qualified by the Supplier to meet the requirements of this document.

2.0 Applicable Documents

The following documents shall form a part of this document to the extent specified herein. Unless a particular issue is specified, the latest revision shall apply.

2.1 US DoD Specifications

MIL-PRF-23699 Lubricating Oil, Aircraft Turbine Engines, Synthetic Base, Class STD

MIL-L-7808 Lubricating Oil, Aircraft Turbine Engines, Synthetic Base, Type 1

2.2 American Society of Testing and Materials.

The following documents are available from ASTM International, 100 Barr Harbor Drive PO Box C700, West Conshohocken, PA 19428-2959:

ASTM D2532 Low Temperature Viscosity

ASTM D97 Pour Point

ASTM D445 Kinetic Viscosity

ISO 3104 Determination of Kinematic viscosity and calculation of dynamic viscosity

3.0 Requirements

The lubricating oil shall conform to the requirements of MIL-PRF-23699, Class STD however, exceptions to the following requirements will be considered:

- Low temperature Viscosity when tested per ASTM D2532.
- Pour Point when tested per ASTM D97.
- Viscosity at 40°C and 100°C when tested per ASTM D445 or ISO 3104
- Base Stock Composition

The specific variations to MIL-PRF-23699, Class STD shall be provided by the oil supplier, along with performance difference impacts, for review by GE.

3.1 Material Compatibility

The lubricating oil shall be compatible with the same elastomer seal and metallic materials as the MIL-PRF-23699, Class STD compliant lubricating oils are.

The lubricating oil shall be mixable with MIL-PRF-23699, Class STD or MIL-L-7808 compliant oil in a ratio of up to 5% of either oil, without adversely affecting the property integrity of the majority, or operating, oil. Mixing of oils is not intended, but will result due to engine location changes.

4.0 Qualification

Lubricating oil shall be considered qualified and acceptable for use in GE Aircraft Derivative gas turbines demonstrating conformance to the requirements and after being listed in paragraph 4.4. The qualification program shall be carried out by the oil supplier in conjunction with a sponsoring gas turbine owner/operator. GE's participation will be limited to technical consultation, review and final approval only.

4.1 Performance Tests

The oil supplier shall conduct tests in accordance with the requirements of MIL-PRF-23699, Class STD and compare the results with the requirements stated therein. All results, and specifically the variations to MIL-PRF-23699, Class STD requirements, shall be reviewed with GE prior to initiation of Service Evaluation Testing. Specifically, the material presented for review shall include, as minimum, the following:

- Physical/Chemical Properties and variations to MIL-PRF-23699, Class STD
- Expected impact to operating systems due to Property variations
- Material Compatibility Lists & Test results
- Oil Coking Test Results

4.2 Service Evaluation Tests

The oil shall undergo service evaluation testing in a LM Series gas turbine application(s). The sponsoring operator will accept total responsibility for all results related to operating with the candidate lubricating oil. The service evaluation engine shall have a known hardware condition baseline, based on depot inspection or new delivery, immediately prior to the service evaluation test.

Service evaluation testing shall be conducted on a minimum of three LM series gas turbines, each accumulating at least 8,000 operating hours, at a baseload operating site, prior to inspection. During operation, periodic oil samples shall be tested and trended for physical and chemical property changes. Inspection shall be performed at an authorized depot, and shall be in accordance with the applicable repair manual.

Inspection shall be focused on the oil wetted parts, including the bearings, gears, elastomer seals, sump oil seals, actuators, and lube/hydraulic pumps. GE will be permitted to witness any of the inspections, at the discretion of GE.

4.3 Qualification Report

The oil supplier, and/or operator, shall prepare and submit a Final Qualification Report to GE. The report shall include, as a minimum, the following:

- Oil Brand Description including the complete formulation
- Certified physical, chemical and performance test results
- Material Safety Data Sheets
- Service evaluation test history including all significant operational and maintenance events
- Service evaluation oil sample trending results
- Final depot engine inspection results

Upon final review and approval of the Final Qualification Report by GE, the candidate oil will be included on the approved oils list.

Formulation changes affecting any approved performance characteristics must be reviewed with GE for impact on qualification results.

4.4 Approved Lubricating Oils

Approved lubricating oils listed on QPL-23699 Class STD, and QPL-7808, (Qualified Products List). Oils listed for MIL-PRF-23699, Class HTS are specifically not approved for aero derivative gas turbines.

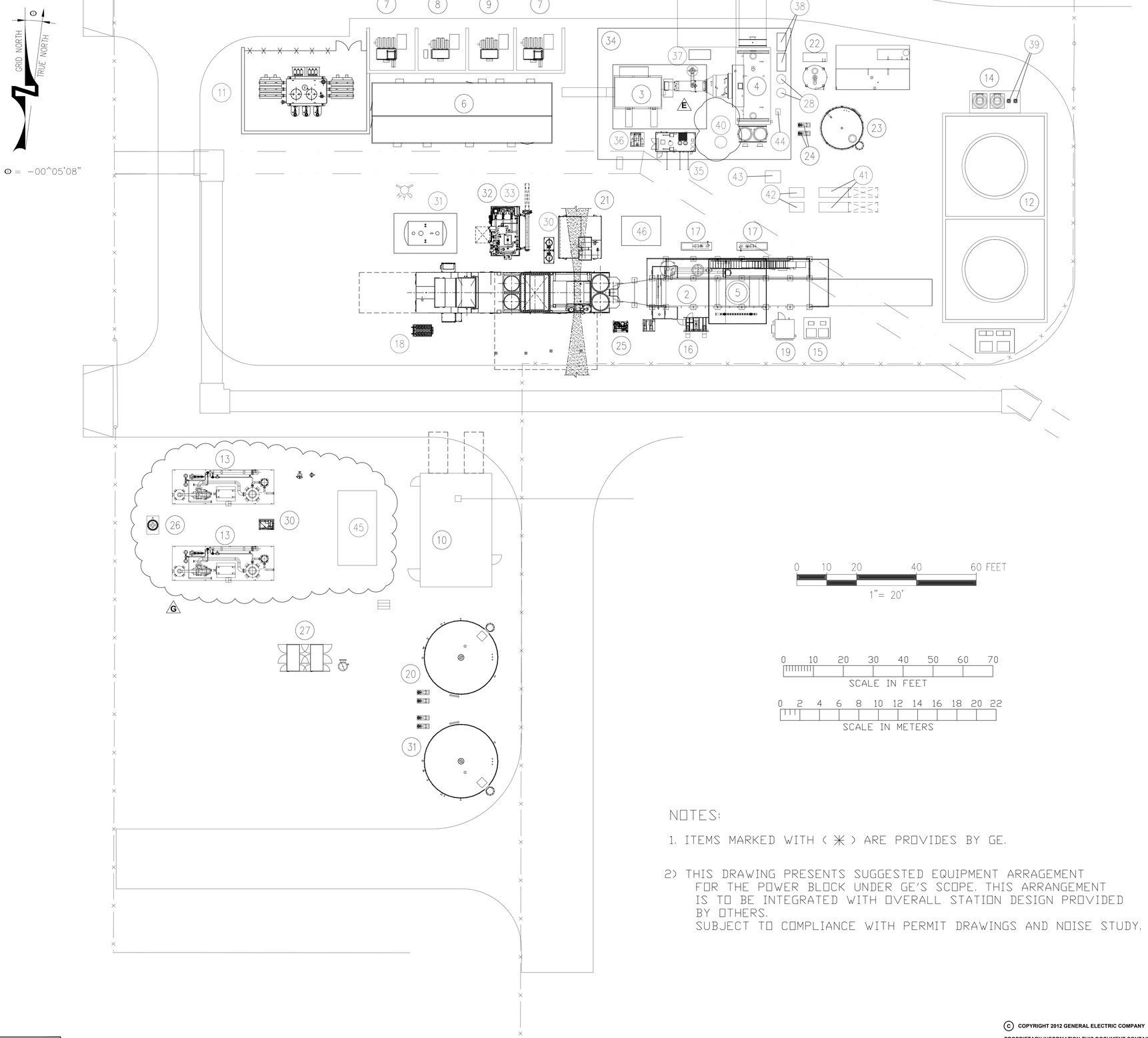
In addition, the following lubricating oils are approved for use in GE Aero Derivative gas turbines and gas generators:

1. None at this time.

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\MECH\ M005_(RG)_120E4746.dwg DATE: SEP 12, 2013 TIME: 1:33 PM

SIZE	DWG NO	SH	REV
E	120E4746	1	G

REVISIONS				
	REV	DESCRIPTION	DATE	APPROVED
F		ITEMS 10 & 30 UPDATED, 45 ADDED	SEP/11/13	GF/AV
G		RELOCATED ITEMS 13, 26, 30 & 45	SEP/12/13	JM/EVN
	A	ITEMS 43, 44 & 45 ADDED	JUL/12/13	GF/AV
	B	ITEMS SIZE AND POSITION UPDATED	JUL/17/13	GF/AV
	C	ITEMS 32 & 33 UPDATED	AUG/08/13	GF/AV
	D	REMOVED ITEM 45 CHANGED GEOMETRY OF ITEM 10	AUG/14/13	JM/EVN
	E	ITEMS 11,25,29,40 & 46 UPDATED	AUG/23/13	GF/AV



LEGEND

1. GAS TURBINE GENERATOR (GTG)
2. ONCE THROUGH STEAM GENERATOR (OTSG)
3. STEAM TURBINE GENERATOR (STG)
4. SURFACE CONDENSER
5. OTSG STACK
6. POWER DISTRIBUTION CENTER (PDC)
7. 4.16KV AUX. TRANSFORMER
8. 480V AUX. TRANSFORMER
9. 480V AUX. TRANSFORMER
10. INLET AIR CHILLER
11. GSU TRANSFORMER
12. COOLING TOWER
13. FUEL GAS COMPRESSOR SKID
14. CIRCULATING WATER PUMPS
15. OTSG CHEMICAL FEED SKID
16. AMMONIA FLOW CONTROL UNIT
17. BOILER FEEDWATER PUMPS
18. GTG CO2 BOTTLES
19. CEMS SKID
20. DEMINERALIZED WATER TANK AND PUMPS
21. GTG AUXILIARY SKID (GTLO, FUEL, WATER WASH AND WATER INJECTION SYSTEMS)
22. CONDENSATE POLISHERS
23. CONDENSATE STORAGE TANK
24. CONDENSATE MAKE UP PUMPS
25. SPRINT SKID
26. FUEL GAS COMPRESSOR DRAINS TANK
27. AIR COMPRESSOR AND RECEIVER
28. CONDENSATE PUMPS
29. NOT USED
30. GTG FUEL GAS FINAL FILTER SKID
31. WATER WASH DRAINS TANK
32. GENERATOR/GEARBOX LUBE OIL SKID
33. LUBE OIL COOLER SKID
34. STEAM TURBINE ENCLOSURE
35. STEAM TURBINE LUBE OIL SKID
36. STEAM TURBINE HYDRAULIC OIL SKID
37. GLAND STEAM CONDENSER
38. VACUUM PUMP
39. AUXILIARY CIRCULATING WATER PUMP
40. ATMOSPHERICAL DRAINS VENT STACK
41. AUXILIARY COOLING HEAT EXCHANGERS
42. CLOSED COOLING WATER PUMP
43. ELECTRICAL AUXILIARY BOILER
44. AUXILIARY BOILER FEED PUMP
45. INLET HEAT EXCHANGE SKID
46. TEMPERING AIR FANS

NOTES:

1. ITEMS MARKED WITH (✳) ARE PROVIDES BY GE.

2) THIS DRAWING PRESENTS SUGGESTED EQUIPMENT ARRAGEMENT FOR THE POWER BLOCK UNDER GE'S SCOPE. THIS ARRANGEMENT IS TO BE INTEGRATED WITH OVERALL STATION DESIGN PROVIDED BY OTHERS.
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THIRD ANGLE PROJECTION

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3 PL DECIMALS ±
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	SIGNATURES	DATE
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ISSUED	A VANSLYKE	13-02-07
CIVIL	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	12-10-18
CONTROLS		

PROJECT: GLENARM REPOWERING PROJECT
MADE FOR: PASADENA WATER & POWER

GE ENERGY
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION-POWER PLANT SYSTEMS

GENERAL ARRANGEMENT

FIRST MADE FOR IPS-423049 M005

SIZE	CAGE CODE	DWG NO	REV
E		120E4746	G
SCALE NONE		SHEET 1	

INSTRUMENT SYMBOLS LEGEND

AAH	ANALYZER ALARM-HI
AAHH	ANALYZER ALARM-HI-HI W/SHUTDOWN
AAL	ANALYZER ALARM-LO
AALL	ANALYZER ALARM-LO-LO W/SHUTDOWN
AE	ANALYZER ELEMENT
AIT	ANALYZER INDICATOR AND TRANSMITTER
ASH	ANALYZER SWITCH-HI
ASHH	ANALYZER SWITCH-HI-HI W/SHUTDOWN
ASL	ANALYZER SWITCH-LO
ASLL	ANALYZER SWITCH-LO-LO W/SHUTDOWN
AT	ANALYZER TRANSMITTER
ATM	ATMOSPHERE
AY	ANALYZER RELAY
BALL	BURNER FLAME ALARM-LO-LO W/SHUTDOWN
BAH	BURNER FLAME ALARM-HI
BAHH	BURNER FLAME ALARM-HI-HI W/SHUTDOWN
BC	BURNER FLAME EXITER
BE	BURNER FLAME ELEMENT
BF	BURNER FLAME DETECTOR
BI	BURNER FLAME INDICATOR
BS	BURNER FLAME SWITCH
BX	BURNER FLAME TV RECEIVER
CAM	CAMERA
CE	CONDUCTIVITY ELEMENT
DS	LIGHT BULB/LAMP
FAH	FLOW ALARM-HI
FAHH	FLOW ALARM-HI-HI W/SHUTDOWN
FAL	FLOW ALARM-LO
FALL	FLOW ALARM-LO-LO W/SHUTDOWN
FC	FLOW CONTROLLER
FCV	FLOW CONTROL VALVE
FE	FLOW ELEMENT
FG	FLOW SIGHT GLASS (LUBE OIL)
FI	FLOW INDICATOR
FIC	FLOW INDICATOR CONTROLLER
FIR	FLOW INDICATOR RECORDER
FIT	FLOW INDICATOR TRANSMITTER
FRO	FLOW RESTRICTION ORIFICE
FPR	FLOW PRESSURE RECORDER (TWO PEN)
FPTR	FLOW PRESSURE TEMPERATURE RECORDER (THREE PEN)
FG	FLOW ANALYZER (FUEL SYSTEM)
FR	FLOW RECORDER
FRC	FLOW RECORDER CONTROLLER
FS	FLOW SWITCH
FSH	FLOW SWITCH-HI
FSHH	FLOW SWITCH-HI-HI W/SHUTDOWN

INSTRUMENT SYMBOLS LEGEND

FSL	FLOW SWITCH-LO
FSLL	FLOW SWITCH-LO-LO W/SHUTDOWN
FSV	FLOW SAFETY VALVE
FT	FLOW TRANSMITTER
FY	CURRENT TO PRESSURE TRANSDUCER
HCV	HAND CONTROL VALVE
HE	HEATER ELEMENT
HIC	HAND INDICATOR CONTROLLER (MANUAL LOADING STATION)
HV	HAND VALVE
HS	HAND SWITCH
IGS	IGNITION GROUNDING SWITCH
LAH	LEVEL ALARM-HI
LAHH	LEVEL ALARM-HI-HI W/SHUTDOWN
LAL	LEVEL ALARM-LO
LALL	LEVEL ALARM-LO-LO W/SHUTDOWN
LC	LEVEL CONTROLLER
LCS	LEVEL CONTROL SWITCH
LCV	LEVEL CONTROL VALVE
LEL	LOW EXPLOSION LEVEL
LG	LEVEL GAUGE
LI	LEVEL INDICATOR
LIC	LEVEL INDICATOR CONTROLLER
LIT	LEVEL INDICATOR TRANSMITTER
LR	LEVEL RECORDER
LRC	LEVEL RECORDER CONTROLLER
LS	LEVEL SWITCH
LSH	LEVEL SWITCH-HI
LSHH	LEVEL SWITCH-HI-HI W/SHUTDOWN
LSL	LEVEL SWITCH-LO
LSLL	LEVEL SWITCH-LO-LO W/SHUTDOWN
LSR	LASER
LT	LEVEL TRANSMITTER
LY	LEVEL RELAY
MA	MANUAL ACTUATOR
MAH	MOISTURE ALARM-HI
MCD	MAGNETIC CHIP DETECTOR
MCDI	MAGNETIC CHIP DETECTOR INDICATOR
MCDL	MAGNETIC CHIP DETECTOR ALARM-LO
MCV	MOTOR CONTROL VALVE
MI	MOISTURE INDICATOR
MLS	MANUAL LOADING SWITCH
MOV	MOTOR OPERATED VALVE
MPT	METER PULSE TRANSMITTER
MT	MOISTURE TRANSMITTER
PAH	PRESSURE ALARM-HI
PAHH	PRESSURE ALARM-HI-HI W/SHUTDOWN

INSTRUMENT SYMBOLS LEGEND

PAL	PRESSURE ALARM-LO
PALL	PRESSURE ALARM-LO-LO W/SHUTDOWN
PC	PRESSURE CONTROLLER
PCV	PRESSURE CONTROL VALVE
PDAH	PRESSURE DIFFERENTIAL ALARM-HI
PDAHH	PRESSURE DIFFERENTIAL ALARM-HI-HI W/SHUTDOWN
PDC	PRESSURE DIFFERENTIAL CONTROLLER
PDI	PRESSURE DIFFERENTIAL INDICATOR
PDR	PRESSURE DIFFERENTIAL RECORDER
PDSH	PRESSURE DIFFERENTIAL SWITCH-HI
PDSHH	PRESSURE DIFFERENTIAL SWITCH-HI-HI W/SHUTDOWN
PDSL	PRESSURE DIFFERENTIAL SWITCH-LO
PDSLL	PRESSURE DIFFERENTIAL SWITCH-LO-LO W/SHUTDOWN
PDT	PRESSURE DIFFERENTIAL TRANSMITTER
PI	PRESSURE INDICATOR
PIC	PRESSURE INDICATING CONTROLLER
PR	PRESSURE RECORDER
PRC	PRESSURE RECORDING CONTROLLER
PSE	PRESSURE SAFETY ELEMENT
PSH	PRESSURE SWITCH-HI
PSHH	PRESSURE SWITCH-HI-HI W/SHUTDOWN
PSL	PRESSURE SWITCH-LO
PSLL	PRESSURE SWITCH-LO-LO W/SHUTDOWN
PSV	PRESSURE SAFETY VALVE
PT	PRESSURE TRANSMITTER
PZ	PRESSURE ACTUATOR
PZV	PRESSURE ACTUATED VALVE
RTD	RESISTANCE TEMPERATURE DETECTOR
SAH	SPEED ALARM-HI
SAHH	SPEED ALARM-HI-HI W/SHUTDOWN
SAL	SPEED ALARM-LO
SALL	SPEED ALARM-LO-LO W/SHUTDOWN
SC	SPEED CONTROLLER
SD/STSY	STEAM SYSTEM SHUTDOWN
SE	SPEED ELEMENT
SI	SPEED INDICATOR
SIC	SPEED INDICATOR AND CONTROLLER
SIT	SPEED INDICATOR TRANSMITTER
SOV	SOLENOID OPERATED VALVE
SRC	SPEED RECORDER AND CONTROLLER
SSH	SPEED SWITCH-HI
SSHH	SPEED SWITCH-HI-HI W/SHUTDOWN
SSL	SPEED SWITCH-LO
SSLL	SPEED SWITCH-LO-LO W/SHUTDOWN
SZ	SPEED ACTUATOR
TAH	TEMPERATURE ALARM-HI

INSTRUMENT SYMBOLS LEGEND

TAHH	TEMPERATURE ALARM-HI-HI W/SHUTDOWN
TAL	TEMPERATURE ALARM-LO
TALL	TEMPERATURE ALARM-LO-LO W/SHUTDOWN
TC	TEMPERATURE CONTROLLER
TCV	TEMPERATURE CONTROL VALVE
TDT	TEMPERATURE DIFFERENTIAL TRANSMITTER
TE	TEMPERATURE ELEMENT
TI	TEMPERATURE INDICATOR
TIC	TEMPERATURE INDICATOR CONTROLLER
TIT	TEMPERATURE INDICATOR TRANSMITTER
TJI	TEMPERATURE MULTIPOINT SCANNING INDICATOR
TJR	TEMPERATURE MULTIPOINT SCANNING RECORDER
TRI	TEMPERATURE RECORDER
TRC	TEMPERATURE RECORDER AND CONTROLLER
TS	THERMAL SPOT ELEMENT
TSE	TEMPERATURE SAFETY ELEMENT
TSH	TEMPERATURE SWITCH-HI
TSHH	TEMPERATURE SWITCH-HI-HI W/SHUTDOWN
TSL	TEMPERATURE SWITCH-LO
TSLL	TEMPERATURE SWITCH-LO-LO W/SHUTDOWN
TT	TEMPERATURE TRANSMITTER
TW	THERMOWELL
TZV	TEMPERATURE ACTUATED VALVE
XAH	VIBRATION ALARM-HI
XAHH	VIBRATION ALARM-HI-HI W/SHUTDOWN
XE	VIBRATION ELEMENT
XI	VIBRATION INDICATOR
XQT	VIBRATION ELEMENT INTERFACE MODULE
XSH	VIBRATION SWITCH-HI
XSHH	VIBRATION SWITCH-HI-HI W/SHUTDOWN
YSA	FIRE/GAS SAFETY ALARM
YSL	FIRE/GAS SAFETY LIGHT
ZAH	POSITION ALARM-HI
ZAHH	POSITION ALARM-HI-HI W/SHUTDOWN
ZC	POSITION CONTROL
ZE	POSITION INDICATOR ELEMENT
ZI	POSITION INDICATOR
ZIC	POSITION INDICATOR CLOSED
ZS	POSITION SWITCH (LIMIT SWITCH)
ZSC	BLOCK VALVE W/POSITION SWITCH
ZSO	POSITION VALVE FULLY OPENED
ZT	POSITION TRANSMITTER
ZV	POSITION VALVE (LIMIT VALVE)
ZY	POSITION DEMAND (VALVE INPUT)

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/31/13	DT

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
COMMON

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & EQUIPMENT SYMBOLS MECHANICAL

DWG NO. 7253049-000231

REV. A

SCALE NONE

SHEET 1 OF 3

ABBREVIATIONS

AC	AIR TO CLOSE
AO	AIR TO OPEN
AS	AIR SUPPLY
D	DRAIN
ES	ELECTRIC SUPPLY
FC	FAIL CLOSE
FL	FAIL LOCKED
FO	FAIL OPEN
GS	GAS SUPPLY
HS	HYDRAULIC SUPPLY
LO	LOCKED OPEN
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NS	NITROGEN SUPPLY
PP	PRESSURE PLUGGED
SP	SET POINT
TP	TEMPERATURE PLUGGED
V	VENT
WS	WATER SUPPLY

FUNCTION DESIGNATIONS FOR RELAYS & TRANSDUCERS

| OR ADD	ADD OR TOTALIZE (ADD AND SUBSTRACT)
Δ OR DIFF	SUBSTRACT
+/-	BIAS
AVG	AVERAGE
x	MULTIPLY
/	DIVIDE
√OR SQ RT	EXTRACT SQUARE ROOT
> HSS	HIGH SELECT
< LSS	LOW SELECT
E/I	VOLTAGE TO CURRENT TRANSDUCER
E/P	VOLTAGE TO PNEUMATIC TRANSDUCER
I/P	CURRENT TO PNEUMATIC TRANSDUCER
P/I	PNEUMATIC TO CURRENT TRANSDUCER

TRANSDUCER SIGNAL CONDITION IDENTIFICATION



E = ELECTRIC (VOLTAGE)
H = HYDRAULIC
I = CURRENT
P = PNEUMATIC

MECHANICAL EQUIPMENT & SYMBOLS LEGEND

A	MIXER
B	BELT
CP	COUPLING
CYL	CYLINDER
E	ENGINE
EE	ELECTRICAL EQUIPMENT
ES	EXHAUST SILENCER
EX	HEAT EXCHANGER
F	FILTER
FA	FLAME ARRESTOR
G	GEAR
GT	GAS TURBINE GENERATOR
HM	HYDRAULIC MOTOR
HRSG	HEAT RECOVERY STEAM GENERATOR
K	COMPRESSOR
LU	LUBRICATOR
M	PACKAGE UNIT
MCC	MOTOR CONTROL CENTER
P	PUMP
PA	PNEUMATIC ACTUATOR
PD	PULSATION DRUM
PM	PNEUMATIC (AIR/GAS) MOTOR
PV	PRESSURE VESSEL
S	SPECIALTY ITEM
ST	TANK (STORAGE)
STR	STRAINER
SV	SHEAVE
T	TANK
VB	BUTTERFLY VALVE
VC	CHECK VALVE
VG	GATE VALVE
VL	BALL VALVE
VN	NEEDLE VALVE
VO	GLOBE VALVE
VP	PLUG VALVE

MECHANICAL EQUIPMENT & SYMBOLS LEGEND


ACCUMULATOR


ARRESTOR, FLAME


ALARM, FIRE/GAS SAFETY


BALLON, 1/2" STANDARD, LOCALLY MOUNTED


3/8" BALLOON—FLOW SHEET MATERIAL LIST NUMBER


CAMERA


COIL, STEAM


COILS, HEATING OR COOLING

COMPENSATOR


COMPUTER FUNCTION AUXILIARY LOCATION


COMPUTER FUNCTION FIELD MOUNTED



CONNECTION, CUSTOMER

CONNECTION NUMBERS SHOWN ON GENERAL ARRANGEMENT DWG



CONNECTION, ENGINE WITH IDENTIFICATION NO.


COVER, SCREEN


DAMPER



DETECTOR, COMBUSTIBLE GAS


DETECTOR, IONIZATION


DETECTOR, OPTICAL FLAME


DISC, RUPTURE (PRESSURE)

MECHANICAL EQUIPMENT & SYMBOLS LEGEND


DISC, RUPTURE (VACUUM)

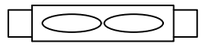

DRAIN, OPEN


DUCT, TRANSITION

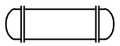

ELEMENT, FLOW (TURBINE)


ELEMENT, FLOW (VENTURI)


ELIMINATOR, BUBBLE


EXCHANGER, HEAT, AIR COOLED


EXCHANGER, HEAT, PLATE AND FRAME


EXCHANGER, HEAT, SHELL AND TUBE


FAN



FLOW PATH, NORMAL



GEAR


GUAGE, LOCALLY MOUNTED (W/O TAG NO)


GUAGE, LOCAL PANEL MOUNTED

HOSE, FLEXIBLE


INDICATOR, DIRECTIONAL FLOW


INDICATOR, FLOW


INSTRUMENT, DISCRETE REAR PANEL MOUNTED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/31/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: COMMON

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & EQUIPMENT SYMBOLS MECHANICAL

DWG NO. 7253049-000231

REV. A

SCALE NONE

SHEET 2 OF 3

MECHANICAL EQUIPMENT & SYMBOLS LEGEND

- XXXX / 0000 — INSTRUMENT SYMBOL
- XXXX / 0000 — 0000 — INSTRUMENT TAG NO.
- JOINT, EXPANSION
- LIGHT, FIRE/GAS SAFETY
- ELEMENT, THERMAL
- LINE CAP OR TERMINATION
- LOGIC AND CONTROL INTERLOCK
- MOT — MOTOR, ELECTRICAL
- M — M—MOTOR E—ENGINE
- NOZZLE, HALON/CO_2
- ORIFICE, FLANGED, (FLOW ELEMENT) OR SCRUBBER
- PETCOCK
- PUMP, CENTRIFUGAL
- PUMP, HAND
- PUMP, POSITIVE
- REGULATOR, BACKPRESSURE, SELF CONTAINED
- NC — VALVE, NORMALLY CLOSED
- REGULATOR, PRESSURE REDUCING
- REVISION SYMBOL
- A2 — REVISION LETTER
- SENSOR, VORTEX FLOW

MECHANICAL EQUIPMENT & SYMBOLS LEGEND

- SHARED DISPLAY/SHARED CONTROL REMOTE CONTROL PANEL MOUNTED (OFF MAIN SKID)
- SEPARATOR OR FILTER
- SILENCER
- STRAINER
- STRAINER, FILLER MESH
- STRAINER, TEMPORARY
- SWITCH, HAND
- TI — THERMOWELL (IMMERSION)
- TI — THERMOWELL (SURFACE)
- T — TRAP, STEAM
- VALVE, BLOCK AND BLEED (INSTRUMENT)
- VALVE, BUTTERFLY
- VALVE, CHECK/VACUUM BREAKER
- VALVE, CHOKE, ADJUSTABLE
- VALVE, CHOKE, FIXED
- VALVE, ANGLE
- VALVE, BALL
- VALVE, CONTROL, AIR TO CLOSE
- VALVE, CONTROL, AIR TO OPEN
- VALVE, CONTROL, DIAPHRAGM ACTUATED SPRING OPPOSED WITH POSITIONER
- FC — VALVE, FAILED CLOSED
- FO — VALVE, FAILED OPEN

MECHANICAL EQUIPMENT & SYMBOLS LEGEND

- VALVE, FLANGED
- VALVE, FOUR WAY
- VALVE, GATE
- VALVE, GLOBE
- VALVE, NEEDLE (INSTRUMENT)
- NO — VALVE, NORMALLY OPEN
- VALVE, PISTON OPERATED, SPRING OR PNEUMATIC
- VALVE, PLUG
- VALVE, QUICK OPENING, LEVER OPERATED
- VALVE, RELIEF, SPRING OR INTEGRAL PILOT
- S — VALVE, SOLENOID OR MOTOR OPERATED S = SOLENOID M = MOTOR
- VALVE, THERMAL (TZV)
- VALVE, THREADED
- VALVE, THREE WAY
- VALVE, WELDED
- VENT, AUTOMATIC

LINE LEGEND

- INSULATION
- LIMITS, PACKAGE
- LINE, CAPILLARY
- LINE, MATCH
- LINE, MAJOR FLOW
- LINE, SECONDARY FLOW
- LINE SIZE CHANGE
- SIGNAL, ELECTRICAL
- SIGNAL, HYDRAULIC
- SIGNAL, PNEUMATIC
- E — TRACE, ELECTRICAL HEAT
- H — TRACE, HOT WATER
- S — TRACE, STEAM HEAT

HYDRAULIC SYMBOLS LEGEND

- COUPLING, FLEXIBLE MECHANICAL
- XXX — CONNECTION, CUSTOMER INTERFACE
- COOLER
- COUPLING, QUICK DISCONNECT
- EXHAUST, QUICK
- FILTER
- FILTER OR STRAINER BY—PASS
- MANUAL SHUTTLE VALVE — FILTER DUPLEX
- MOTOR, HYDRAULIC, VARIABLE DISPLACEMENT
- PUMP, HYDRAULIC
- PUMP, HYDRAULIC, VARIABLE DISPLACEMENT
- SEPARATOR WITH AUTOMATIC DRAIN
- VALVE, ADJUSTABLE PRESSURE RELIEF
- VALVE, CHECK, SPRING LOADED

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: COMMON

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & EQUIPMENT SYMBOLS MECHANICAL

DWG NO. 7253049—000231

REV. A

SCALE NONE

SHEET 3 OF 3

INSTRUMENT IDENTIFICATION

AE	ANALYZER ELEMENT
AS(*)	ANALYZER SWITCH
AT	ANALYZER TRANSMITTER
BE	BURNER ELEMENT (FLAME)
BOV	BLOW OFF VALVE
BS	BURNER SWITCH (FLAME)
CE	CONDUCTIVITY ELEMENT
FC	FLOW CONTROLLER
FCV	FLOW CONTROL VALVE
FE	FLOW ELEMENT
FS(*)	FLOW SWITCH
FT	FLOW TRANSMITTER
HE	HEATER ELEMENT
HS	HAND SWITCH
LS(*)	LEVEL SWITCH
LT	LEVEL TRANSMITTER
MCD	MAGNETIC CHIP DETECTOR
MOT	MOTOR
MOV	MOTOR OPERATED VALVE
MT	HUMIDITY TRANSMITTER
PDS(*)	PRESSURE DIFFERENTIAL SWITCH
PDT	PRESSURE DIFFERENTIAL TRANSMITTER
PS(*)	PRESSURE SWITCH
PT	PRESSURE TRANSMITTER
SE	SPEED ELEMENT
SOV	SOLENOID OPERATED VALVE
SSS(*)	SPEED SAFETY SWITCH
SSW(*)	SPEED SWITCH
TC	TEMPERATURE CONTROLLER
TDT	TEMPERATURE DIFFERENTIAL TRANSMITTER
TE	TEMPERATURE ELEMENT
TS(*)	TEMPERATURE SWITCH
TT	TEMPERATURE TRANSMITTER
XE	VIBRATION ELEMENT
XQT	ACCELEROMETER INTERFACE MODULE
XS(*)	VIBRATION SWITCH
YSA	FIRE/GAS SAFETY ALARM
YSL	FIRE/GAS SAFETY LIGHT
ZC	POSITION CONTROLLER
ZE	POSITION ELEMENT
ZSC	POSITION SWITCH CLOSED
ZSO	POSITION SWITCH OPEN
ZT	POSITION TRANSMITTER

(*) SUFFIX IDENTIFICATION

H = HIGH
HH = HIGH HIGH
L = LOW
LL = LOW LOW

NOTES:

CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.

Color	IEC* Letter Code	IEC–NEC GE Design Colors
Black	BK	BLK
Brown	BN	BRN
Red	RD	RED
Orange	OG	ORN
Yellow	YE	YEL
Green	GN	GRN
Blue	BU	BLU
Violet	VT	VLT
Gray	GY	GRY
White	WH	WHT
Pink	PK	PNK
Gold	GD	GD
Turquoise	TQ	TQ
Silver	SR	SR
Green–and–yellow	GNYE	GRN/YEL

* IEC COLORS CHART PER IEC PUBLICATION 757, TABLE 1.

WIRE GAUGE CONVERSION TABLE
(AMERICAN WIRE GAUGE–METRIC)

US Standard AWG	NEAREST AVAILABLE CROSS–SECTION mm^2
22	0.4
18	0.75
16	1.5
14	2.5
12	4.0
10	6.0
8	10.0
6	16.0
4	25.0
3	35.0
2	35.0
1	50.0
1/0	70.0
2/0	70.0
3/0	95.0
4/0	120.0
250 kcmil	150.0
400 kcmil	240.0
500 kcmil	300.0
750 kcmil	400.0
1000 kcmil	500.0

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
ELECTRICAL SYMBOLS ABBREVIATIONS AND REFERENCE DATA

DWG NO. 7253049–969005
REV. A

SCALE NONE
SHEET 1 OF 4

EQUIPMENT IDENTIFICATION

ACLE	MODULE, APPLICATION CONTROL LAYER
A I/O	ANALOG I/O
AMVAS	SWITCH, AUTO/MANUAL VOLTAGE REGULATOR ADJUST
ASTB	TERMINAL BOX, AUXILIARY SKID
AVR	REGULATOR, AUTO/MANUAL VOLTAGE
A#	MODULE
A15	ASSEMBLY, ELECTRONIC SAFETY SWITCH
A17	ASSEMBLY, ZERO SPEED
BATT	BATTERY
BFX	TRANSDUCER, BUS FREQUENCY
BFX2	TRANSDUCER, UTILITY FREQUENCY
BVX	TRANSDUCER, BUS VOLTAGE
BVX2	TRANSDUCER, UTILITY VOLTAGE
BLR#	BLOWER
C	HEATER CONTACTOR
CAN	CAN COMMUNICATION
CB#	CIRCUIT BREAKER
CBCS1	SWITCH, CIRCUIT BREAKER CONTROL "52G"
CBCS2	SWITCH, CIRCUIT BREAKER CONTROL "52U"
CCCT#	TRANSFORMER, CROSS CURRENT COMPENSATION
CCLT	LIGHT, TCP CONTROL CUBICLE
CHG#	CHARGER, BATTERY
CONV#	DC-DC CONVERTER
CPT	TRANSFORMER, CONTROL POWER
CPU	CENTRAL PROCESSING UNIT
CR	DIODE, SUPPRESSION (EXTERNAL TO RELAY)
CR1	DIODE, SUPPRESSION (BUILT INTO RELAY)
CT#	TRANSFORMER, CURRENT
DA#	ASSEMBLY, DIODE
DCS	DISTRIBUTED CONTROL SYSTEM
D I/O	DISCRETE I/O
DIS	DISPLAY
DMMF	METER, DIGITAL MULTIFUNCTION
DS#	LAMP
DSM	SYNCHRONIZER, AUTO SPEED-VOLTAGE MATCHING
DSPX	BOARD, DIGITAL SIGNAL PROCESSOR
DSW24C	FUSED DISCONNECT SWITCH, 24 VDC CONTROL POWER
DSW24F	FUSED DISCONNECT SWITCH, 24 VDC FIRE & GAS POWER
DSW125C	FUSED DISCONNECT SWITCH, 125 VDC CONTROL POWER
DSW#	FUSED DISCONNECT SWITCH
DVP	POSITIONER, DIGITAL VALVE
EAX	TRANSDUCER, EXCITER FIELD CURRENT
ECTB	BOARD, EXCITER CONTACT TERMINAL
EGD	ETHERNET GLOBAL DATA
EMS	SWITCH, EXCITATION MODE
ENET#	SWITCH, ETHERNET
EPCT	BOARD, EXCITER CT/PT
EPSM	MODULE, EXCITER POWER SUPPLY
ERDD	EXCITER INTERFACE AND DYNAMIC DISCHARGE
ERIO	EXCITER REGULATOR I/O
EROC	EXCITER REGULATOR OPTIONS CARD
ES	SWITCH, VOLTAGE REGULATOR "ON-OFF"
ESAS	SWITCH, EMERGENCY STOP, AUXILIARY SKID
ESGR#	SWITCH, EMERGENCY STOP, GENERATOR ROOM
ESTR#	SWITCH, EMERGENCY STOP, TURBINE ROOM
EVX	TRANSDUCER, EXCITER FIELD VOLTAGE
EXC	EXCITER
ES3	SWITCH, EMERGENCY STOP, TCP
FBCP#	FUSE BLOCK, CONTROL POWER
FLTR#	FILTER
FO	FIBER OPTIC
FPP	PANEL, FIRE & GAS PROTECTION
FS#	FUSE
FTM#	MODULE, FIELD TERMINATION
FU#	FUSE

EQUIPMENT IDENTIFICATION

GDB#	GROUNDING BLOCK
GLAC	GENERATOR LINESIDE CUBICLE
GNAC	GENERATOR NEUTRAL CUBICLE
GND	GROUND
GS#	GROUND STUD
GTG	GAS TURBINE GENERATOR
GVX	TRANSDUCER, GENERATOR VOLTAGE
HMI	HUMAN-MACHINE INTERFACE
HOA	SWITCH, HAND-OFF-AUTOMATIC
HPC	COMPRESSOR, HIGH PRESSURE
HTR#	HEATER, SPACE
I#	INPUT
IE#	GROUND BAR, INSTRUMENT EARTH
I/O	INPUT/OUTPUT
IGPS#	INTEGRATED GENERATOR PROTECTION SYSTEM
ISO#	ISOLATOR, 4-20mA TO 4-20mA
J#	RECEPTACLE OR CONNECTOR
JB#	BOX, JUNCTION
LA#	ARRESTOR, LIGHTNING
LDP#	PANEL, LIGHTING & DISTRIBUTION
LK#	LINK
LNT#	TERMINATION MODULE, LINKNET
LOTO	LOCK OUT-TAG OUT
LPC	COMPRESSOR, LOW PRESSURE
LPT	TURBINE, LOW PRESSURE
LRS	SWITCH, LOCAL/REMOTE SELECTOR
LSW#	SWITCH, LIMIT LIGHT
LVDT	LINEAR VARIABLE DIFFERENTIAL TRANSFORMER
M	MOTOR STARTER
MCC	MOTOR CONTROL CENTER
MGTB	TERMINAL BOX, MAIN GENERATOR
MCP	PROTECTOR, MOTOR CIRCUIT (MANUAL)
MS	SHUNT, METER
MTTB	TERMINAL BOX, MAIN TURBINE
MVAS	SWITCH, MANUAL VOLTAGE ADJUST
NBA	AMMETER, NULL BALANCE
N#	DISTRIBUTIVE I/O MODULE
NF#	NOTCH FILTER
NTWK	NETWORK
OCPD	OVERCURRENT PROTECTIVE DEVICE (THERMAL-MAGNETIC)
OL	PROTECTIVE DEVICE, RUNNING OVERLOAD
O#	OUTPUT
OSM	ON SITE MONITOR
P#	PLUG
PE#	GROUND BAR, PROTECTIVE EARTH
PFAS	SWITCH, PF/VAR ADJUST
PLC	CONTROLLER, PROGRAMMABLE LOGIC
PMG	GENERATOR, PERMANENT MAGNET
PRC	PROTECTIVE RELAY CUBICLE
PSS	POWER SYSTEM STABILIZER
PS#	POWER SUPPLY
PTB#	TERMINAL BLOCK, POWER
PWRS#	POWER STRIP
R	RESISTOR
RDD	RESISTOR, DYNAMIC DISCHARGE
RG	RESISTOR, GROUNDING
RGFT	SWITCH, TEST, GENERATOR ROTOR GROUND FAULT RELAY
RTD	DETECTOR, RESISTANCE TEMPERATURE
RTN	MODULE, REAL-TIME NETWORK
S#	SWITCH
SAS	SWITCH, SPEED ADJUST
SC#	CAPACITOR, SURGE
SIO	MODULE, SERIAL I/O
SL#	LAMP, SYNCHRONIZING
SPI	ISOLATOR, SPEED PICKUP
SS	SWITCH, SYNCHRONIZE
SSW#	SWITCH, SPEED
STB#	TERMINAL BLOCK, SHORTING

EQUIPMENT IDENTIFICATION

SWGR	SWITCHGEAR
SY	METER, SYNCHROSCOPE
SW24C	DISCONNECT SWITCH, 24 VDC CONTROL POWER
SW24F	DISCONNECT SWITCH, 24 VDC FIRE & GAS POWER
SW125C	DISCONNECT SWITCH, 125 VDC CONTROL POWER
TB#	TERMINAL BLOCK
TBA#	ASSEMBLY, TERMINAL BLOCK
TBG#	TERMINAL GROUND BLOCK
TB24A,B	TERMINAL BLOCK, POWER DISTRIBUTION (24VDC)
TB125A,B	TERMINAL BLOCK, POWER DISTRIBUTION (125VDC)
TCLT	LIGHT, TCP TERMINATION CUBICLE
TCP	PANEL, TURBINE CONTROL
TEE	CAN NETWORK JUNCTION
TG	TRANSFORMER, GROUNDING
TSB#	SWITCH BLOCK, TEST, VOLTAGE & CURRENT
TSS	SWITCH, TURBINE START/STOP
TS#	THERMOSTAT
UL#	UNIT LOCAL CONTROLLER CHASSIS (TCP)
UR#	UNIT REMOTE CONTROLLER CHASSIS (MTTB)
VCES	SWITCH, VOLTAGE/PF/VAR CONTROL ENABLE
VIB	MONITOR, VIBRATION
VT#	TRANSFORMER, VOLTAGE
WX	TRANSDUCER, WATT
W#	CONNECTOR/CABLE ASSEMBLY
XFMR	TRANSFORMER
Z	SUPPRESSOR, SURGE (DC)
Z1	SUPPRESSOR, SURGE (AC)
52a,b	CONTACT, BREAKER AUXILIARY
52G	AC CIRCUIT BREAKER (GENERATOR)
52U	AC CIRCUIT BREAKER (UTILITY)

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: ELECTRICAL SYMBOLS ABBREVIATIONS AND REFERENCE DATA

DWG NO.: 7253049-969005

REV.: A

SCALE: NONE

SHEET: 2 OF 4

RELAYS

GFEP	RELAY, GROUND FAULT EQUIPMENT PROTECTION
K#	RELAY
KR	CONTROL RELAY
K1	RELAY, POSITIVE SHUTDOWN (MASTER)
K2	RELAY, POSITIVE SHUTDOWN (SLAVE)
K3	RELAY, POSITIVE SHUTDOWN (SLAVE)
K5	RELAY, VIBRATION RESET/SYSTEM RESET
K22	RELAY, RAISE VOLTAGE
K23	RELAY, LOWER VOLTAGE
K28	RELAY, GTG SYNCHRONIZER ENABLE
K67	RELAY, SINGLE UNIT
K75	RELAY, GTG/BUS SYNCHRONIZER ENABLE
K76	RELAY, UTILITY BUS SYNCHRONIZER ENABLE
K83	RELAY, IGNITORS CONTROL
K84	RELAY, CIRCUIT BREAKER CLOSE (52G)
K85	RELAY, CIRCUIT BREAKER TRIP (52G)
K85A	RELAY, CIRCUIT BREAKER TRIP AUX (52G)
K100	RELAY, SYNCHRONIZER ENABLE (GENERATOR) (REMOTE)
K102	RELAY, SYNCHRONIZER ENABLE (UTILITY) (REMOTE)
K103	RELAY, CIRCUIT BREAKER CLOSE (UTILITY)
K107	RELAY, TIME DELAY, DC LIGHTING, TURBINE ROOM
K108	RELAY, DC LIGHTING, TURBINE ROOM (AUX)
K109	RELAY, TIME DELAY, DC LIGHTING, GENERATOR ROOM
K110	RELAY, DC LIGHTING, GENERATOR ROOM (AUX)
K114	RELAY, DSM GENERATOR SENSE ENABLE
K115	RELAY, EMERGENCY STOP RESET, ONE SHOT
K189	RELAY, POSITIVE SHUTDOWN (SLAVE)
K229	RELAY, GENERATOR BREAKER 52a
K230	RELAY, GENERATOR BREAKER 52b
K231	RELAY, UTILITY BREAKER 52a
K232	RELAY, UTILITY BREAKER 52b
K361	RELAY, TURBINE PRIMARY MANIFOLD GAS PURGE VALVE AUX
K520	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 1 STAGING VALVE NO. 1 AUX
K521	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 1 STAGING VALVE NO. 2 AUX
K522	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 1 STAGING VALVE NO. 3 AUX
K523	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 2 STAGING VALVE NO. 1 AUX
K524	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 2 STAGING VALVE NO. 2 AUX
K525	RELAY, TURBINE GAS FUEL DLE OUTER MAIN MANIFOLD NO. 2 STAGING VALVE NO. 3 AUX
K529	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 1 AUX
K530	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 2 AUX
K531	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 3 AUX
K532	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 4 AUX
K533	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 5 AUX
K534	RELAY, TURBINE GAS FUEL DLE OUTER PILOT MANIFOLD STAGING VALVE NO. 6 AUX
RGF	RELAY, GENERATOR ROTOR GROUND FAULT
25A	RELAY, SYNCH CHECK (UTILITY)
86G	RELAY, LOCKOUT (GENERATOR)

FUNCTION NUMBERS (IEEE STD C37.2–2008)

1	MASTER ELEMENT
2	TIME–DELAY STARTING OR CLOSING RELAY
3	CHECKING OR INTERLOCKING RELAY
4	MASTER CONTACTOR
5	STOPPING DEVICE
6	STARTING CIRCUIT BREAKER
7	RATE–OF–CHANGE RELAY
8	CONTROL POWER DISCONNECTING DEVICE
9	REVERSING DEVICE
10	UNIT SEQUENCE SWITCH
11	MULTIFUNCTION DEVICE
12	OVERSPEED DEVICE
13	SYNCHRONOUS–SPEED DEVICE
14	UNDERSPEED DEVICE
15	SPEED OR FREQUENCY MATCHING DEVICE
16	DATA COMMUNICATIONS DEVICE
17	SHUNTING OR DISCHARGE SWITCH
18	ACCELERATING OR DECELERATING DEVICE
19	STARTING–TO–RUNNING TRANSITION CONTACTOR
20	ELECTRICALLY OPERATED VALVE
21	DISTANCE RELAY
22	EQUALIZER CIRCUIT BREAKER
23	TEMPERATURE CONTROL DEVICE
24	VOLTS PER HERTZ RELAY
25	SYNCHRONIZING OR SYNCHRONISM–CHECK RELAY
26	APPARATUS THERMAL DEVICE
27	UNDERVOLTAGE RELAY
28	FLAME DETECTOR
29	ISOLATING CONTACTOR OR SWITCH
30	ANNUNCIATOR RELAY
31	SEPARATE EXCITATION DEVICE
32	DIRECTIONAL POWER RELAY
33	POSITION SWITCH
34	MASTER SEQUENCE DEVICE
35	BRUSH–OPERATING OR SLIP–RING SHORT–CIRCUITING DEVICE
36	POLARITY OR POLARIZING VOLTAGE DEVICE
37	UNDERCURRENT OR UNDERPOWER RELAY
38	BEARING PROTECTIVE DEVICE
39	MECHANICAL CONDITION MONITOR
40	FIELD (OVER/UNDER EXCITATION) RELAY
41	FIELD CIRCUIT BREAKER
42	RUNNING CIRCUIT BREAKER
43	MANUAL TRANSFER OR SELECTOR DEVICE
44	UNIT SEQUENCE STARTING RELAY
45	ABNORMAL ATMOSPHERIC CONDITION MONITOR
46	REVERSE–PHASE OR PHASE–BALANCE CURRENT RELAY
47	PHASE–SEQUENCE OR PHASE–BALANCE VOLTAGE RELAY
48	INCOMPLETE SEQUENCE RELAY
49	MACHINE OR TRANSFORMER THERMAL RELAY
50	INSTANTANEOUS OVERCURRENT RELAY
51	AC INVERSE TIME OVERCURRENT RELAY
52	AC CIRCUIT BREAKER
53	FIELD EXCITATION RELAY
54	TURNING GEAR ENGAGING DEVICE
55	POWER FACTOR RELAY
56	FIELD APPLICATION RELAY
57	SHORT–CIRCUITING OR GROUNDING DEVICE
58	RECTIFICATION FAILURE RELAY
59	OVERVOLTAGE RELAY
60	VOLTAGE OR CURRENT BALANCE RELAY
61	DENSITY SWITCH OR SENSOR
62	TIME–DELAY STOPPING OR OPENING RELAY
63	PRESSURE SWITCH
64	GROUND DETECTOR RELAY
65	GOVERNOR

FUNCTION NUMBERS

66	NOTCHING OR JOGGING DEVICE
67	AC DIRECTIONAL OVERCURRENT RELAY
68	BLOCKING OR "OUT–OF–STEP" RELAY
69	PERMISSIVE CONTROL DEVICE
70	RHEOSTAT
71	LIQUID LEVEL SWITCH
72	DC CIRCUIT BREAKER
73	LOAD–RESISTOR CONTACTOR
74	ALARM RELAY
75	POSITION CHANGING MECHANISM
76	DC OVERCURRENT RELAY
77	TELEMETERING DEVICE
78	PHASE–ANGLE MEASURING RELAY
79	AC RECLOSING RELAY
80	FLOW SWITCH
81	FREQUENCY RELAY
82	DC LOAD–MEASURING RECLOSING RELAY
83	AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY
84	OPERATING MECHANISM
85	PILOT COMMUNICATIONS, CARRIER OR PILOT–WIRE RELAY
86	LOCKOUT RELAY
87	DIFFERENTIAL PROTECTIVE RELAY
88	AUXILIARY MOTOR OR MOTOR GENERATOR
89	LINE SWITCH
90	REGULATING DEVICE
91	VOLTAGE DIRECTIONAL RELAY
92	VOLTAGE AND POWER DIRECTIONAL RELAY
93	FIELD–CHANGING CONTACTOR
94	TRIPPING OR TRIP–FREE RELAY
95	USED ONLY FOR SPECIFIC APPLICATIONS
96	
97	
98	
99	

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: ELECTRICAL SYMBOLS ABBREVIATIONS AND REFERENCE DATA

DWG NO.: 7253049–969005

REV.: A

SCALE: NONE

SHEET: 3 OF 4

BASIC SYMBOLS

- RESISTOR
- CAPACITOR
- BATTERY
- THERMOCOUPLE
- RESISTANCE TEMPERATURE DETECTOR
- PERMANENT MAGNET
- THERMAL ELEMENT
- HEATER
- SOLENOID
- DIODE (RECTIFIER)
- SURGE SUPPRESSOR
- SPARK GAP
- LIGHTNING ARRESTOR
- EARTH GROUND
- PE GROUND
- CHASSIS GROUND
- SEPARABLE CONNECTORS (ENGAGED)
- FUSE
- LINK
- GENERATOR
- MOTOR, GENERAL
- MOTOR, DC
- MOTOR, 3 PHASE AC
- INDICATING LAMP

CIRCUIT BREAKERS

52 — POWER CIRCUIT BREAKER
DRAWOUT TYPE

1600AF
1200AT — AIR CIRCUIT BREAKER, DRAWOUT TYPE
1600AF = MAXIMUM BREAKER FRAME RATING
1200AT = BREAKER TRIP RATING

600AF
400AT (ST) — MOLDED CASE CIRCUIT BREAKER
600AF = MAXIMUM BREAKER FRAME RATING
400AT = BREAKER TRIP RATING

OPTIONAL ACCESSORIES
K = KEYED INTERLOCK
MO = MOTOR OPERATED
ST = SHUNT TRIP

CONTACTS, RELAYS & SWITCHES

- CONTACT, NORMALLY CLOSED
- CONTACT, NORMALLY OPEN
- RELAY COIL
- CLOSED SWITCH, TIMED WHEN ENERGIZED
- OPEN SWITCH, TIMED WHEN ENERGIZED
- PUSHBUTTON SWITCH
- FLOW SWITCH
- LEVEL SWITCH
- PRESSURE SWITCH
- TEMPERATURE SWITCH
- POSITION SWITCH
- PRESSURE DIFFERENTIAL SWITCH
- EARTHING SAFETY SWITCH

TRANSFORMERS 50 HZ

CT (3)
4000:1 — CURRENT TRANSFORMER
(3) = QUANTITY
4000:1 = RATIO

VT (2)
11500:115 — VOLTAGE TRANSFORMER
(2) = QUANTITY
11500:115 = RATIO

TRANSFORMER
400:400/230 = RATIO

400:400/230

TRANSFORMERS 60 HZ

CT (3)
3000:5 — CURRENT TRANSFORMER
(3) = QUANTITY
3000:5 = RATIO

VT (2)
14400:120 — VOLTAGE TRANSFORMER
(2) = QUANTITY
14400:120 = RATIO

TRANSFORMER
480:208/120 = RATIO

480:208/120

QUALIFYING SYMBOLS

- 3 PHASE, 3 WIRE DELTA OR MESH
- 3 PHASE, 3 WIRE DELTA, GROUNDED
- 3 PHASE OPEN DELTA
- 3 PHASE OPEN DELTA GROUNDED AT COMMON POINT
- 3 PHASE WYE, GROUNDED NEUTRAL
- 3 PHASE WYE, GROUNDED PHASE 2
- 3 PHASE OPEN DELTA, GROUNDED

SYMBOLS FOR TRANSMISSION PATH

- CONDUCTOR CROSSING, NO CONNECTION
- CONDUCTOR CROSSING, CONNECTED
- INTERCONNECT/FIELD WIRING
- XXX — CABLE IN CONDUIT WITH IDENTIFICATION NO.
- XXXX — CABLE WITH IDENTIFICATION NO.
- SHIELDED CABLE

GENERAL INSTRUMENT SYMBOLS FOR LOOP & SCHEMATIC DIAGRAMS

/ # — X
COMPUTER FUNCTION
X = INPUT/OUTPUT
# = TERMINAL NUMBER

XXXX ####
/
FIELD MOUNTED INSTRUMENT
XXXX = INSTRUMENT IDENTIFICATION (SHEET 1)
= INSTRUMENT NUMBER
= TERMINAL NUMBER/CONNECTION

INTERNAL SYSTEM LINK
(SOFTWARE OR DATA LINK)

XXX
#/#/# or #/#/#/#
N / #
PROGRAMMABLE LOGIC CONTROL
XXX = CONTROLLER
#/#/# = CHASSIS/BOARD/CHANNEL
#/#/#/# = CHASSIS/NETWORK/NODE/CHANNEL
N = CONTROLLER CHASSIS
# = CONTROLLER CHASSIS #

M / 1
SHARED DISPLAY/CONTROL AUXILIARY LOCATION

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A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS: .XX ± .03, .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: ELECTRICAL SYMBOLS ABBREVIATIONS AND REFERENCE DATA

DWG NO. 7253049-969005

REV. A

SCALE NONE

SHEET 4 OF 4

NOTES:

1. THIS DRAWING IS ONLY AN INTERCONNECT PLAN THAT REFERENCES AND IDENTIFIES RACEWAY RUNS.
2. RACEWAY RUNS SHOWN TO PANELS AND CONTROLS ARE GENERAL AND DO NOT INDICATE ACTUAL ENTRY POINTS.
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. * ASTERISK INDICATES FURNISHED BY OTHERS. ITEMS SHOWN AS "BY OTHERS" MAY VARY BUT ARE SHOWN TO ATTEMPT CLARITY OF PERSPECTIVE ON THIS DRAWING.
5. ALL CABLES, CABLE GLANDS & RACEWAYS ARE FURNISHED BY OTHERS, UNLESS OTHERWISE INDICATED. ALL CABLES AND CABLE GLANDS SHALL MEET THE IP/NEMA RATING OF THE TERMINATION BOX AND PANELS. A RACEWAY IS AN ENCLOSED CHANNEL DESIGNED TO HOLD CABLES, WIRES, BUS–BARS. RACEWAY SHOULD BE METALLIC OR NON METALLIC MATERIAL AND CAN BE CONDUIT, CABLE TRAY, FLEXIBLE CONDUIT, UNDER GROUND DUCT. RACEWAYS THAT ARE METALLIC SHOULD BE BONDED THROUGH THEIR PERIMETER AND GROUNDED AT BOTH ENDS, AS A MINIMUM
6. CUSTOMER IS ADVISED TO PULL A MINIMUM OF 10% EXTRA WIRING FOR SPARES. ALL SPARE CONDUCTORS MUST BE GROUNDED ON BOTH ENDS. GROUND BARS TO BE ON CUSTOMER SCOPE OF SUPPLY AS REQUIRED
7. CABLES WITH THE SAME RACEWAY NUMBER AND SAME VOLTAGE MAY BE RUN IN MULTI CONDUCTOR CABLE. CABLE SHOULD HAVE OVERALL OUTER SHIELD AND SHIELD FOR EACH PAIR, TRIAD, QUAD AS APPLICABLE.
8. ALL CABLES WITH DIFFERENT VOLTAGE CAN NOT COEXIST IN THE SAME RACEWAY NUMBER.
9. ALL FIRE SYSTEM CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES, WHICH IS IN ACCORDANCE WITH NFPA 70 (NEC) AND LOCAL JURISDICTION CODES.
10. ALL COMMUNICATION CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES AND NOT COMBINED WITH NON–COMMUNICATION CABLE RACEWAYS.
11. FOR INSTRUMENTATION CABLES THAT ARE INCORPORATED IN MULTICONDUCTOR CABLES, INDIVIDUAL SHIELDS MUST BE INCORPORATED AS INDICATED FOR EACH INDIVIDUAL PAIR, TRIAD, ETC. CABLES WITH SHIELDS SHALL HAVE THEIR SHIELD DRESSED OUT NO MORE THAN 1 IN. [25 mm].
12. CUSTOMER TO ENSURE PROPER CABLE INSTALLATION AND SEPARATION BY SERVICE LEVEL IN ACCORDANCE TO THE FOLLOWING INDUSTRY STANDARDS OR EQUIVALENT:
    IEEE 422: IEEE GUIDE FOR THE DESIGN AND INSTALLATION OF CABLE SYSTEMS IN POWER GENERATING SYSTEMS.
    NFPA 70 (NEC): ARTICLE 300–310 CONDUCTORS OF DIFFERENT SYSTEMS.
    IEC 61000–5–2: EMC – INSTALLATION AND MITIGATION GUIDELINES, EARTHING AND CABLING.

    INSTRUMENTATION & CONTROL (24 VDC OR LESS) AND COMMUNICATION CABLES SHALL BE SEGREGATED FROM POWER CABLES
    IN ACCORDANCE TO THE FOLLOWING AIR GAP REQUIREMENT, AS A MINIMUM (BASED ON 100 M RUNS):

    75 TO 130 V: ENSURE 30 IN. [0.75 M] AIR GAP, LOW VOLTAGE.
    150 TO 230 V: ENSURE 60 IN. [1.5 M] AIR GAP, LOW VOLTAGE.
    380 TO 480 V: ENSURE 90 IN. [2.25 M] AIR GAP, LOW VOLTAGE.
    600 TO 15 KV: ENSURE 120 IN. [3 M] AIR GAP, MEDIUM VOLTAGE.

    IF SEGREGATION AIR GAP IS NOT POSSIBLE, METAL BARRIERS WITH GROUNDS TO BE ADDED BETWEEN CABLE RUNS. ALL CABLES SHOULD NOT BE BENT TO A RADIUS LESS THAN 8 TIMES THE OVERALL DIAMETER FOR NON–SHIELDED CABLES OR 12 TIMES THE OVERALL DIAMETER FOR SHIELDED CABLES.
    ALL CABLES SHALL BE RATED FOR ALL OF THE ENVIRONMENTAL CONDITIONS WHERE THEY ARE TO BE INSTALLED.
    WHEN METALLIC SHEATH ARMOR CABLES ARE USED, BOTH ENDS OF THE OUTER ARMOR SHOULD BE GROUNDED TO PE.

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969007	INTERCONNECT WIRING DIAGRAM, CUSTOMER
X–969009	INTERCONNECT CABLE SCHEDULE

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

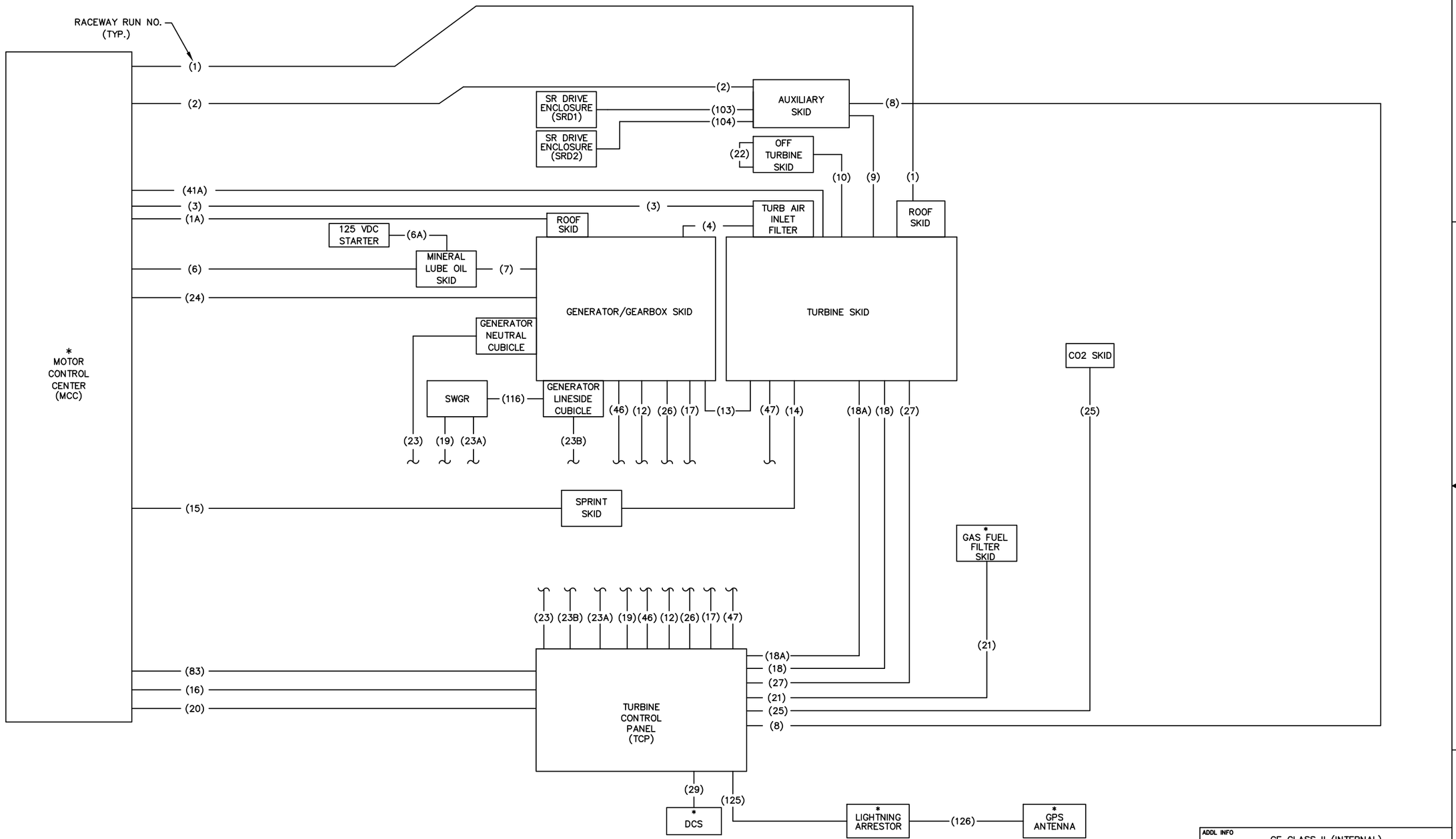
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INTERCONNECT PLAN
ELECTRICAL

DWG NO. 7253049–969006
REV. A

SCALE NONE
SHEET 1 OF 5



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NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

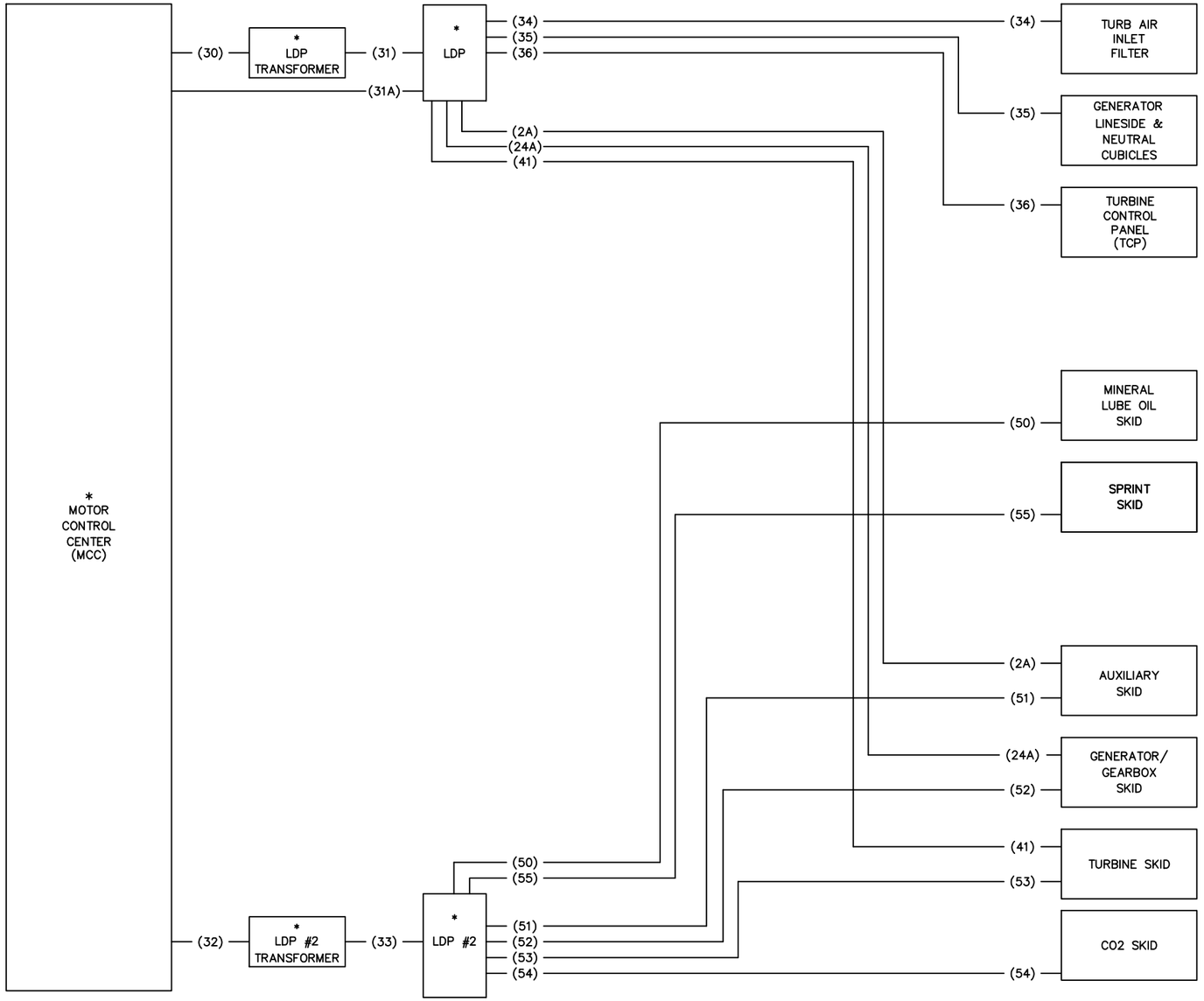
TITLE: INTERCONNECT PLAN ELECTRICAL

DWG NO. 7253049-969006

REV. A

SCALE NONE

SHEET 2 OF 5



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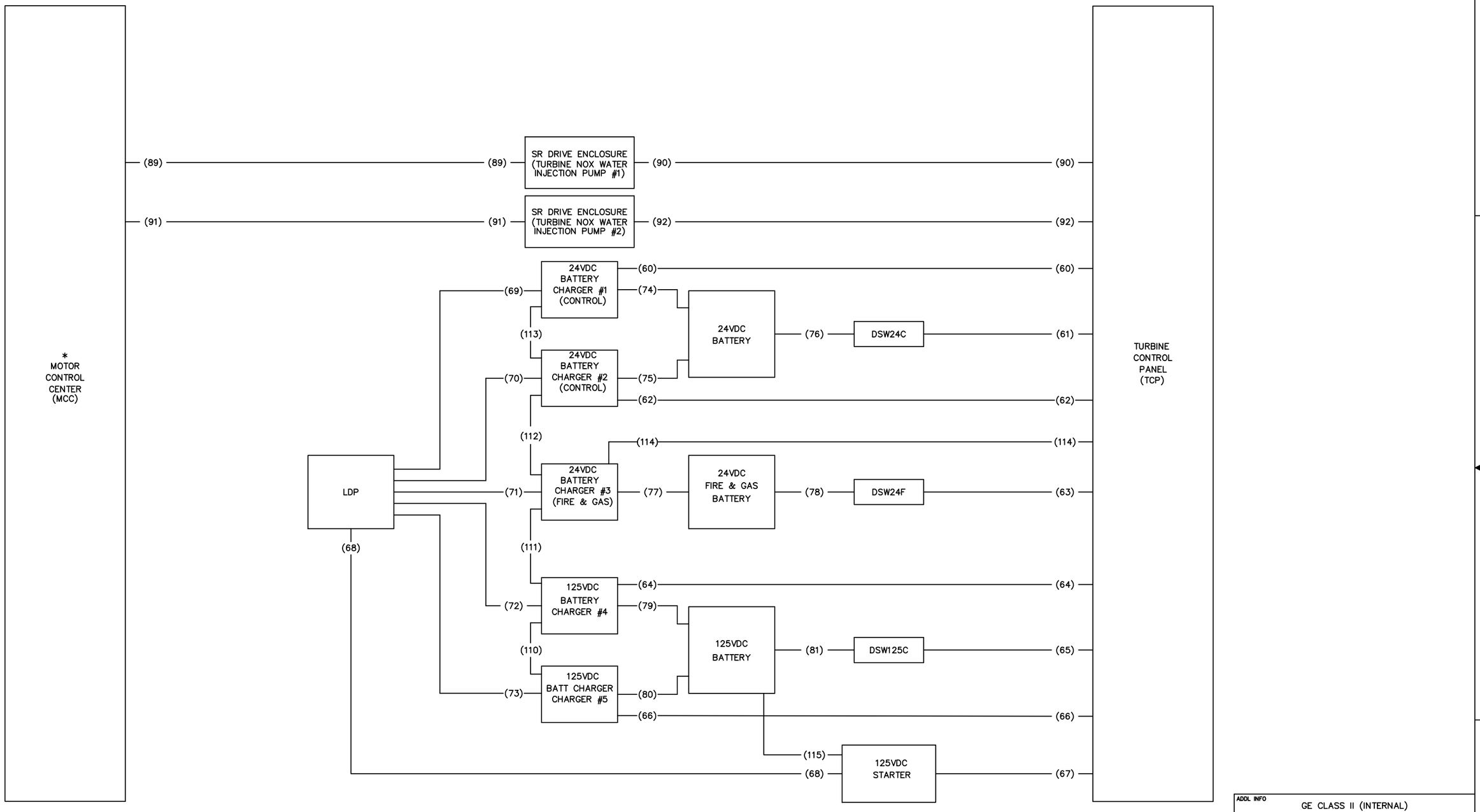
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DWG NO. 7253049-969006

REV. A

SCALE NONE

SHEET 3 OF 5



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DECIMALS .XX ± .03 .XXX ± .010
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ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

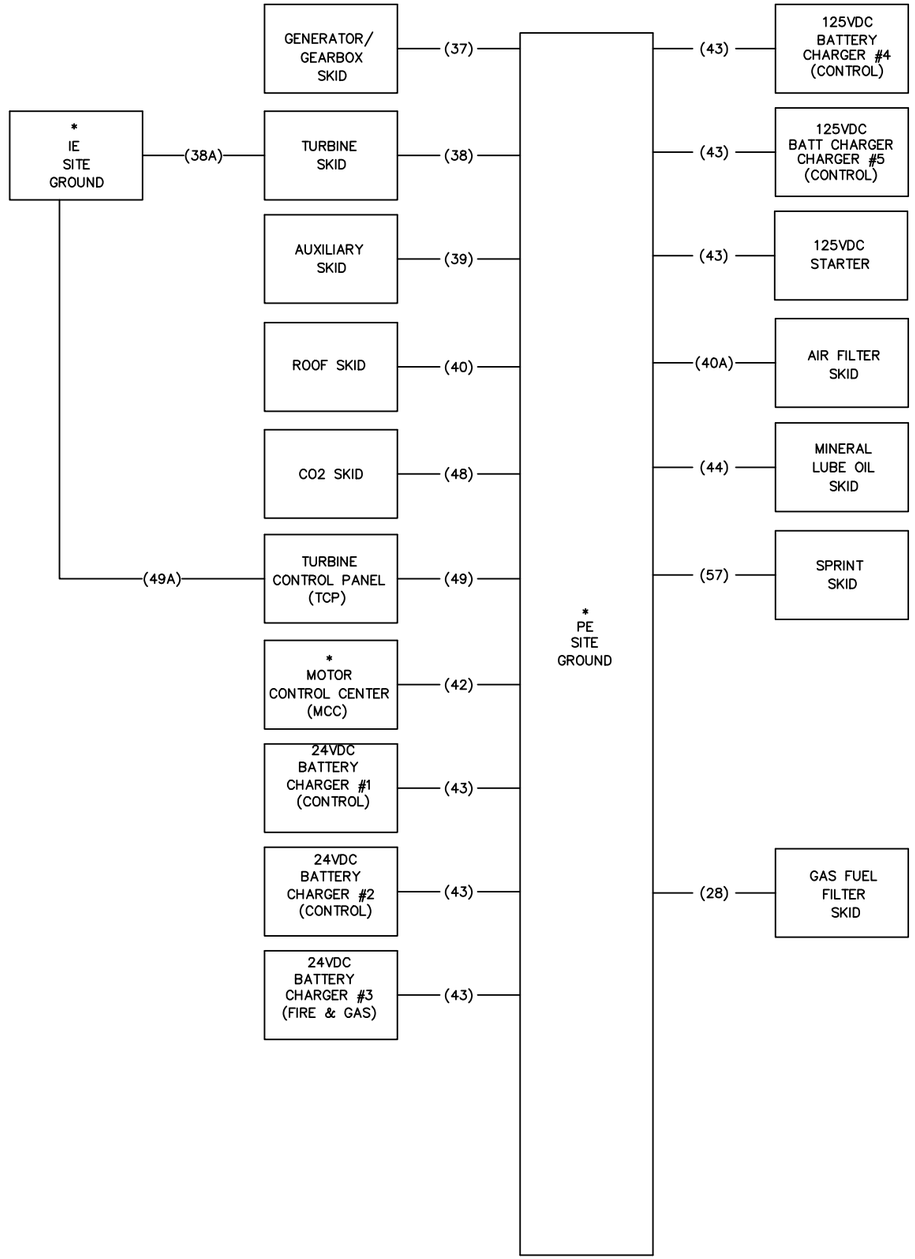
TITLE
INTERCONNECT PLAN
ELECTRICAL

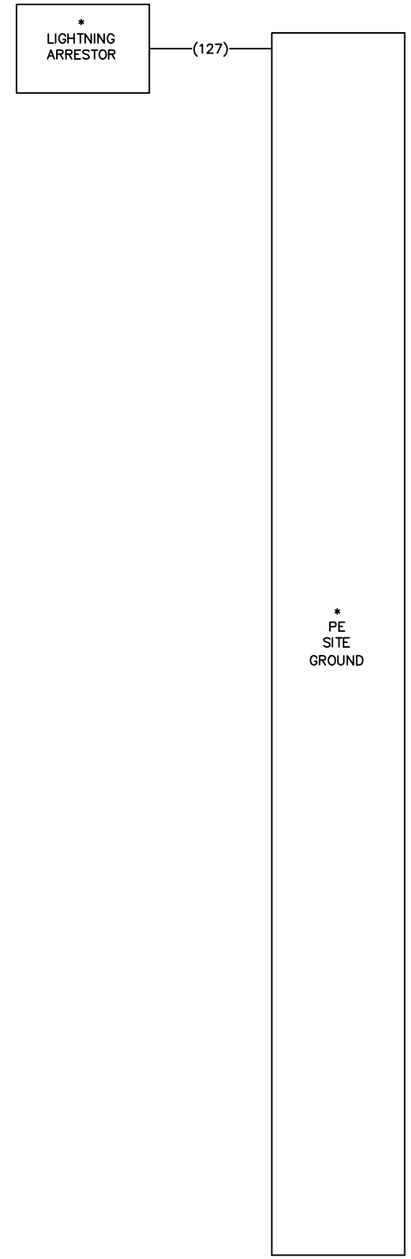
DWG NO. 7253049-969006

REV. A

SCALE NONE

SHEET 4 OF 5





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DECIMALS .XX ± .03 .XXX ± .010
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UNIT TYPE
LM6000®

ADDL INFO
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GE PACKAGED POWER, L.P.

TITLE
INTERCONNECT PLAN
ELECTRICAL

DWG NO. 7253049-969006

REV. A

SCALE NONE

SHEET 5 OF 5

NOTES:

1. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
2. THE WIRE SIZE SHOWN IS ESTIMATED MINIMUM SIZE BASED ON COPPER CONDUCTORS TYPE THW OR RHW INSULATION, OR EQUIVALENT, AND A LENGTH OF 100 FT [30.48 M]. ALL WIRE SHALL BE TWISTED STRANDED TYPE, SHIELDED (AS APPLICABLE), IN ACCORDANCE WITH THIS SCHEDULE.
3. THE CUSTOMER IS ADVISED TO MAKE ALLOWANCES FOR CABLE LENGTHS GREATER THAN THE 100 FT [30.48 M] SO AS TO LIMIT THE VOLTAGE DROPS TO 3% MAXIMUM. UNLESS OTHERWISE INDICATED.
4. CUSTOMER IS ADVISED TO PULL A MINIMUM OF 10% EXTRA WIRING FOR SPARES. ALL SPARE CONDUCTORS MUST BE GROUNDED ON BOTH ENDS. GROUND BARS TO BE ON CUSTOMER SCOPE OF SUPPLY AS REQUIRED.
5. NOT USED.
6. CABLES WITH THE SAME RACEWAY NUMBER AND SAME VOLTS MAY BE RUN IN SAME MULTICONDUCTOR CABLE. MULTICONDUCTOR SHOULD HAVE OVERALL OUTER SHIELD AND SHIELD FOR EACH PAIR, TRIAD, QUAD, AS APPLICABLE.
7. ALL CABLES SHALL HAVE 600V INSULATION TO COEXIST IN THE SAME RACEWAY NUMBER AC AND DC CABLE SHALL BE SEGREGATED ACCORDING TO THIS DRAWINGS.
8. ALL FIRE SYSTEM CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES IN ACCORDANCE WITH NFPA 70 (NEC) AND LOCAL JURISDICTION CODES.
9. ALL COMMUNICATION CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES AND NOT COMBINED WITH NON–COMMUNICATION CABLE RACEWAYS.
10. FOR INSTRUMENTATION CABLES THAT ARE INCORPORATED IN MULTICONDUCTOR CABLES, INDIVIDUAL SHIELDS MUST BE INCORPORATED AS INDICATED FOR EACH INDIVIDUAL PAIR, TRIAD, ETC. CABLES WITH SHIELDS SHALL HAVE THEIR SHIELD DRESSED OUT NO MORE THAN 1 IN. [25 mm].
11. CUSTOMER TO ENSURE PROPER CABLE INSTALLATION AND SEPARATION BY SERVICE LEVEL IN ACCORDANCE TO THE FOLLOWING INDUSTRY STANDARDS OR EQUIVALENT:

    IEEE 422: IEEE GUIDE FOR THE DESIGN AND INSTALLATION OF CABLE SYSTEMS IN POWER GENERATING SYSTEMS.
    NFPA 70 (NEC): ARTICLE 300–310 CONDUCTORS OF DIFFERENT SYSTEMS.
    IEC 61000–5–2: EMC–INSTALLATION AND MITIGATION GUIDELINES, EARTHING AND CABLING.

    INSTRUMENTATION & CONTROL (24 VDC OR LESS) AND COMMUNICATION CABLES SHALL BE SEGREGATED FROM POWER CABLES IN ACCORDANCE TO THE FOLLOWING AIR GAP REQUIREMENT, AS A MINIMUM (BASED ON 100 M RUNS):
    75 TO 130 V: ENSURE 30 IN. [0.75 M] AIR GAP, LOW VOLTAGE.
    150 TO 230 V: ENSURE 60 IN. [1.5 M] AIR GAP, LOW VOLTAGE.
    380 TO 480 V: ENSURE 90 IN. [2.25 M] AIR GAP, LOW VOLTAGE.
    600 TO 15 KV: ENSURE 120 IN. [3 M] AIR GAP, MEDIUM VOLTAGE.

    IF SEGREGATION AIR GAP IS NOT POSSIBLE, METAL BARRIERS WITH GROUNDS TO BE ADDED BETWEEN CABLE RUNS. ALL CABLES SHOULD NOT BE BENT TO A RADIUS LESS THAN 8 TIMES THE OVERALL DIAMETER FOR NON–SHIELDED CABLES OR 12 TIMES THE OVERALL DIAMETER FOR SHIELDED CABLES. ALL CABLES SHALL BE RATED FOR ALL OF THE ENVIRONMENTAL CONDITIONS WHERE THEY ARE TO BE INSTALLED. WHEN METALLIC SHEATH ARMOR CABLES ARE USED, BOTH ENDS OF THE OUTER ARMOR SHOULD BE GROUNDED TO PE.
12. USE CORNING OPTICAL FIBER CABLE NO. 006KSF–T4130D20 OR EQUAL W/INTEGRAL STAINLESS STEEL SC TYPE CONNECTOR ON BOTH ENDS OF THE CABLE, WHERE INDICATED.
13. MAINTAINED SWITCH CONTACT, WHERE INDICATED.
14. MOMENTARY SWITCH CONTACT, WHERE INDICATED.
15. ACTIVE ONLY WHEN SELECTED BY LOCAL/REMOTE SWITCH ON THE LOCAL CONTROL PANEL (TCP), WHERE INDICATED.
16. IF SIGNAL IS NOT REQUIRED, ADD JUMPER BETWEEN ITS TERMINAL POINTS, WHERE INDICATED.
17. OPEN CONTACT = CONDITION SHOWN, WHERE INDICATED.
18. ALL WIRES TO BE LABELED AT EACH TERMINATION WITH A SLEEVE TYPE WIRE MARKERS.
19. BREAKDOWN OF BLOCK IDENTIFICATION:
    CABLE ID./RACEWAY NO.
    AC03/617
    12 AWG/4
    WIRE SIZE/NO. OF CONDUCTORS
20. ALL CABLES, CABLE GLANDS & RACEWAYS ARE FURNISHED BY OTHERS, UNLESS OTHERWISE INDICATED. ALL CABLES AND CABLE GLANDS SHALL MEET THE IP/NEMA RATING OF THE TERMINATION BOX AND PANELS. A RACEWAY IS AN ENCLOSED CHANNEL DESIGNED TO HOLD CABLES, WIRES, BUS–BARS. RACEWAY SHOULD BE METALLIC OR NON METALLIC MATERIAL AND CAN BE CONDUIT, CABLE TRAY, FLEXIBLE CONDUIT, UNDER GROUND DUCT. RACEWAYS THAT ARE METALLIC SHOULD BE BONDED THROUGH THEIR PERIMETER AND GROUNDED AT BOTH ENDS, AS A MINIMUM.
21. TWISTED PAIR SHIELDED CABLE TO BE 22 AWG, TINNED COPPER, 8.8 PF/FT [28.86 PF/M], STRANDED, 150V, 150 OHMS IMPEDANCE, BELDEN NO. 89182 OR EQUAL, WHERE INDICATED.
22. USE CAT5e SHIELDED ETHERNET CABLE W/RJ45 CONNECTORS, WHERE INDICATED.
23. USE GREEN/YELLOW CABLE, WHERE INDICATED.
24. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
25. ALL UNUSED INDIVIDUAL WIRE ENDS (INCLUDING THOSE IN SHIELDED CABLES) TO BE FOLDED BACK AND TAPED.
26. ALL SHIELDING WILL HAVE A MAXIMUM EXPOSED SHIELD LENGTH OF 2 IN [51 mm] AT TERMINAL END.
27. FOR 60 HZ NEC/CSA APPLICATIONS, AC WIRING COLORS SHALL BE PER NEC ARTICLE 200. STANDARD WIRING COLORS ARE RED, BLACK, BROWN FOR POWER PHASES AND WHITE FOR NEUTRAL. PE GROUND WIRING COLOR IS GREEN/YELLOW STRIPE, OR GREEN.
28. FOR 50 HZ IEC APPLICATIONS, AC WIRING COLORS SHALL BE PER IEC ARTICLE 60446. STANDARD WIRING COLORS ARE BLACK, BROWN, GRAY FOR POWER PHASES AND BLUE FOR NEUTRAL. PE GROUND WIRING COLOR IS GREEN/YELLOW STRIPE.
29. IF DISTANCE BETWEEN REMOTE HMI AND TCP IS LESS THAN 300 FT [91.4 M], USE CAT5e SHIELDED ETHERNET CABLE W/RJ45 CONNECTORS, WHERE INDICATED. IF DISTANCE BETWEEN REMOTE HMI AND TCP IS GREATER THAN 300 FT [91.4 M], USE FIBER OPTIC CABLE WITH FIBER OPTIC TO ETHERNET MEDIA CONVERTER AT EACH END, WHERE INDICATED.
30. CABLE TO BE SIZED BY CUSTOMER, WHERE INDICATED.
31. ALL CABLE GLANDS AND CABLE SUPPORT SYSTEMS ARE WITHIN CUSTOMER SCOPE OF SUPPLY AND NOT SUPPLIED BY GE.
32. SYSTEM SUPPLIED BY GEPPLP, INSTALLATION AND LOCATION IS UNDER THE CUSTOMER SCOPE AND MUST COMPLY WITH THE INSTALLATION INSTRUCTIONS STATED IN THE USER'S GUIDE. THE MAXIMUM LENGTH OF THE CABLE FROM ANTENNA TO HMI IS 300 FT [91.44 M] PER GEPPLP DESIGN.
33. SYSTEM SUPPLIED BY CUSTOMER, GEPPLP RECOMMEND TO USE GE PART #398A4893P0001 (SUPPLY BY MEINBERG).
34. INSTALLATION AND LOCATION IS UNDER CUSTOMER SCOPE AND MUST COMPLY WITH THE INSTALLATION INSTRUCTIONS STATED IN THE USER'S GUIDE. THE MAXIMUM LENGTH OF THE CABLE FROM ANTENNA TO HMI IS 300 FT [91.44 M] PER GEPPLP DESIGN.
35. ENET8 IS SUPPLIED BY GE WHEN REMOTE HMI OPTION IS PURCHASED ETHERNET SWITCH IS AN ALLIED TELESYN INTERNATION AT–8026FC MODEL.
36. WOBBE METER CAN SUPPORT UP TO 3 GAS TURBINE GENERATOR SETS, FOR CAT5e ETHERNET CABLE INSTALLATION THE WOBBE METER CAN DIRECT CONNECT TO EACH UNIT FEATURING ONBOARD ETHERNET SWITCH(ENET7), PORT 3 IS FOR UNIT 1, PORT 4 IS FOR UNIT 2, AND PORT 5 IS FOR UNIT 3.
37. WOBBE METER CAN SUPPORT UP TO 3 GAS TURBINE GENERATOR SETS, FOR FIBER OPTIC CABLE INSTALLATION THE WOBBE METER CAN DIRECT CONNECT TO ONE UNIT FEATURING ONBOARD ETHERNET SWITCH WITH FIBER OPTIC PORT. THE FIBER PORT SHALL INTERFACE WITH ENET1 FIBER OPTIC PORT, IF MULTIPLE UNIT INSTALLATION IS REQUIRED ENET1 AND ENET2 AS APPLICABLE SHALL BE LINKED TO ENET1 AND ENET2 AS APPLICABLE OF ADDITIONAL UNITS UP TO 3.
38. ALL CABLES WITH DIFFERENT VOLTS CAN NOT COEXIST IN THE SAME RACEWAY NUMBER.

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS AND REFERENCE DATA
X–969006	INTERCONNECT PLAN, ELECTRICAL
X–969009	INTERCONNECT CABLE SCHEDULE

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

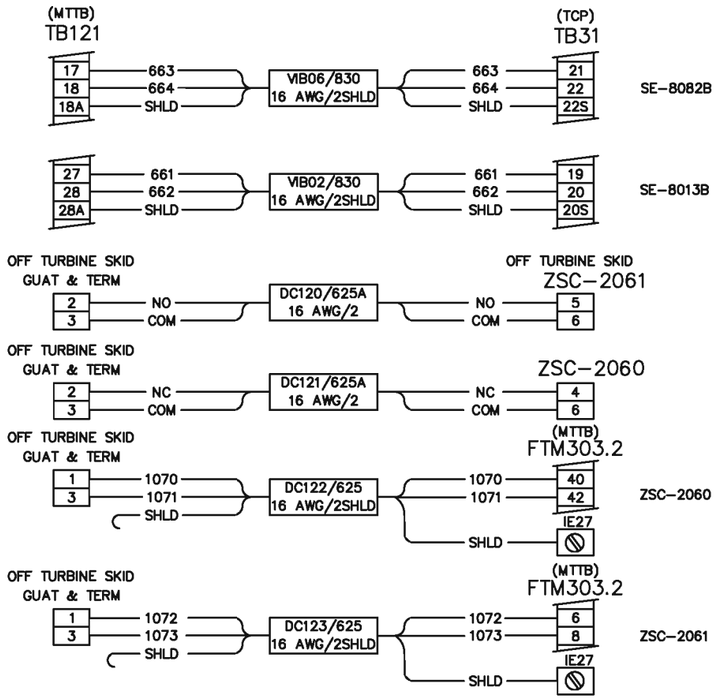
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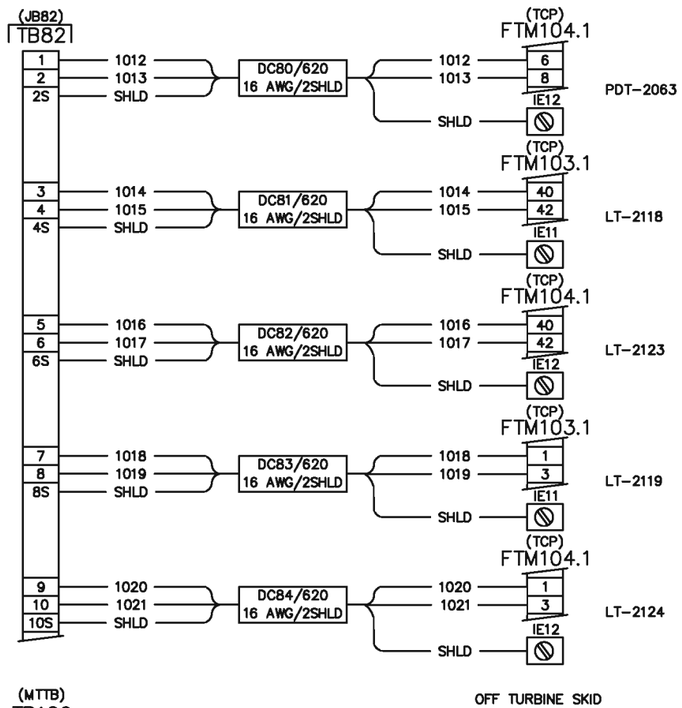
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REV. A

SCALE NONE

SHEET 1 OF 28





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FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

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LM6000©

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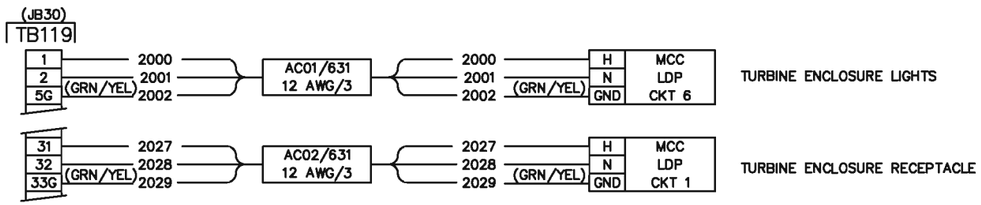
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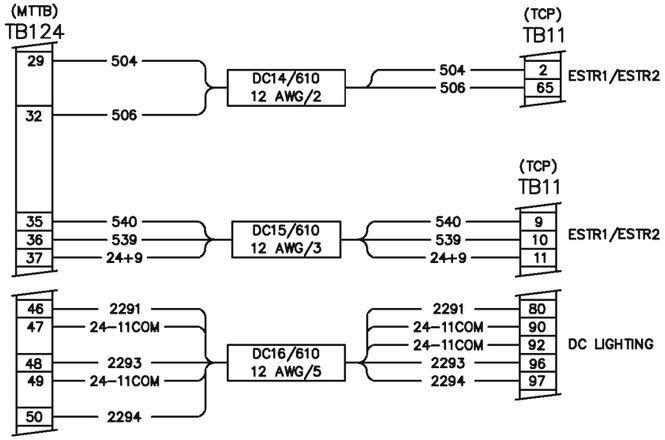
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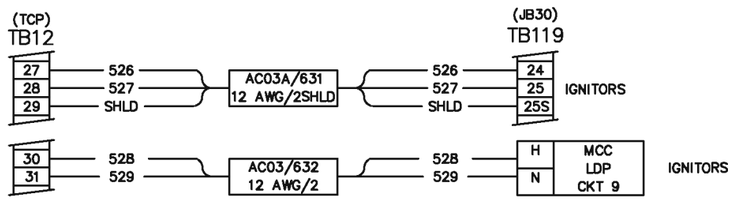
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SCALE NONE

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

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GE PACKAGED POWER, L.P.

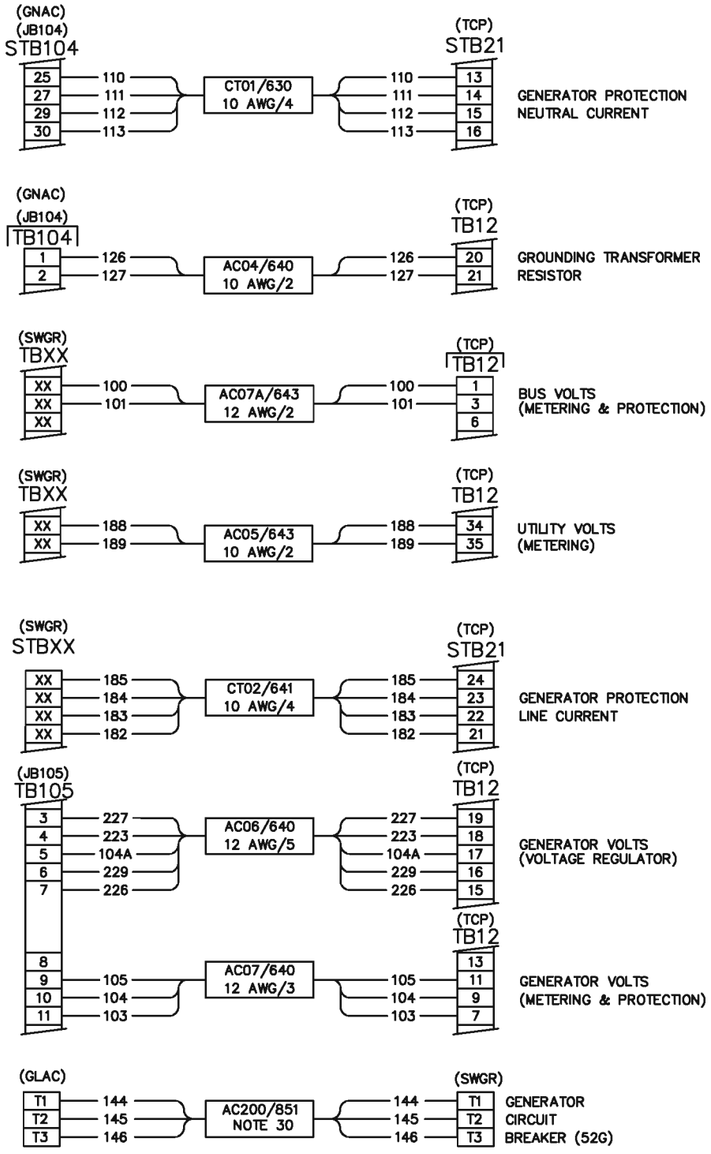
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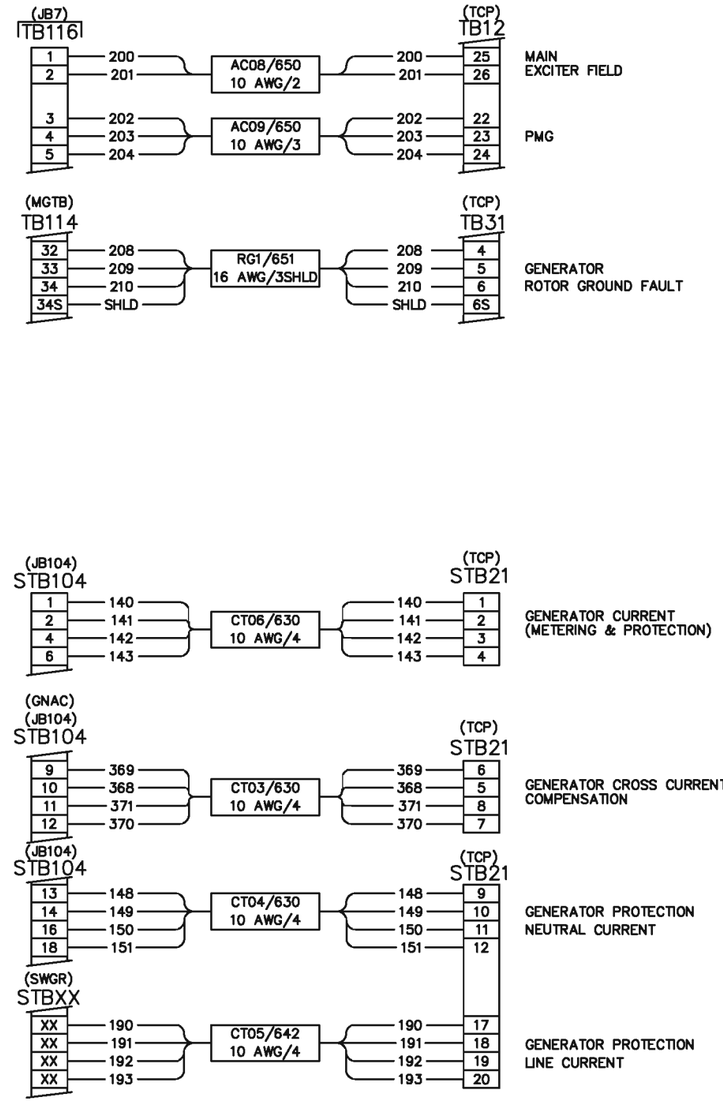
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SCALE NONE

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THIRD ANGLE PROJECTION

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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

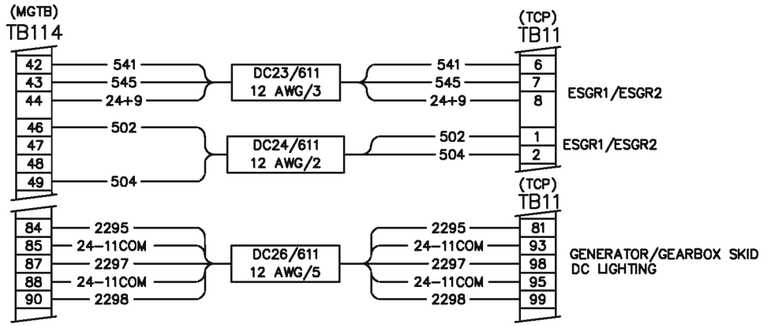
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CUSTOMER

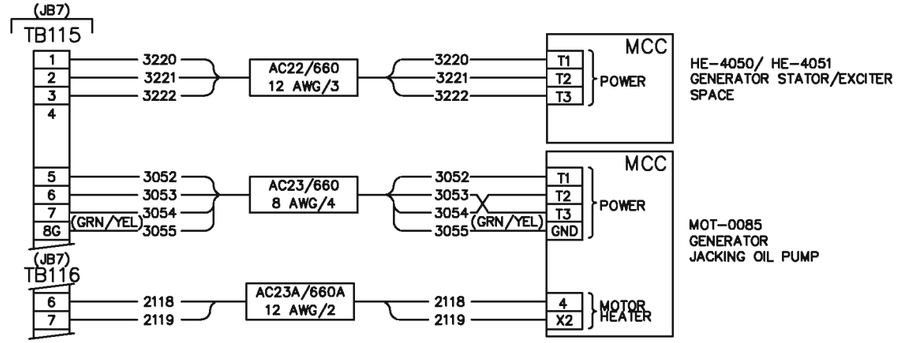
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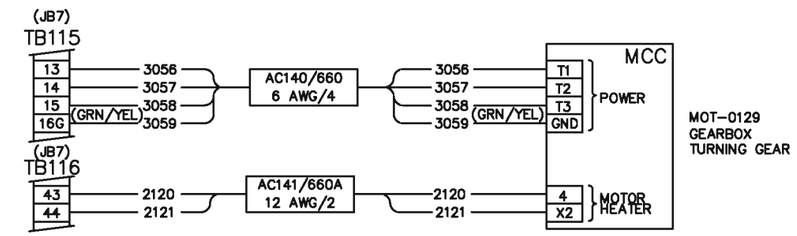
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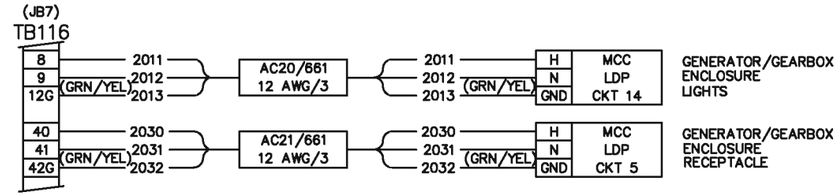
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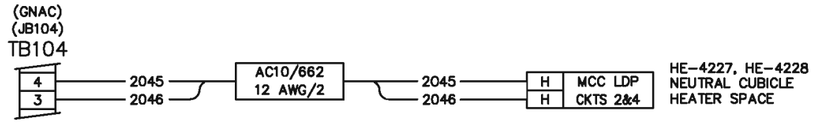
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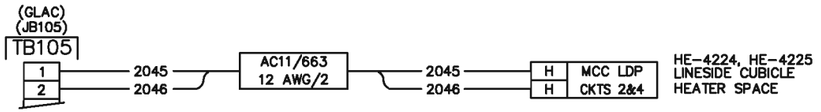














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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

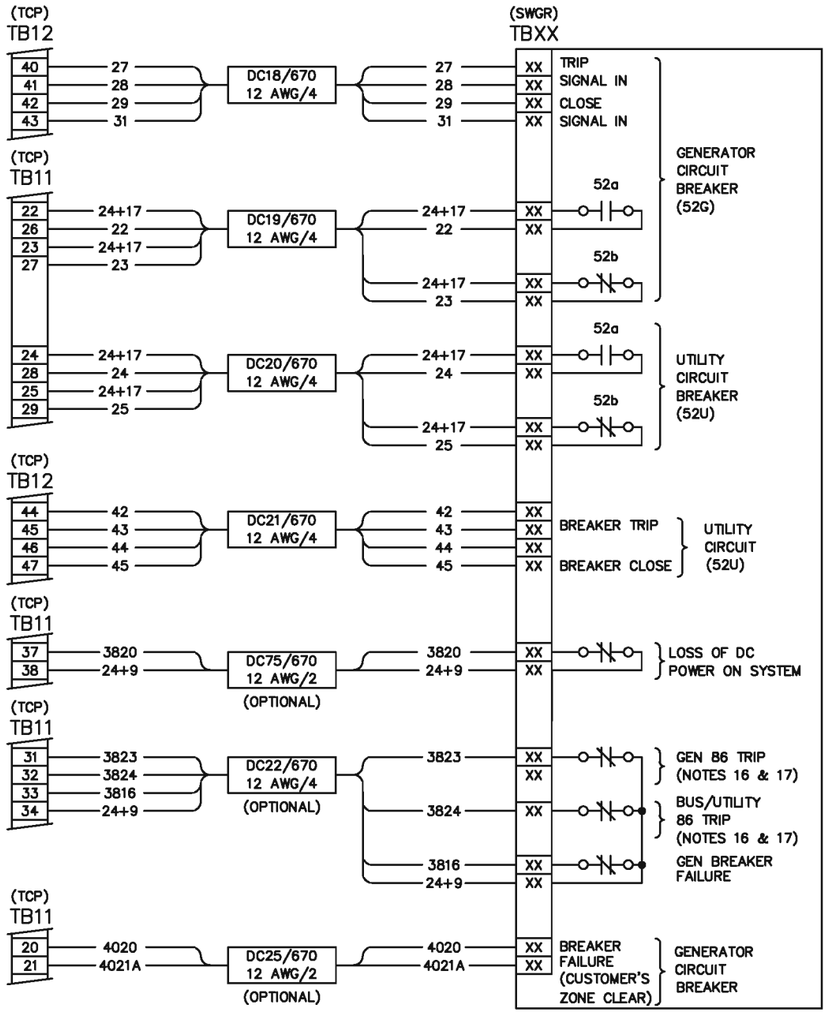
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INTERCONNECT WIRING DIAGRAM
CUSTOMER

DWG NO. 7253049-969007

REV. A

SCALE NONE

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

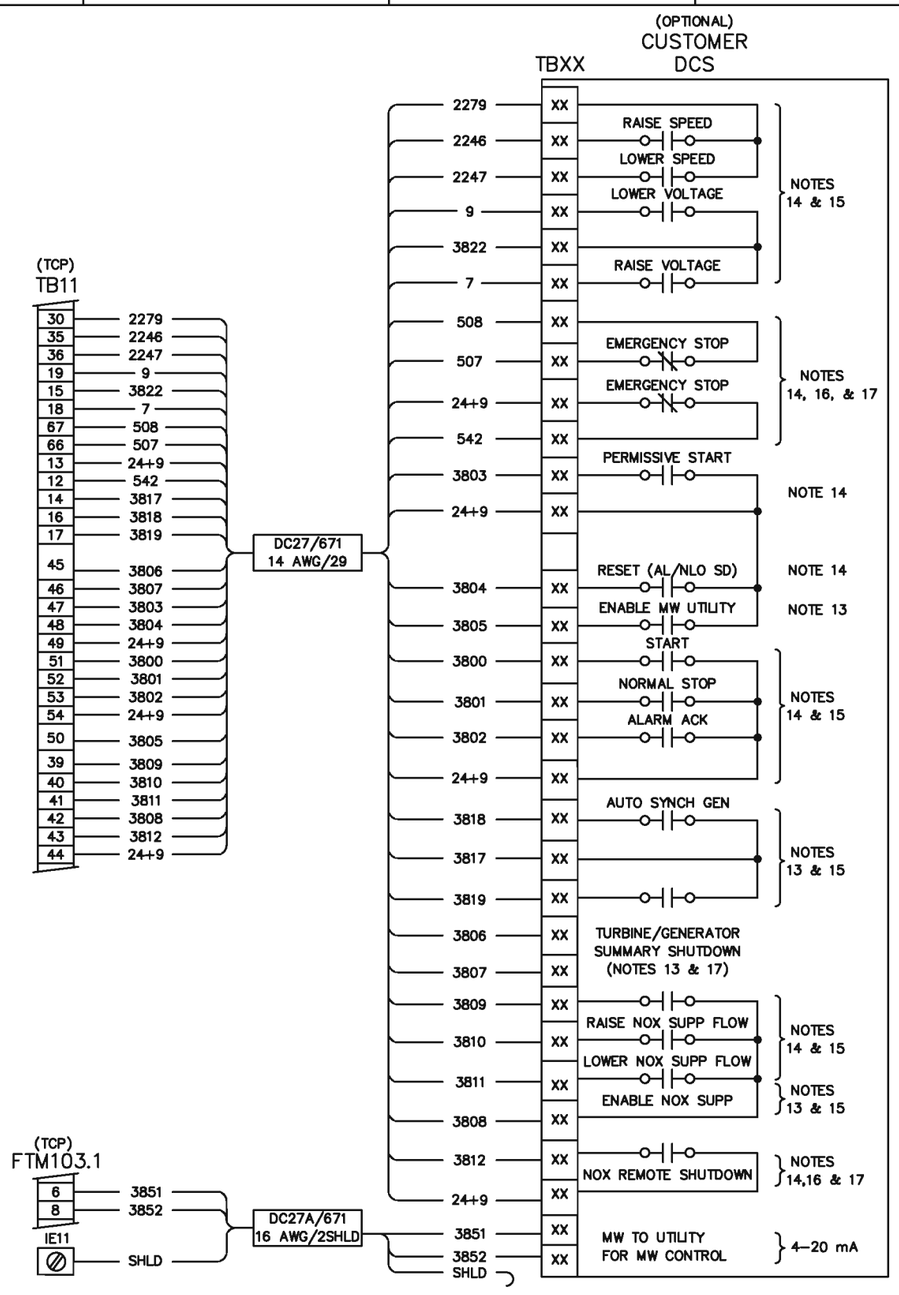
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SCALE NONE

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

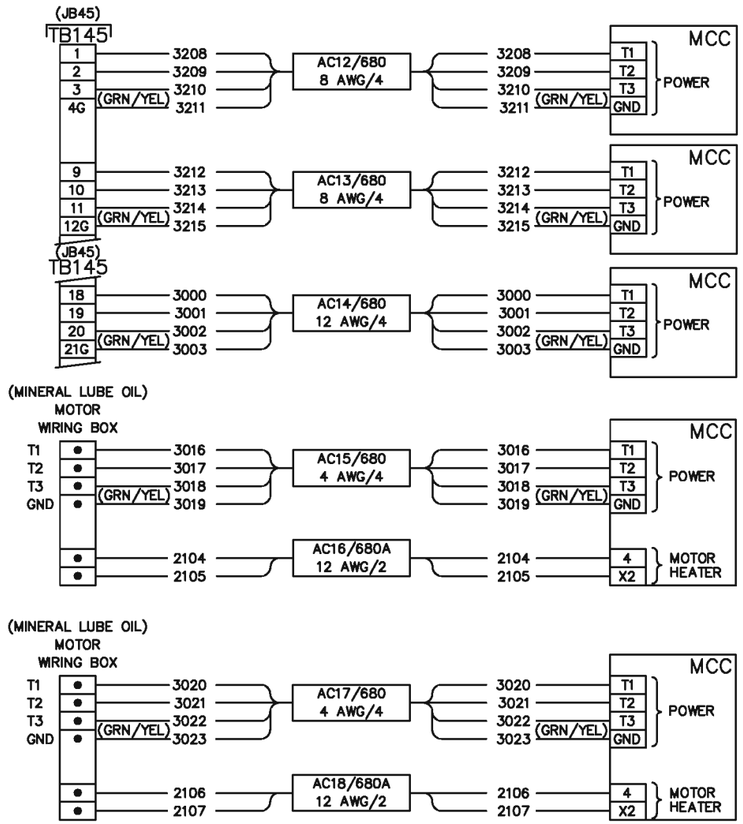
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CUSTOMER

DWG NO. 7253049-969007

REV. A

SCALE NONE

SHEET 7 OF 28



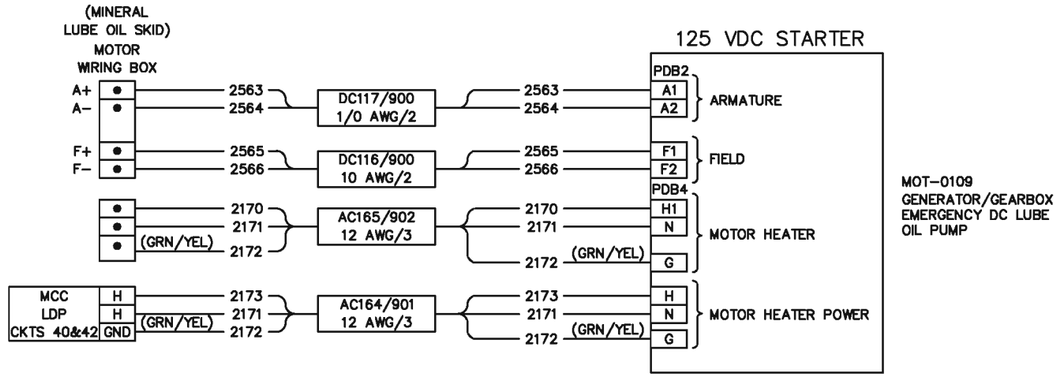
HE–0105
MINERAL LUBE OIL
TANK (HEATER NO. 1)

HE–0106
MINERAL LUBE OIL
TANK (HEATER NO. 2)

MOT–0110
MINERAL LUBE OIL
AIR/OIL SEPARATOR FAN

MOT–0108A
MINERAL LUBE
OIL AC PUMP (A)

MOT–0108B
MINERAL LUBE
OIL AC PUMP (B)



MOT–0109
GENERATOR/GEARBOX
EMERGENCY DC LUBE
OIL PUMP

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DECIMALS .XX ± .03 .XXX ± .010
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NEXT ASSY.

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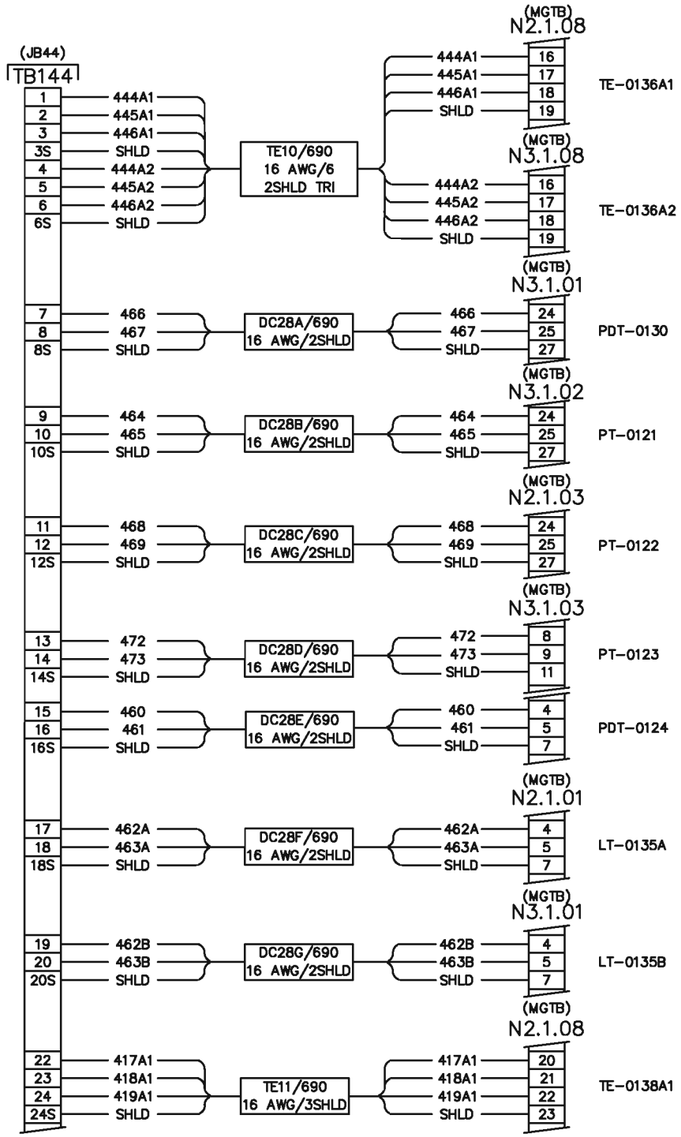
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DWG NO. 7253049–969007

REV. A

SCALE NONE

SHEET 8 OF 28



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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

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LM6000

ADDL INFO
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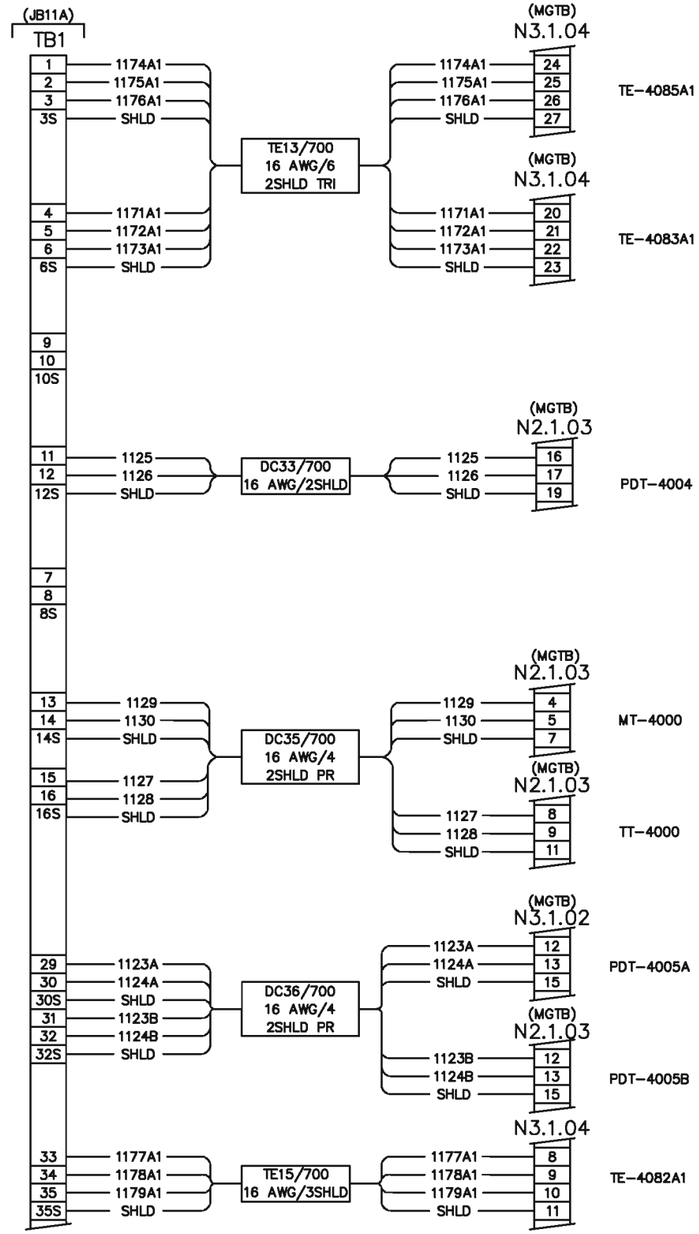
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CUSTOMER

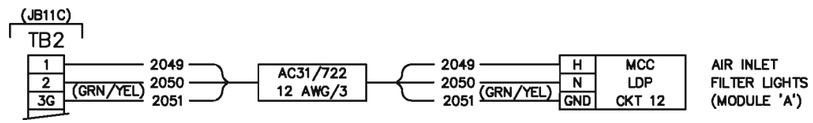
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REV. A

SCALE NONE

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

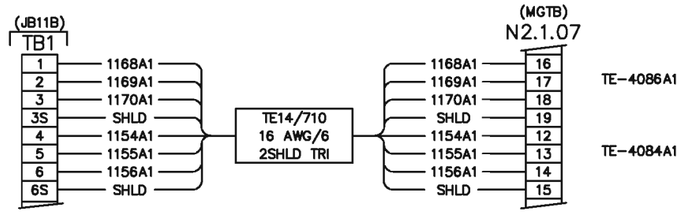
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INTERCONNECT WIRING DIAGRAM
CUSTOMER

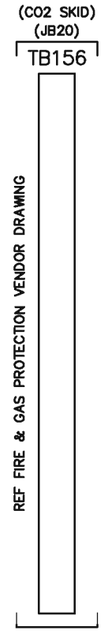
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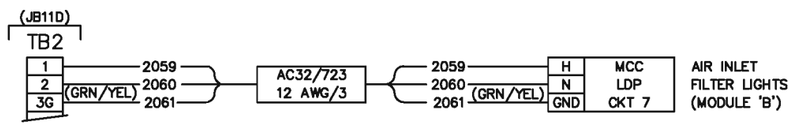
REV. A

SCALE NONE

SHEET 10 OF 28







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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

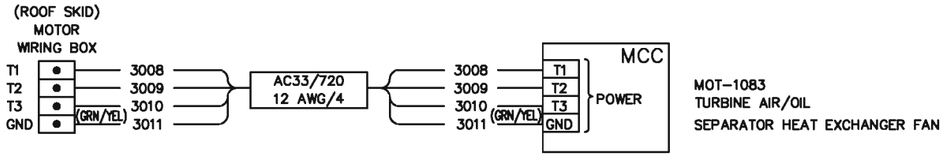
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CUSTOMER

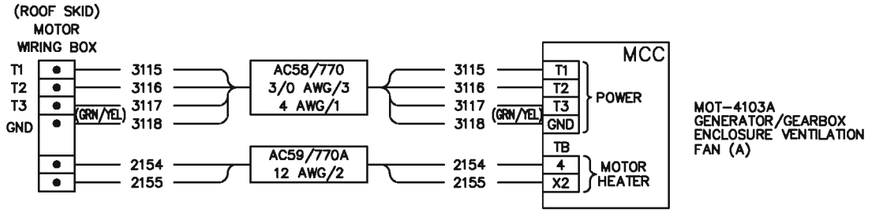
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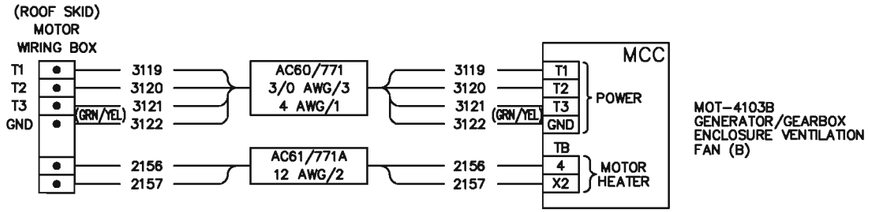
REV. A

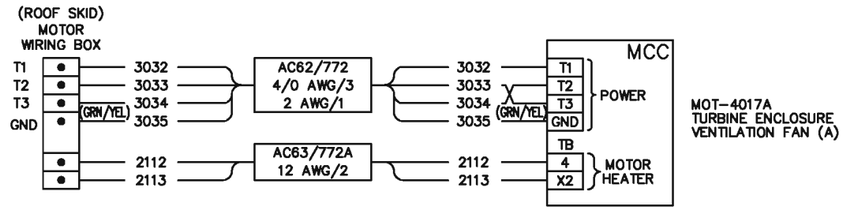
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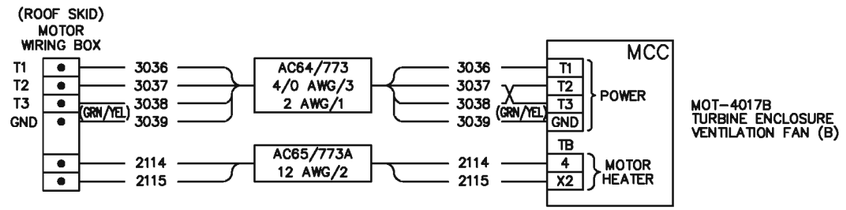
SHEET 11 OF 28











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A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

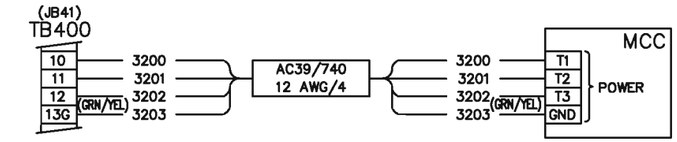
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INTERCONNECT WIRING DIAGRAM
CUSTOMER

DWG NO. 7253049-969007

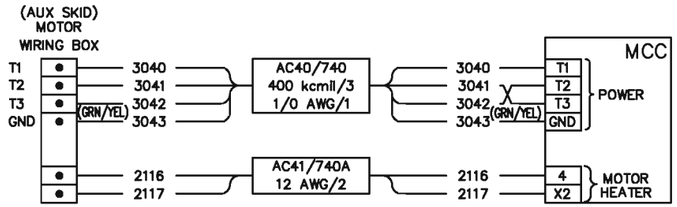
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SCALE NONE

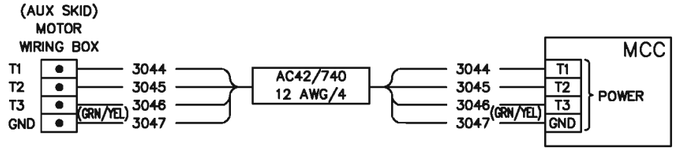
SHEET 12 OF 28



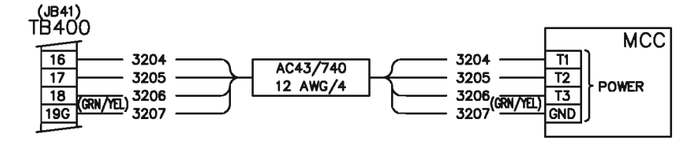
HE-6010
TURBINE HYDRAULIC
STARTER OIL TANK



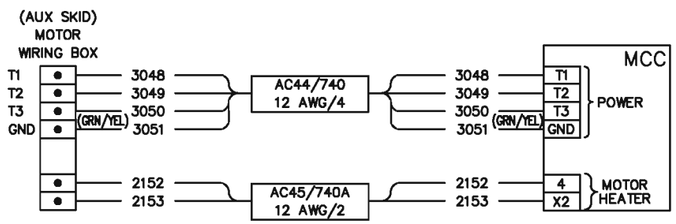
MOT-6015
TURBINE HYDRAULIC
STARTER PUMP



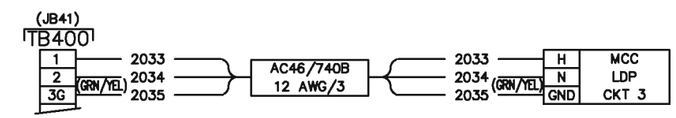
MOT-6016
TURBINE HYDRAULIC
STARTER OIL HEAT EXCHANGER FAN



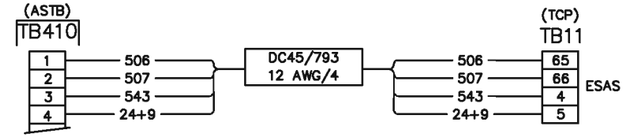
HE-1004
TURBINE
LUBE OIL TANK

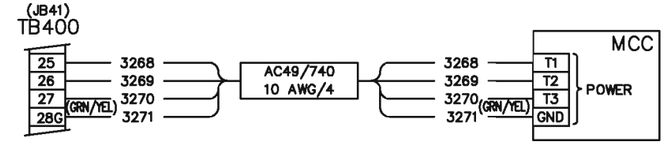


MOT-5035
TURBINE
WATER WASH PUMP

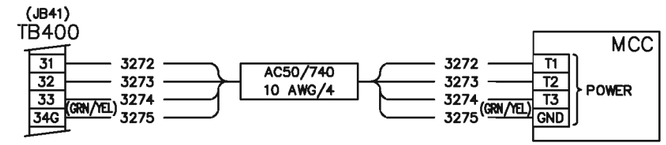


AUXILIARY SKID
ENCLOSURE LIGHTING

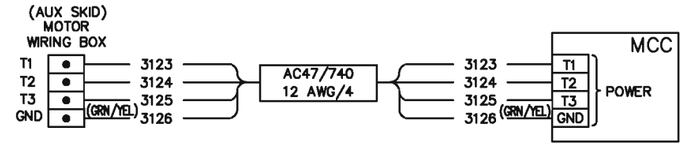




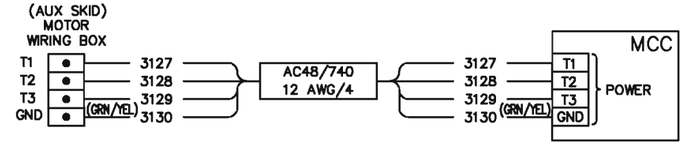
HE-5036
TURBINE WATER
WASH TANK (NO. 1)



HE-5044
TURBINE WATER
WASH TANK (NO. 2)



MOT-4027A
AUXILIARY SKID
ENCLOSURE
VENTILATION FAN (A)



MOT-4027B
AUXILIARY SKID
ENCLOSURE
VENTILATION FAN (B)

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000©

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

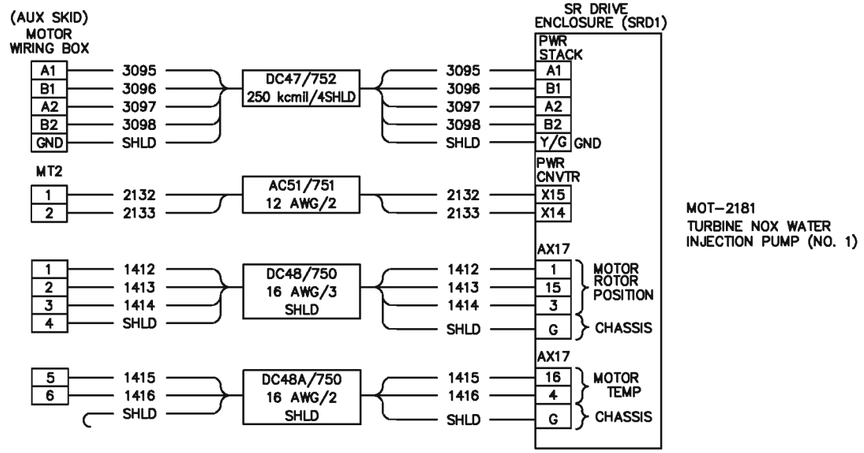
TITLE
INTERCONNECT WIRING DIAGRAM
CUSTOMER

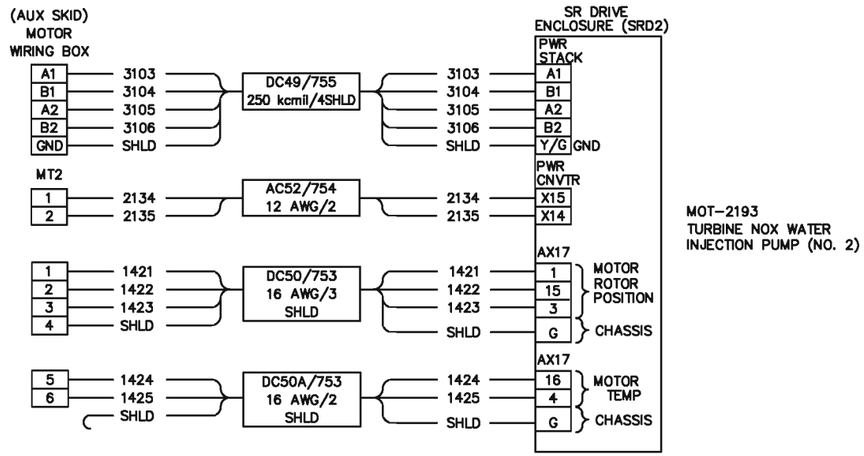
DWG NO. 7253049-969007

REV. A

SCALE NONE

SHEET 13 OF 28





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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

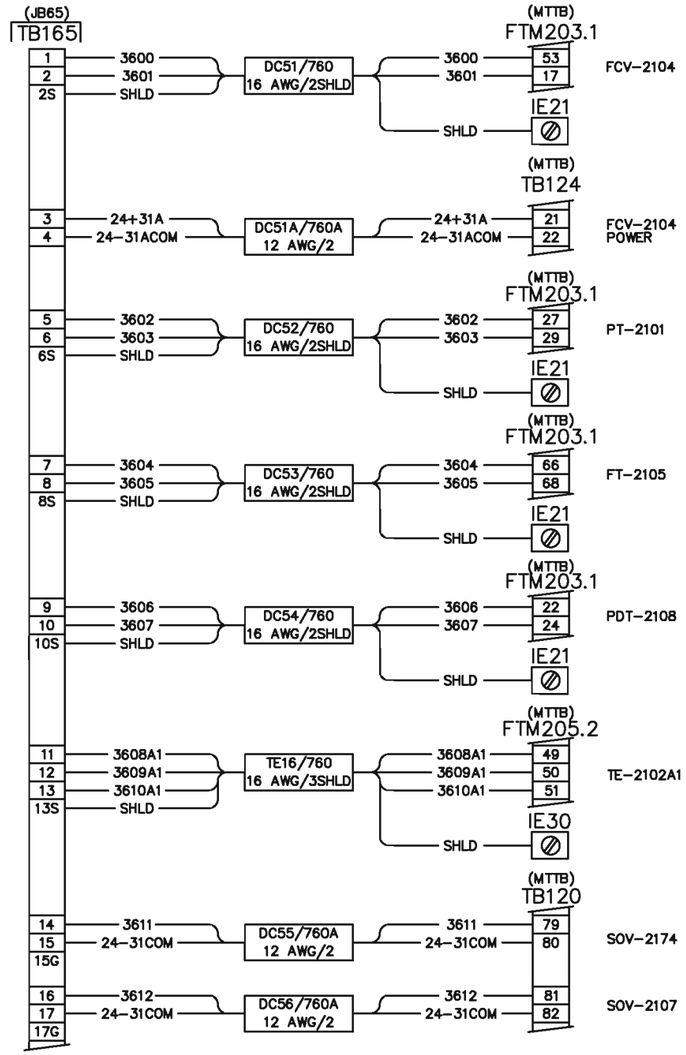
TITLE
INTERCONNECT WIRING DIAGRAM
CUSTOMER

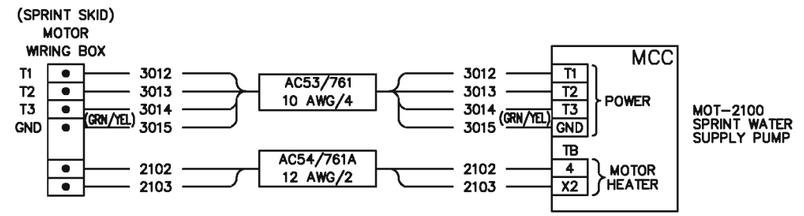
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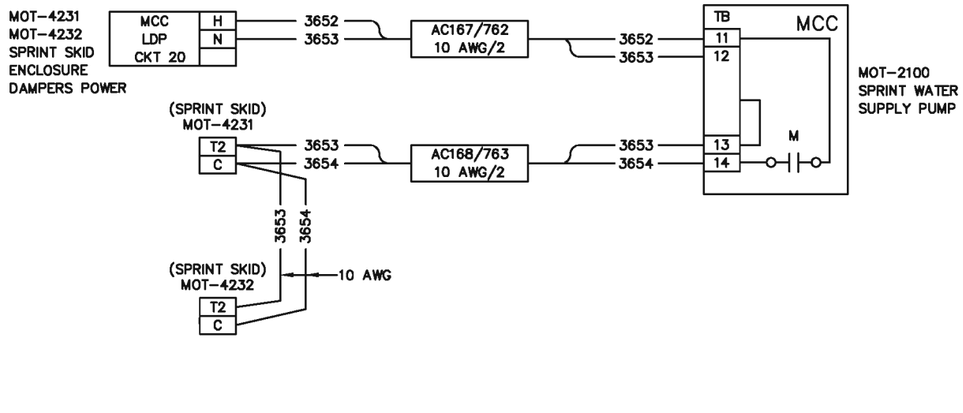
REV. A

SCALE NONE

SHEET 14 OF 28







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REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

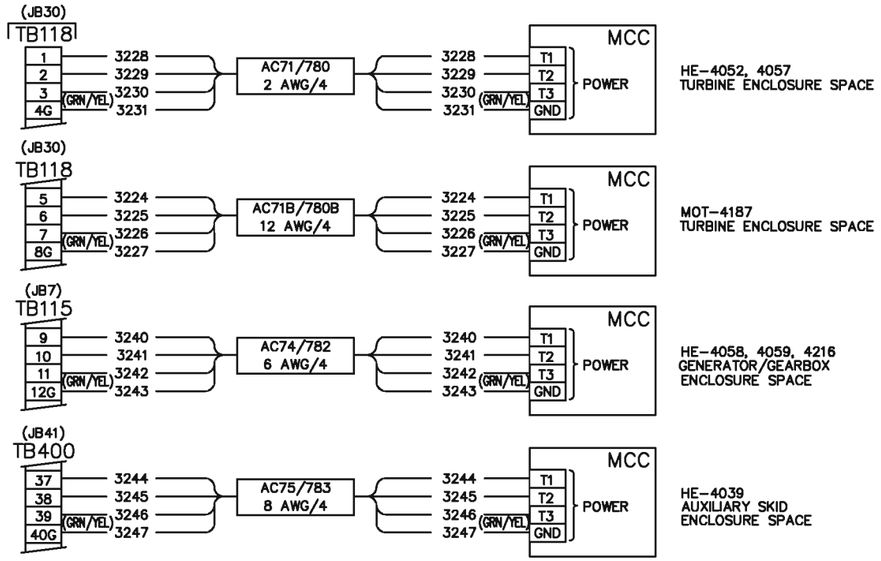
TITLE
INTERCONNECT WIRING DIAGRAM
CUSTOMER

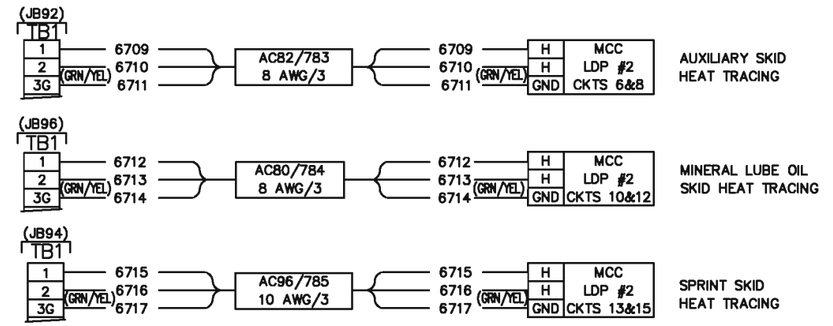
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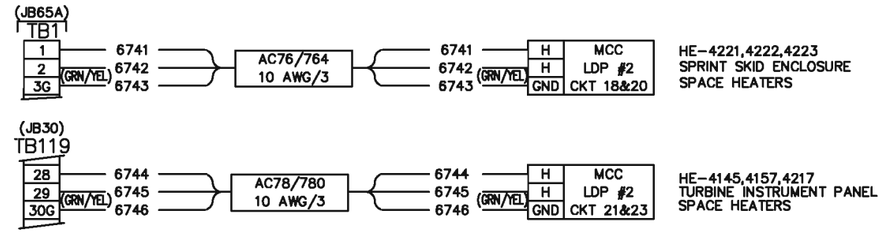
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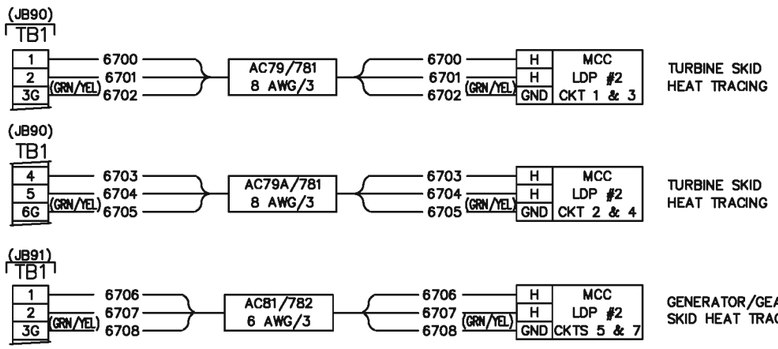
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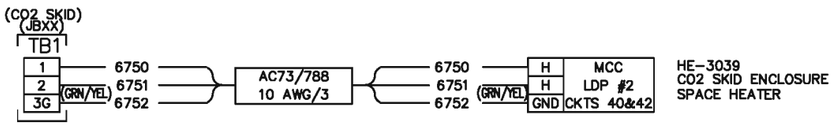
SHEET 15 OF 28











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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

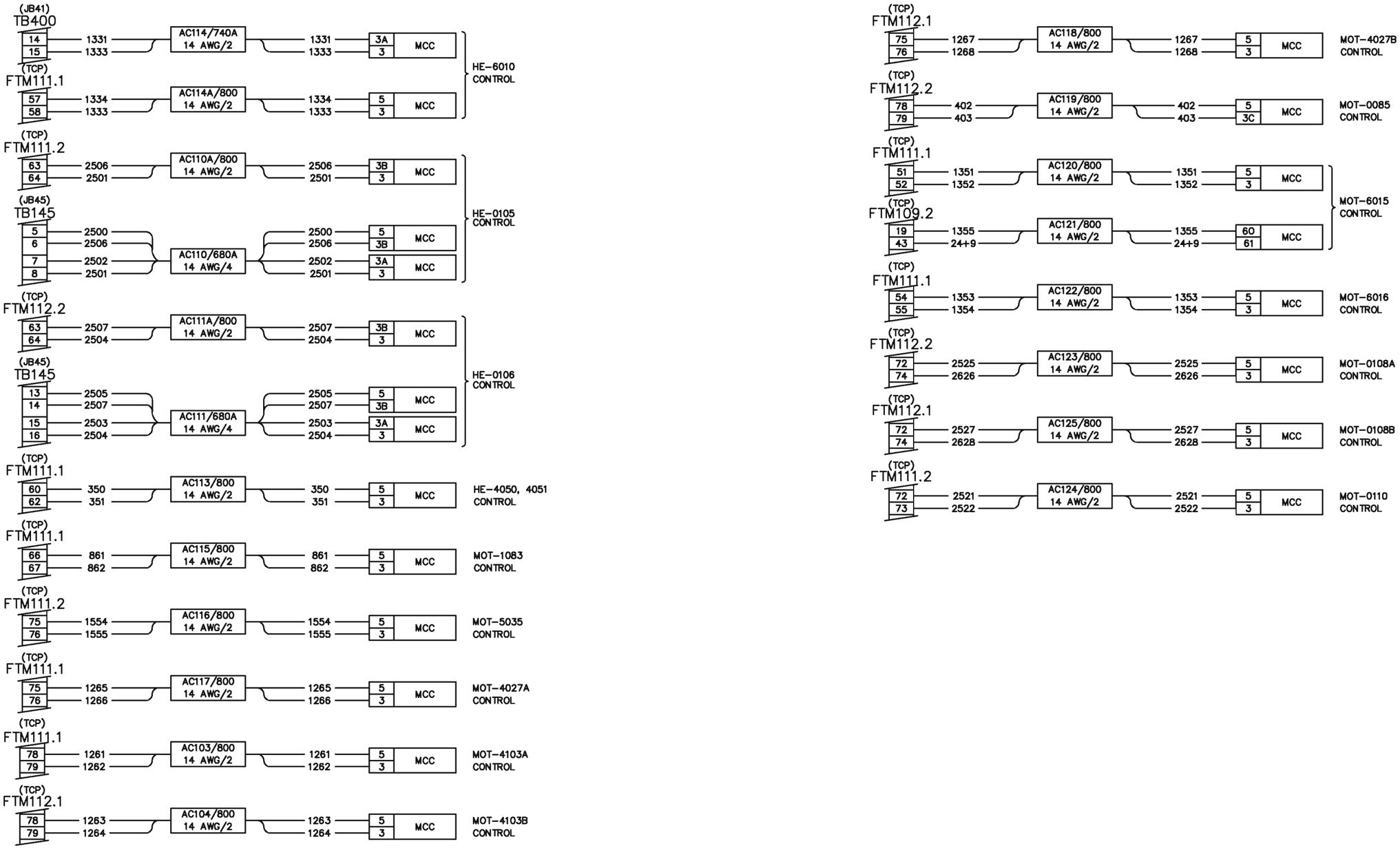
TITLE
INTERCONNECT WIRING DIAGRAM
CUSTOMER

DWG NO.
7253049-969007

REV.
A

SCALE NONE

SHEET 16 OF 28



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

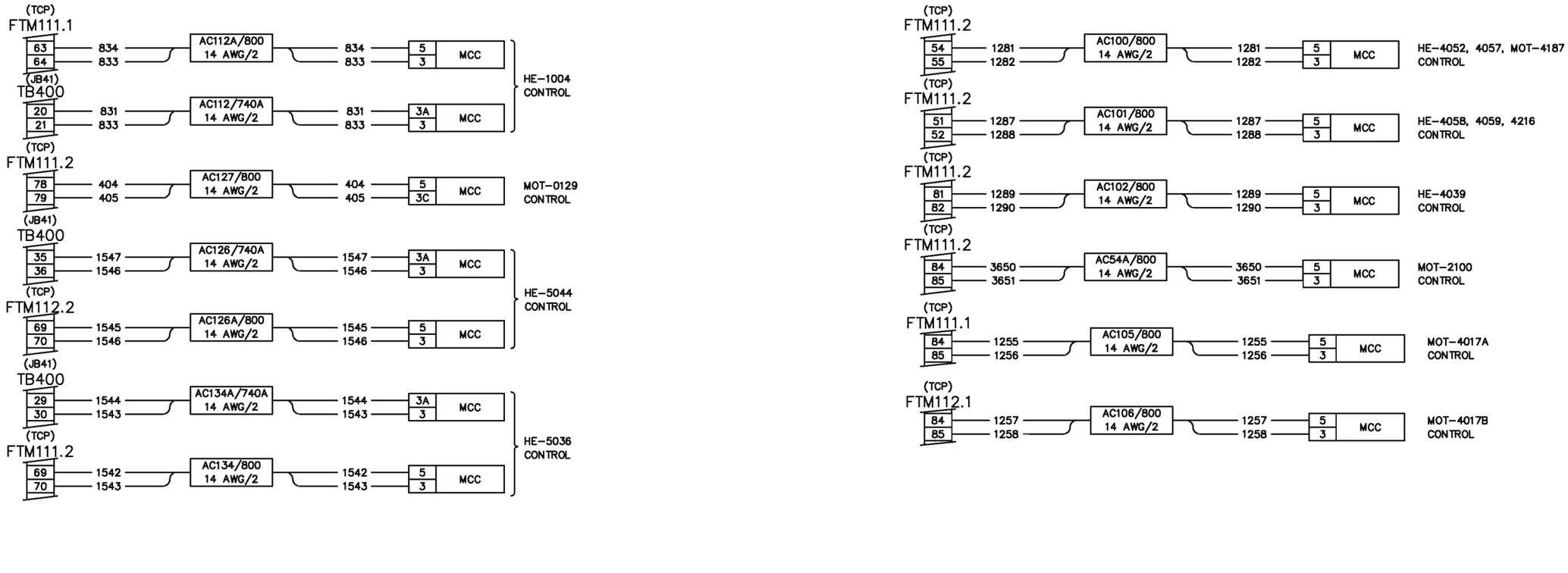
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DWG NO. 7253049-969007

REV. A

SCALE NONE

SHEET 17 OF 28



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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

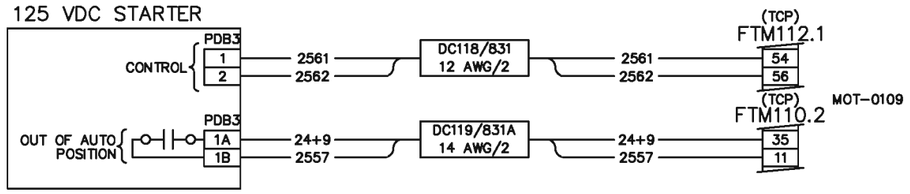
TITLE
INTERCONNECT WIRING DIAGRAM
CUSTOMER

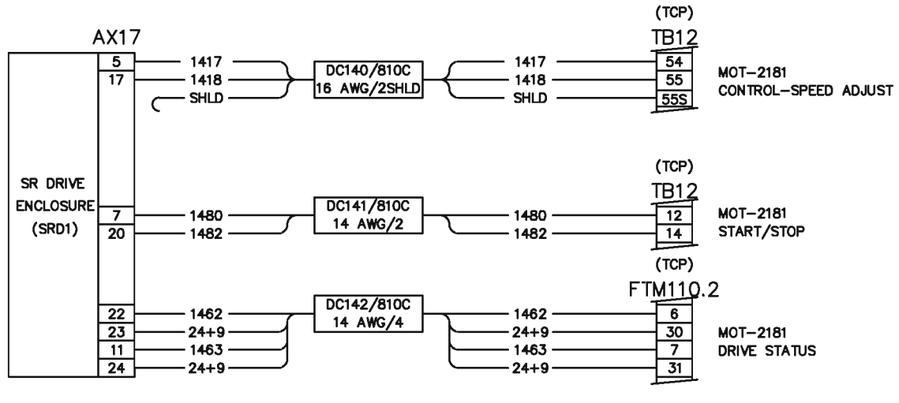
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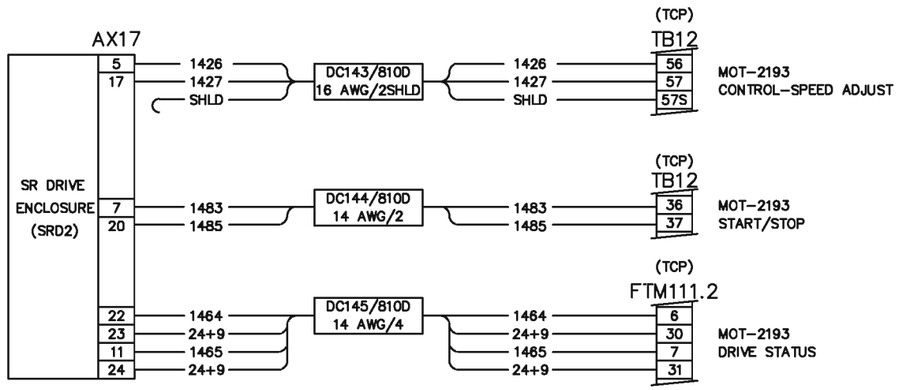
REV. A

SCALE NONE

SHEET 18 OF 28







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THIRD ANGLE PROJECTION

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DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

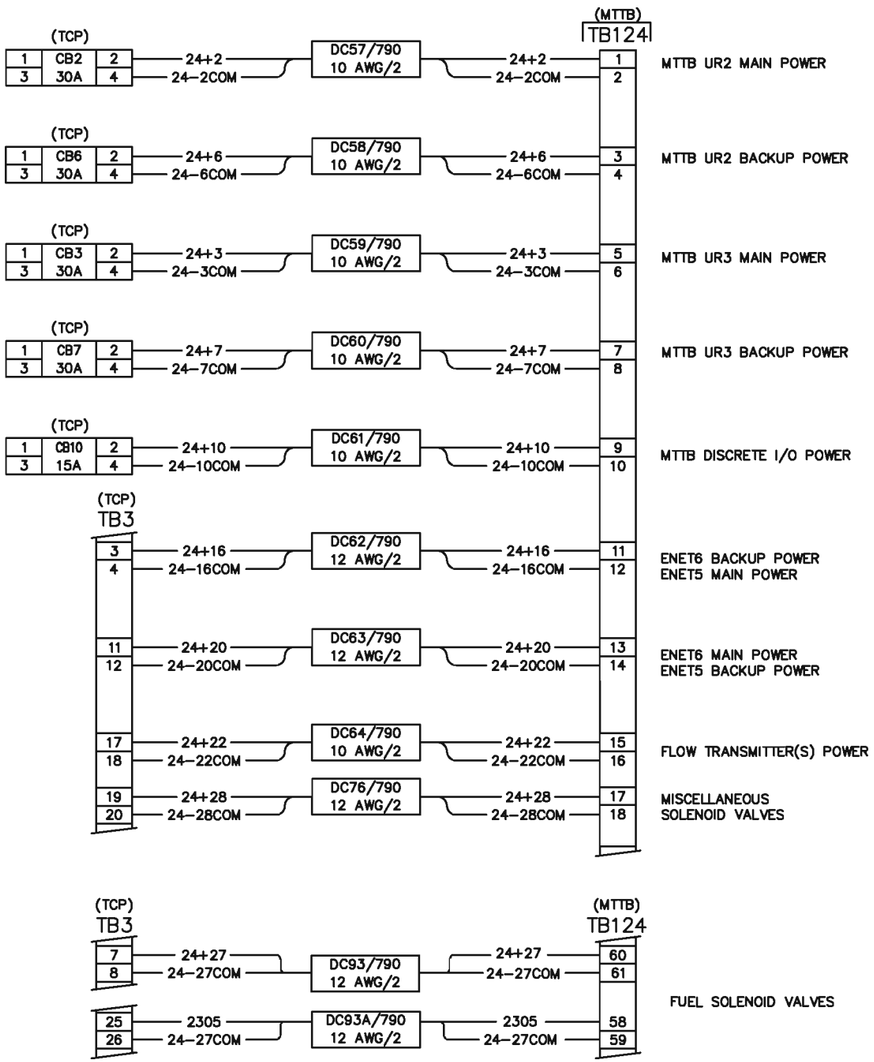
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CUSTOMER

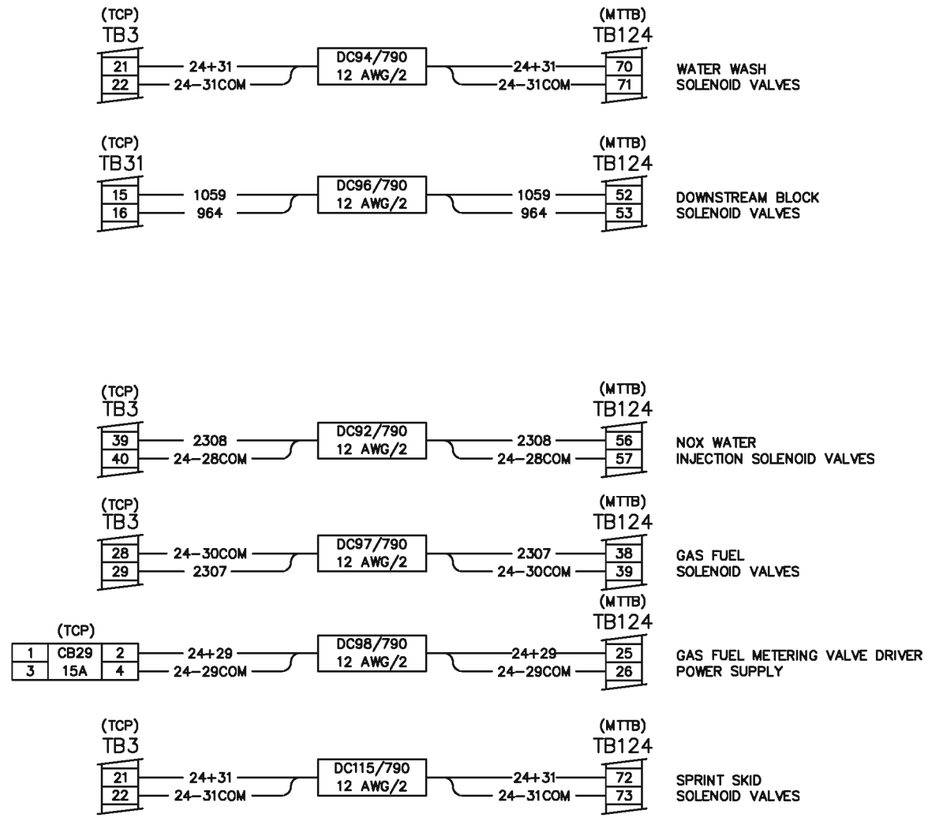
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

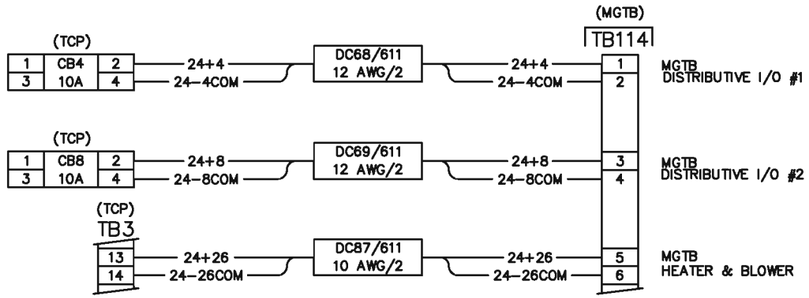
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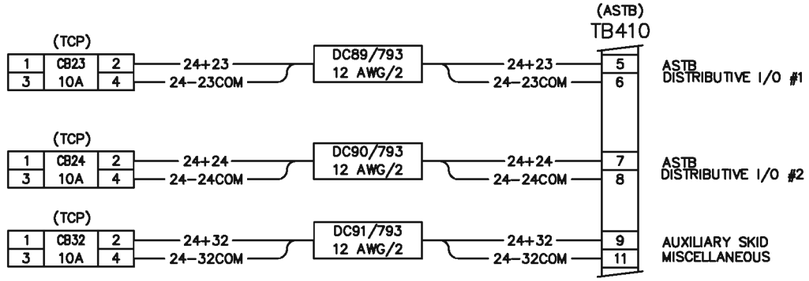
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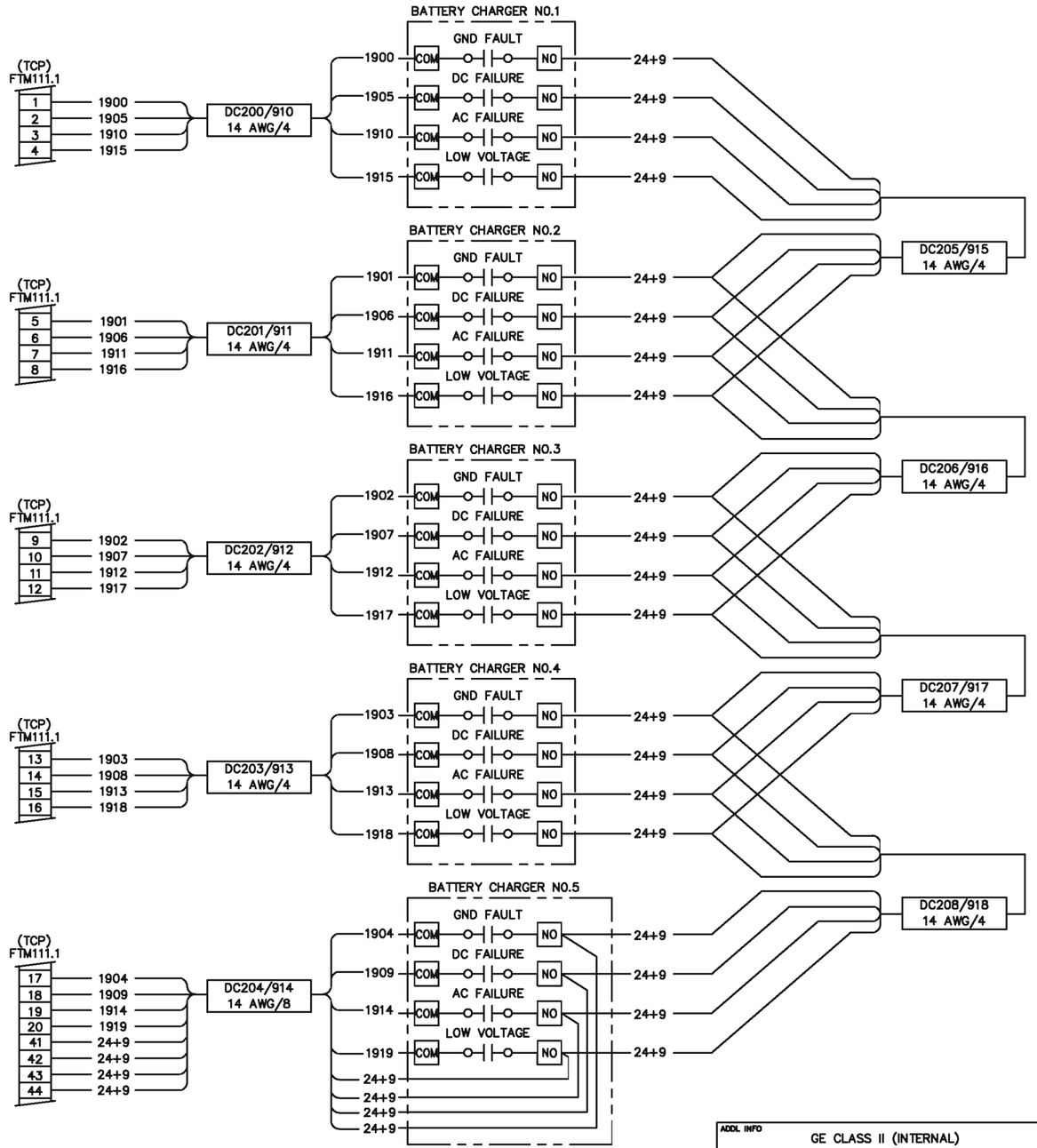
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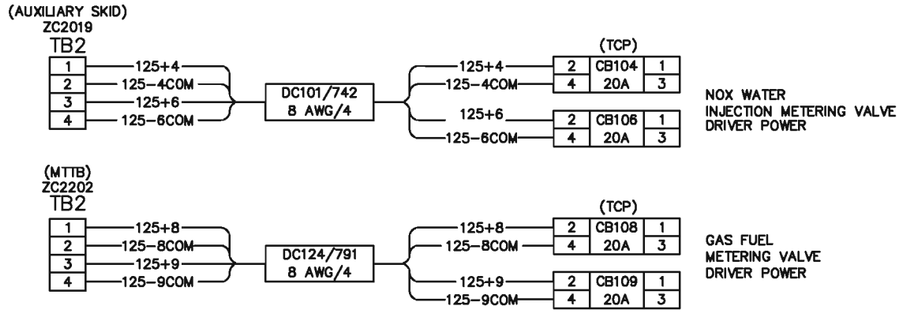
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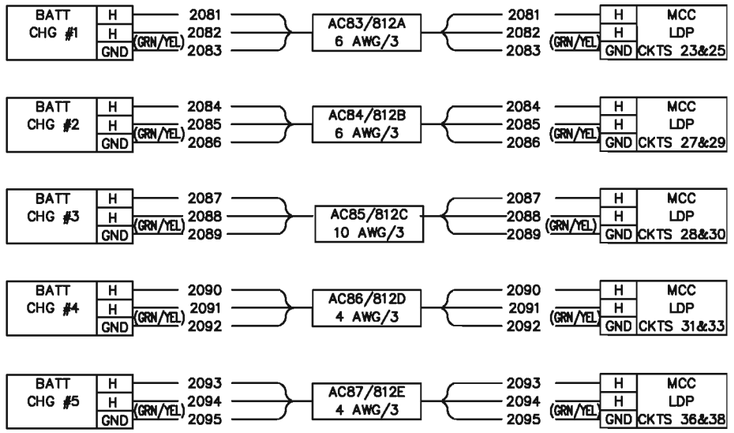
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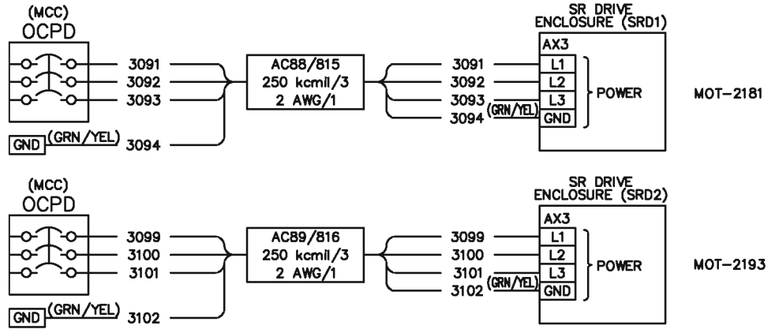
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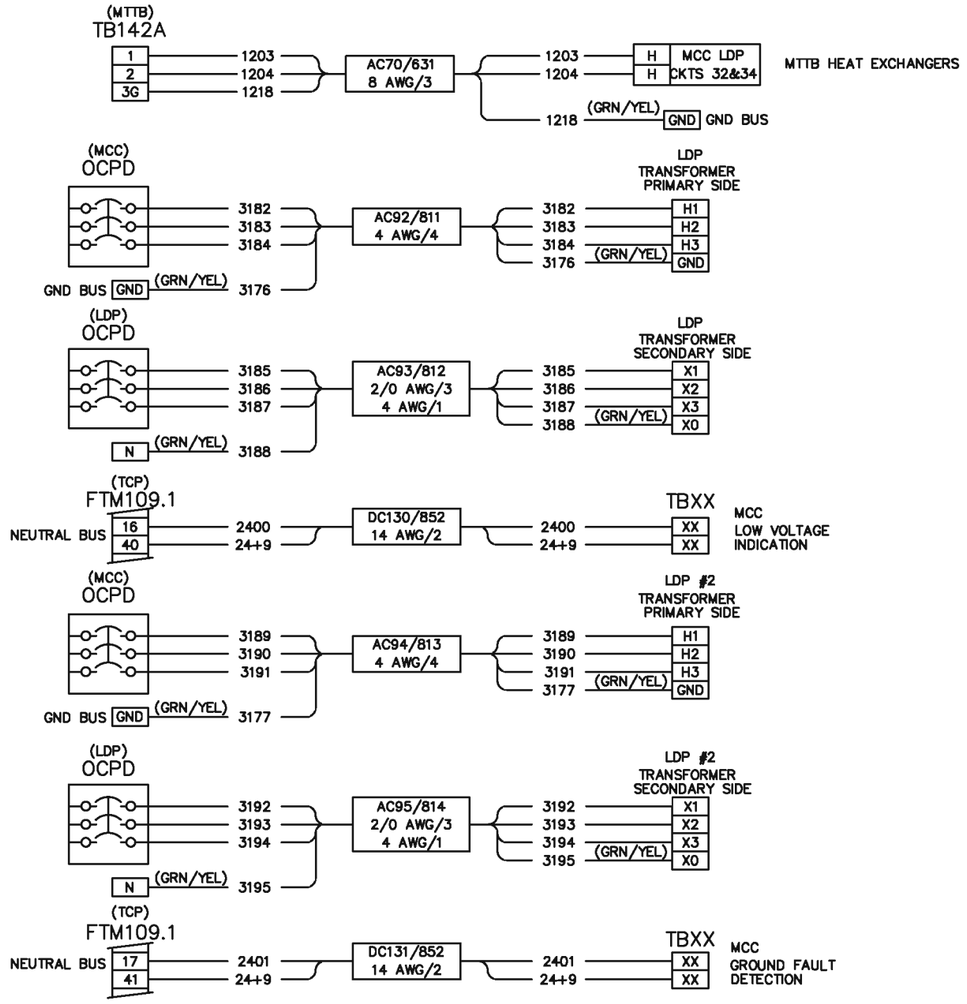
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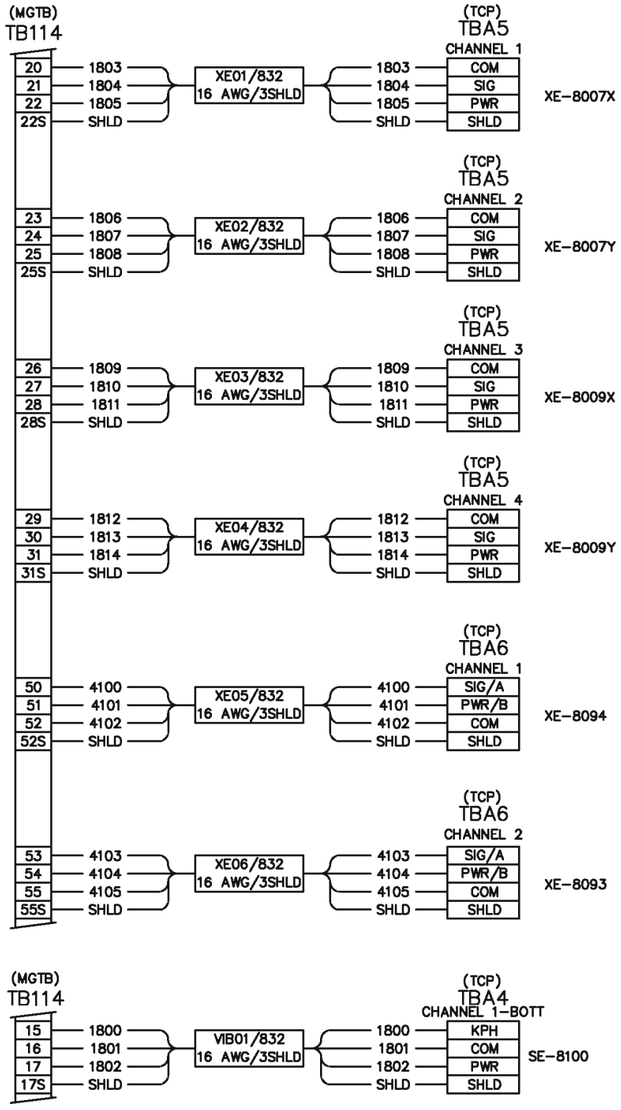
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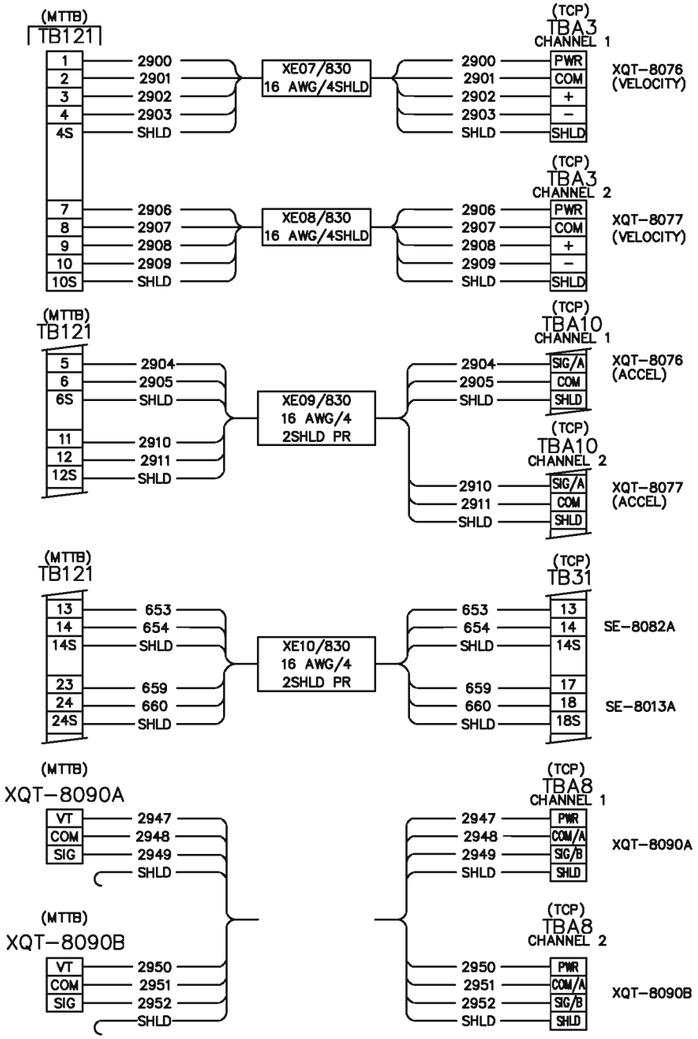
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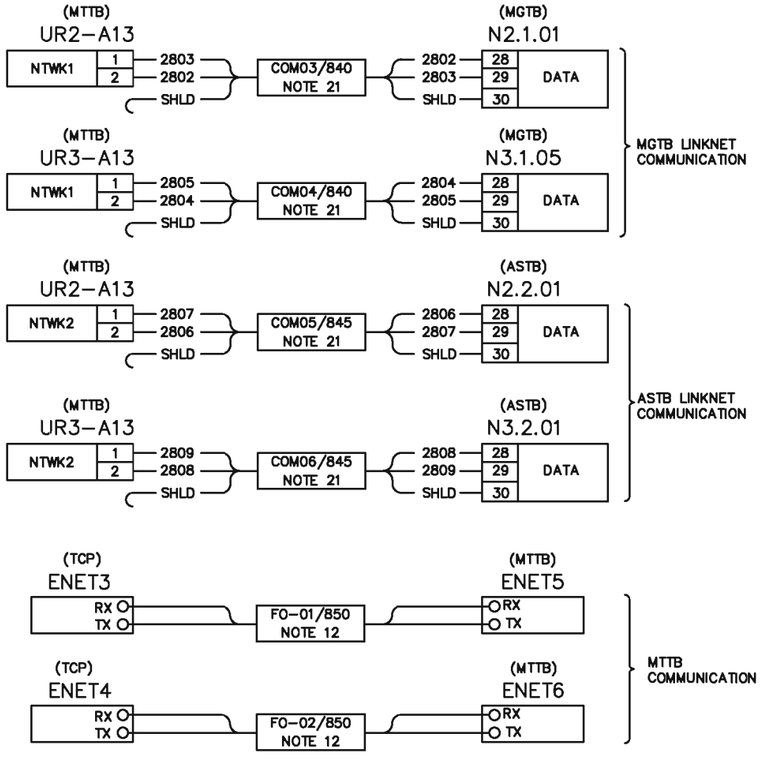
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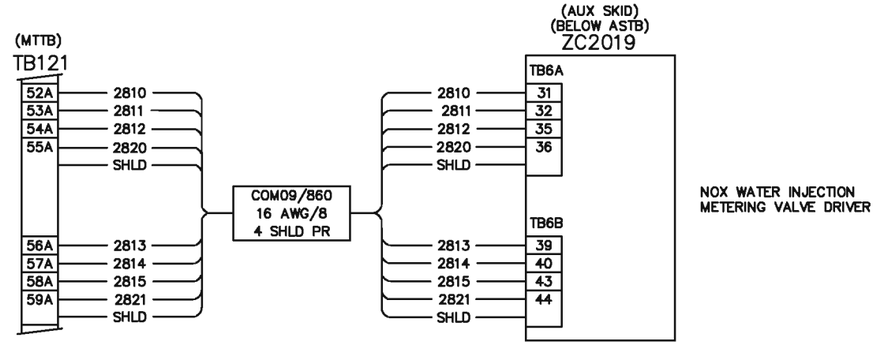
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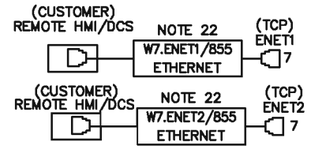
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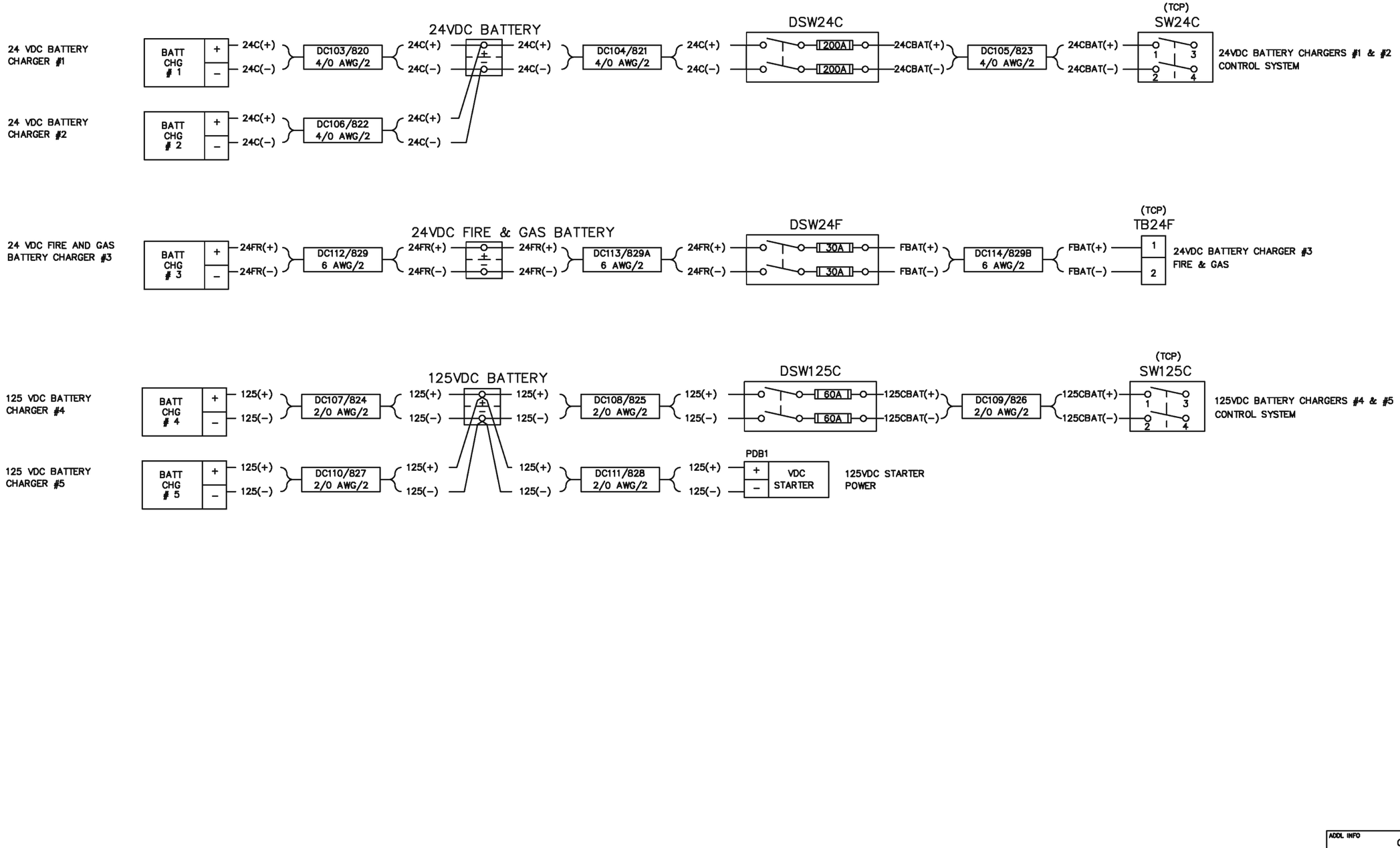
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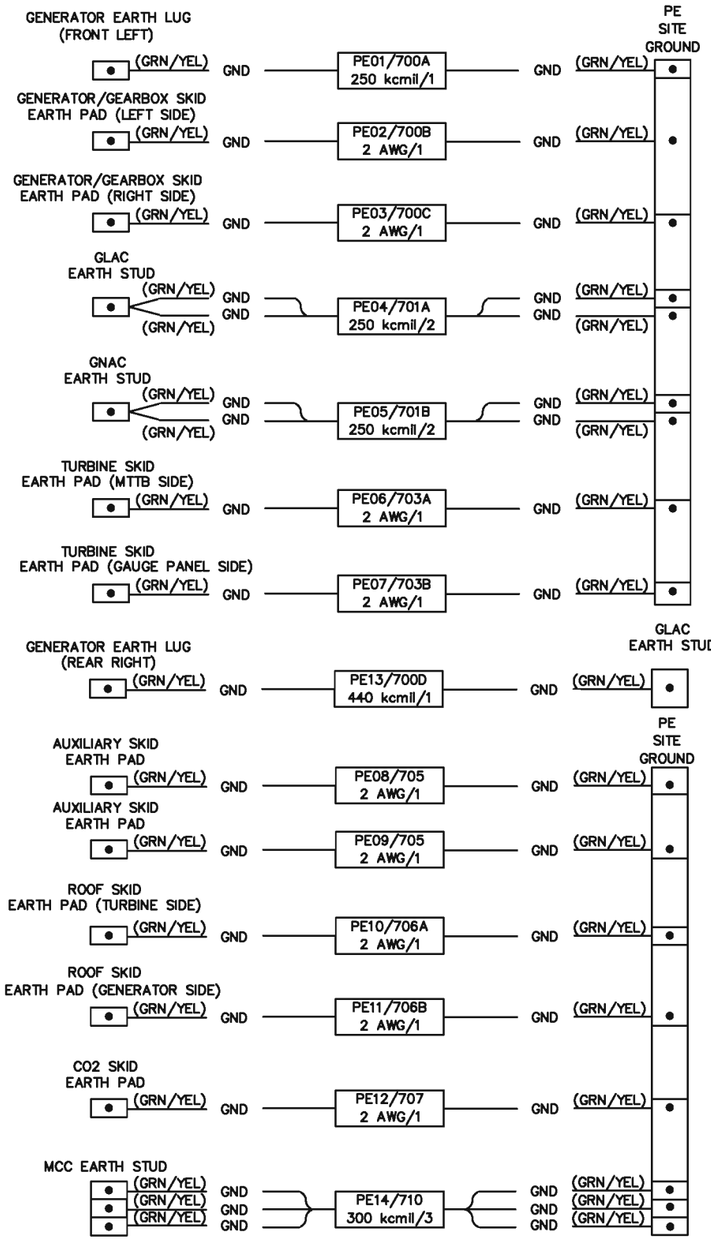
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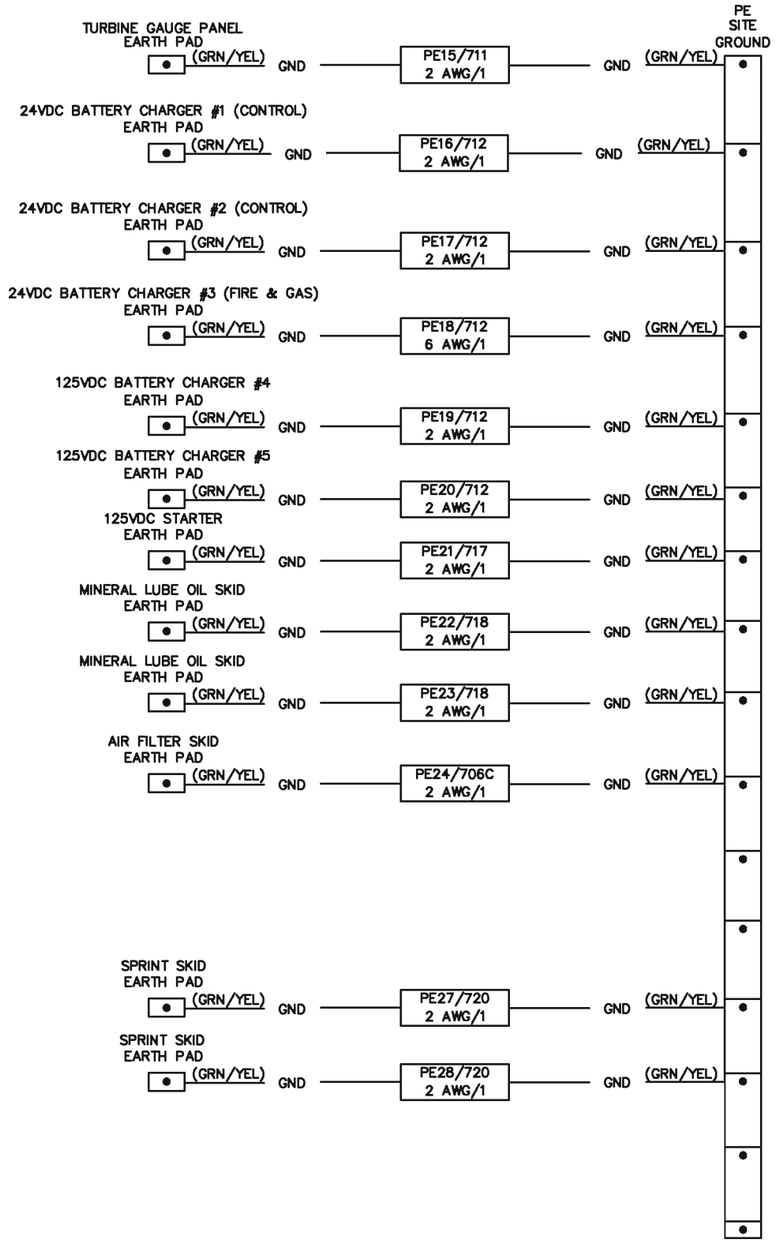
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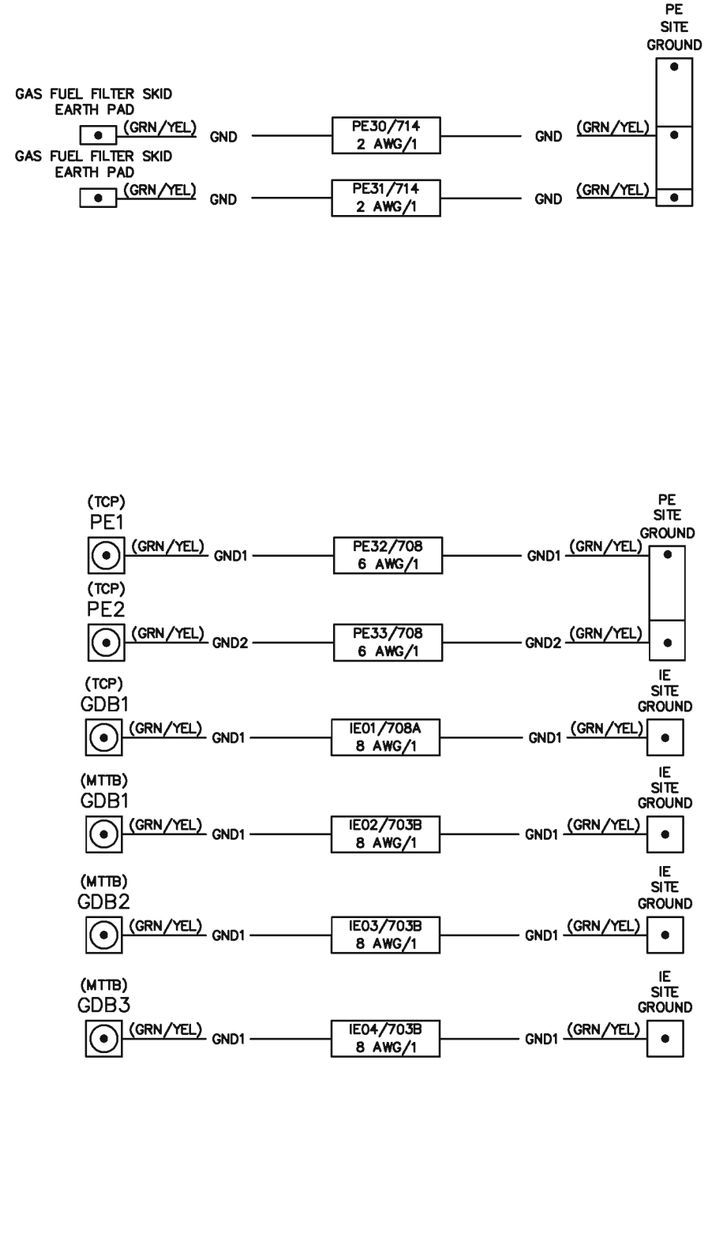
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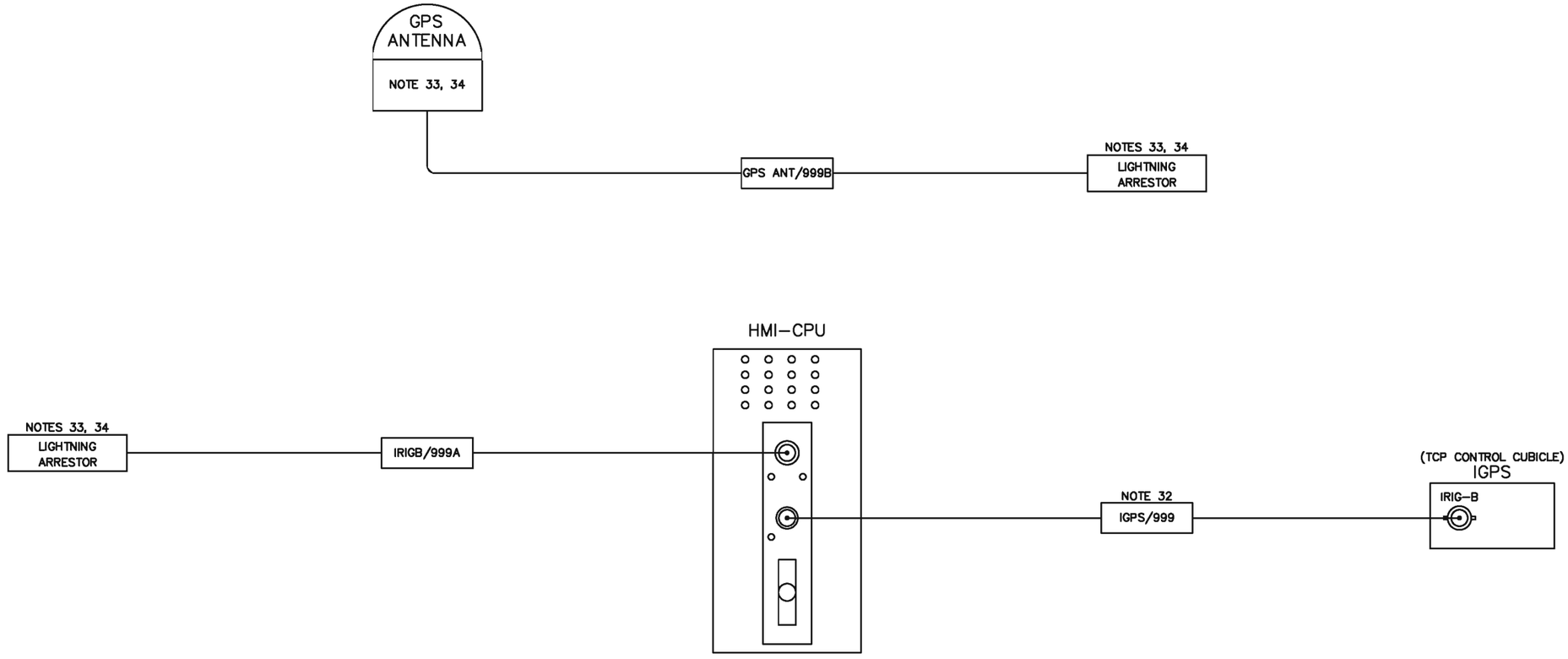
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NOTES:

1. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X=ORDER NUMBER.
2. THE WIRE SIZE SHOWN IS ESTIMATED MINIMUM SIZE BASED ON COPPER CONDUCTORS TYPE THW OR RHW INSULATION, OR EQUIVALENT, AND A LENGTH OF 100 ft [30.48 m]. ALL WIRE SHALL BE TWISTED STRANDED TYPE, SHIELDED (AS APPLICABLE), IN ACCORDANCE WITH THIS SCHEDULE.
3. THE CUSTOMER IS ADVISED TO MAKE ALLOWANCES TO LIMIT THE VOLTAGE DROPS TO 3% MAXIMUM, UNLESS OTHERWISE INDICATED.
4. CUSTOMER IS ADVISED TO PULL A MINIMUM OF 10% EXTRA WIRING FOR SPARES. ALL SPARE CONDUCTORS MUST BE GROUNDED ON BOTH ENDS. GROUND BARS TO BE ON CUSTOMER SCOPE OF SUPPLY AS REQUIRED
5. ALL CABLES, CABLE GLANDS & RACEWAYS ARE FURNISHED BY OTHERS, UNLESS OTHERWISE INDICATED.
   ALL CABLES AND CABLE GLANDS SHALL MEET THE IP/NEMA RATING OF THE TERMINATION BOX AND PANELS.
   A RACEWAY IS AN ENCLOSED CHANNEL DESIGNED TO HOLD CABLES, WIRES, BUS BARS.
   RACEWAYS SHOULD BE METALLIC OR NON-METALLIC MATERIAL AND CAN BE CONDUIT, CABLE TRAY, FLEXIBLE CONDUIT, UNDER GROUND DUCT.
   RACEWAYS THAT ARE METALLIC SHOULD BE BONDED THROUGH THEIR PERIMETER AND GROUNDED AT BOTH ENDS, AS A MINIMUM.
6. CUSTOMER TO ENSURE PROPER CABLE INSTALLATION AND SEPARATION BY SERVICE LEVEL IN ACCORDANCE TO THE FOLLOWING INDUSTRY STANDARDS OR EQUIVALENT:

   IEEE 422: IEEE GUIDE FOR THE DESIGN AND INSTALLATION OF CABLE SYSTEMS IN POWER GENERATING SYSTEMS.
   NFPA 70 (NEC): ARTICLE 300-310 CONDUCTORS OF DIFFERENT SYSTEMS.
   IEC 61000-5-2: EMC - INSTALLATION AND MITIGATION GUIDELINES, EARTHING AND CABLING.

   INSTRUMENTATION & CONTROL (24 VDC OR LESS) AND COMMUNICATION CABLES SHALL BE SEGREGATED FROM POWER CABLES IN ACCORDANCE TO THE FOLLOWING AIR GAP REQUIREMENT, AS A MINIMUM (BASED ON 100 M RUNS):
   75 TO 130 V: ENSURE 30 IN. [0.75 M] AIR GAP, LOW VOLTAGE.
   150 TO 230 V: ENSURE 60 IN. [1.5 M] AIR GAP, LOW VOLTAGE.
   380 TO 480 V: ENSURE 90 IN. [2.25 M] AIR GAP, LOW VOLTAGE.
   600 TO 15 KV: ENSURE 120 IN. [3 M] AIR GAP, MEDIUM VOLTAGE.

   IF SEGREGATION AIR GAP IS NOT POSSIBLE, METAL BARRIERS WITH GROUNDS TO BE ADDED BETWEEN CABLE RUNS.
   ALL CABLES SHOULD NOT BE BENT TO A RADIUS LESS THAN 8 TIMES THE OVERALL DIAMETER FOR NON-SHIELDED CABLES OR 12 TIMES THE OVERALL DIAMETER FOR SHIELDED CABLES.
   ALL CABLES SHALL BE RATED FOR ALL OF THE ENVIRONMENTAL CONDITIONS WHERE THEY ARE TO BE INSTALLED.
   WHEN METALLIC SHEATH ARMOR CABLES ARE USED, BOTH ENDS OF THE OUTER ARMOR SHOULD BE GROUNDED TO PE.
7. CABLES WITH THE SAME RACEWAY NUMBER AND SAME VOLTS MAY BE RUN IN MULTICONDUCTOR CABLE.
   MULTICONDUCTOR CABLES SHOULD HAVE OVERALL OUTER SHIELD AND SHIELD FOR EACH PAIR, TRIAD, QUAD, AS APPLICABLE.
8. ALL CABLES WITH DIFFERENT VOLTS CANNOT COEXIST IN THE SAME RACEWAY NUMBER.
9. ALL FIRE SYSTEM CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES IN ACCORDANCE WITH NFPA 70 (NEC) AND LOCAL JURISDICTION CODES.
10. ALL COMMUNICATION CABLES SHALL BE SEGREGATED FROM ALL OTHER CABLES AND NOT COMBINED WITH NON-COMMUNICATION CABLE RACEWAYS.
11. FOR INSTRUMENTATION CABLES THAT ARE INCORPORATED IN MULTICONDUCTOR CABLES, INDIVIDUAL SHIELDS MUST BE INCORPORATED AS INDICATED FOR EACH INDIVIDUAL PAIR, TRIAD, ETC.
    CABLES WITH SHIELDS SHALL HAVE THEIR SHIELD DRESSED OUT NO MORE THAN 1 IN. [25 mm].

12. NOT USED
13. USE CORNING OPTICAL FIBER CABLE NO. 006KSF-T4130D20 OR EQUAL W/INTEGRAL STAINLESS STEEL SC TYPE CONNECTOR ON BOTH ENDS OF THE CABLE, WHERE INDICATED.
14. TWISTED PAIR SHIELDED CABLE TO BE 22 AWG, TINNED COPPER, 8.8 pF/ft [28.86 pF/m], STRANDED, 150 V, 150 OHMS IMPEDANCE, BELDEN NO. 89182 OR EQUAL, WHERE INDICATED.
15. FOR 60 Hz NEC/CSA APPLICATIONS, AC WIRING COLORS SHALL BE PER NEC ARTICLE 200.
    STANDARD WIRING COLORS ARE RED, BLACK, BROWN FOR POWER PHASES AND WHITE FOR NEUTRAL.
    PE GROUND WIRING COLOR IS GREEN/YELLOW STRIPE, OR GREEN.
16. NOT USED
17. USE CAT5e SHIELDED ETHERNET CABLE W/RJ45 CONNECTORS, WHERE INDICATED.
18. CUSTOMER TO SUPPLY COAXIAL CABLE RG58/CU - 50 OHM WITH SMA AND BNC CONNECTORS AND MOLDED STRAIN RELIEF BOOTS WITH 300 FT [100 M] MAXIMUM LENGTH OR EQUAL.
19. MEDIUM VOLTAGE CABLES SHOULD BE SHIELDED. MEDIUM VOLTAGE CABLES SHOULD HAVE THEIR SHIELD CONNECTED AT ONE END ONLY TO PREVENT CABLE LOCAL HEATING.
    MEDIUM VOLTAGE CABLES OPERATING AT DIFFERENT VOLTAGE LEVELS SHOULD NOT OCCUPY THE SAME RACEWAY.

REFERENCE DRAWINGS:

X-969005 ELECTRICAL SYMBOLS, ABBREVIATIONS AND REFERENCE DATA
X-969006 INTERCONNECT PLAN, ELECTRICAL
X-969007 INTERCONNECT WIRING DIAGRAM, CUSTOMER

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SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
1	720	AC33	12 AWG	4		ROOF SKID	MOTOR WIRING BOX	MCC		1.5 A	480 VAC		X			MOT-1083 POWER
1	772	AC62	4/0 AWG 2 AWG	3 1		ROOF SKID	MOTOR WIRING BOX	MCC		143.0 A	480 VAC		X			MOT-4017A POWER
1	772A	AC63	12 AWG	2		ROOF SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-4017A HEATER
1	773	AC64	4/0 AWG 2 AWG	3 1		ROOF SKID	MOTOR WIRING BOX	MCC		143.0 A	480 VAC		X			MOT-4017B POWER
1	773A	AC65	12 AWG	2		ROOF SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-4017B HEATER
1A	770	AC58	3/0 AWG 4 AWG	3 1		ROOF SKID	MOTOR WIRING BOX	MCC		116.0 A	480 VAC		X			MOT-4103A POWER
1A	770A	AC59	12 AWG	2		ROOF SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-4103A HEATER
1A	771	AC60	3/0 AWG 4 AWG	3 1		ROOF SKID	MOTOR WIRING BOX	MCC		116.0 A	480 VAC		X			MOT-4103B POWER
1A	771A	AC61	12 AWG	2		ROOF SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-4103B HEATER
2	740	AC39	12 AWG	4		JB41	TB400	MCC		3.6 A	480 VAC		X			HE-6010 POWER
2	740	AC40	400 kcmil 1/0 AWG	3 1		AUXILIARY SKID	MOTOR WIRING BOX	MCC		222 A	480 VAC		X			MOT-6015 POWER
2	740	AC42	12 AWG	4		AUXILIARY SKID	MOTOR WIRING BOX	MCC		3.9 A	480 VAC		X			MOT-6016 POWER
2	740	AC43	12 AWG	4		JB41	TB400	MCC		3.6 A	480 VAC		X			HE-1004 POWER
2	740	AC44	12 AWG	4		AUXILIARY SKID	MOTOR WIRING BOX	MCC		6.2 A	480 VAC		X			MOT-5035 POWER
2	740	AC47	12 AWG	4		AUXILIARY SKID	MOTOR WIRING BOX	MCC		1.5 A	480 VAC		X			MOT-4027A POWER
2	740	AC48	12 AWG	4		AUXILIARY SKID	MOTOR WIRING BOX	MCC		1.5 A	480 VAC		X			MOT-4027B POWER
2	740	AC49	10 AWG	4		JB41	TB400	MCC		10.8 A	480 VAC		X			HE-5036 POWER
2	740	AC50	10 AWG	4		JB41	TB400	MCC		10.8 A	480 VAC		X			HE-5044 POWER
2	740A	AC41	12 AWG	2		AUXILIARY SKID	MOTOR WIRING BOX	MCC		1.25 A	120 VAC		X			MOT-6015 HEATER
2	740A	AC45	12 AWG	2		AUXILIARY SKID	MOTOR WIRING BOX	MCC		0.6 A	120 VAC		X			MOT-5035 HEATER
2	740A	AC112	14 AWG	2		JB41	TB400	MCC		1.0 A	120 VAC		X			HE-1004 CONTROL
2	740A	AC114	14 AWG	2		JB41	TB400	MCC		1.0 A	120 VAC		X			HE-6010 CONTROL
2	740A	AC126	14 AWG	2		JB41	TB400	MCC		1.0 A	120 VAC		X			HE-5044 CONTROL
2	740A	AC134A	14 AWG	2		JB41	TB400	MCC		1.0 A	120 VAC		X			HE-5036 CONTROL
2A	740B	AC46	12 AWG	3		JB41	TB400	LDP	CKT3	2.5 A	120 VAC		X			AUXILIARY SKID ENCLOSURE LIGHTING
4	700	TE13	16 AWG	6	2 SHLD TRI	JB11A	TB1	MGTB	N3.1.04	2 mA	24 VDC		X			TE-4085A1, TE-4083A1
4	700	TE15	16 AWG	3	SHLD	JB11A	TB1	MGTB	N3.1.04	2 mA	24 VDC		X			TE-4082A1
4	700	DC33	16 AWG	2	SHLD	JB11A	TB1	MGTB	N2.1.03	4-20 mA	24 VDC		X			PDT-4004
4	700	DC36	16 AWG	4	2 SHLD PR	JB11A	TB1	MGTB	N3.1.02, N2.1.03	4-20 mA	24 VDC		X			PDT-4005A, PDT-4005B
4	700	DC35	16 AWG	4	2 SHLD PR	JB11A	TB1	MGTB	N2.1.03	10 mA	24 VDC		X			MT-4000, TT-4000
4	710	TE14	16 AWG	6	2 SHLD TRI	JB11B	TB1	MGTB	N2.1.07	2 mA	24 VDC		X			TE-4086A1, TE-4084A1
6	680	AC12	8 AWG	4		JB45	TB145	MCC		18.0 A	480 VAC		X			HE-0105 POWER
6	680	AC13	8 AWG	4		JB45	TB145	MCC		18.0 A	480 VAC		X			HE-0106 POWER
6	680	AC14	12 AWG	4		JB45	TB145	MCC		3.9 A	480 VAC		X			MOT-0110 POWER
6	680	AC15	4 AWG	4		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	MCC		47.0 A	480 VAC		X			MOT-0108A POWER
6	680	AC17	4 AWG	4		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	MCC		47.0 A	480 VAC		X			MOT-0108B POWER
6	680A	AC16	12 AWG	2		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-0108A HEATER
6	680A	AC18	12 AWG	2		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	MCC		1.3 A	120 VAC		X			MOT-0108B HEATER
6	680A	AC110	14 AWG	4		JB45	TB145	MCC		1.0 A	120 VAC		X			HE-0105 CONTROL
6	680A	AC111	14 AWG	4		JB45	TB145	MCC		1.0 A	120 VAC		X			HE-0106 CONTROL
6A	902	AC165	12 AWG	3		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	125 VDC STARTER		0.5 A	208 VAC		X			MOT-0109 HEATER
7	690	TE10	16 AWG	6	2 SHLD TRI	JB44	TB144	MGTB	N2.1.08, N3.1.08	2 mA	24 VDC		X			TE-0136A1/A2
7	690	TE11	16 AWG	3	SHLD	JB44	TB144	MGTB	N2.1.08	2 mA	24 VDC		X			TE-0138A1
7	690	DC28A	16 AWG	2	SHLD	JB44	TB144	MGTB	N3.1.01	4-20 mA	24 VDC		X			PDT-0130

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SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
7	690	DC28B	16 AWG	2	SHLD	JB44	TB144	MGTB	N3.1.02	4-20 mA	24 VDC		X			PT-0121
7	690	DC28C	16 AWG	2	SHLD	JB44	TB144	MGTB	N2.1.03	4-20 mA	24 VDC		X			PT-0122
7	690	DC28D	16 AWG	2	SHLD	JB44	TB144	MGTB	N3.1.03	4-20 mA	24 VDC		X			PT-0123
7	690	DC28E	16 AWG	2	SHLD	JB44	TB144	MGTB	N3.1.03	4-20 mA	24 VDC		X			PDT-0124
7	690	DC28F	16 AWG	2	SHLD	JB44	TB144	MGTB	N2.1.01	4-20 mA	24 VDC		X			LT-0135A
7	690	DC28G	16 AWG	2	SHLD	JB44	TB144	MGTB	N3.1.01	4-20 mA	24 VDC		X			LT-0135B
8	793	DC45	12 AWG	4		TCP	TB11	ASTB	TB410		24 VDC		X			ESAS E-STOP
8	793	DC89	12 AWG	2		TCP	CB23	ASTB	TB410	10.0 A	24 VDC		X			ASTB DISTRIBUTIVE I/O #1
8	793	DC90	12 AWG	2		TCP	CB24	ASTB	TB410	10.0 A	24 VDC		X			ASTB DISTRIBUTIVE I/O #2
8	793	DC91	12 AWG	2		TCP	CB32	ASTB	TB410	10.0 A	24 VDC		X			AUXILIARY SKID MISCELLANEOUS
10	625	DC122	16 AWG	2	SHLD	MTTB	FTM303.2	ZSC-2060	GUAT & TERM	0.1 A	24 VDC		X			ZSC-2060
10	625	DC123	16 AWG	2	SHLD	MTTB	FTM303.2	ZSC-2061	GUAT & TERM	0.1 A	24 VDC		X			ZSC-2061
10	625	DC85	12 AWG	2	SHLD	MTTB	TB120	OFF TURBINE SKID	SOV-2060	1.3 A	24 VDC		X			SOV-2060
10	625	DC86	12 AWG	2	SHLD	MTTB	TB120	OFF TURBINE SKID	SOV-2061	1.3 A	24 VDC		X			SOV-2061
12	611	DC23	12 AWG	3		MGTB	TB114	TCP	TB11	0.1 A	24 VDC		X			ESGR1/ESGR2
12	611	DC24	12 AWG	2		MGTB	TB114	TCP	TB11	0.1 A	24 VDC		X			ESGR1/ESGR2
12	611	DC68	12 AWG	2		MGTB	TB114	TCP	CB4	10.0 A	24 VDC		X			MGTB DISTRIBUTIVE I/O #1
12	611	DC69	12 AWG	2		MGTB	TB114	TCP	CB8	10.0 A	24 VDC		X			MGTB DISTRIBUTIVE I/O #2
12	611	DC87	10 AWG	2		MGTB	TB114	TCP	TB3	10.0 A	24 VDC		X			MGTB HEATER & BLOWER
12	651	RG1	16 AWG	3	SHLD	MGTB	TB114	TCP	TB31	0.5 A	120 VAC		X			GENERATOR ROTOR GROUND FAULT
14	760	DC51	16 AWG	2	SHLD	JB65	TB165	MTTB	FTM203.1	4-20 mA	24 VDC		X			FCV-2104
14	760	DC52	16 AWG	2	SHLD	JB65	TB165	MTTB	FTM203.1	4-20 mA	24 VDC		X			PT-2101
14	760	DC53	16 AWG	2	SHLD	JB65	TB165	MTTB	FTM203.1	4-20 mA	24 VDC		X			FT-2105
14	760	DC54	16 AWG	2	SHLD	JB65	TB165	MTTB	FTM203.1	4-20 mA	24 VDC		X			PDT-2108
14	760	TE16	16 AWG	3	SHLD	JB65	TB165	MTTB	FTM205.2	10 mA	24 VDC		X			TE-2102A1
14	760A	DC51A	12 AWG	2		JB65	TB165	MTTB	TB124	0.8 A	24 VDC		X			FCV-2104 POWER
14	760A	DC55	12 AWG	2		JB65	TB165	MTTB	TB120	2.0 A	24 VDC		X			SOV-2174
14	760A	DC56	12 AWG	2		JB65	TB165	MTTB	TB120	1.1 A	24 VDC		X			SOV-2107
15	761	AC53	10 AWG	4		SPRINT SKID	MOTOR WIRING BOX	MCC		12.7 A	480 VAC		X			MOT-2100 POWER
15	763	AC168	10 AWG	2		SPRINT SKID		MCC		2.0 A	208 VAC		X			ENCLOSURE DAMPERS
15	761A	AC54	12 AWG	2		SPRINT SKID	MOTOR WIRING BOX	MCC		1.0 A	120 VAC		X			MOT-2100 HEATER
16	800	AC103	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-4103A CONTROL
16	800	AC104	14 AWG	2		TCP	FTM112.1	MCC		1.0 A	120 VAC		X			MOT-4103B CONTROL
16	800	AC105	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-4017A CONTROL
16	800	AC106	14 AWG	2		TCP	FTM112.1	MCC		1.0 A	120 VAC		X			MOT-4017B CONTROL
16	800	AC110A	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			HE-0105 CONTROL
16	800	AC111A	14 AWG	2		TCP	FTM112.2	MCC		1.0 A	120 VAC		X			HE-0106 CONTROL
16	800	AC112A	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			HE-1004 CONTROL
16	800	AC113	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			HE-4050, 4051 CONTROL
16	800	AC114A	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			HE-6010 CONTROL
16	800	AC115	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-1083 CONTROL
16	800	AC116	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			MOT-5035 CONTROL
16	800	AC117	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-4027A CONTROL
16	800	AC118	14 AWG	2		TCP	FTM112.1	MCC		1.0 A	120 VAC		X			MOT-4027B CONTROL
16	800	AC119	14 AWG	2		TCP	FTM112.2	MCC		1.0 A	120 VAC		X			MOT-0085 CONTROL
16	800	AC120	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-6015 CONTROL
16	800	AC121	14 AWG	2		TCP	FTM109.2	MCC		1.0 A	120 VAC		X			MOT-6015 CONTROL
16	800	AC122	14 AWG	2		TCP	FTM111.1	MCC		1.0 A	120 VAC		X			MOT-6016 CONTROL
16	800	AC123	14 AWG	2		TCP	FTM112.2	MCC		1.0 A	120 VAC		X			MOT-0108A CONTROL
16	800	AC124	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			MOT-0110 CONTROL
16	800	AC125	14 AWG	2		TCP	FTM112.1	MCC		1.0 A	120 VAC		X			MOT-0108B CONTROL
16	800	AC126A	14 AWG	2		TCP	FTM112.2	MCC		1.0 A	120 VAC		X			HE-5044 CONTROL
16	800	AC127	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			MOT-0129 CONTROL
16	800	AC134	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			HE-5036 CONTROL
16	800	AC54A	14 AWG	2		TCP	FTM111.2	MCC		1.0 A	120 VAC		X			MOT-2100 CONTROL
17	650	AC08	10 AWG	2		TCP	TB12	JB7	TB116	6.4 A	48 VDC		X			MAIN EXCITER FIELD
17	650	AC09	10 AWG	3		TCP	TB12	JB7	TB116	3.5 A	264 VAC		X			PMG
18	610	DC14	12 AWG	2		TCP	TB11	MTTB	TB124	0.1 A	24 VDC		X			ESTR1/ESTR2
18	610	DC15	12 AWG	3		TCP	TB11	MTTB	TB124	0.1 A	24 VDC		X			ESTR1/ESTR2
18	790	DC57	10 AWG	2		TCP	CB2	MTTB	TB124	15.0 A	24 VDC		X			MTTB UR2 MAIN POWER
18	790	DC58	10 AWG	2		TCP	CB6	MTTB	TB124	15.0 A	24 VDC		X			MTTB UR2 BACKUP POWER
18	790	DC59	10 AWG	2		TCP	CB3	MTTB	TB124	15.0 A	24 VDC		X			MTTB UR3 MAIN POWER
18	790	DC60	10 AWG	2		TCP	CB7	MTTB	TB124	15.0 A	24 VDC		X			MTTB UR3 BACKUP POWER
18	790	DC61	10 AWG	2		TCP	CB10	MTTB	TB124	15.0 A	24 VDC		X			MTTB DISCRETE I/O POWER
18	790	DC62	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			ENET5 MAIN POWER, ENET6 BACKUP POWER
18	790	DC63	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			ENET5 BACKUP POWER, ENET6 MAIN POWER
18	790	DC64	10 AWG	2		TCP	TB3	MTTB	TB124	15.0 A	24 VDC		X			FLOW TRANSMITTER(S) POWER
18	790	DC92	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			NOX WATER INJ. SOLENOID VALVES
18	790	DC93	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			FUEL SOLENOID VALVES
18	790	DC93A	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			FUEL SOLENOID VALVES
18	790	DC94	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			WATER WASH SOLENOID VALVES
18	790	DC96	12 AWG	2		TCP	TB31	MTTB	TB124	10.0 A	24 VDC		X			DOWNSTREAM BLOCK SOLENOID VALVES
18	790	DC97	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			GAS FUEL SOLENOID VALVES
18	790	DC98	12 AWG	2		TCP	CB29	MTTB	TB124	10.0 A	24 VDC		X			GAS FUEL METERING DRIVER POWER SUPPLY
18	790	DC115	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			SPRINT SKID SOLENOID VALVES
18	790	DC76	12 AWG	2		TCP	TB3	MTTB	TB124	10.0 A	24 VDC		X			MISCELLANEOUS SOLENOID VALVES
18A	631	AC03A	12 AWG	2	SHLD	TCP	TB12	JB30	TB119	7.0 A	120VAC		X			IGNITORS
19	670	DC18	12 AWG	4		TCP	TB12	SWGR	TBXX	0.1 A	24 VDC		X			GENERATOR CIRCUIT BREAKER (52G)
19	670	DC19	12 AWG	4		TCP	TB11	SWGR	TBXX	0.1 A	24 VDC		X			GENERATOR CIRCUIT BREAKER (52G)
19	670	DC20	12 AWG	4		TCP	TB11	SWGR	TBXX	0.1 A	24 VDC		X			UTILITY CIRCUIT BREAKER (52U)
19	670	DC21	12 AWG	4		TCP	TB12	SWGR	TBXX	0.1 A	24 VDC		X			UTILITY CIRCUIT BREAKER (52U)
19	670	DC22	12 AWG	4		TCP	TB11	SWGR	TBXX	0.1 A	24 VDC		X			86 TRIP / GEN BREAKER FAILURE

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GE PACKAGED POWER, L.P.

SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
19	670	DC75	12 AWG	2		TCP	TB11	SWGR	TBXX	0.1 A	24 VDC		X			LOSS OF DC POWER ON SYSTEM
19	670	DC25	12 AWG	2		TCP	TB11	SWGR	TBXX	0.1 A	24 VDC		X			GENERATOR CIRCUIT BREAKER (52G) ZONE TRIP
20	852	DC130	14 AWG	2		TCP	FTM109.1	MCC	TBXX	0.1 A	24 VDC		X			LOW VOLTAGE INDICATION
21	620	DC80	16 AWG	2	SHLD	JB82	TB82	TCP	FTM104.1	4-20 mA	24 VDC		X			PDT-2063
21	620	DC81	16 AWG	2	SHLD	JB82	TB82	TCP	FTM103.1	4-20 mA	24 VDC		X			LT-2118
21	620	DC82	16 AWG	2	SHLD	JB82	TB82	TCP	FTM104.1	4-20 mA	24 VDC		X			LT-2123
21	620	DC83	16 AWG	2	SHLD	JB82	TB82	TCP	FTM103.1	4-20 mA	24 VDC		X			LT-2119
21	620	DC84	16 AWG	2	SHLD	JB82	TB82	TCP	FTM104.1	4-20 mA	24 VDC		X			LT-2124
22	625A	DC120	16 AWG	2		OFF TURBINE SKID	ZSC-2061	ZSC-2061	GUAT & TERM	0.1 A	24 VDC		X			ZSC-2061
22	625A	DC121	16 AWG	2		OFF TURBINE SKID	ZSC-2060	ZSC-2060	GUAT & TERM	0.1 A	24 VDC		X			ZSC-2060
23	630	CT01	10 AWG	4		JB104	STB104	TCP	STB21	5.0 A	120 VAC		X			GENERATOR PROTECTION NEUTRAL CURRENT
23	630	CT03	10 AWG	4		JB104	STB104	TCP	STB21	5.0 A	120 VAC		X			GENERATOR CROSS CURRENT COMPENSATION
23	630	CT04	10 AWG	4		JB104	STB104	TCP	STB21	5.0 A	120 VAC		X			GENERATOR PROTECTION NEUTRAL CURRENT
23	630	CT06	10 AWG	4		JB104	STB104	TCP	STB21	5.0 A	120 VAC		X			GENERATOR CURRENT(METERING & PROTECTION)
23	640	AC04	10 AWG	2		JB104	TB104	TCP	TB12	0.5 A	240 VAC		X			GROUNDING TRANSFORMER RESISTOR
23A	641	CT02	10 AWG	4		SWGR	STBXX	TCP	STB21	5.0 A	120 VAC		X			GENERATOR PROTECTION LINE CURRENT
23A	642	CT05	10 AWG	4		SWGR	TBXX	TCP	STB21	5.0 A	120 VAC		X			GENERATOR PROTECTION LINE CURRENT
23A	643	AC05	10 AWG	2		SWGR	TBXX	TCP	TB12	0.5 A	120 VAC		X			UTILITY VOLTS (METERING)
23A	643	AC07A	12 AWG	2		SWGR	TBXX	TCP	TB12	0.5 A	120 VAC		X			BUS VOLTS(METERING & PROTECTION)
23B	640	AC06	12 AWG	5		JB105	TB105	TCP	TB12	0.5 A	120 VAC		X			GENERATOR VOTS (VOLTAGE REGULATOR)
23B	640	AC07	12 AWG	3		JB105	TB105	TCP	TB12	0.5 A	120 VAC		X			GENERATOR VOLTS(METERING & PROTECTION)
23B	641	CT02	10 AWG	4		JB105	STB105	TCP	STB21	5.0 A	120 VAC		X			GENERATOR PROTECTION LINE CURRENT
24	660	AC22	12 AWG	3		JB7	TB115	MCC		6.6 A	480 VAC		X			HE-4050/4051 POWER
24	660	AC23	8 AWG	4		JB7	TB115	MCC		20.0 A	480 VAC		X			MOT-0085 POWER
24	660	AC140	6 AWG	4		JB7	TB115	MCC		36.5 A	480 VAC		X			MOT-0129 POWER
24	660A	AC23A	12 AWG	2		JB7	TB116	MCC		0.5 A	120 VAC		X			MOT-0085 HEATER
24	660A	AC141	12 AWG	2		JB7	TB116	MCC		0.5 A	120 VAC		X			MOT-0129 HEATER
24A	661	AC20	12 AWG	3		JB7	TB116	LDP	CKT 14	7.5 A	120 VAC		X			GENERATOR/GEARBOX ENCLOSURE LIGHTS
24A	661	AC21	12 AWG	3		JB7	TB116	LDP	CKT 5	15.0 A	120 VAC		X			GENERATOR/GEARBOX ENCLOSURE RECEPTACLE
24A	661	AC146	12 AWG	3		JB7	TB116	LDP	CKT 10	15.0 A	120 VAC		X			
29	671	DC27	14 AWG	29		TCP	TB11	CUSTOMER DCS	TBXX	0.5 A	24 VDC		X			CUSTOMER CONTROL SIGNALS
29	671	DC27A	16 AWG	2	SHLD	TCP	FTM103.1	CUSTOMER DCS	TBXX	4-20 mA	24 VDC		X			CUSTOMER CONTROL SIGNALS
30	811	AC92	4 AWG	4		XFMR	45 kVA	MCC		60.0 A	480 VAC		X			45 kVA TRANSFORMER POWER

GE PACKAGED POWER, L.P.

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SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
31	812	AC93	2/0 AWG 4 AWG	3 1		XFMR	45 kVA	LDP		125.0 A	120 VAC		X			LDP MAIN BREAKER
31A	762	AC167	10 AWG	2		LDP	CKT 20&22	MCC		2.0 A	208 VAC		X			ENCLOSURE DAMPERS POWER
34	722	AC31	12 AWG	3		JB11C	TB2	LDP	CKT 12	8.0 A	120 VAC		X			AIR INLET FILTER LIGHTS (MODULE ´A´)
34	723	AC32	12 AWG	3		JB11D	TB2	LDP	CKT 7	8.0 A	120 VAC		X			AIR INLET FILTER LIGHTS (MODULE ´B´)
35	662	AC10	12 AWG	2		JB104	TB104	LDP	CKT 2&4	1.8 A	208 VAC		X			HE-4227/4228 (NEUTRAL CUBICLE HEATER SPACE)
35	663	AC11	12 AWG	2		JB105	TB105	LDP	CKT 2&4	1.8 A	208 VAC		X			HE-4224/4225 (LINSIDE CUBICLE HEATERS SPACE)
36	632	AC03	12 AWG	2		TCP	TB12	LDP	CKT 9	7.0 A	120 VAC		X			IGNITORS
41	631	AC01	12 AWG	3		JB30	TB119	LDP	CKT 6	5.5 A	120 VAC		X			TURBINE ENCLOSURE LIGHTS
41	631	AC02	12 AWG	3		JB30	TB119	LDP	CKT 1	15.0 A	120 VAC		X			TURBINE ENCLOSURE RECEPTACLE
41	631	AC70	8 AWG	3		MTTB	TB142A	LDP	CKTS 32 & 34	60.0 A	208 VAC		X			MTTB HEAT EXCHANGER
60	910	DC200	14 AWG	4		BATT CHG#1		TCP	FTM111.1	0.1 A	24 VDC		X			24VDC BATTERY CHARGER #1 STATUS
61	823	DC105	4/0 AWG	2		DSW24C		TCP	SW24C	165.0 A	24 VDC		X			24VDC CONTROL SYSTEM POWER
62	911	DC201	14 AWG	4		BATT CHG#2		TCP	FTM111.1	0.1 A	24 VDC		X			24VDC BATTERY CHARGER #2 STATUS
63	829B	DC114	6 AWG	2		DSW24F		TCP	TB24F	13.0 A	24 VDC		X			24VDC FIRE & GAS POWER
64	913	DC203	14 AWG	4		BATT CHG#4		TCP	FTM111.1	0.1 A	24 VDC		X			125VDC BATTERY CHARGER #4 STATUS
66	914	DC204	14 AWG	8		BATT CHG#5		TCP	FTM111.1	0.1 A	24 VDC		X			125VDC BATTERY CHARGER #5 STATUS
67	831A	DC119	14 AWG	2		TCP	FTM110.2	125 VDC STARTER		0.1 A	24 VDC		X			MOT-0109 CONTROL
68	901	AC164	12 AWG	3		LDP	CKT 40&42	125 VDC STARTER		0.5 A	208 VAC		X			MOT-0109 HEATER
69	812A	AC83	6 AWG	3		BATT CHG#1		LDP	CKT 23&25	39 A	208 VAC		X			24VDC CONTROL BATTERY CHARGER #1
70	812B	AC84	6 AWG	3		BATT CHG#2		LDP	CKT 27&29	39 A	208 VAC		X			24VDC CONTROL BATTERY CHARGER #2 POWER
71	812C	AC85	10 AWG	3		BATT CHG#3		LDP	CKT 28&30	6.4 A	208 VAC		X			24VDC FIRE & GAS BATTERY CHARGER #3 POWER
72	812D	AC86	4 AWG	3		BATT CHG#4		LDP	CKT 31&33	55 A	208 VAC		X			125VDC CONTROL BATTERY CHARGER #4 POWER
73	812E	AC87	4 AWG	3		BATT CHG#5		LDP	CKT 36&38	55 A	208 VAC		X			125VDC CONTROL BATTERY CHARGER #5 POWER
74	820	DC103	4/0 AWG	2		BATT CHG#1		24VDC BATTERY		82.5 A	24 VDC		X			24VDC CONTROL BATTERY POWER
75	822	DC106	4/0 AWG	2		BATT CHG#2		24VDC BATTERY		82.5 A	24 VDC		X			24VDC CONTROL BATTERY POWER
76	821	DC104	4/0 AWG	2		24 VDC BATTERY		DSW24C		165.0 A	24 VDC		X			24VDC CONTROL SYSTEM POWER
77	829	DC112	6 AWG	2		BATT CHG#3		24VDC FIRE & GAS BATT		13.0 A	24 VDC		X			24VDC FIRE & GAS BATTERY POWER
78	829A	DC113	6 AWG	2		24VDC FIRE & GAS BATT		DSW24F		13.0 A	24 VDC		X			24VDC FIRE & GAS POWER
89	815	AC88	250 kcmil 2 AWG	3 1		SR DRIVE#1 ENCLOSURE	AX3	MCC		180.0 A	480 VAC		X			MOT-2181 POWER
90	810C	DC140	16 AWG	2	SHLD	SRD1 ENCLOSURE	AX17	TCP	TB12	20 mA	24 VDC		X			MOT-2181 CONTROL SPEED
90	810C	DC141	14 AWG	2		SRD1 ENCLOSURE	AX17	TCP	TB12	0.1 A	24 VDC		X			MOT-2181 CONTROL START-STOP
90	810C	DC142	14 AWG	4		SRD1 ENCLOSURE	AX17	TCP	FTM110.2	0.1 A	24 VDC		X			MOT-2181 CONTROL STATUS
91	816	AC89	250 kcmil 2 AWG	3 1		SR DRIVE#2 ENCLOSURE	AX3	MCC		180.0 A	480 VAC		X			MOT-2193 POWER
92	810D	DC143	16 AWG	2	SHLD	SRD2 ENCLOSURE	AX17	TCP	TB12	20 mA	24 VDC		X			MOT-2193 CONTROL SPEED
92	810D	DC144	14 AWG	2		SRD2 ENCLOSURE	AX17	TCP	TB12	0.1 A	24 VDC		X			MOT-2193 CONTROL START-STOP
92	810D	DC145	14 AWG	4		SRD2 ENCLOSURE	AX17	TCP	FTM111.2	0.1 A	24 VDC		X			MOT-2193 CONTROL STATUS
103	750	DC48	16 AWG	3	SHLD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #1 ENCLOSURE	AX17	0.1 A	15 VDC		X			MOT-2181 POSITION
103	750	DC48A	16 AWG	2	SHLD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #1 ENCLOSURE	AX17	0.1 A	15 VDC		X			MOT-2181 TEMPERATURE
103	751	AC51	12 AWG	2		AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #1 ENCLOSURE	PWR CNVTR	0.5 A	220 VAC		X			MOT-2181 HEATER
103	752	DC47	250 kcmil	4	SHLD QUAD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #1 ENCLOSURE	PWR STACK	175 A	750 VDC		X			MOT-2181 POWER
104	753	DC50	16 AWG	3	SHLD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #2 ENCLOSURE	AX17	0.1 A	15 VDC		X			MOT-2193 POSITION
104	753	DC50A	16 AWG	2	SHLD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #2 ENCLOSURE	AX17	0.1 A	15 VDC		X			MOT-2193 TEMPERATURE
104	754	AC52	12 AWG	2		AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #2 ENCLOSURE	PWR CNVTR	0.5 A	220 VAC		X			MOT-2193 HEATER
104	755	DC49	250 kcmil	4	SHLD QUAD	AUXILIARY SKID	MOTOR WIRING BOX	SR DRIVE #2 ENCLOSURE	PWR STACK	175 A	750 VDC		X			MOT-2193 POWER
110	918	DC208	14 AWG	4		BATT CHG#4		BATT CHG#5		0.1 A	24 VDC		X			BATTERY CHARGER STATUS LINK
111	917	DC207	14 AWG	4		BATT CHG#3		BATT CHG#4		0.1 A	24 VDC		X			BATTERY CHARGER STATUS LINK
112	916	DC206	14 AWG	4		BATT CHG#2		BATT CHG#3		0.1 A	24 VDC		X			BATTERY CHARGER STATUS LINK
113	915	DC205	14 AWG	4		BATT CHG#1		BATT CHG#2		0.1 A	24 VDC		X			BATTERY CHARGER STATUS LINK
114	912	DC202	14 AWG	4		BATT CHG#3		TCP	FTM111.1	0.1 A	24 VDC		X			24VDC BATTERY CHARGER #3 STATUS
119	652	DC166	12 AWG	2		INVERTER	TA1	TCP	TB32	0.1 A	24 VDC		X			DC LOW VOLTAGE ALARM
119	652	DC167	12 AWG	2		INVERTER	TA1	TCP	TB32	0.1 A	24 VDC		X			SYSTEM TROUBLE ALARM
121	654	AC144	8 AWG	3		INVERTER	TB2	MTTB	TB142A		208 VAC		X			MOT-4019 , MOT-4120
124	999	IGPS		1	NOTE 17	HMI-CPU	J2	IGPS	IRIG-B				X	300FT MAX		IRIG-B CARD
125																
126																
	WINTERIZATION															
2	783	AC75	8 AWG	4		JB41	TB400	MCC		18.1 A	480 VAC		X			HE-4039 POWER
16	800	AC100	14 AWG	2		TCP	FTM111.2	MCC		0.1 A	208 VAC		X			HE-4052, 4057, MOT-4187 CONTROL
16	800	AC101	14 AWG	2		TCP	FTM111.2	MCC		0.1 A	208 VAC		X			HE-4058, 4059, 4216 CONTROL
16	800	AC102	14 AWG	2		TCP	FTM111.2	MCC		0.1 A	120 VAC		X			HE-4039 CONTROL
20	852	DC131	14 AWG	2		TCP	FTM109.1	MCC	TBXX	0.1 A	24 VDC		X			GROUND FAULT DETECTION
24	782	AC74	6 AWG	4		JB7	TB115	MCC		42.1 A	480 VAC		X			HE-4058, 4059, 4216 POWER
32	813	AC94	4 AWG	4		XFMR	45 kVA	MCC		60.0 A	480 VAC		X			45 kVA TRANSFORMER POWER
33	814	AC95	2/0 AWG 4 AWG	3 1		XFMR	45 kVA	LDP#2		125.0 A	120 VAC		X			LDP#2 MAIN BREAKER
41A	780	AC71	2 AWG	4		JB30	TB118	MCC		72.2 A	480 VAC		X			HE-4052/4057 POWER
41A	780B	AC71B	12 AWG	4		JB30	TB118	MCC		1.8 A	480 VAC		X			MOT-4187 POWER
50	784	AC80	8 AWG	3		JB96	TB1	LPD #2	CKT 10&12	27.0 A	208 VAC		X			MLO SKID HEAT TRACING
51	783	AC82	8 AWG	3		JB92	TB1	LPD #2	CKT 6&8	26.0 A	208 VAC		X			AUXILIARY SKID HEAT TRACING
52	782	AC81	6 AWG	3		JB91	TB1	LPD #2	CKT 5&7	37.0 A	208 VAC		X			GENERATOR/GEARBOX SKID HEAT TRACING
53	780	AC78	10AWG	3		JB30	TB119	LPD #2	CKT 21&23	5.0 A	208 VAC		X			HE-4145, 4157, 4217 POWER
53	781	AC79A	8 AWG	3		JB90	TB1	LPD #2	CKT 2&4	27.0 A	208 VAC		X			TURBINE SKID HEAT TRACING
53	781	AC79	8 AWG	3		JB90	TB1	LPD #2	CKT 1&3	27.0 A	208 VAC		X			TURBINE SKID HEAT TRACING
54	788	AC73	10 AWG	3		JBXX	TB1	LPD #2	CKT 40&42	15.0 A	208 VAC		X			HE-3039 CO2 SKID ENCLOSURE SPACE HEATER
55	764	AC76	10 AWG	3		JB65A	TB1	LPD #2	CKT 18&20	5 A	208 VAC		X			HE-4221, 4222, 4223 POWER
55	785	AC96	10 AWG	3		JB94	TB1	LPD #2	CKT 13&15	4.0 A	208 VAC		X			SPRINT SKID HEAT TRACING
56	787	AC77	10 AWG	3		JB43A	TB1	LPD #2	CKT 22&24	16.3 A	208 VAC		X			HE-4112, 4218 POWER
	125VDC SUPPLY															
6A	900	DC117	1/0 AWG	2		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	125 VDC STARTER		136.0 A	125 VDC		X			MOT-0109 ARMATURE POWER

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GE PACKAGED POWER, L.P.

SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

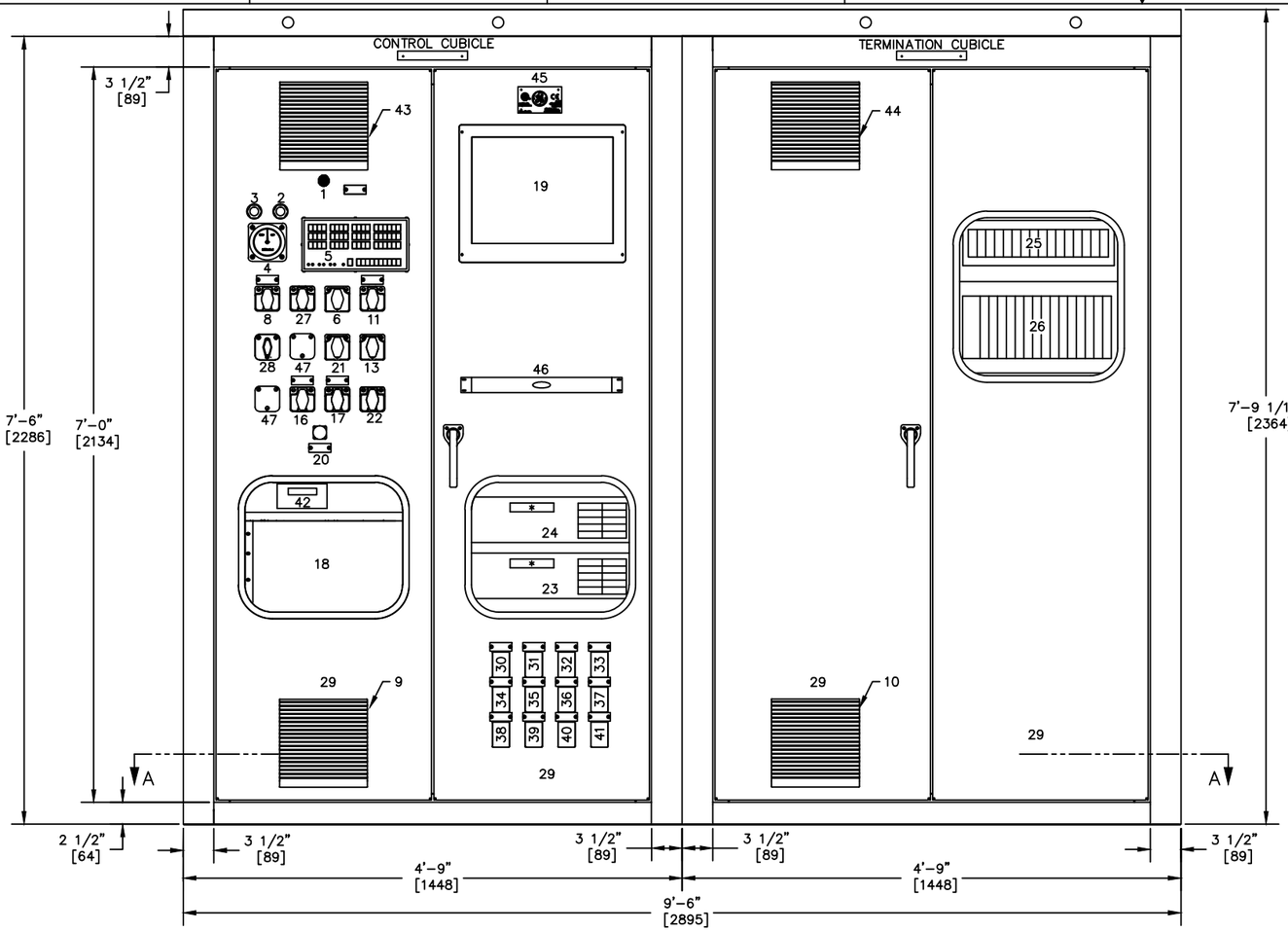
RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
6A	900	DC116	10 AWG	2		MINERAL LUBE OIL SKID	MOTOR WIRING BOX	125 VDC STARTER		2.0 A	125 VDC		X			MOT-0109 FIELD POWER
8	742	DC101	8 AWG	4		TCP	CB104, CB106	AUXILIARY SKID	ZC2019-TB2	20.0 A	125 VDC		X			NOX WATER INJECTION METERING VALVE DRIVER POWER
18	791	DC124	8 AWG	4		TCP	CB108, CB109	MTTB	ZC2202-TB2	20.0 A	125 VDC		X			GAS FUEL METERING VALVE DRIVER
65	826	DC109	2/0 AWG	2		DSW125C		TCP	SW125C	90.0 A	125 VDC		X			125VDC CONTROL SYSTEM POWER
67	831	DC118	12 AWG	2		TCP	FTM112.1	125 VDC STARTER		0.5 A	125 VDC		X			MOT-0109 CONTROL
79	824	DC107	2/0 AWG	2		BATT CHG#4		125VDC BATTERY		45.0 A	125 VDC		X			125VDC CONTROL BATTERY POWER
80	827	DC110	2/0 AWG	2		BATT CHG#5		125VDC BATTERY		45.0 A	125 VDC		X			125VDC CONTROL BATTERY POWER
81	825	DC108	2/0 AWG	2		125VDC BATTERY		DSW125C		90 A	125 VDC		X			125VDC CONTROL SYSTEM POWER
115	828	DC111	2/0 AWG	2		125VDC BATTERY		125VDC STARTER		136 A	125 VDC		X			125VDC STARTER POWER
118	655	DC168	8 AWG	2		INVERTER	TB1	TCP	CB101	60.0 A	125 VDC		X			MTTB HEAT EXCHANGER POWER
	VIBRATION															
26	832	XE01	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA5 CH1	0.1 A	24 VDC		X			XE-8007X
26	832	XE02	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA5 CH2	0.1 A	24 VDC		X			XE-8007Y
26	832	XE03	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA5 CH3	0.1 A	24 VDC		X			XE-8009X
26	832	XE04	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA5 CH4	0.1 A	24 VDC		X			XE-8009Y
26	832	XE05	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA6 CH1	0.1 A	24 VDC		X			XE-8094
26	832	XE06	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA6 CH2	0.1 A	24 VDC		X			XE-8093
26	832	VIB01	16 AWG	3	SHLD	MGTB	TB114	TCP	TBA4 CH1-BOTT	0.1 A	24 VDC		X			SE-8100
27	830	XE07	16 AWG	4	SHLD	MTTB	TB121	TCP	TBA3 CH1	0.1 A	24 VDC		X			XQT-8076 VELOCITY
27	830	VIB06	16 AWG	2	SHLD	MTTB	TB121	TCP	TB31	12 mA	24 VDC		X			SE-8082B
27	830	VIB02	16 AWG	2	SHLD	MTTB	TB121	TCP	TB31	12 mA	24 VDC		X			SE-8013B
27	830	XE08	16 AWG	4	SHLD	MTTB	TB121	TCP	TBA3 CH2	0.1 A	24 VDC		X			XQT-8077 VELOCITY
27	830	XE09	16 AWG	4	2 SHLD PR	MTTB	TB121	TCP	TBA10 CH1-CH2	0.1 A	24 VDC		X			XQT-8077, XQT-8076 (ACCELERATION)
27	830	XE10	16 AWG	4	2 SHLD PR	MTTB	TB121	TCP	TB31	0.1 A	24 VDC		X			SE-8082A, SE-8013A
27	830	XE11	16 AWG	6	2 SHLD TRI	MTTB	XQT	TCP	TBA8 CH1-CH2	0.1 A	24 VDC		X			XQT-8090A, XQT-8090B
	COMMUNICATION															
9	845	COM05	22 AWG	2	NOTE 14	MTTB	UR2-A13	ASTB	N2.2.01	N/A	N/A		X			ASTB LINKNET NETWORK #2
9	845	COM06	22 AWG	2	NOTE 14	MTTB	UR3-A13	ASTB	N3.2.01	N/A	N/A		X			ASTB LINKNET NETWORK #2
9	860	COM09	16 AWG	8	4 SHLD PR	MTTB	TB121	AUXILIARY SKID	ZC2019	N/A	N/A		X			ZC-2019 (NOX DRIVER)
13	840	COM03	22 AWG	2	NOTE 14	MTTB	UR2-A13	MGTB	N2.1.01	N/A	N/A		X			MGTB LINKNET NETWORK #1
13	840	COM04	22 AWG	2	NOTE 14	MTTB	UR3-A13	MGTB	N3.1.05	N/A	N/A		X			MGTB LINKNET NETWORK #1
27	850	FO-01			NOTE 13	TCP	ENET3	MTTB	ENET5	N/A	N/A		X			MTTB COMMUNICATION #1
27	850	FO-02			NOTE 13	TCP	ENET4	MTTB	ENET6	N/A	N/A		X			MTTB COMMUNICATION #2
29	855	FO-03			NOTE 13	TCP	ENET1 CH13	REMOTE DCS	CUSTOMER ENET8	N/A	N/A		X			REMOTE DCS
29	855	FO-04			NOTE 13	TCP	ENET2 CH13	REMOTE DCS	CUSTOMER ENET8	N/A	N/A		X			REMOTE DCS
29	855	W7.ENET1			NOTE 17	TCP	ENET1	CUSTOMER	REMOTE HMI / DCS	N/A	N/A		X			REMOTE DCS
29	855	W7.ENET2			NOTE 17	TCP	ENET2	CUSTOMER	REMOTE HMI / DCS	N/A	N/A		X			REMOTE DCS
116	851	AC200	SIZING BY CUSTOMER			GLAC		SWGR		4500 A	15 kVAC		X			GENERATOR CIRCUIT BREAKER 52G
	FIRE & GAS PROTECTION PANEL															
25	600	CO2 SKID TO TCP - REFERENCE FIRE & GAS PROTECTION VENDOR DRAWING														
46	601	GENERATOR/GEARBOX SKID TO TCP - REFERENCE FIRE & GAS PROTECTION VENDOR DRAWING														
47	602	TURBINE SKID TO TCP - REFERENCE FIRE & GAS PROTECTION VENDOR DRAWING														
	PE GROUNDING															
37	700A	PE01	250 kcmil	1		GENERATOR (FRONT LEFT)	EARTH LUG	PE SITE GROUND		N/A	N/A		X			
37	700B	PE02	2 AWG	1		GENERATOR/GEARBOX SKID (LEFT SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
37	700C	PE03	2 AWG	1		GENERATOR/GEARBOX SKID (RIGHT SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
37	701A	PE04	250 kcmil	2		GLAC	EARTH STUD	PE SITE GROUND		N/A	N/A		X			
37	701B	PE05	250 kcmil	2		GNAC	EARTH STUD	PE SITE GROUND		N/A	N/A		X			
38	703A	PE06	2 AWG	1		TURBINE SKID (MTTB SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
38	703B	PE07	2 AWG	1		TURBINE SKID (GAUGE PANEL SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
39	705	PE08	2 AWG	1		AUXILIARY SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
39	705	PE09	2 AWG	1		AUXILIARY SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
40	706A	PE10	2 AWG	1		ROOF SKID (TURBINE SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
40	706B	PE11	2 AWG	1		ROOF SKID (GENERATOR SIDE)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			

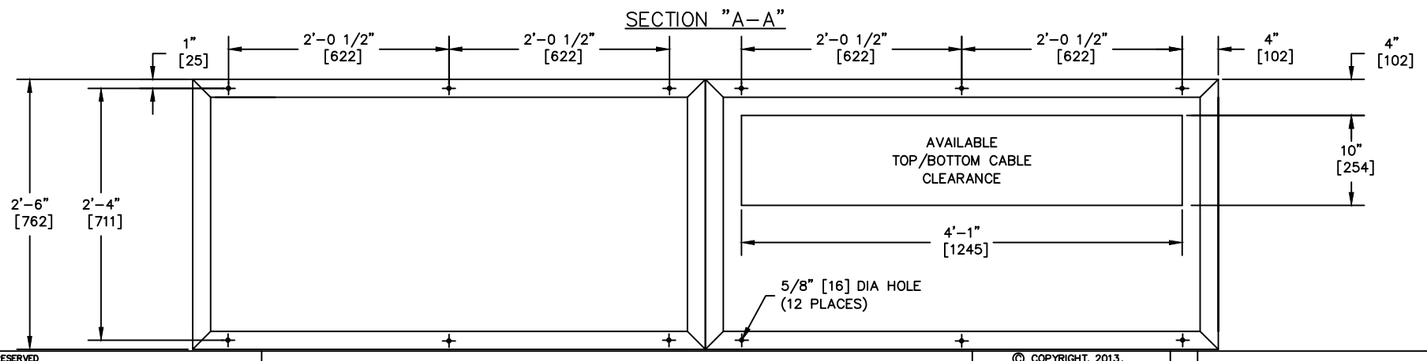
GE PACKAGED POWER, L.P.

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SYSTEM FREQUENCY, Hz 60
CT SECONDARY CURRENT, AMPS 5
SAC

RACEWAY RUN	RACEWAY NUMBER	CABLE ID	RECOMMENDED AWG/kcmil	RECOMMENDED NO. COND	CABLE TYPE	ROUTING FROM		ROUTING TO		RATINGS AMPS	RATINGS VOLTS	SUPPLIED BY GE	SUPPLIED BY OTHERS	CABLE LENGTH	REV NO.	FUNCTION
48	707	PE12	2 AWG	1		CO2 SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
37	700D	PE13	440 kcmil	1		GENERATOR (REAR RIGHT)	EARTH LUG	GLAC	EARTH STUD	N/A	N/A		X			
42	710	PE14	300 kcmil	3		MCC	EARTH STUD	PE SITE GROUND		N/A	N/A		X			
38	711	PE15	2 AWG	1		TURB GAUGE PANEL	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	712	PE16	2 AWG	1		24VDC BATTERY CHARGER #1 (CONTROL)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	712	PE17	2 AWG	1		24VDC BATTERY CHARGER #2 (CONTROL)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	712	PE18	6 AWG	1		24VDC BATTERY CHARGER #3 (FIRE & GAS)	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	712	PE19	2 AWG	1		125VDC BATTERY CHARGER #4	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	712	PE20	2 AWG	1		125VDC BATTERY CHARGER #5	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
43	717	PE21	2 AWG	1		125VDC STARTER	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
44	718	PE22	2 AWG	1		MINERAL LUBE OIL SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
44	718	PE23	2 AWG	1		MINERAL LUBE OIL SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
40A	706C	PE24	2 AWG	1		AIR FILTER SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
57	720	PE27	2 AWG	1		SPRINT SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
57	720	PE28	2 AWG	1		SPRINT SKID	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
49	708	PE32	6 AWG	1		TCP	PE1	PE SITE GROUND		N/A	N/A		X			
49	708	PE33	6 AWG	1		TCP	PE2	PE SITE GROUND		N/A	N/A		X			
122	957	PE36	6 AWG	1		INVERTER	EARTH PAD	PE SITE GROUND		N/A	N/A		X			
123	958	PE37	8 AWG	1		DISTRIBUTION PANEL	EARTH PAD	PE SITE GROUND		N/A	N/A		X			DISTRIBUTION PANEL
	IE GROUNDING															
38A	703B	IE02	8 AWG	1		MTTB	GDB1	IE SITE GROUND		N/A	N/A		X			
38A	703B	IE03	8 AWG	1		MTTB	GDB2	IE SITE GROUND		N/A	N/A		X			
38A	703B	IE04	8 AWG	1		MTTB	GDB3	IE SITE GROUND		N/A	N/A		X			
49A	708A	IE01	8 AWG	1		TCP	GDB1	IE SITE GROUND		N/A	N/A		X			





LEGEND:

1_____HORN
2___SL1____ LAMP, SYNCHRONIZING
3___SL2____ LAMP, SYNCHRONIZING
4___SY_____ METER, SYNCHROSCOPE
5__DMMF-DIS_ DISPLAY, DIGITAL MULTIFUNCTION METER
6___SS_____ SWITCH, SYNCHRONIZE

8___86G____ RELAY, LOCKOUT (GENERATOR)
9___BLR1___ BLOWER, CONTROL CUBICLE
10__BLR2___ BLOWER, TERMINATION CUBICLE
11__CBCS1__ SWITCH, CIRCUIT BREAKER CONTROL AND STATUS "52G"

13__VCES___ SWITCH, VOLTAGE/PF/VAR CONTROL ENABLE

15__ES_____ SWITCH, VOLTAGE REGULATOR "ON/OFF" (INSIDE PANEL)
16__EMS____ SWITCH, EXCITATION MODE
17__AMVAS__ SWITCH, AUTOMATIC/MANUAL VOLTAGE REGULATOR ADJUST
18__AVR____ REGULATOR, AUTO/MANUAL VOLTAGE
19__HMI-DIS_ DISPLAY, HUMAN MACHINE INTERFACE
20__ES3____ SWITCH, EMERGENCY STOP, TCP
21__LRS____ SWITCH, LOCAL/REMOTE SELECTOR
22__SAS____ SWITCH, SPEED ADJUST
23__IGPS___ INTEGRATED GENERATOR PROTECTION SYSTEM
24__IGPS2___ INTEGRATED GENERATOR PROTECTION SYSTEM (DUAL IGPS)
25__FPP____ PANEL, FIRE & GAS PROTECTION
26__VIB_____MONITOR, VIBRATION
27__TSS____ SWITCH, TURBINE START-STOP
28__CBCS2___SWITCH, CIRCUIT BREAKER CONTROL AND STATUS "52U"
29_____DOOR, ACCESS
30__TSB1___ SWITCH BLOCK, TEST, BUS VOLTAGE
31__TSB2___ SWITCH BLOCK, TEST, GENERATOR VOLTAGE
32__TSB3___ SWITCH BLOCK, GENERATOR CURRENT METERING
33__TSB4___ SWITCH BLOCK, BUS CURRENT PROTECTION
34__TSB5___ SWITCH BLOCK, TEST, GENERATOR CURRENT PROTECTION
35__TSB6___ SWITCH BLOCK, TEST, GENERATOR CURRENT PROTECTION (DUAL IGPS)
36__TSB7___ SWITCH BLOCK, BUS CURRENT PROTECTION (DUAL IGPS)
37__TSB8___ SWITCH BLOCK, TEST, GENERATOR LOCKOUT RELAY (86G)
38__TSB9___ SWITCH BLOCK, TEST, UTILITY VOLTAGE (52U)
39__TSB10___SWITCH BLOCK, TEST, SPARE
40__TSB11___ SWITCH BLOCK, TEST, SPARE
41__TSB12___ SWITCH BLOCK, TEST, SPARE
42__DSM_____ DIGITAL SYNCHRONIZER MODULE
43__FLTR1___ FILTER, CONTROL CUBICLE
44__FLTR2___ FILTER, TERMINATION CUBICLE
45_____NAMEPLATE
46_____KEYBOARD, HUMAN MACHINE INTERFACE
47_____HOLE, RESERVED

NOTES:

1. REQUIRED CLEARANCE IN FRONT OF CUBICLES: 3'-0" [914].
2. APPROXIMATE WEIGHT: 2800 LBS [1270 KG].
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. PAINT IN ACCORDANCE WITH GEPPLP SPECIFICATION 95953, LATEST REVISION.
5. BOTTOM COVER PROVIDED AND TO BE INSTALLED BETWEEN FLOOR AND TURBINE CONTROL PANEL BOTTOM FRAME, AS REQUIRED.
6. APPROXIMATE HEAT LOAD: 3071 BTU/HR [900 WATTS].
7. REQUIRED CONTROL ROOM AMBIENT TEMPERATURE: 75 F [23.8 C].

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11807	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: PLAN & ELEVATION TURBINE CONTROL PANEL

DWG NO. 7253049-969014

REV. A

SCALE NONE

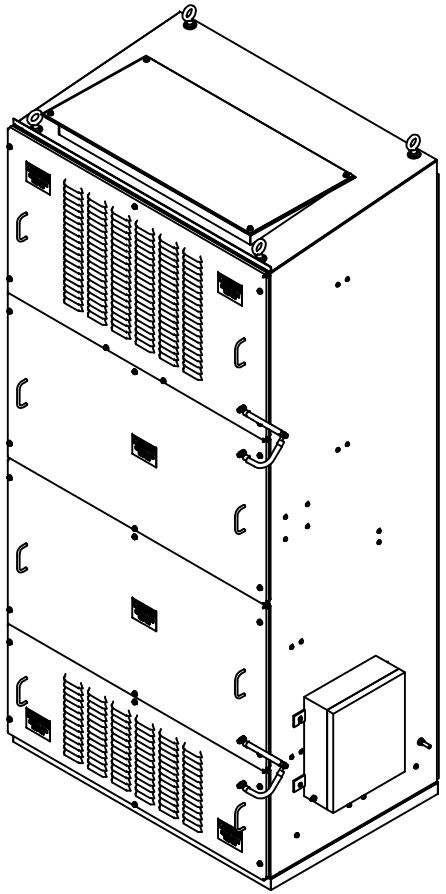
SHEET 1 OF 1

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION:
   ASME Y14.5M-1994, DIMENSIONING AND TOLERANCING.
2. REMOVE ALL BURRS AND SHARP EDGES.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. SURFACE PREPARATION / FINISHING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION: A-95953.
5. DRILLING AND WELDING SHALL BE DONE PRIOR TO SURFACE PREPARATION / FINISHING.
6. CONSTRUCTION:
   CUBICLE - FABRICATED FROM 11 GAUGE STEEL SHEET, PICKLED AND OILED WITH ANGLE FRAMEWORK.
   BUSDUCT - FABRICATED FROM 1/8" ALUMINUM SHEET.
7. INGRESS PROTECTION TO IP54.
8. APPROXIMATE WEIGHT OF CUBICLE : 3100 lbs [1406 kg]
9. COPPER BUS BAR SHALL BE SILVER PLATED PER ASTM B700 AT ELECTRICAL JOINTS.
10. ALL MAIN BUSBAR JOINTS ARE TO BE FASTENED USING 316 STAINLESS STEEL HARDWARE.
11. ALL LIVE COPPER WORK TO BE FULLY INSULATED USING HEATSHRINK SLEEVING, ALONG WITH FILLER PLASTIC AND POLYISOBUTYLENE SELF-AMALGAMATING TAPE FOR BOLTED JOINTS (CONNECTIONS TO GENERATOR TERMINALS TO BE INSULATED DURING MOUNTING).
12. CIRCUIT REFERENCE LABELS TO BE FITTED ADJACENT TO EACH COMPONENT.
13. LANGUAGE OF LABEL IN SPEC 289273.
14. TORQUE FLEX LINK BOLTS TO 35 ft*lb (34Nm). USE NIKAL ANTI-SEIZE (GE PART #393A3967P0001) ON BOLTS BEFORE INSTALLING.
15. SERVICE: TO BE 10.5/11.0/11.5/13.8 kV, 3 PHASE, 3 WIRE, 50/60 Hz AS APPLICABLE.
16. BUSSING: MAIN BUS TO BE 5200 A COPPER (2) 1/2" X 6" [13 X 152] BRACED FOR 75kA ASYM. AT 221 °F [105 °C] TOTAL TEMPERATURE. BUS TO BE FULLY INSULATED. BUS CONNECTIONS TO BE SILVER PLATED. HARDWARE TO BE STAINLESS STEEL. GROUND BUS TO BE FULL LENGTH 1/4" X 2" [6 X 51] COPPER.
17. THERMOSTAT SHOULD BE SET TO SWITCH HEATERS OFF AT 55 °F [12.7 °C].
18. CUSTOMER CABLE CONNECTIONS AT BUS BAR TO BE COVERED WITH DUCT SEAL COMPOUND (GE PART # 393A3635P0001 OR EQUAL) AND APPLY HIGH VOLTAGE TAPE (GE PART # HVBT -4-R OR EQUAL).
19. ADDITIONAL HOLES FOR TOP COVER SUPPLIED BY CUSTOMER.
20. REFER TO X-969225 FOR LIFTING DETAILS.

LABELS	
REF.	INSCRIPTION
A	LINE CUBICLE
B	L.V. TERMINAL BOX
C	FRAME EARTH
D	DANGER - HIGH VOLTAGE
E	WARNING - LIVE TERMINALS NOTE: HEATER SUPPLY IS FROM A SEPARATE SOURCE. ISOLATE BEFORE REMOVING COVER
F	SERIAL NUMBER ********-***

NOTE! LABELS ARE TO BE IN CUSTOMER LANGUAGE



ISOMETRIC VIEW

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

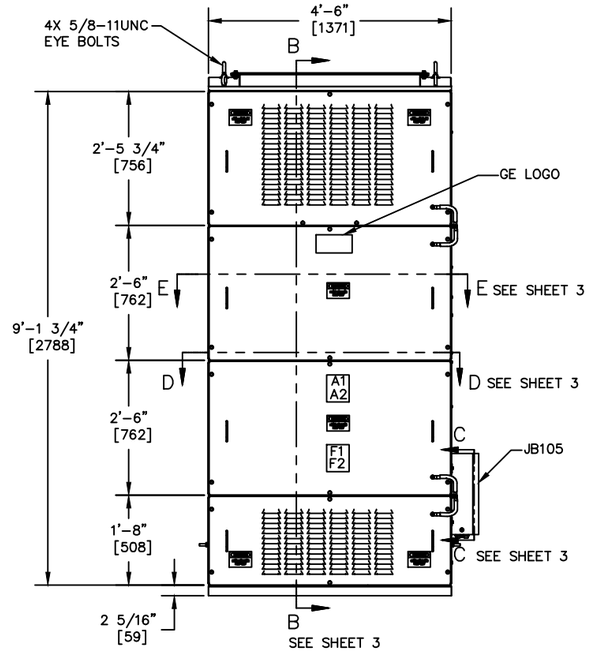
ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

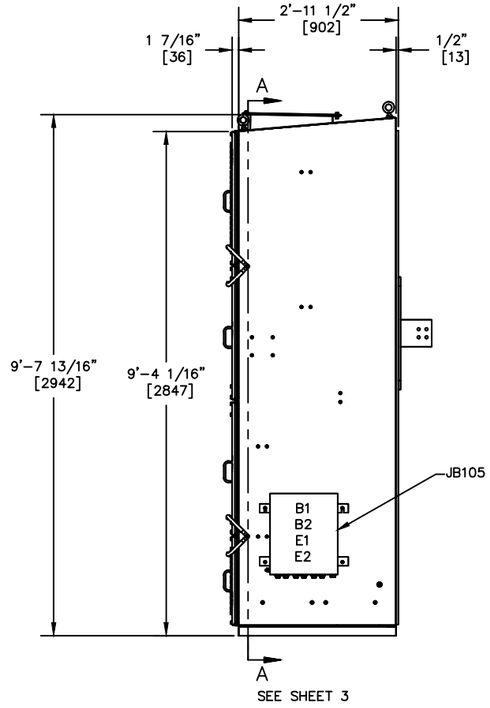
TITLE
PLAN & ELEVATION
GENERATOR LINESIDE CUBICLE
CABLE ENTRY TOP/BOTTOM

DWG NO. 7253049-969021 REV. A

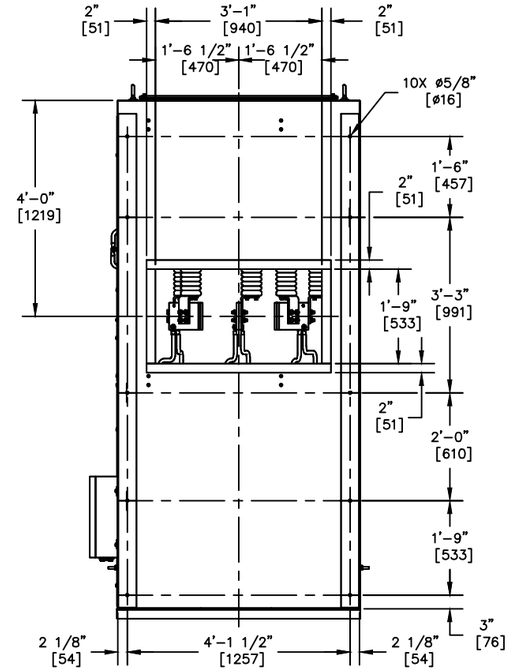
SCALE 1 1/2" = 1'-0" SHEET 1 OF 3



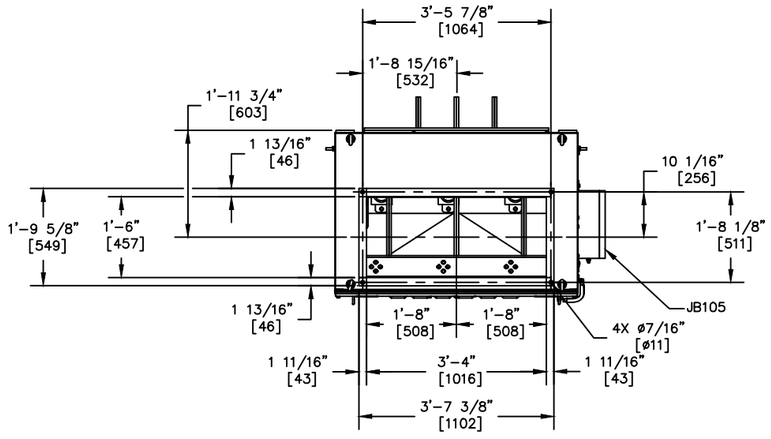
FRONT VIEW



SIDE VIEW

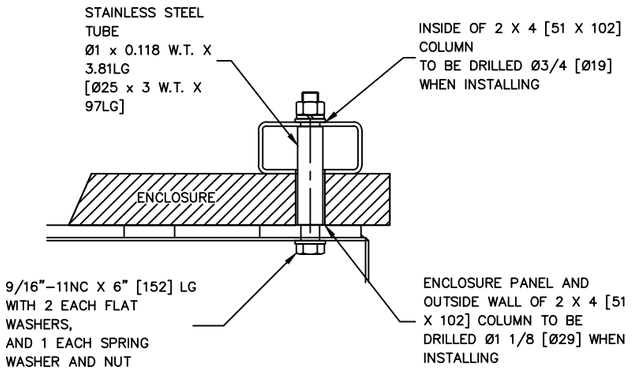


REAR VIEW



PLAN VIEW

TOP BUS COVER REMOVED FOR CLARITY
FLANGE / COVER HOLE PATTERN SHOWN



MOUNTING DETAIL

SEE NOTE 14

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THIRD ANGLE PROJECTION

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DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

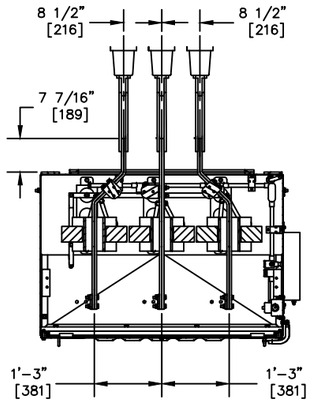
UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

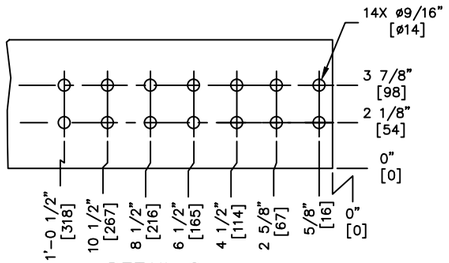
TITLE
PLAN & ELEVATION
GENERATOR LINESIDE CUBICLE
CABLE ENTRY TOP/BOTTOM

DWG NO. 7253049–969021
REV. A
SCALE 3/4" = 1'–0"
SHEET 2 OF 3



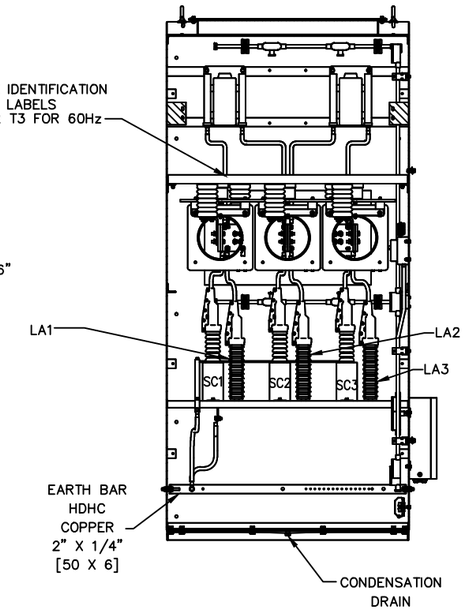
SECTION E-E

SEE SHEET 2



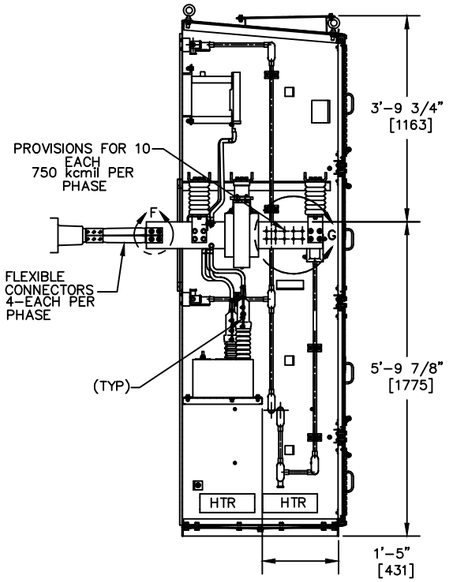
DETAIL G

BUS BAR DRILLING



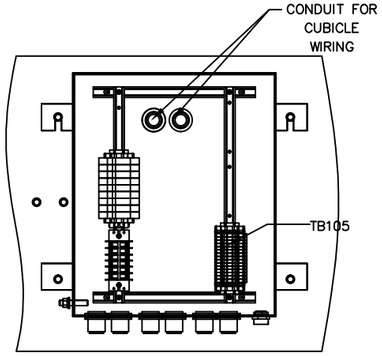
SECTION A-A

SEE SHEET 2



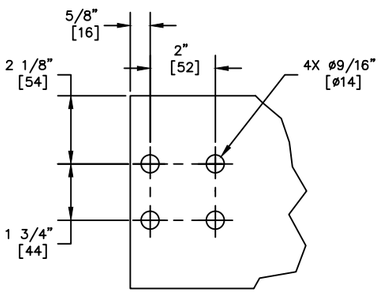
SECTION B-B

SEE SHEET 2



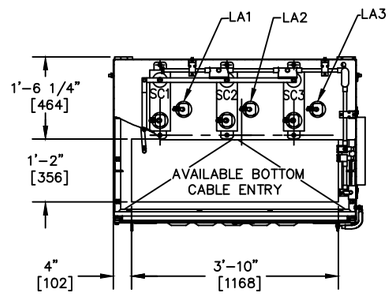
SECTION C-C
JB105

SEE SHEET 2



DETAIL F

BUS BAR DRILLING
FLEXIBLE CONNECTORS IS NOT SHOWN FOR CLARITY



SECTION D-D

SEE SHEET 2

WIRE NOT SHOWN FOR CLARITY

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REVISIONS

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A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
PLAN & ELEVATION
GENERATOR LINESIDE CUBICLE
CABLE ENTRY TOP/BOTTOM

DWG NO. 7253049-969021
REV. A

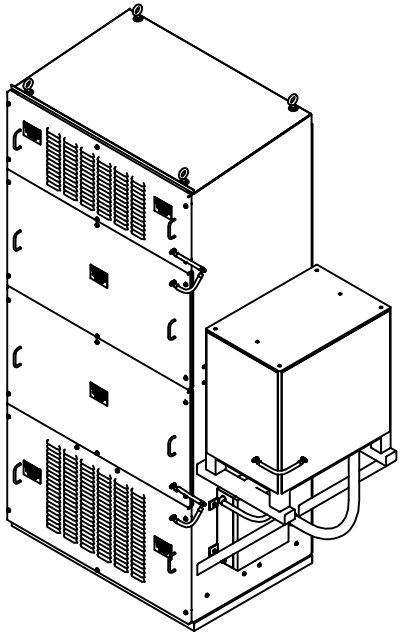
SCALE 3/4" = 1'-0"
SHEET 3 OF 3

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION:
   ASME Y14.5M–1994, DIMENSIONING AND TOLERANCING.
2. REMOVE ALL BURRS AND SHARP EDGES.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. SURFACE PREPARATION / FINISHING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION: A–26983.
5. DRILLING AND WELDING SHALL BE DONE PRIOR TO SURFACE PREPARATION / FINISHING.
6. CONSTRUCTION:
   CUBICLE – FABRICATED FROM 11 GAUGE STEEL SHEET, PICKLED AND OILED WITH ANGLE FRAMEWORK.
   BUSDUCT – FABRICATED FROM 1/8" ALUMINUM SHEET.
7. INGRESS PROTECTION TO IP54.
8. APPROXIMATE WEIGHT OF CUBICLE : 3300 LBS [1496 KG].
9. COPPER BUS BAR SHALL BE SILVER PLATED PER ASTM B700 AT ELECTRICAL JOINTS.
10. ALL MAIN BUSBAR JOINTS ARE TO BE FASTENED USING 316 STAINLESS STEEL HARDWARE.
11. ALL LIVE COPPER WORK TO BE FULLY INSULATED USING HEATSHRINK SLEEVING, ALONG WITH FILLER PLASTIC AND POLYISOBUTYLENE SELF–AMALGAMATING TAPE FOR BOLTED JOINTS (CONNECTIONS TO GENERATOR TERMINALS TO BE INSULATED DURING MOUNTING).
12. CIRCUIT REFERENCE LABELS TO BE FITTED ADJACENT TO EACH COMPONENT.
13. LANGUAGE OF LABEL IN SPEC 256272.
14. TORQUE FLEX LINK BOLTS TO 35 ft•lb (34Nm). USE NIKAL ANTI–SEIZE (GE PART #383A3867P0001) ON BOLTS BEFORE INSTALLING.
15. SERVICE: TO BE 10.5/11.0/11.5/13.8 kV, 3 PHASE, 3 WIRE, 50/60 Hz AS APPLICABLE.
16. BUSWING: MAIN BUS TO BE 5200 A COPPER [2] 1/2" X 6" [13 X 152] BRACED FOR 78kA ASYM. AT 221 °F [105 °C] TOTAL TEMPERATURE. BUS TO BE FULLY INSULATED. BUS CONNECTIONS TO BE SILVER PLATED. HARDWARE TO BE STAINLESS STEEL. GROUND BUS TO BE FULL LENGTH 1/4" X 2" [6 X 51] COPPER.
17. THERMOSTAT SHOULD BE SET TO SWITCH HEATERS OFF AT 85 °F [12.7 °C].
18. CUSTOMER CABLE CONNECTIONS AT BUS BAR TO BE COVERED WITH DUCT SEAL COMPOUND (GE PART # 383A3635P0001 OR EQUAL) AND APPLY HIGH VOLTAGE TAPE (GE PART # HVBT –4–R OR EQUAL)
19. ADDITIONAL HOLES FOR TOP COVER SUPPLIED BY CUSTOMER.
20. REFER TO X–969225 FOR LIFTING DETAILS.

LABELS	
REF.	INSCRIPTION
A	LINE CUBICLE
B	L.V. TERMINAL BOX
C	FRAME EARTH
D	DANGER – HIGH VOLTAGE
E	WARNING – LIVE TERMINALS NOTE: HEATER SUPPLY IS FROM A SEPARATE SOURCE. ISOLATE BEFORE REMOVING COVER
F	SERIAL NUMBER ******-***

NOTE! LABELS ARE TO BE IN CUSTOMER LANGUAGE



ISOMETRIC VIEW

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

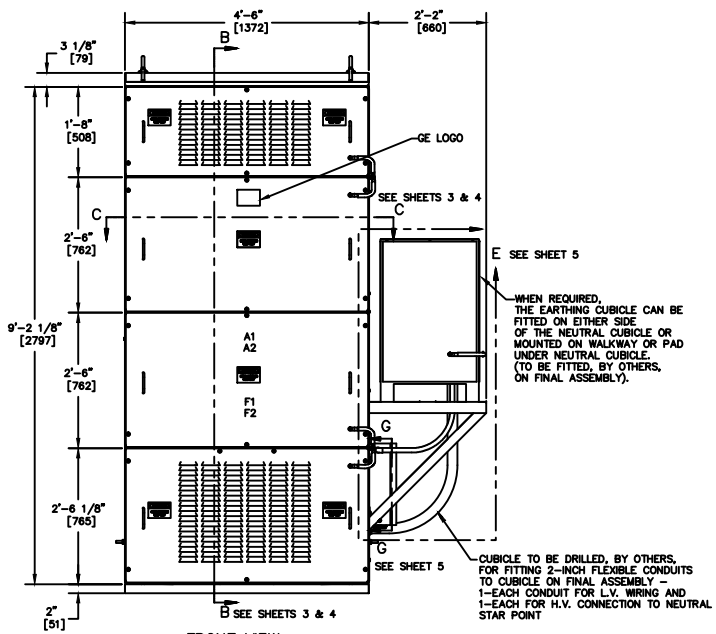
TITLE: PLAN & ELEVATION
GENERATOR NEUTRAL CUBICLE

DWG NO. 7253049–969023

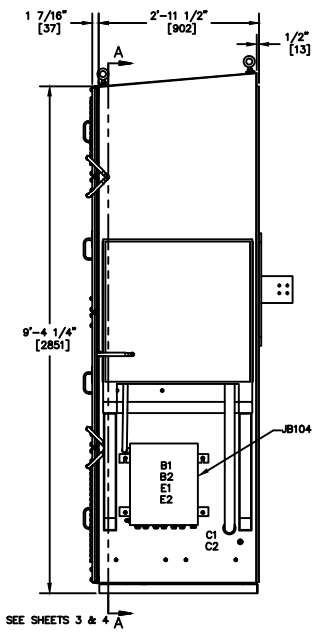
REV. A

SCALE 1" = 1'–0"

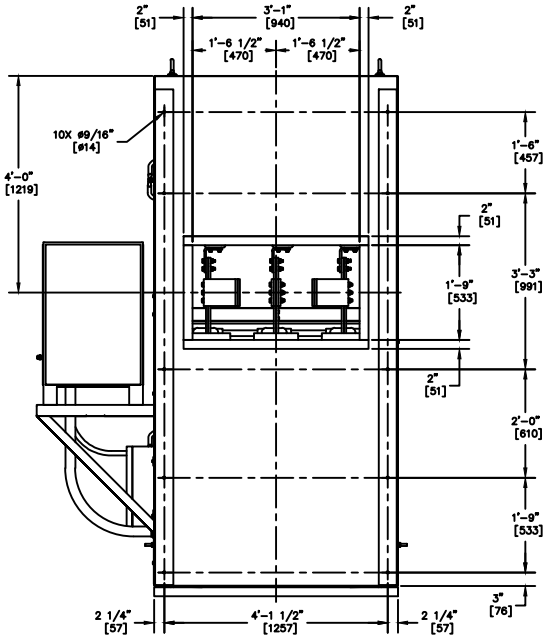
SHEET 1 OF 4



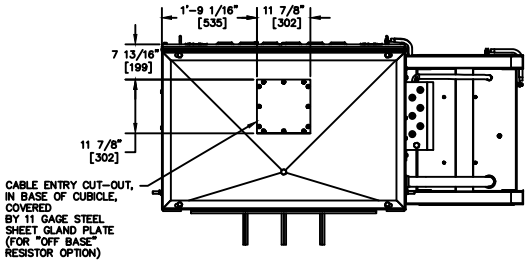
FRONT VIEW



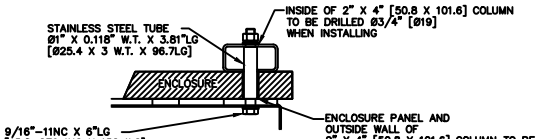
RIGHT SIDE VIEW



REAR VIEW



BOTTOM VIEW



MOUNTING DETAIL

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

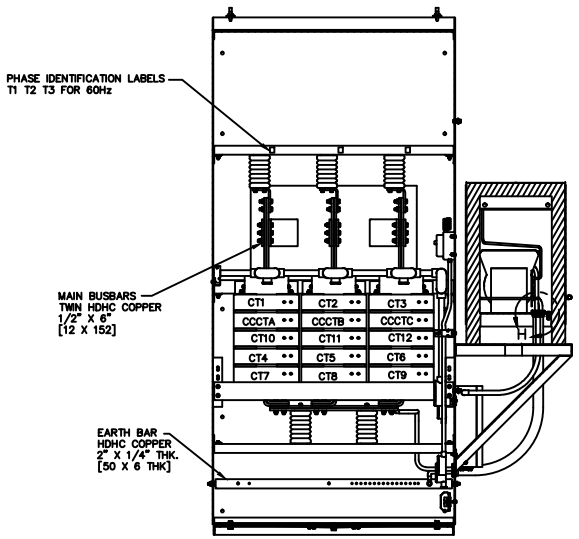
TITLE
PLAN & ELEVATION
GENERATOR NEUTRAL CUBICLE

DWG NO. 7253049-969023

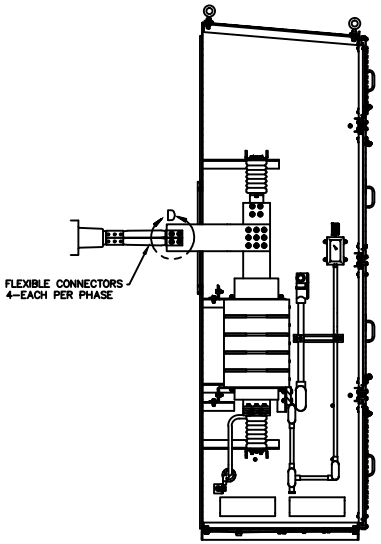
REV. A

SCALE 1" = 1'-0"

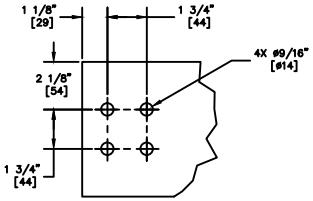
SHEET 2 OF 4



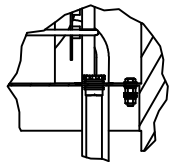
SECTION A–A
SEE SHEET 2



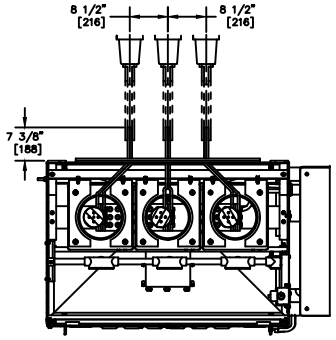
SECTION B–B
SEE SHEET 2



DETAIL D



DETAIL H



SECTION C–C
SEE SHEET 2

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

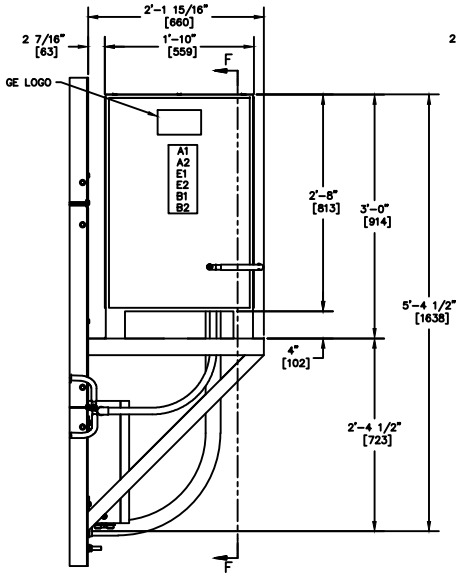
TITLE
PLAN & ELEVATION
GENERATOR NEUTRAL CUBICLE

DWG NO. 7253049-969023

REV. A

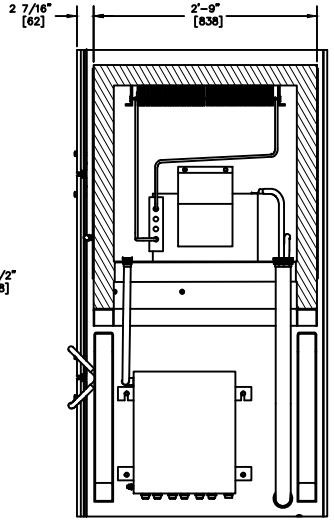
SCALE 1" = 1'-0"

SHEET 3 OF 4



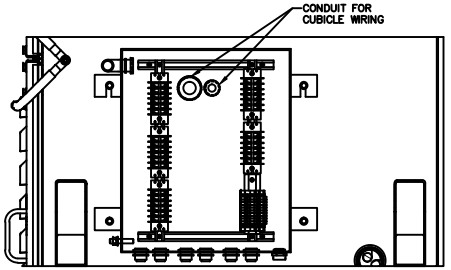
DETAIL E

SEE SHEET 2
NOT TO SCALE



SECTION F-F

NOT TO SCALE



SECTION G-G

SEE SHEET 2

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
PLAN & ELEVATION
GENERATOR NEUTRAL CUBICLE

DWG NO.
7253049-969023

REV.
A

SCALE 1" = 1'-0"

SHEET 4 OF 4

NOTES:

1. * ASTERISK INDICATES FURNISHED BY OTHERS. ITEMS SHOWN AS "BY OTHERS" MAY VARY BUT ARE SHOWN TO ATTEMPT CLARITY OF PERSPECTIVE ON THIS DRAWING.
2. APPLICABLE STANDARD/SPECIFICATION: IEEE 315-1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. ALL COMPONENTS SHOWN DE-ENERGIZED (SHELF STATE).
5. GENERATOR PHASE SEQUENCE IS T1-T2-T3 FOR LEFT HAND LINESIDE CUBICLE OR T4-T5-T6 FOR RIGHT HAND LINESIDE CUBICLE. SEE MAIN UNIT GENERAL ARRANGEMENT FOR LINESIDE PLACEMENT.
6. VOLTAGE TRANSFORMER FUSE LOSS DETECTION HAS BEEN PROGRAMMED IN THE IGPS.
7. DMMF INCLUDES THE FOLLOWING: VOLTS, AMPS, POWER FACTOR, kW, kVA, kvar, FREQ, kVAh & kWh.
8. REFERENCE X-969964 FOR INTEGRATED GENERATOR PROTECTION SYSTEM (IGPS) SETTINGS.
9. TEST SWITCHES SHOWN WITH PLUG REMOVED.
10. CUSTOMER TO ENSURE PROPER PHASE ANGLE AND VOLTAGE FOR SYNCHRONIZER OPERATION.
11. AVR INCLUDES POWER SYSTEM STABILIZER FUNCTION.

LEGEND:

SEE X-969005

REFERENCE DRAWINGS:

X-969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
ONE LINE DIAGRAM

DWG NO. 7253049-969031
REV. A

SCALE NONE
SHEET 1 OF 3

13.8 kV, 3250 A, BUS

CT (3) 4000:5 C200

4000:5 C200

15.0 kV 3250 A 50 kA

52G

CT (3) 4000:5 C200

CT (3) 4000:5 C200

86G

CBCS1

K84

TSB7 (0)

TSB4 (0)

FROM SHEET 3 3

TO SHEET 3 1

VT (2) 14400:120

0.5A

6A

TSB2 (0)

CT (3) 4000:5 C200

6A

6A

86G

K229A

K231A

AVR (90V) NOTE 11

LA (3)

SC (3) 0.25μF

GLAC

GTG 76.941 MVA 13.8 kV PF=0.85 3 PH, 60 Hz XD=2.54 X'D=0.265 X"D=0.156 X2=0.191 X0=0.103

T1 (T4)

T2 (T5)

T3 (T6)

NOTE 5

PMG

74

RGF (64)

GEN FIELD

EXC FIELD

76

CT (3) 4000:5 C400

CCCT (3) 4000:5 C200

CT (3) 4000:5 C200

CT (3) 4000:5 C200

CT (3) 4000:5 C200

CT (3) 4000:5 C400

CUSTOMER

TG

7967:139 10 kVA

RG 0.37 OHMS 376 A 30 SECONDS

GNAC

TSB3 (0)

TSB6 (0)

TSB5 (0)

K85

IGPS & IGPS2

BREAKER OPEN	I1	52G*
SPARE	I2	
SPARE	I3	K85A, CBCS1, K85B
BREAKER FAIL INITIATE	I4	
BREAKER CLOSED	I5	
SPARE	I6	52G*

24-1, 24-2, 32-1 40-1, 40-2, 46INV, 50/27	01	
51V, 59-1, 59-2, 59N-1, 87-1	02	TSB8 (0) → 86G
24-1, 24-2, 32-1 40-1, 40-2, 46INV, 50/27	07	
27-1, 81-2, 81-4, 46DEF, 60FL	08	
IRIG-B		
50BF, 59N-2	04	TSB8 (0) → * CUSTOMER 50BF ZONE ISOLATOR
25D	05	
25S	06	* CUSTOMER DCS
SELFTEST		
POWER SUPPLY ALARM	P/S	

NOTES 6 & 8

GVX

BVX, BFX (SHT 3)

WX

DMMF

NOTE 7

TURBINE

VIB

FPP

FUEL

OSM

TCP

GTG CONTROL SYSTEM

BVX2, BFX2 (SHT 3)

* VT (2) 14400:120

2

5

BUS POTENTIAL TO SHEET 3

4 TO SHEET 3

* 100 A

* 750 kVA 13800:480

RECOMMENDED SCHEME ONLY

* 1200 A

* 45 kVA 480:208/120

* 45 kVA 480:208/120

* 480 V MOTOR CONTROL CENTER (MCC)

27

LDP

GFEP

LDP #2

HMI

IRIG-B

* CHG #1 — 208 VAC

* 24 VDC CNTRL BATT

* CHG #2 — 208 VAC

* 24 VDC FIRE BATT

* CHG #3 — 208 VAC

* CHG #4 — 208 VAC

* 125 VDC CNTRL BATT

* CHG #5 — 208 VAC

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010

FRACTIONAL ±1/16"

ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

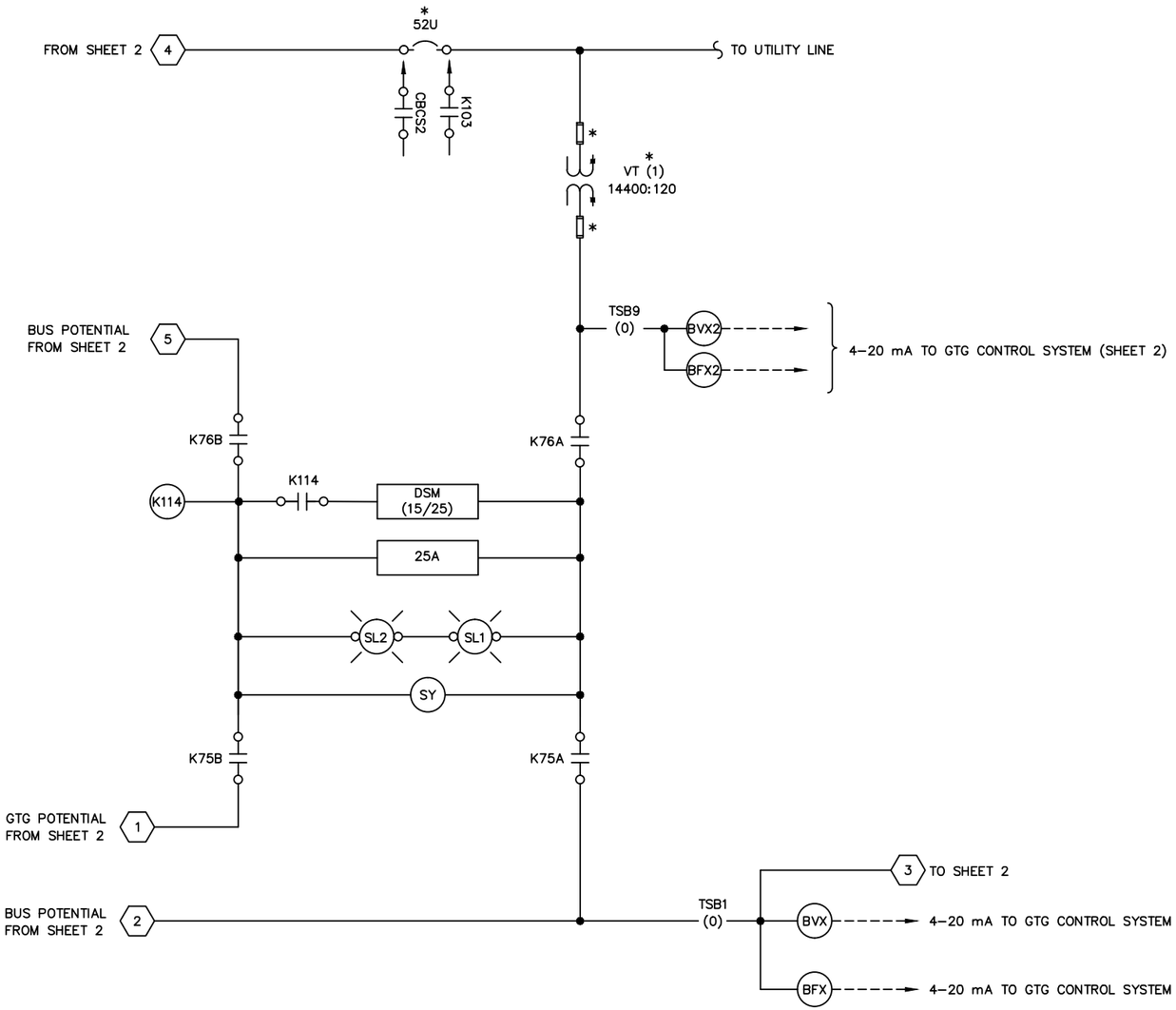
TITLE: ONE LINE DIAGRAM

DWG NO. 7253049-969031

REV. A

SCALE NONE

SHEET 2 OF 3



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
ONE LINE DIAGRAM

DWG NO. 7253049–969031

REV. A

SCALE NONE

SHEET 3 OF 3

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4. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
5. GENERATOR PHASE SEQUENCE IS T1–T2–T3 FOR LEFT HAND LINESIDE CUBICLE OR T4–T5–T6 FOR RIGHT HAND LINESIDE CUBICLE. SEE MAIN UNIT GENERAL ARRANGEMENT FOR LINESIDE PLACEMENT.
6. ALL TERMINAL BLOCKS ARE LOCATED IN THE TURBINE CONTROL PANEL, UNLESS OTHERWISE INDICATED.
7. TEST SWITCHES SHOWN WITH PLUG REMOVED.
8. CUSTOMER TO ENSURE PROPER PHASE ANGLE AND VOLTAGE FOR SYNCHRONIZER OPERATION.
9. CURRENT TRANSFORMERS SHORTED, CUSTOMER TO REMOVE JUMPERS DURING INSTALLATION OF 87B PROTECTION CIRCUIT.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969007	INTERCONNECT WIRING DIAGRAM, CUSTOMER
X–969031	ONE LINE DIAGRAM
X–969037	SYSTEM SCHEMATIC, GENERATOR EXCITATION
X–969041	SCHEMATIC DIAGRAM, CIRCUIT BREAKER CONTROL
X–969769	SCHEMATIC DIAGRAM, MISCELLANEOUS

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UNIT TYPE
LM6000®

ADDL INFO
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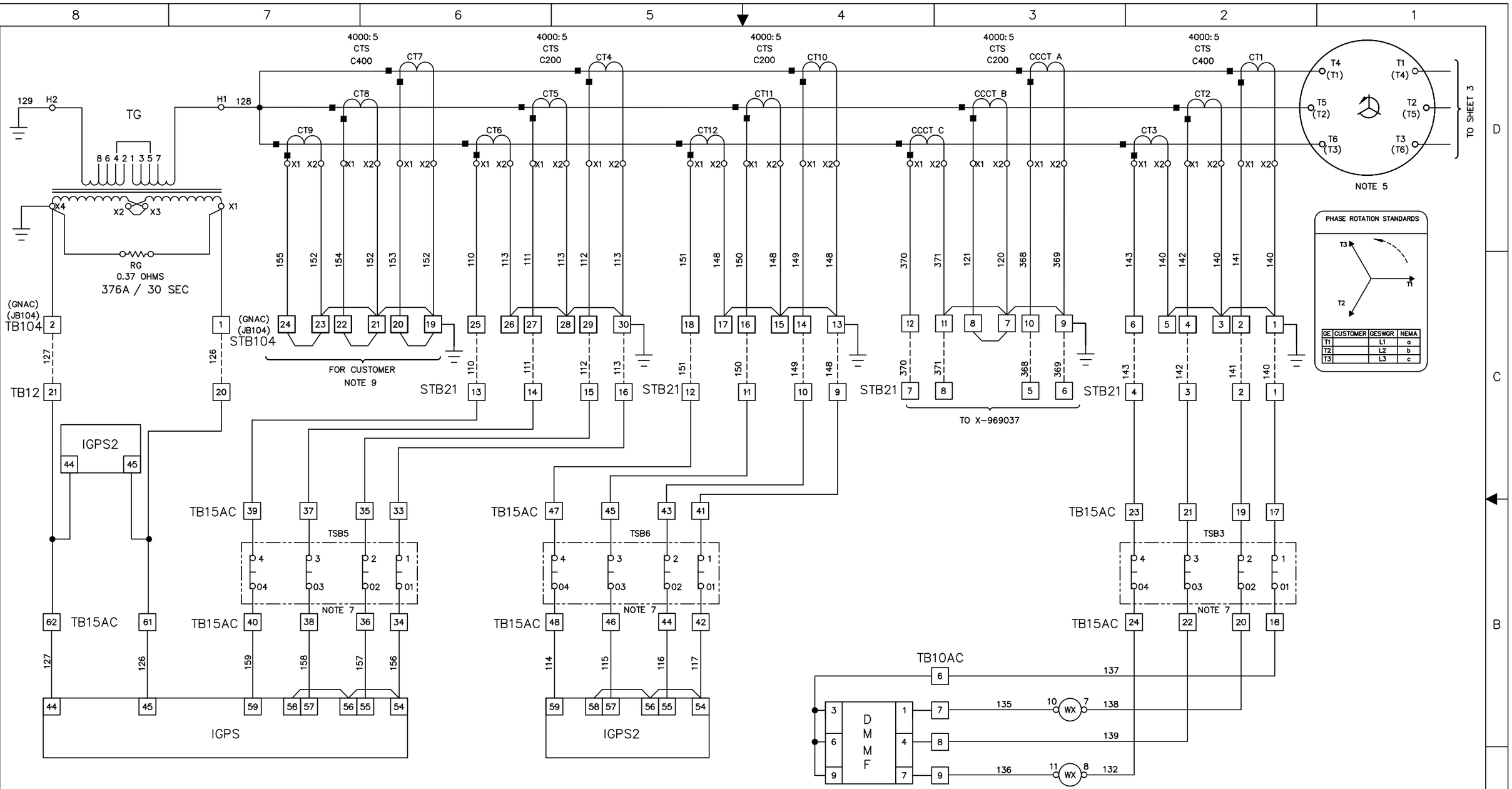
TITLE
THREE LINE DIAGRAM
GENERATOR METERING

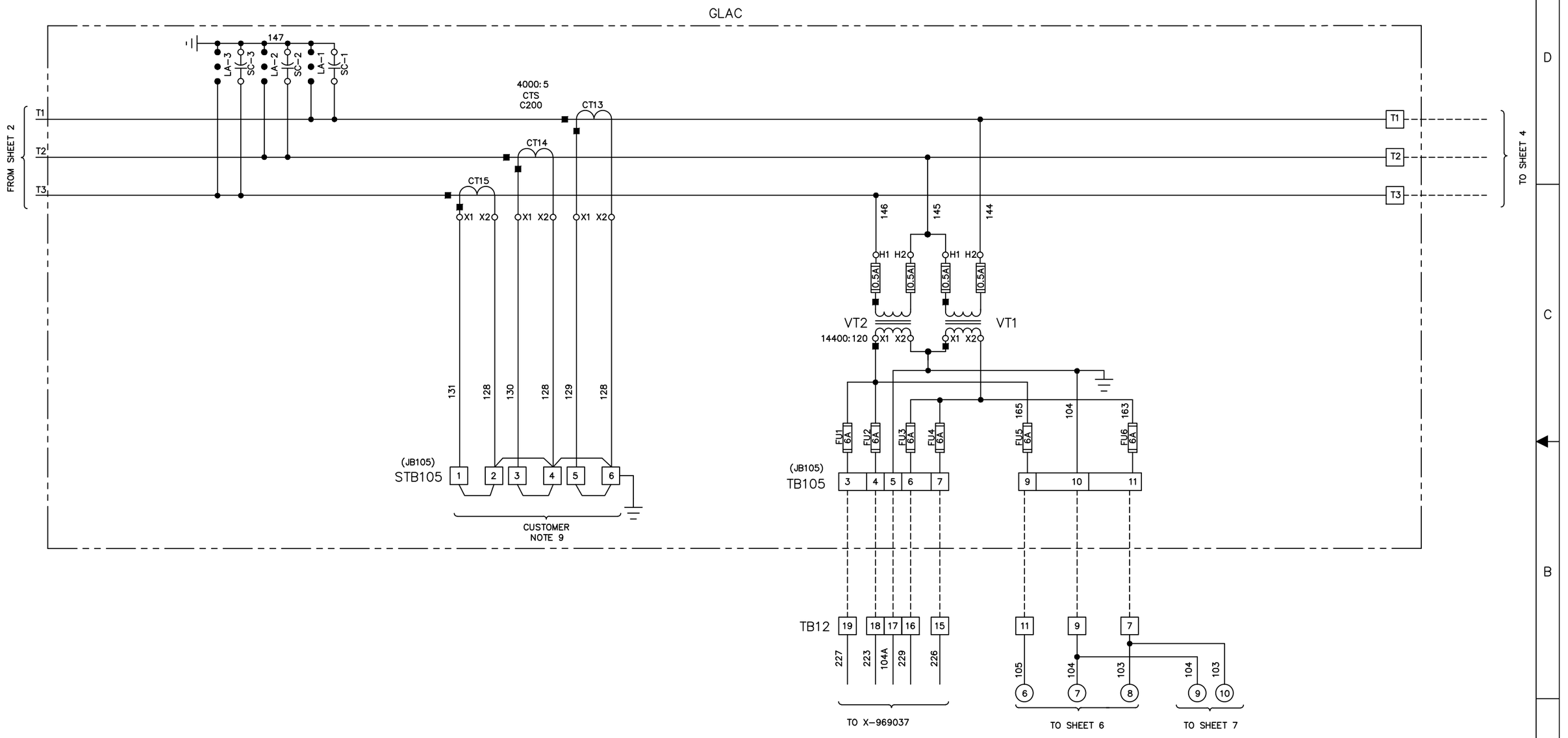
DWG NO. 7253049–969032

REV. A

SCALE NONE

SHEET 1 OF 7


4000:5 CTS C400
4000:5 CTS C200
4000:5 CTS C200
4000:5 CTS C200
4000:5 CTS C400
CT7
CT4
CT10
CCCT A
CT1
CT8
CT5
CT11
CCCT B
CT2
CT9
CT6
CT12
CCCT C
CT3
TG
129 H2
H1 128
8 6 4 2 1 3 5 7
X4 X2 X3 X1
RG
0.37 OHMS
376A / 30 SEC
T4 (T1)
T1 (T4)
T5 (T2)
T2 (T5)
T6 (T3)
T3 (T6)
TO SHEET 3
NOTE 5
PHASE ROTATION STANDARDS
T3
T1
T2
GE CUSTOMER GESWGR NEMA
T1 L1 a
T2 L2 b
T3 L3 c
(GNAC) (JB104) TB104
STB104
FOR CUSTOMER NOTE 9
STB21
TO X-969037
TB12
IGPS2
TB15AC
TSB5
TSB6
TSB3
NOTE 7
IGPS
IGPS2
TB10AC
DMMF
WX
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REV DESCRIPTION ECO DRAWN DATE DESIGN
A ORIGINAL ISSUE 11809 MR 10/09/13 ARA
REVISIONS
THIRD ANGLE PROJECTION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING
TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°
NEXT ASSY.
UNIT TYPE
LM6000®
ADDL INFO
GE CLASS II (INTERNAL)
GE PACKAGED POWER, L.P.
TITLE
THREE LINE DIAGRAM GENERATOR METERING
DWG NO. 7253049-969032
REV. A
SCALE NONE
SHEET 2 OF 7



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GE PACKAGED POWER, L.P.

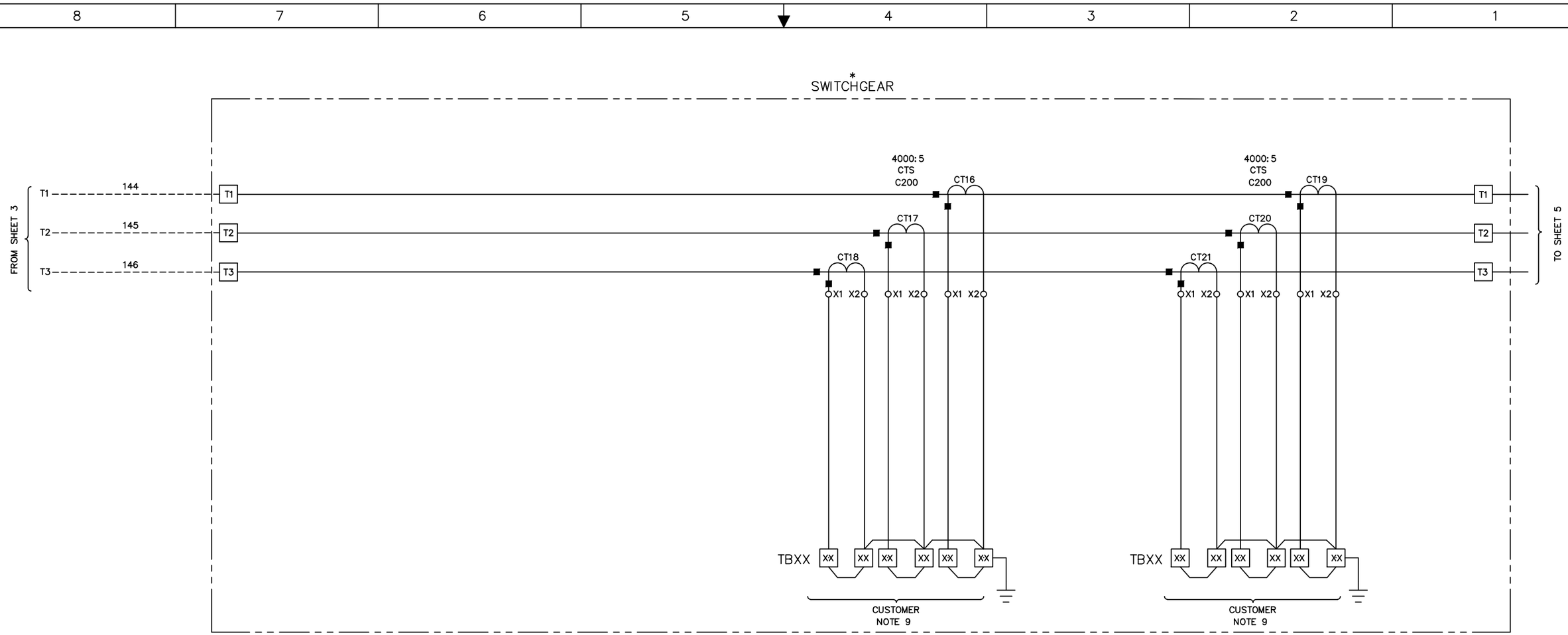
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DWG NO. 7253049-969032

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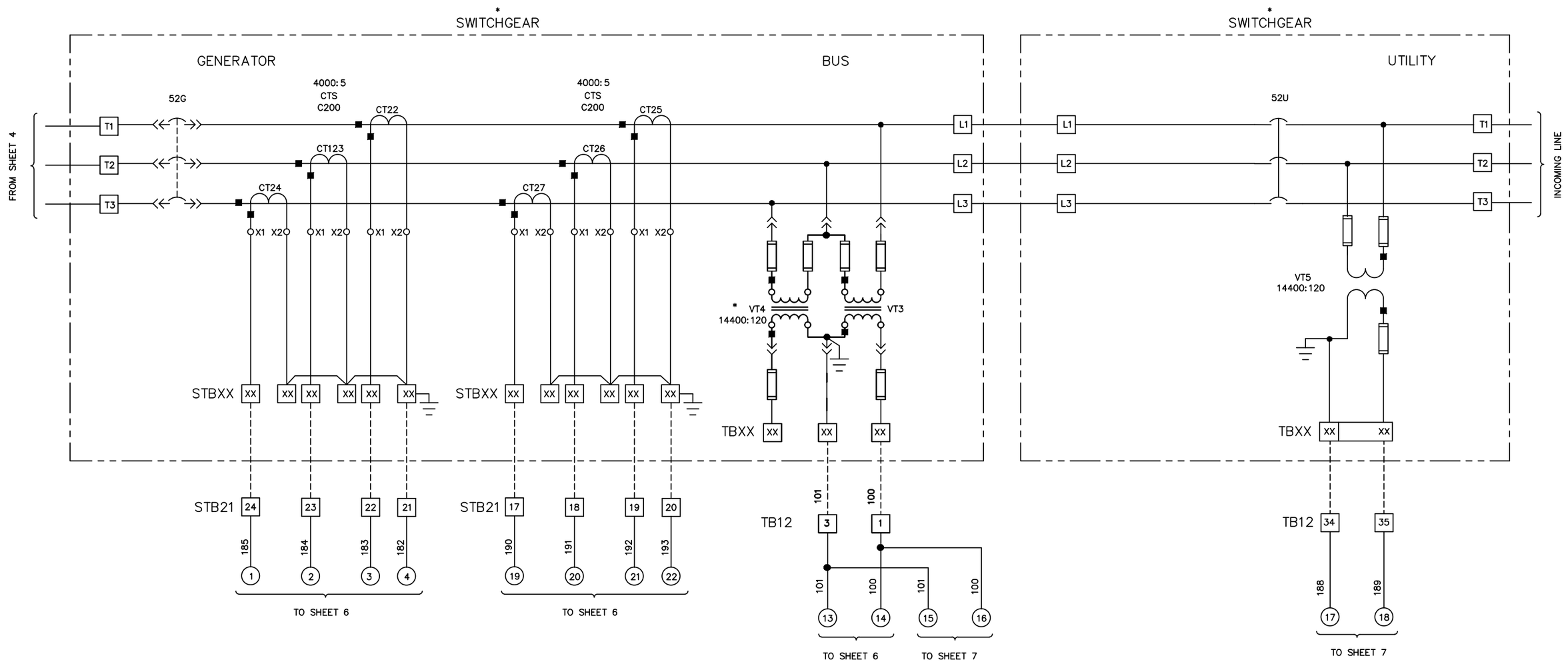
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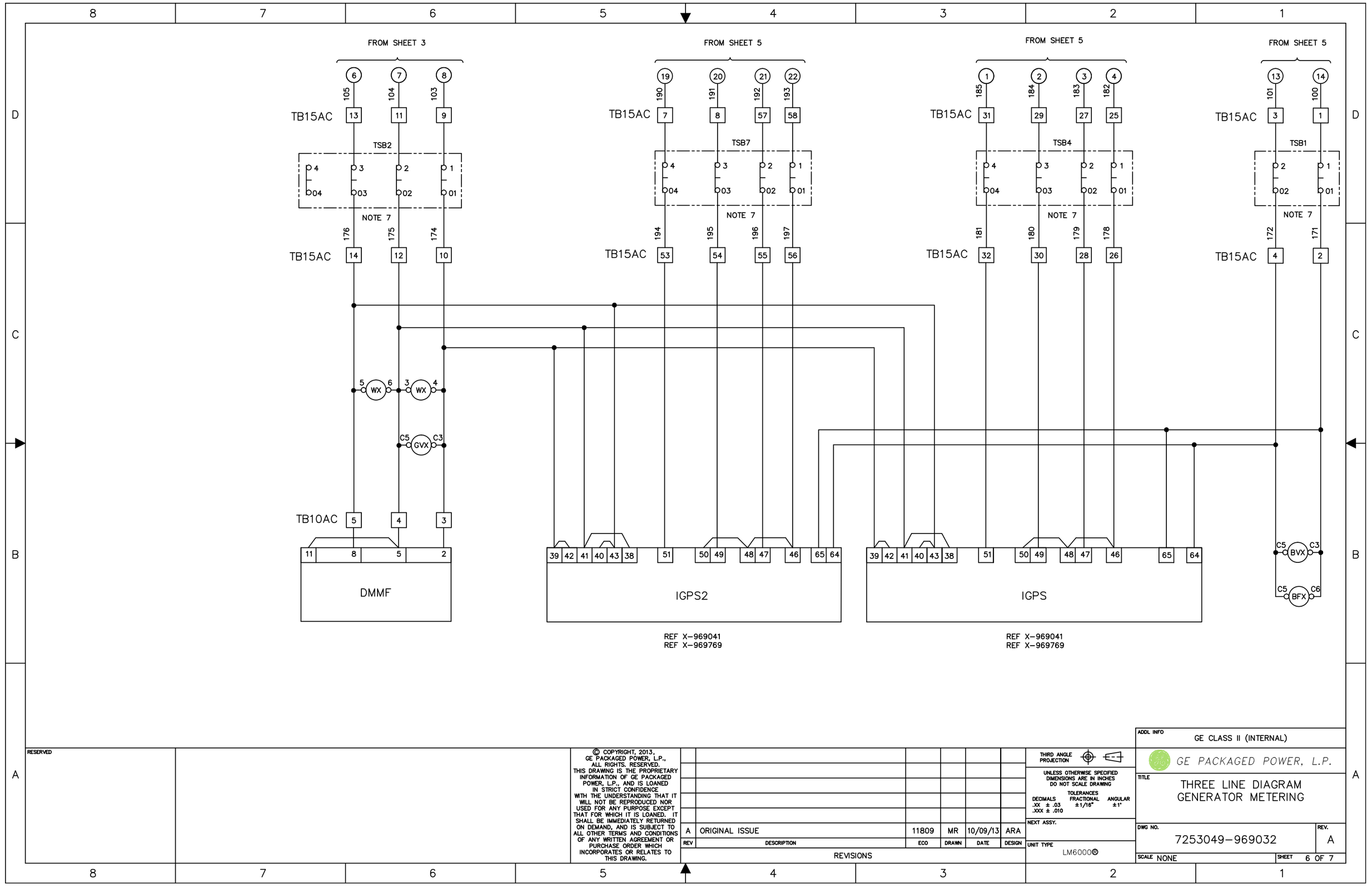
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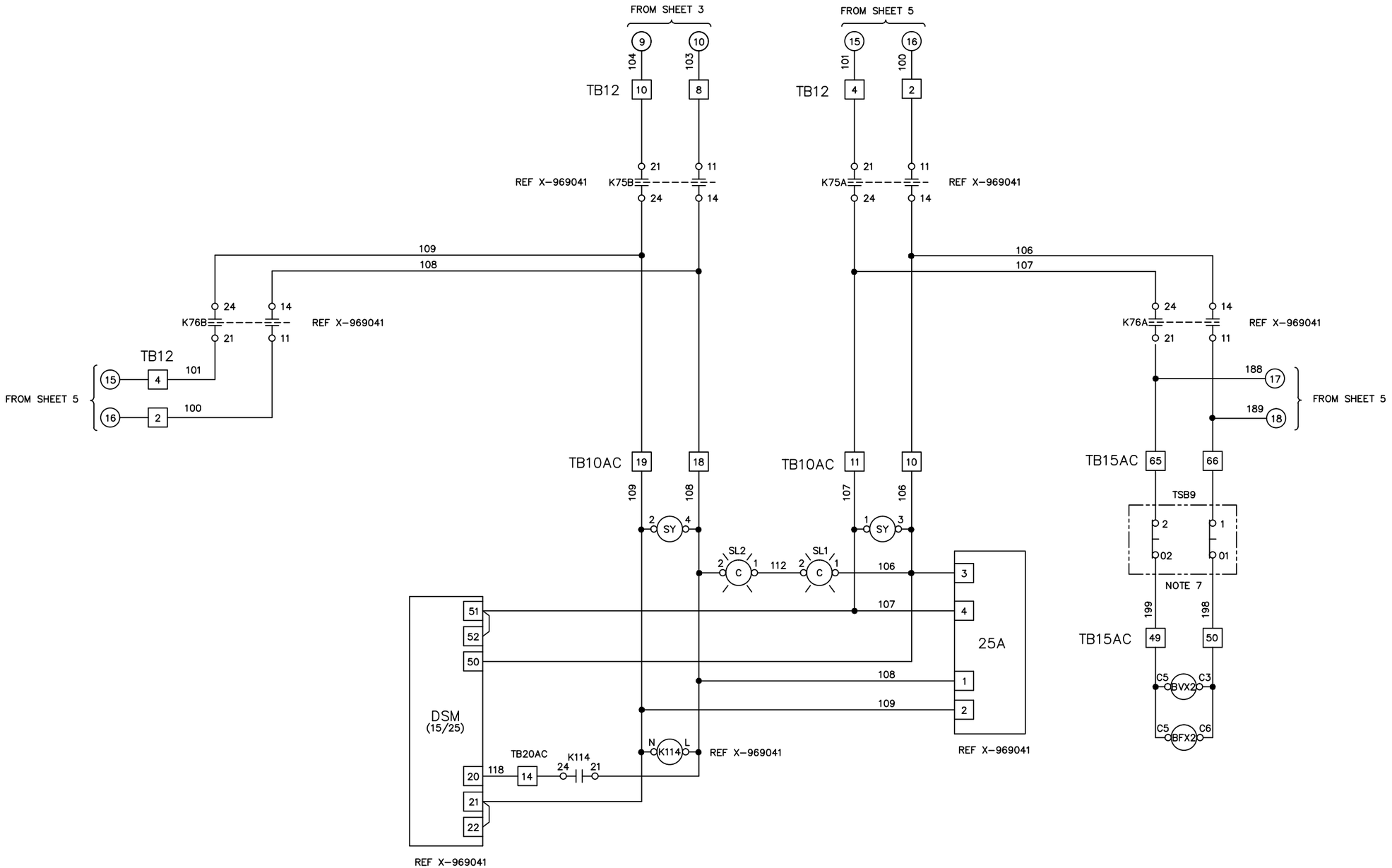
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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: THREE LINE DIAGRAM GENERATOR METERING

DWG NO. 7253049-969032

REV. A

SCALE NONE

SHEET 7 OF 7

REFERENCE DRAWING ONLY
MOTOR CONTROL CENTER IS NOT IN GE PACKAGED POWER, L.P. SCOPE OF SUPPLY

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CUSTOMER:	LM6000 PG/PH
GENERATOR:	**BRUSH**
ENTRY/NEMA:	TOP & BOTTOM / NEMA 1 (12" WIREWAYS)
MOUNTING:	BACK TO BACK
VOLTAGE/ FREQUENCY:	480 V/ 60 Hz
MAIN BUS:	3 PH/3 W/1200 A BUS/1200 A LUGS
INTERRUPTING/BRACINC	65000 A
MAIN CIRCUIT BREAKER	NONE, MLO
TRANSFORMER(S):	ONE (1) 45 kVA , 480: 208/120 V, EXTERNAl ONE (1) 45 kVA , 480: 208/120 V, EXTERNAL (WINTERIZATION OPTION)
OTHER:	(4) 500 kcmil INCOMING CABLES PER PHASE (4) 1/0 AWG INCOMING GROUND CABLES 300 A MIN VERTICAL COPPER MCC LOCATION: CUSTOMER CONTROL HOUSE MANUFACTURED PER GE PACKAGED POWER, L.P. SPECIFICATION 285439 (IF SUPPLIED BY GE PACKAGED POWER, L.P.)
REFERENCE DRAWINGS:	X-969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA X-969044 SCHEMATIC DIAGRAM, MOTOR CONTROL CENTER

ITEM	kW	HP	STARTER TYPE	FLA	AUX	NAMEPLATE INFORMATION	TAG NAME	OPTION	READY TO START STANDBY LOADS	BLACK START LOADS	NORMAL OPERATING LOADS	NORMAL SHUTDOWN LOADS	EMERGENCY SHUTDOWN LOADS
1	5.5 kW		FVC	6.6		GENERATOR STATOR / EXCITER SPACE HEATERS	HE-4050 / 4051		X				
2	15 kW		FVC	18.0		MINERAL LUBE OIL TANK HEATER (NO. 1)	HE-0105		X	X			
3	15 kW		FVC	18.0		MINERAL LUBE OIL TANK HEATER (NO. 2)	HE-0106		X	X			
4	3 kW		FVC	3.6		TURBINE HYDRAULIC STARTER OIL TANK HEATER	HE-6010		X	X			
5	3 kW		FVC	3.6		TURBINE LUBE OIL TANK HEATER	HE-1004		X	X			
6	74.6 kW	100 HP	FVNR	116.0		GENERATOR/GEARBOX ENCLOSURE VENTILATION FAN (A)	MOT-4103A			X	X	X	X
7	74.6 kW	100 HP	FVNR	116.0		GENERATOR/GEARBOX ENCLOSURE VENTILATION FAN (B)	MOT-4103B						
8	93.3 kW	125 HP	FVNR	140.0		TURBINE ENCLOSURE VENTILATION FAN (A)	MOT-4017A			X	X	X	X
9	93.3 kW	125 HP	FVNR	140.0		TURBINE ENCLOSURE VENTILATION FAN (B)	MOT-4017B						
10	29.8 kW	40 HP	FVNR	47.0	1 NO	MINERAL LUBE OIL AC PUMP (A)	MOT-0108A			X	X	X	X
11	29.8 kW	40 HP	FVNR	47.0	1 NO	MINERAL LUBE OIL AC PUMP (B)	MOT-0108B						
12	11.2 kW	15 HP	FVNR	18.3	1 NO	GENERATOR JACKING OIL PUMP	MOT-0085			X			
13	2.2 kW	3 HP	FVNR	3.9		MINERAL LUBE OIL AIR/OIL SEPARATOR FAN	MOT-0110			X	X	X	X
14	22.4 kW	30 HP	FVNR	36.5		GEARBOX TURNING GEAR	MOT-0129	SEE NOTE 3		X			
15	0.75 kW	1 HP	FVNR	1.5		TURBINE AIR/OIL SEPARATOR HEAT EXCHANGER FAN	MOT-1083			X	X	X	X
16	3.7 kW	5 HP	FVNR	6.2		TURBINE WATER WASH PUMP	MOT-5035						
17	149.2 kW	200 HP	FVNR	222.0	1 NC	TURBINE HYDRAULIC STARTER PUMP	MOT-6015			X		X	X
18	2.2 kW	3 HP	FVNR	3.9		TURBINE HYDRAULIC STARTER OIL HEAT EXCHANGER FAN	MOT-6016			X		X	X
19	0.75 kW	1 HP	FVNR	1.5		AUXILIARY SKID ENCLOSURE VENTILATION FAN (A)	MOT-4027A			X	X	X	X
20	0.75 kW	1 HP	FVNR	1.5		AUXILIARY SKID ENCLOSURE VENTILATION FAN (B)	MOT-4027B						

ITEM	kW	HP	STARTER TYPE	FLA	AUX	NAMEPLATE INFORMATION	TAG NAME	OPTION	READY TO START STANDBY LOADS	BLACK START LOADS	NORMAL OPERATING LOADS	NORMAL SHUTDOWN LOADS	EMERGENCY SHUTDOWN LOADS
21	45 kVA			54.0		LIGHTING AND DISTRIBUTION PANEL	208Y/120 V 3PH 4W 42 CKTS		X	X	X	X	X
22				125.0		LIGHTING AND DISTRIBUTION BREAKER							
23	45 kVA			54.0		LIGHTING AND DISTRIBUTION PANEL #2	208Y/120 V 3PH 4W 42 CKTS		X	X	X	X	X
24				125.0		LIGHTING AND DISTRIBUTION BREAKER #2							
25	131 kW	175 HP	SR DRIVE	180.0		TURBINE NOX WATER INJECTION PUMP (NO. 1) BREAKER	MOT-2181				X		
26	131 kW	175 HP	SR DRIVE	180.0		TURBINE NOX WATER INJECTION PUMP (NO. 2) BREAKER	MOT-2193						
27	7.5 kW	10 HP	FVNR	12.7	1 NO	SPRINT WATER SUPPLY PUMP	MOT-2100				X		
28	9 kW		FVC	10.8		TURBINE WATER WASH TANK HEATER (NO. 1)	HE-5036						
29	9 kW		FVC	10.8		TURBINE WATER WASH TANK HEATER (NO. 2)	HE-5044						
30	50 kW		FVC	60.2		TURBINE ENCLOSURE SPACE HEATERS	HE-4052/HE-4057		X	X			
31	25 kW		FVC	30.1		GENERATOR/GEARBOX ENCLOSURE SPACE HEATERS	HE-4058/HE-4059/HE-4216		X	X			
32	10 kW		FVC	12.0		AUXILIARY SKID ENCLOSURE SPACE HEATER	HE-4039		X	X			
33	1.5 kW	2 HP	FVNR	1.8		TURBINE ENCLOSURE HEATED AIR FLOW DISTRIBUTION BLOWER	MOT-4187		X	X			

	TOTAL READY TO START STANDBY LOAD (KW)	TOTAL BLACK START LOAD (KW)	TOTAL NORMAL OPERATING LOAD (KW)	TOTAL NORMAL SHUTDOWN LOAD (KW)	TOTAL EMERGENCY SHUTDOWN LOAD (KW)
GAS OPERATION	241	577	**430**	**443**	**443**

NOTES: **1) LOAD VALUES ARE MINIMUM REQUIRED AND DO NOT REFLECT ADDED MARGINS TO SIZE BLACKSTART DIESEL.**
2) MOTOR CONTROL CENTER VENDOR TO PROVIDE AN AC VOLTAGE RELAY DEVICE 27 (LOSS OF VOLTAGE) RELAY, WITH TIME DELAY FROM 0 TO 5 SEC.
3) STARTER OVERLOAD FOR MOT-0129 MUST MEET IEC TRIP CLASS 30.
4) MOTOR CONTROL CENTER VENDOR TO PROVIDE GROUND FAULT EQUIPMENT PROTECTION (GFEP) (LEAKAGE CURRENT OF 30 mA) FOR LIGHTING & DISTRIBUTION PANEL #2.
5) SR DRIVE IS RATED TO 10kA AND NEEDS TO HAVE A BREAKER RATED FOR THIS APPLICATION OR ADDITIONAL FUSES OR BREAKERS TO COMPLY.

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
4. ALL TERMINAL BLOCKS ARE LOCATED IN THE TURBINE CONTROL PANEL, UNLESS OTHERWISE INDICATED.
5. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS

   XX/XX/XX
   - EXAMPLE: 1/03/04
   - CHANNEL
   - BOARD
   - CHASSIS
6. INDICATION OF ROTOR GROUND FAULT SHOWN HEALTHY.
7. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969032	THREE LINE DIAGRAM, GENERATOR METERING
X–969041	SCHEMATIC DIAGRAM, CIRCUIT BREAKER CONTROL
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969934	SYSTEM SCHEMATIC, COMMUNICATION

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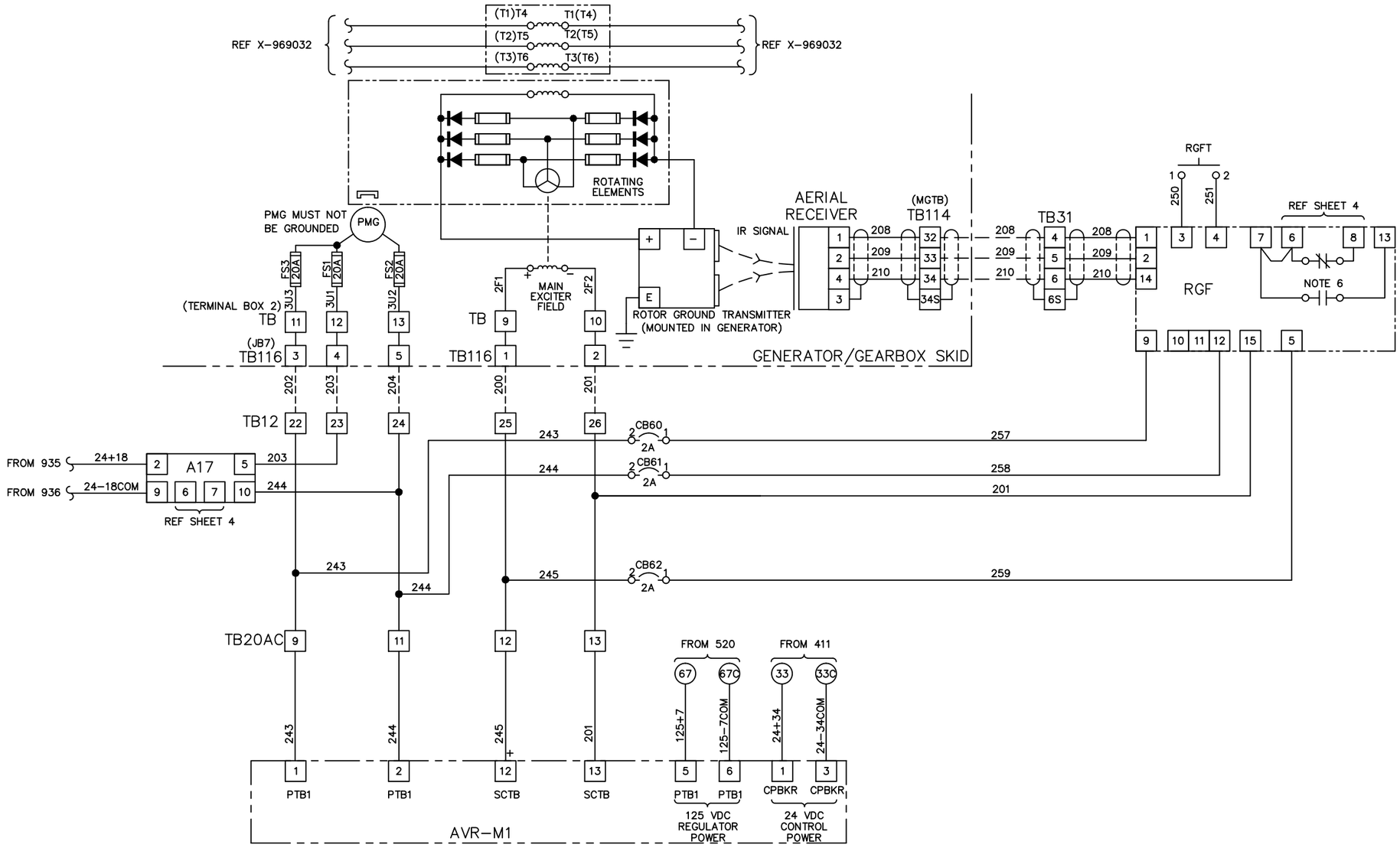
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GENERATOR EXCITATION

DWG NO. 7253049–969037

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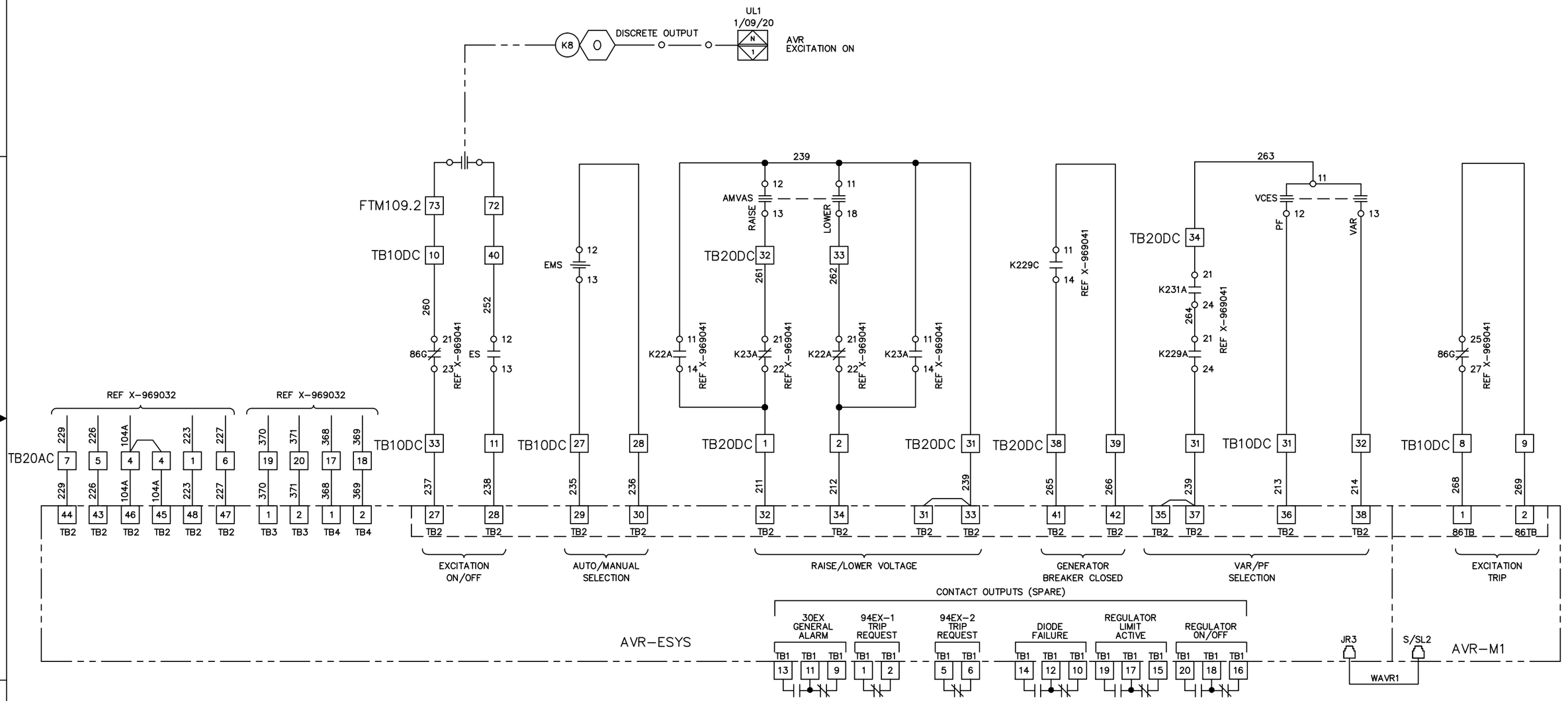
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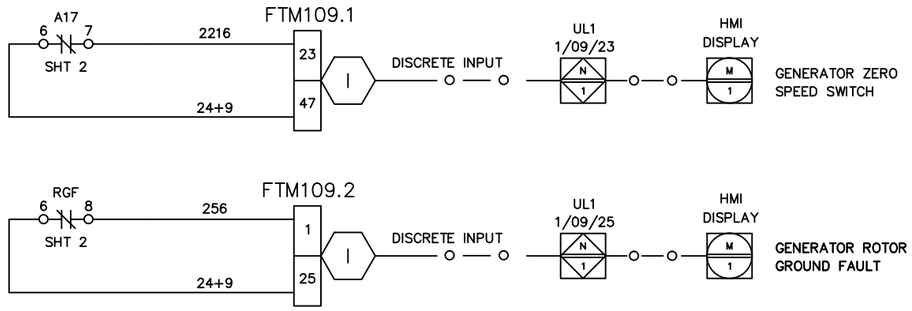
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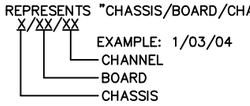
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3. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



4. * = FURNISHED BY OTHERS. ITEMS MAY VARY BUT ARE SHOWN TO ATTEMPT CLARITY OF PERSPECTIVE ON THIS DRAWING ONLY.
5. ALL DEVICES SHOWN DE-ENERGIZED (SHELF STATE).
6. ALL TERMINAL BLOCKS ARE LOCATED IN THE TURBINE CONTROL PANEL, UNLESS OTHERWISE INDICATED.
7. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
8. CURRENT TEST SWITCHES SHOWN WITH PLUG REMOVED.
9. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X-969767.
10. FOR 6XXX SERIES REFERENCE LINE NUMBERS, SEE X-969768.

LEGEND:

SEE X-969005

REFERENCE DRAWINGS:

X-969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X-969032 THREE LINE DIAGRAM, GENERATOR METERING
X-969037 SYSTEM SCHEMATIC, GENERATOR EXCITATION
X-969767 SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X-969768 SCHEMATIC DIAGRAM, CRITICAL SHUTDOWN PATH

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	COR	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO

GE PACKAGED POWER, L.P.

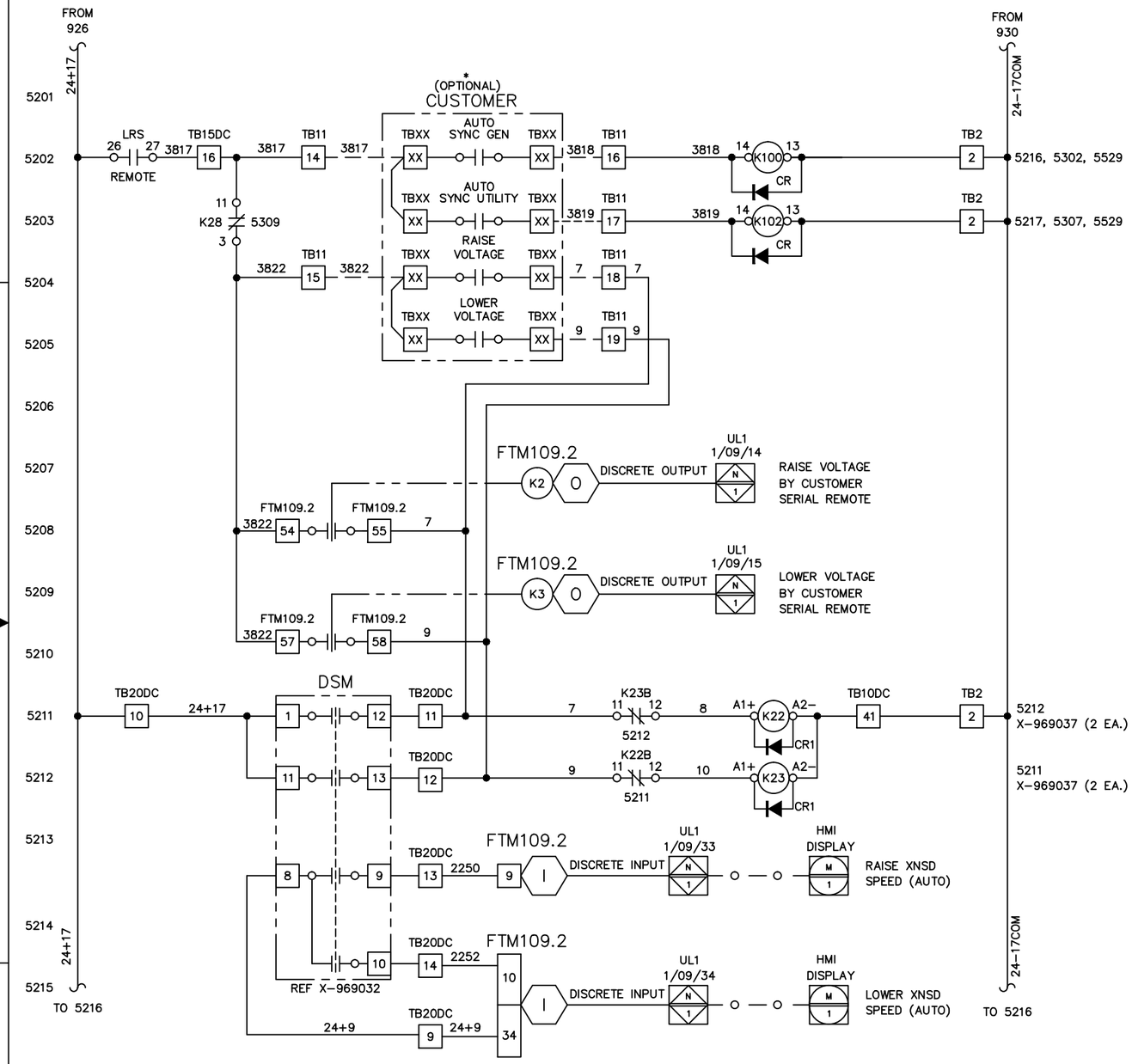
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CIRCUIT BREAKER CONTROL

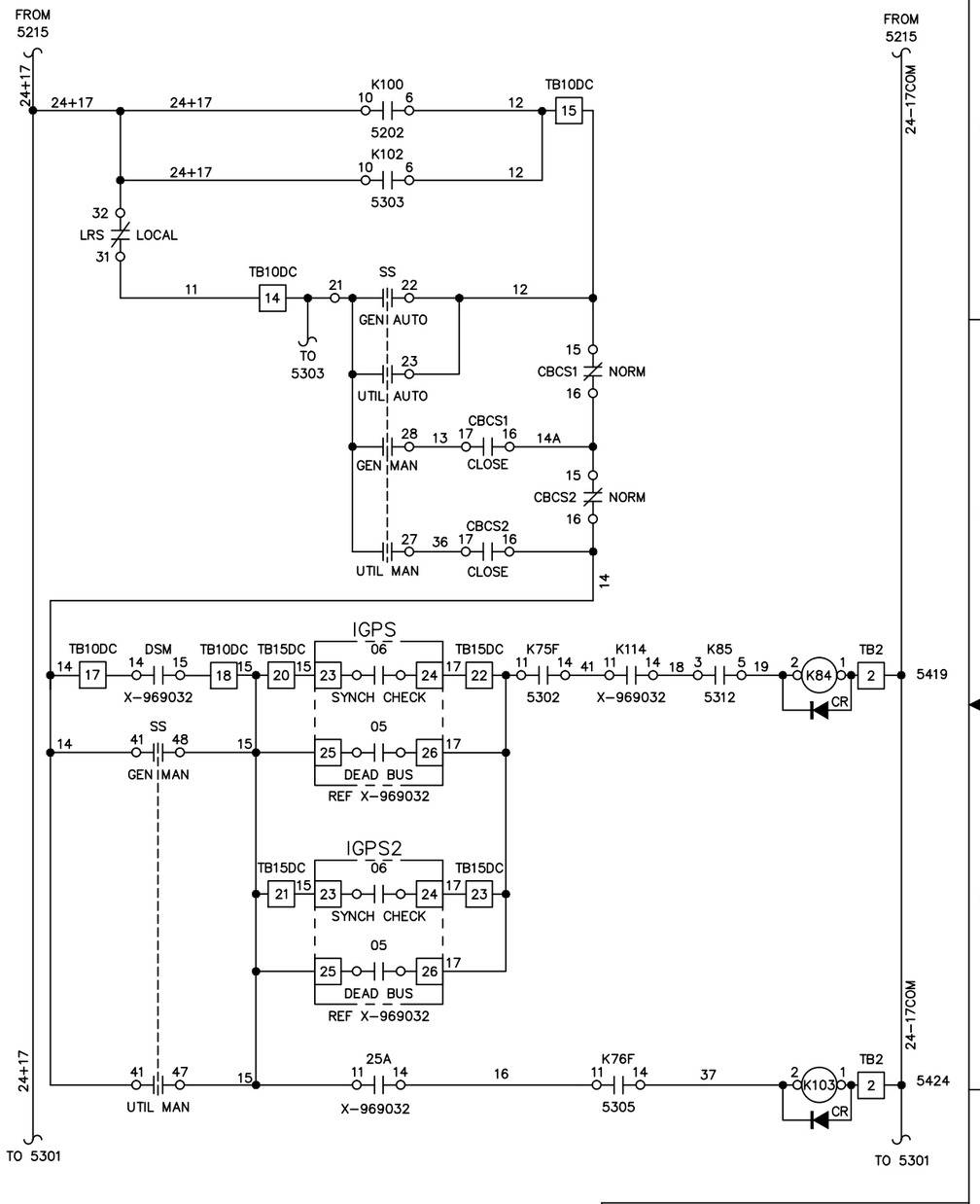
DWG NO. 7253049-969041

REV. A

SCALE NONE

SHEET 1 OF 5





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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO

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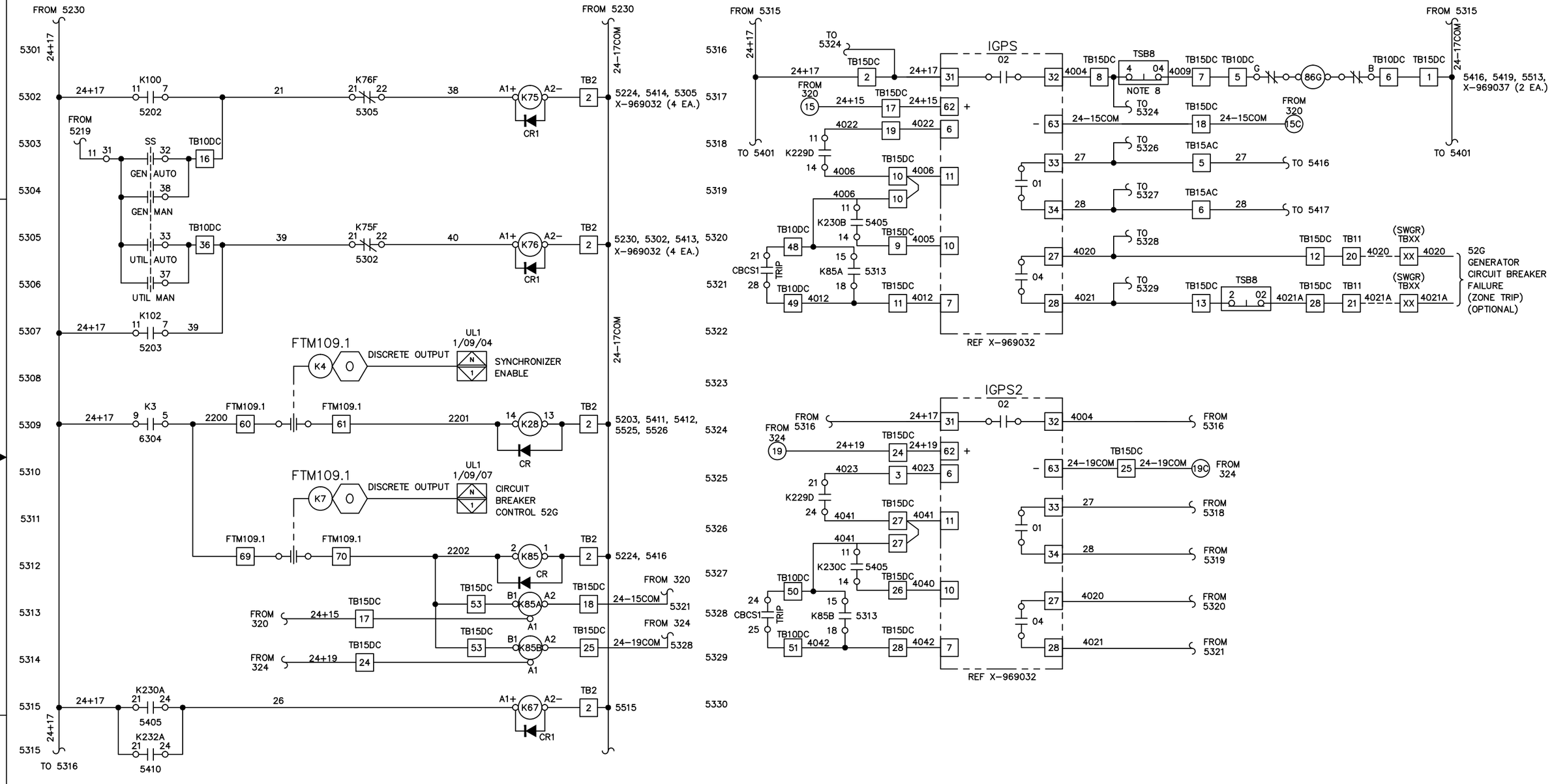
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SCHEMATIC DIAGRAM
CIRCUIT BREAKER CONTROL

DWG NO. 7253049-969041

REV. A

SCALE NONE

SHEET 2 OF 5



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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO

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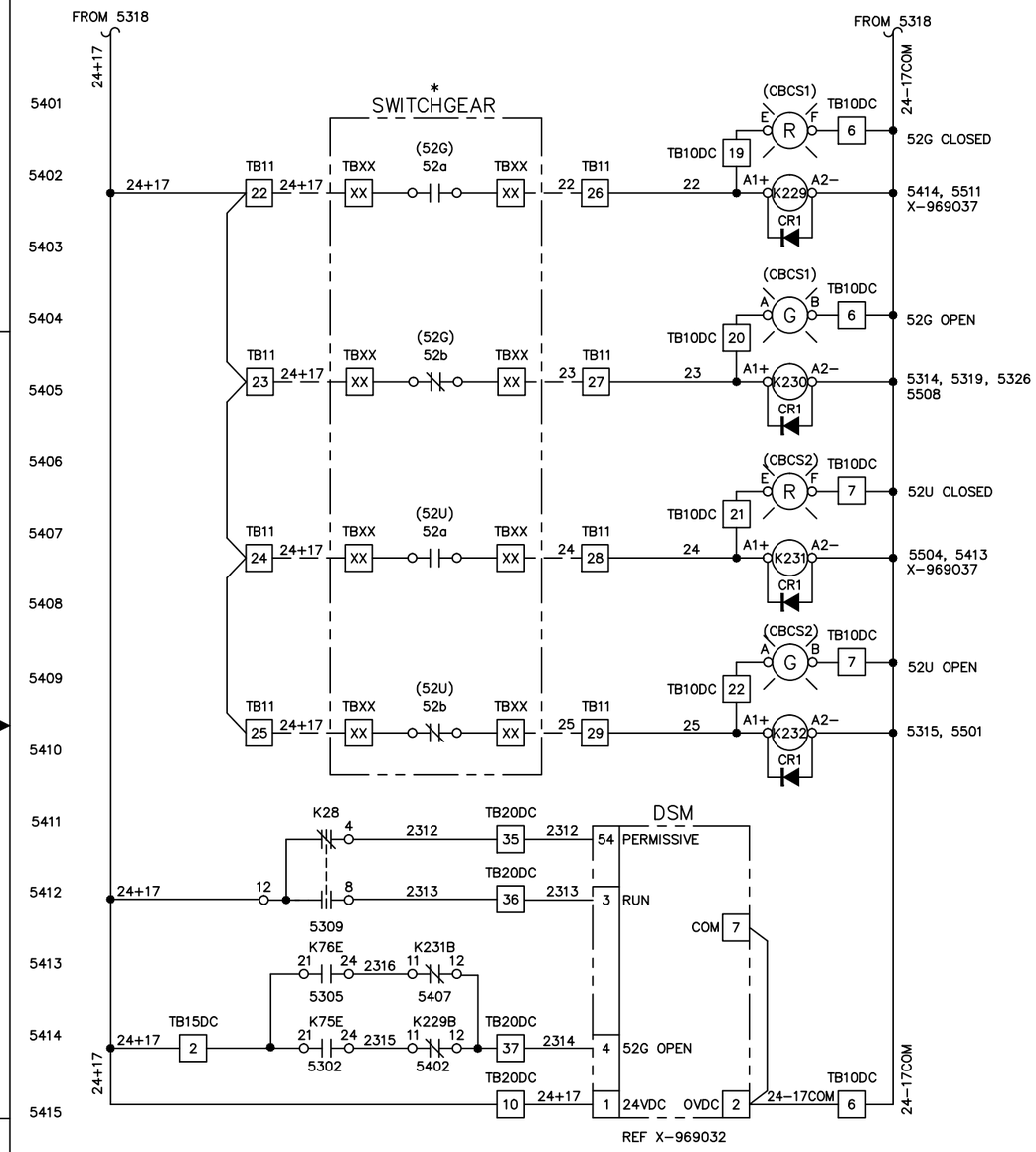
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CIRCUIT BREAKER CONTROL

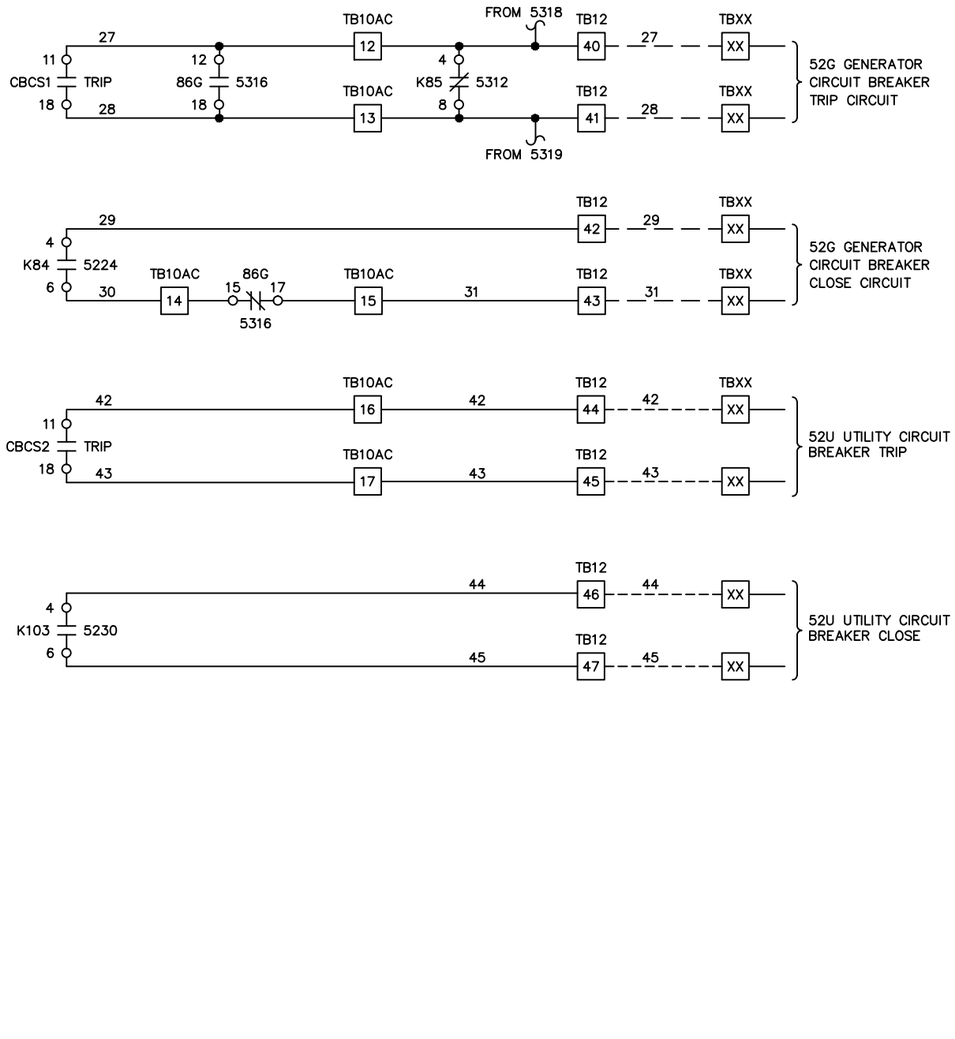
DWG NO. 7253049–969041

REV. A

SCALE NONE

SHEET 3 OF 5





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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO

GE PACKAGED POWER, L.P.

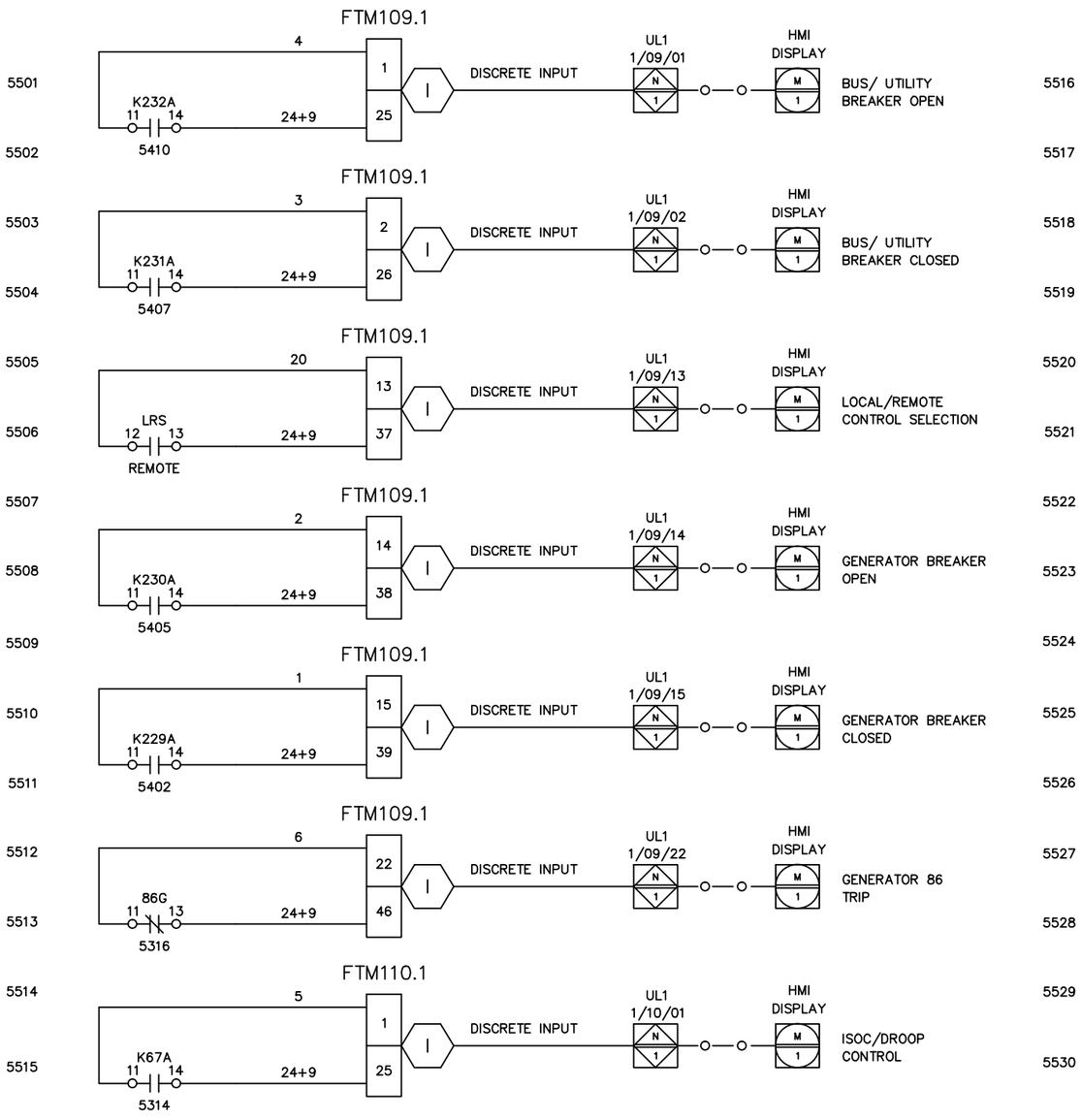
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SCHEMATIC DIAGRAM
CIRCUIT BREAKER CONTROL

DWG NO. 7253049–969041

REV. A

SCALE NONE

SHEET 4 OF 5



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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
SCHEMATIC DIAGRAM
CIRCUIT BREAKER CONTROL

DWG NO. 7253049-969041

REV. A

SCALE NONE

SHEET 5 OF 5

NOTES:

1. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
2. ALL DEVICES SHOWN DE–ENERGIZED (SHELF STATE).
3. FC #/##/## (1/10/45) REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS.
4. NOT USED.
5. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
6. SET RELAY AT 30 mA, WHERE INDICATED.
7. SEE SUPPLIER DRAWING FOR DETAILS ON INTERNAL WIRING, WHERE INDICATED.
8. THERMAL CUTOUT REQUIRES MANUAL RESET WHERE INDICATED.
9. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
10. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.
11. FOR 6XXX SERIES REFERENCE LINE NUMBERS, SEE X–969768.
12. SR DRIVE IS RATED TO 10 kA AND NEED TO HAVE A BREAKER RATED FOR THIS APPLICATION OR ADDITIONAL FUSES OR BREAKERS TO COMPLY.
13. APPLICABLE STANDARD SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
14. LIGHTING AND DISTRIBUTION PANEL IS TYPICAL, MAY VARY PER CUSTOMER REQUIREMENTS.
15. ALL GROUND WIRES TO BE GRN/YEL 10 AWG, TYPE TFE STRANDED OR EQUAL, 600V, UNLESS OTHERWISE INDICATED.
16. INSURE LINKS ARE INSTALLED TO MAKE MOTOR CONNECTION DELTA.
17. ALL BREAKERS ARE "B" TRIP CURVE, UNLESS NOTED OTHERWISE.
18. ALL MOTORS DELTA WIRED, CONSULT MANUFACTURES DATA FOR WIRING DETAILS.
19. MOTOR RATING TOLERANCE IS +/– 1% OF LISTED VALUE.
20. #/##/##–KXX (1/13/3–K3) REPRESENTS CONTROL SYSTEM RELAY CONTACT OUTPUT & ITS ADDRESS.
21. FOR HAND–MANUAL OPERATION DURING COMMISSIONING AND/OR WHEN CONTROL SYSTEM IS NOT POWERED UP, INSERT CONTROLLED LOTO JUMPER AT IDENTIFIED TERMINAL POINTS IN TCP. MUST ENSURE OIL LEVEL IS ADEQUATE PRIOR TO OPERATION OF OIL TANK HEATER SYSTEM. WHEN HAND–MANUAL OPERATIONS ARE COMPLETE, REMOVE CONTROLLED LOTO JUMPER.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS AND REFERENCE DATA
X–969007	INTERCONNECT WIRING DIAGRAM, CUSTOMER
X–969035	SCHEDULE, MOTOR CONTROL CENTER
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969768	SCHEMATIC DIAGRAM, CRITICAL SHUTDOWN PATH

REFERENCE DRAWING ONLY
MOTOR CONTROL CENTER IS NOT IN GEPPLP SCOPE OF SUPPLY

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

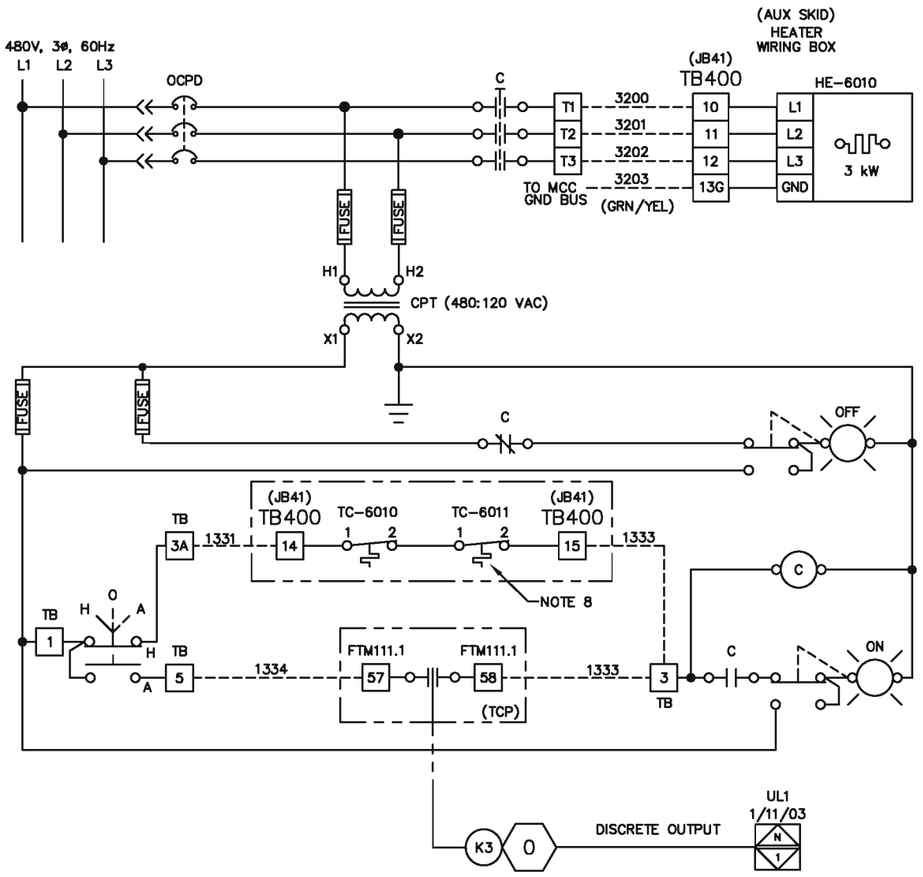
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DWG NO. 7253049–969044

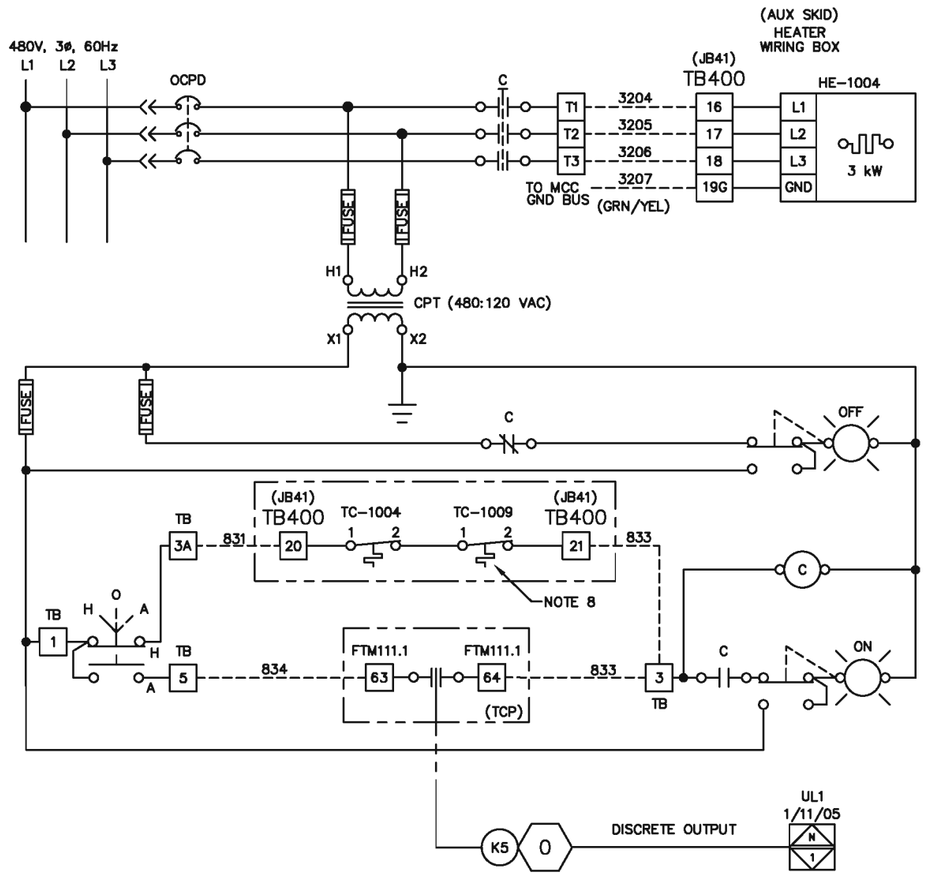
REV. A

SCALE NONE

SHEET 1 OF 23



HEATER ELEMENT–TURBINE HYDRAULIC STARTER OIL TANK



HEATER ELEMENT–TURBINE LUBE OIL TANK

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

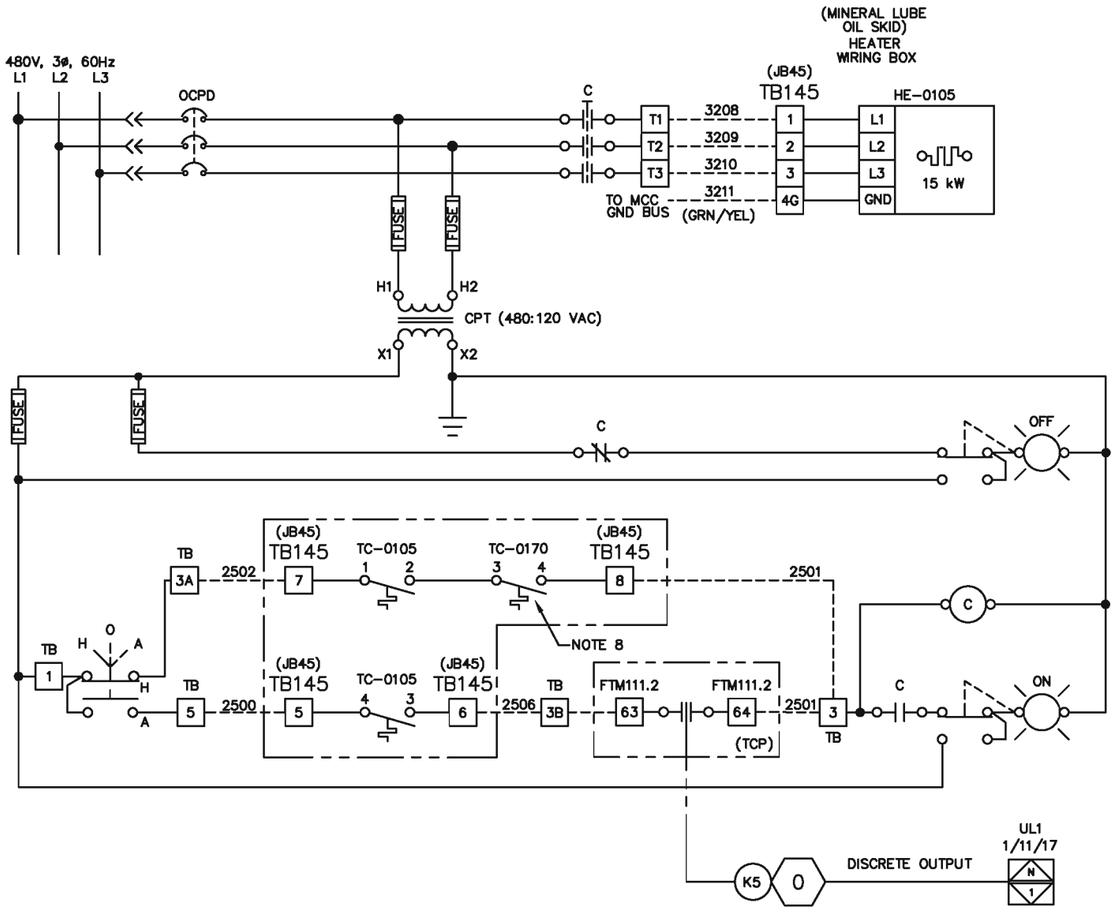
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SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

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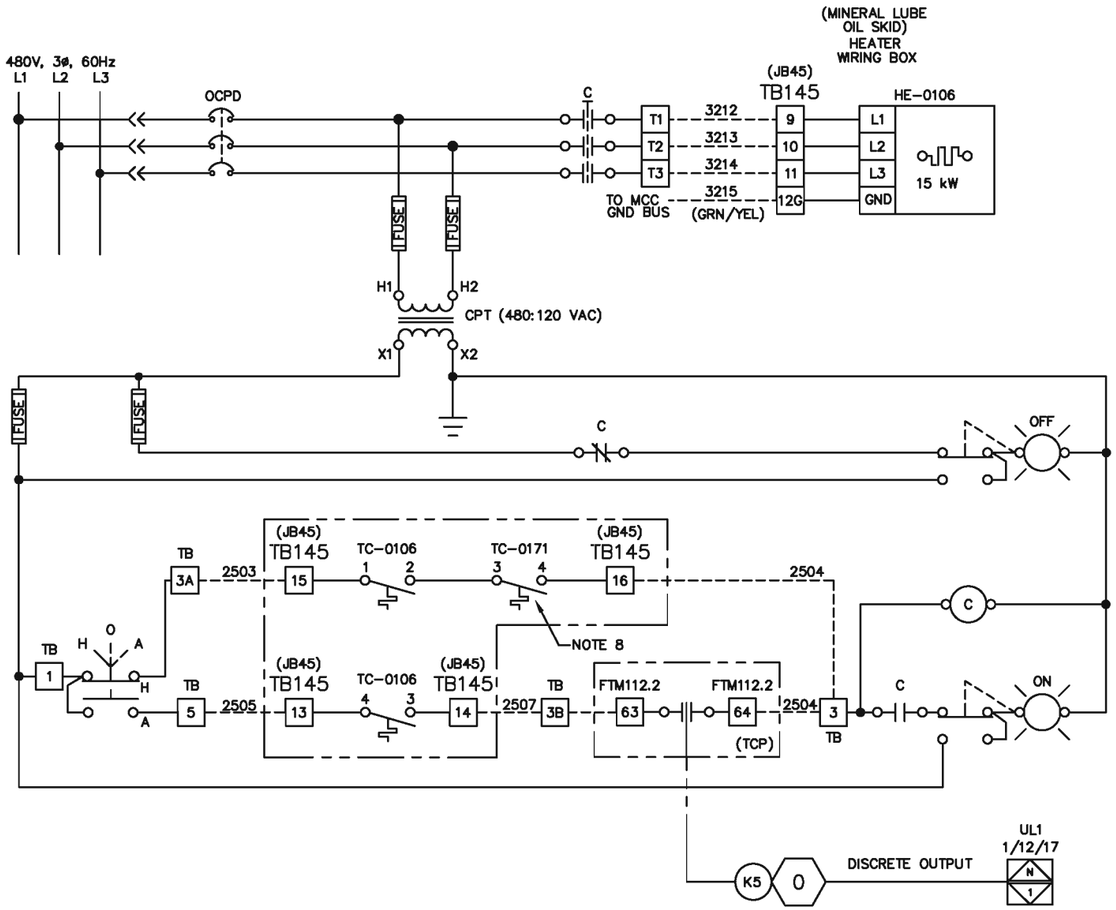
REV. A

SCALE NONE

SHEET 2 OF 23



HEATER ELEMENT–MINERAL LUBE OIL TANK (HEATER NO. 1)



HEATER ELEMENT–MINERAL LUBE OIL TANK (HEATER NO. 2)

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

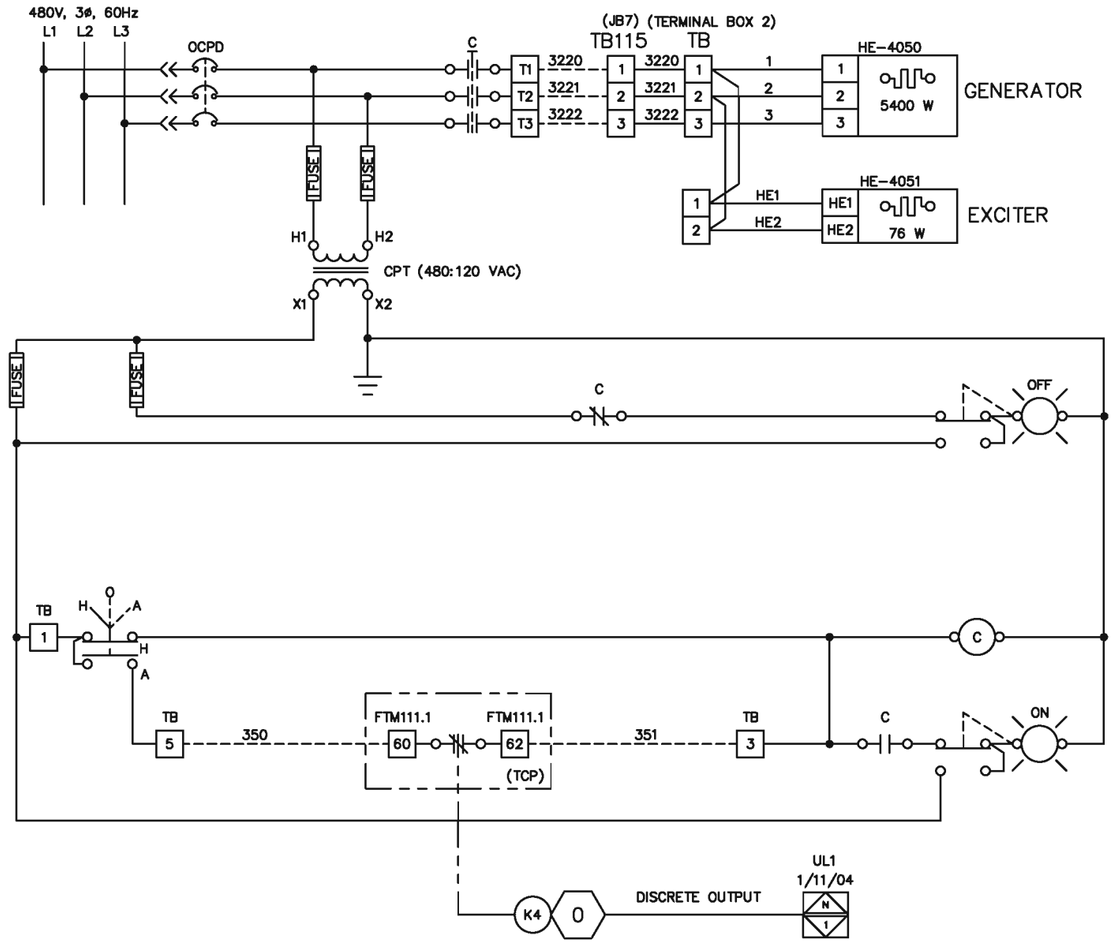
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SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

REV. A

SCALE NONE

SHEET 3 OF 23



HEATER ELEMENT–GENERATOR STATOR/EXCITER SPACE

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

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GE PACKAGED POWER, L.P.

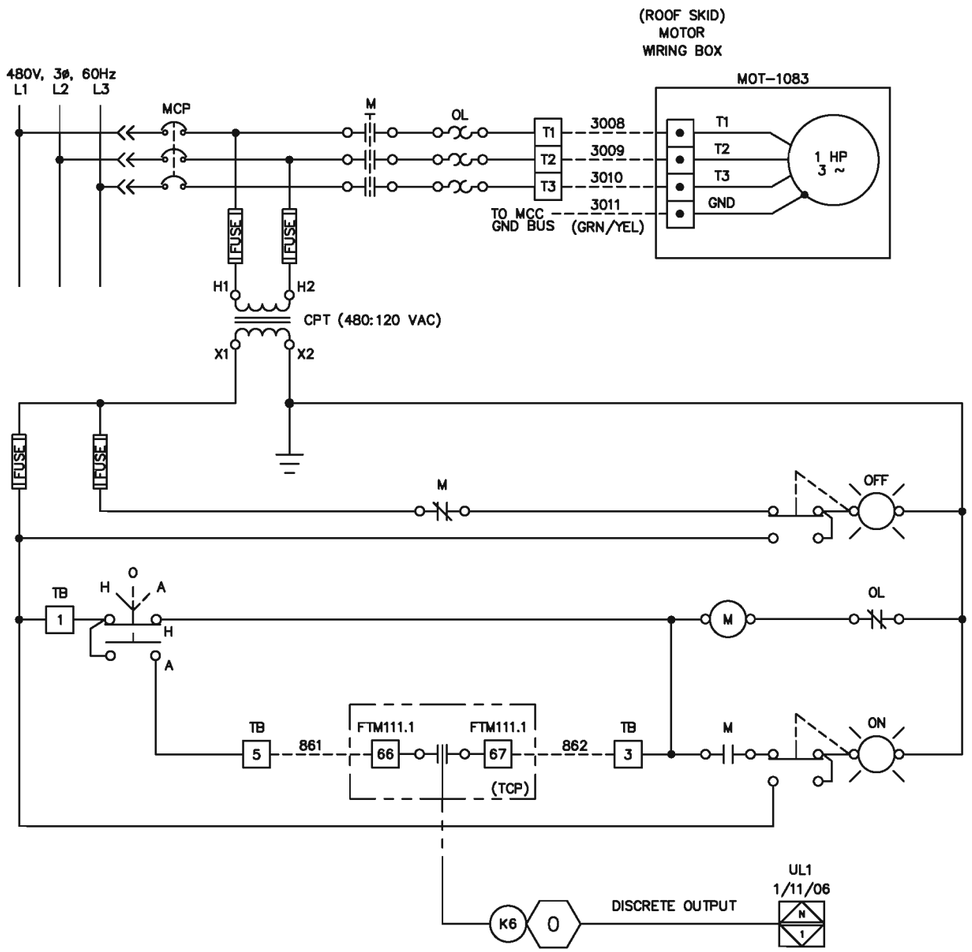
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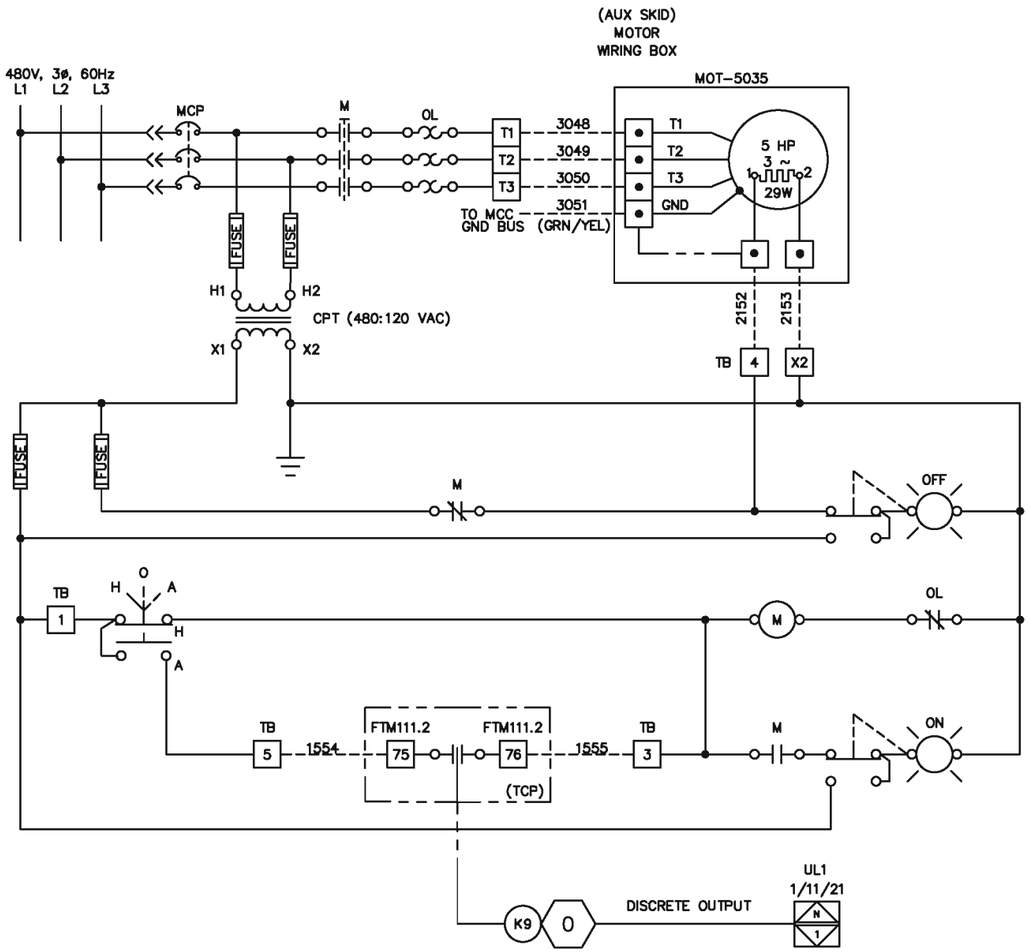
REV. A

SCALE NONE

SHEET 4 OF 23



MOTOR–TURBINE AIR/OIL SEPARATOR HEAT EXCHANGER FAN



MOTOR–TURBINE WATER WASH PUMP

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

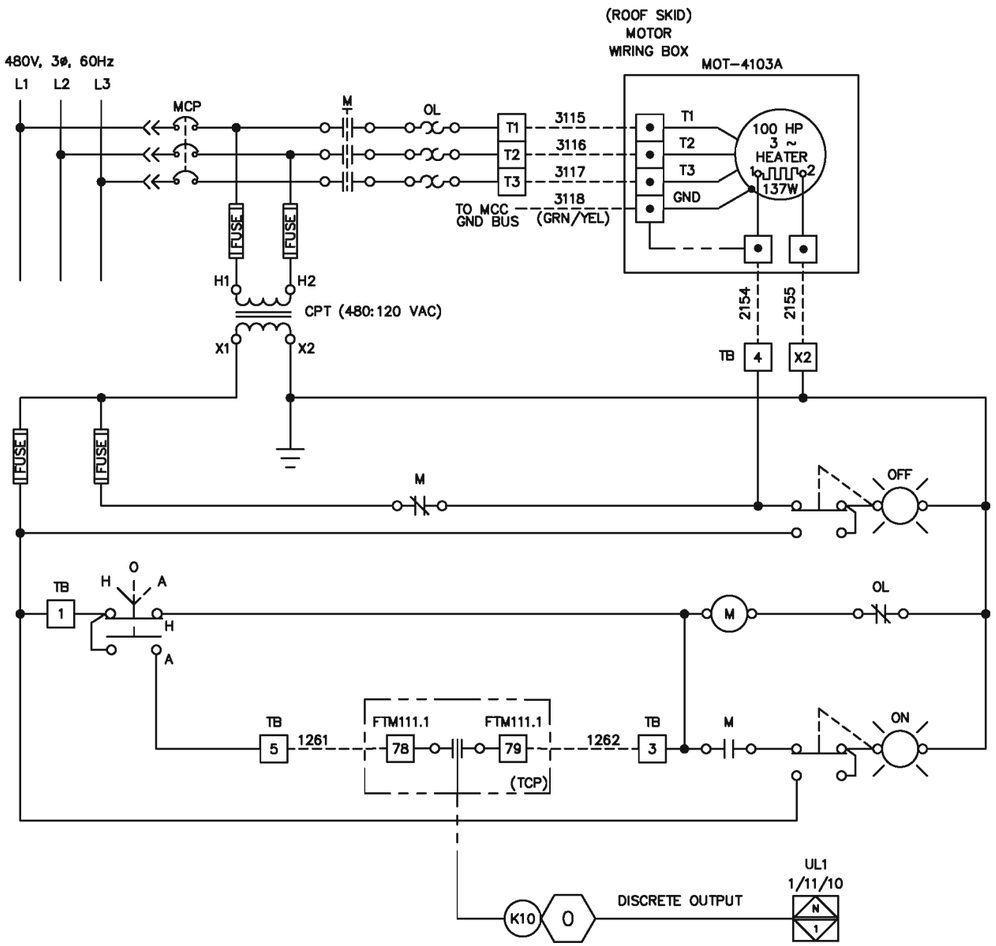
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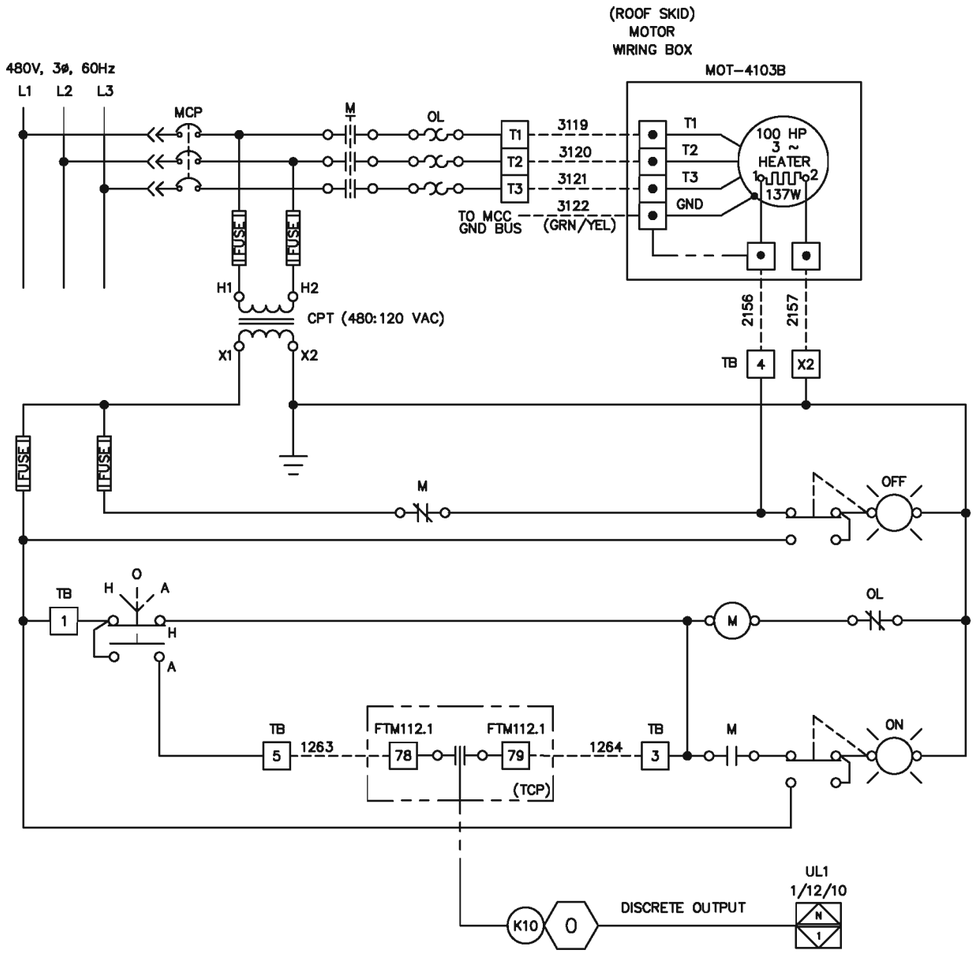
REV. A

SCALE NONE

SHEET 5 OF 23



MOTOR-GENERATOR/GEARBOX ENCLOSURE VENTILATION FAN (A)



MOTOR-GENERATOR/GEARBOX ENCLOSURE VENTILATION FAN (B)

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

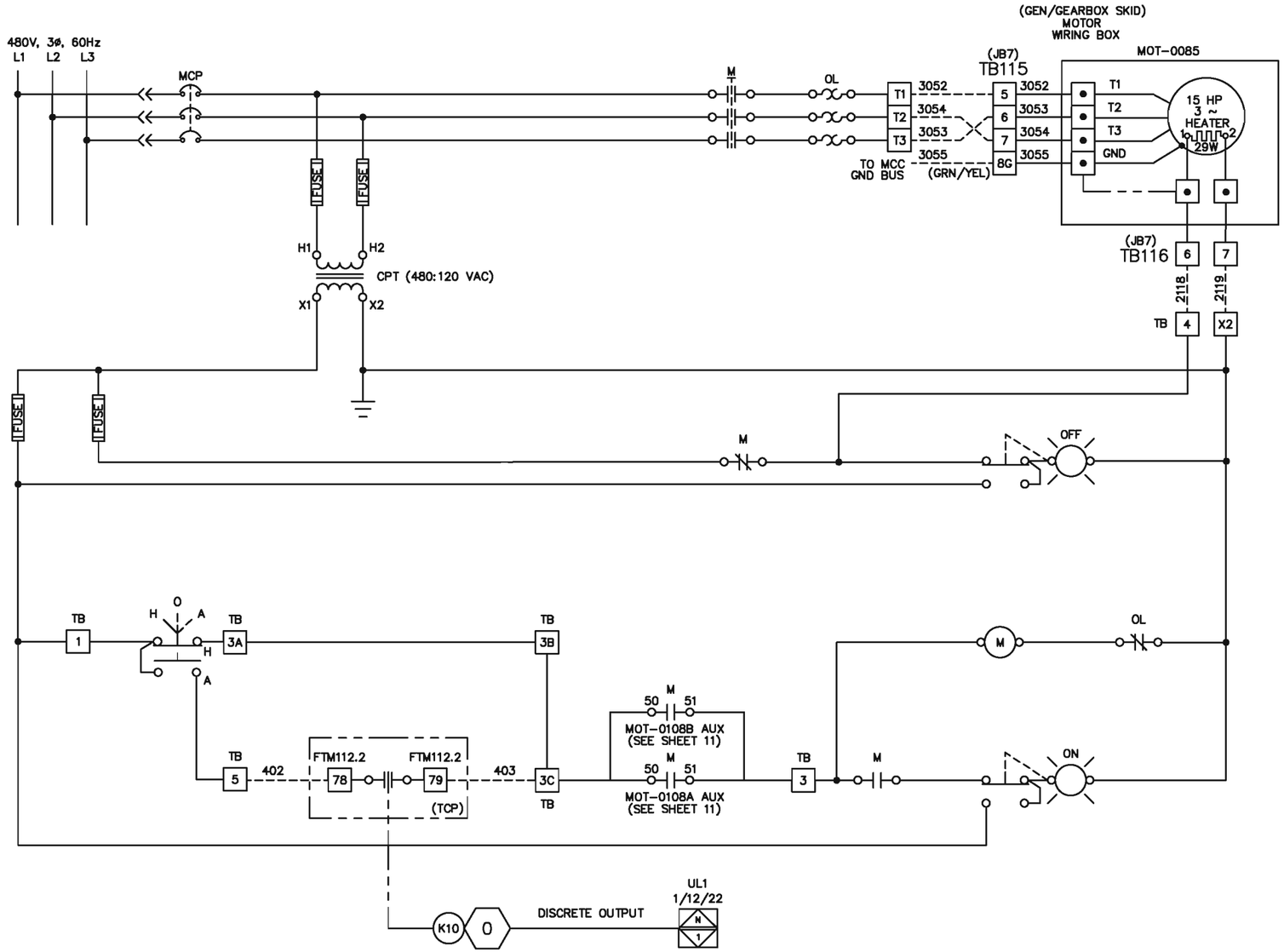
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 6 OF 23



MOTOR-GENERATOR JACKING OIL PUMP

REFERENCE DRAWING ONLY
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GEPPLP SCOPE OF SUPPLY

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DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

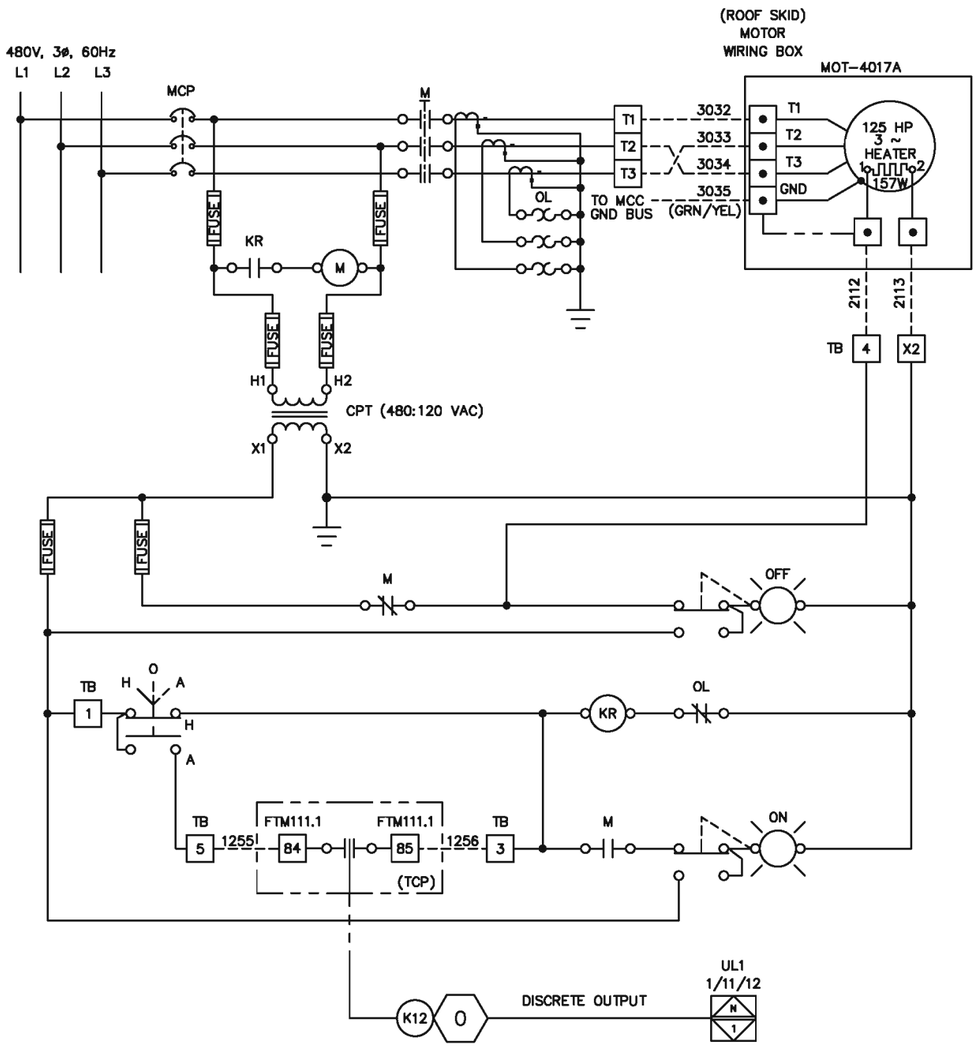
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 7 OF 23



MOTOR–TURBINE ENCLOSURE VENTILATION FAN (A)

REFERENCE DRAWING ONLY
MOTOR CONTROL CENTER IS NOT IN GEPPLP SCOPE OF SUPPLY

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

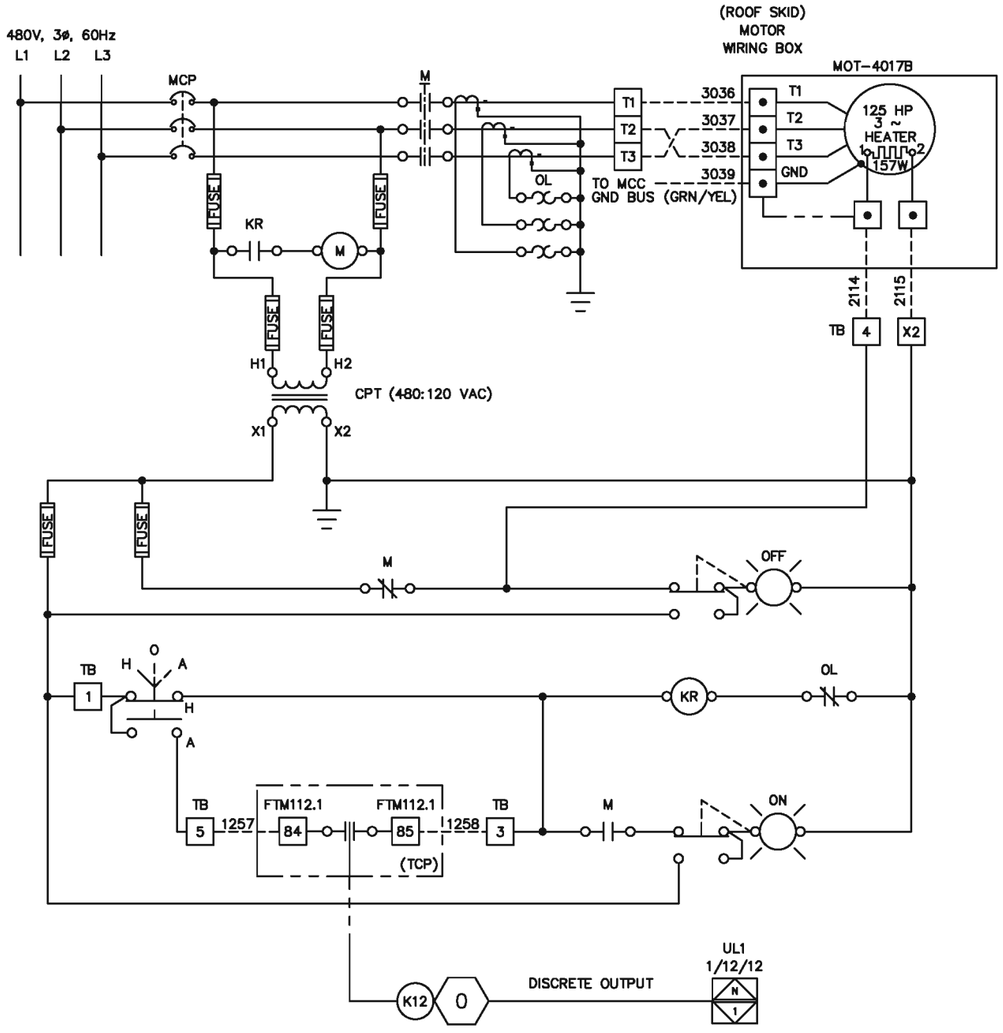
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

REV. A

SCALE NONE

SHEET 8 OF 23



MOTOR–TURBINE ENCLOSURE VENTILATION FAN (B)

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

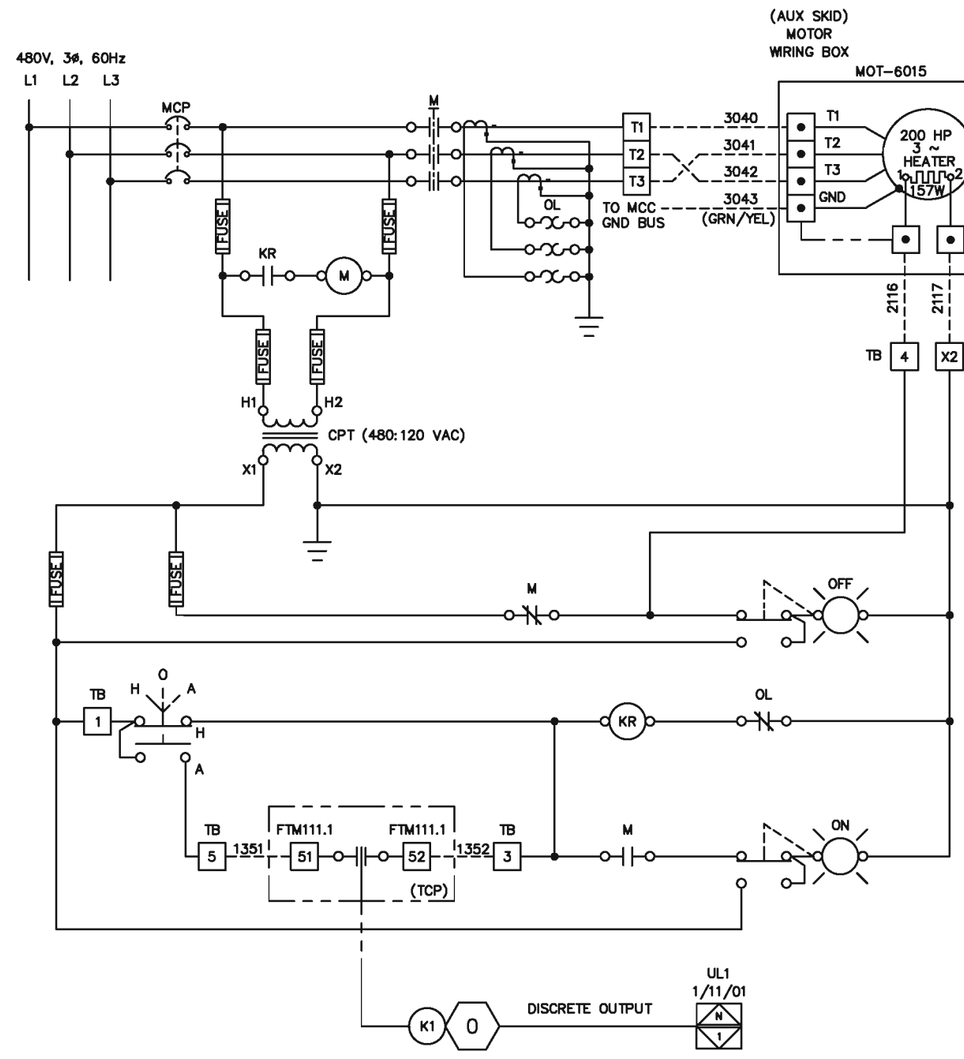
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SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

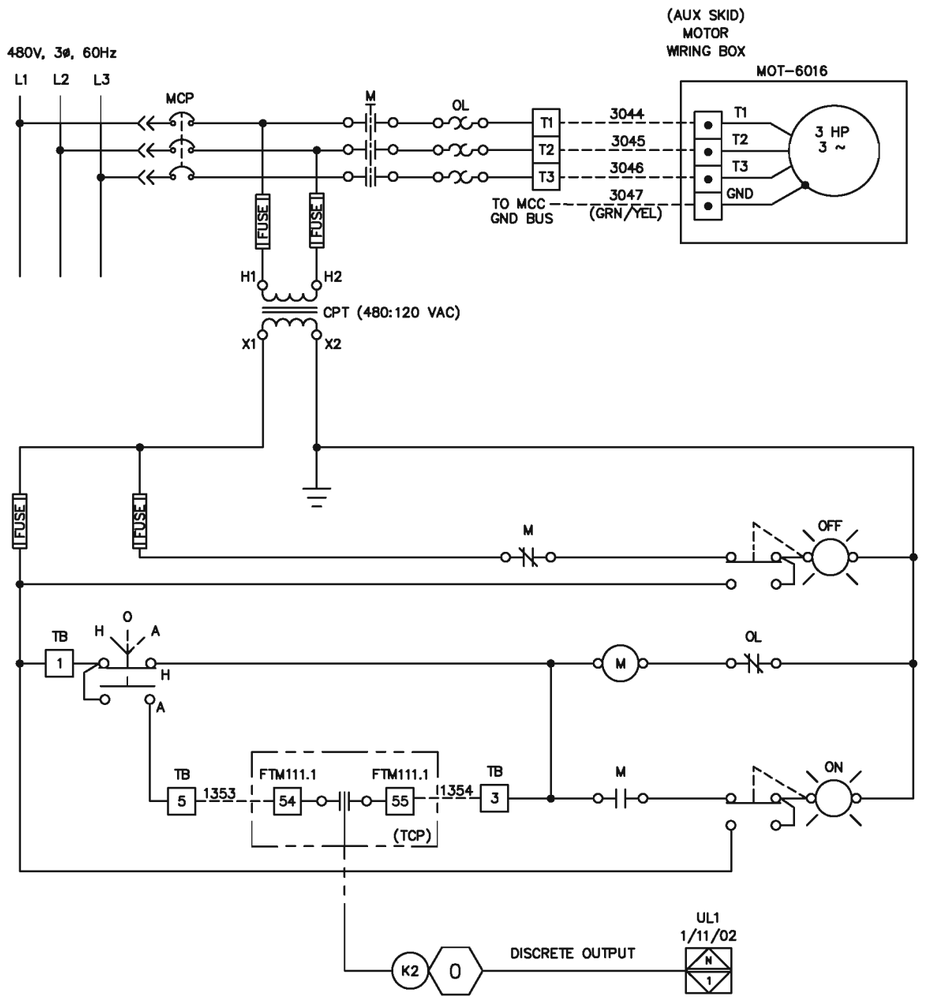
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SCALE NONE

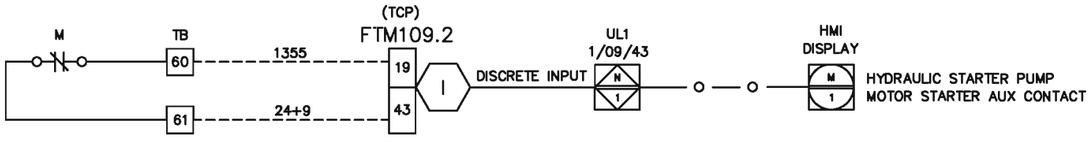
SHEET 9 OF 23



MOTOR–TURBINE HYDRAULIC STARTER PUMP



MOTOR–TURBINE HYDRAULIC STARTER OIL HEAT EXCHANGER FAN



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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

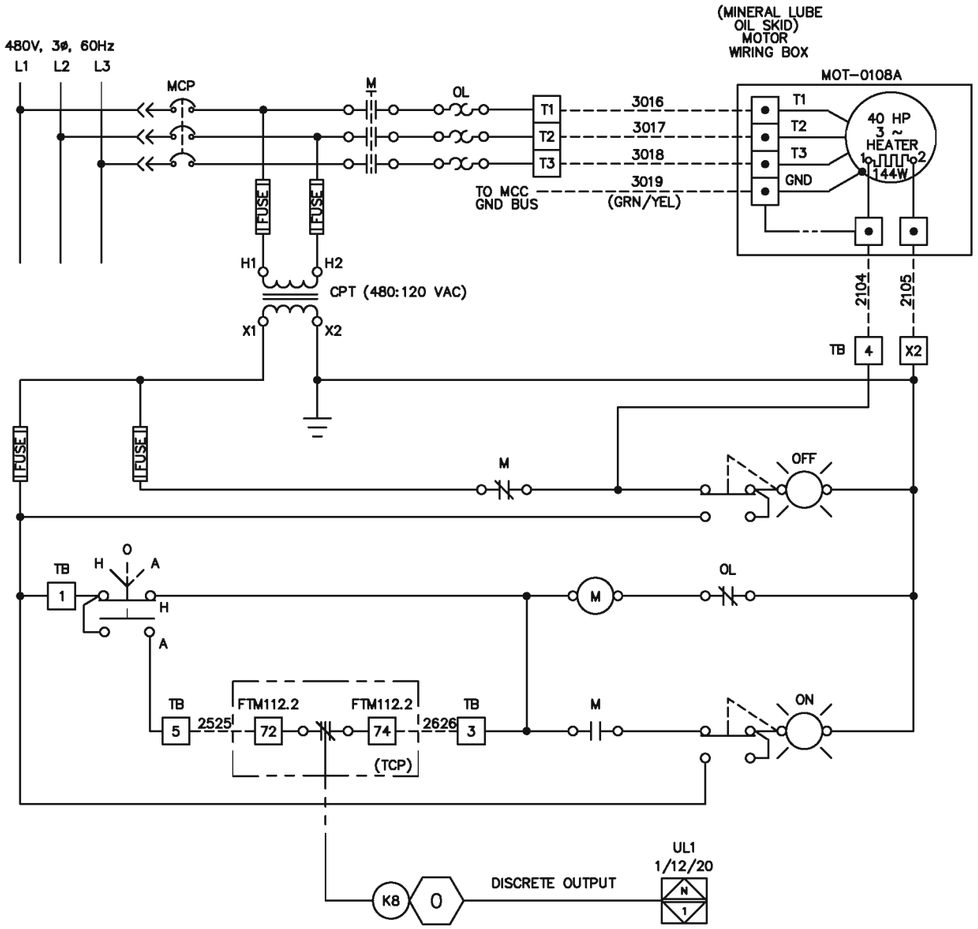
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MOTOR CONTROL CENTER

DWG NO. 7253049–969044

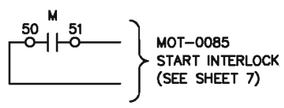
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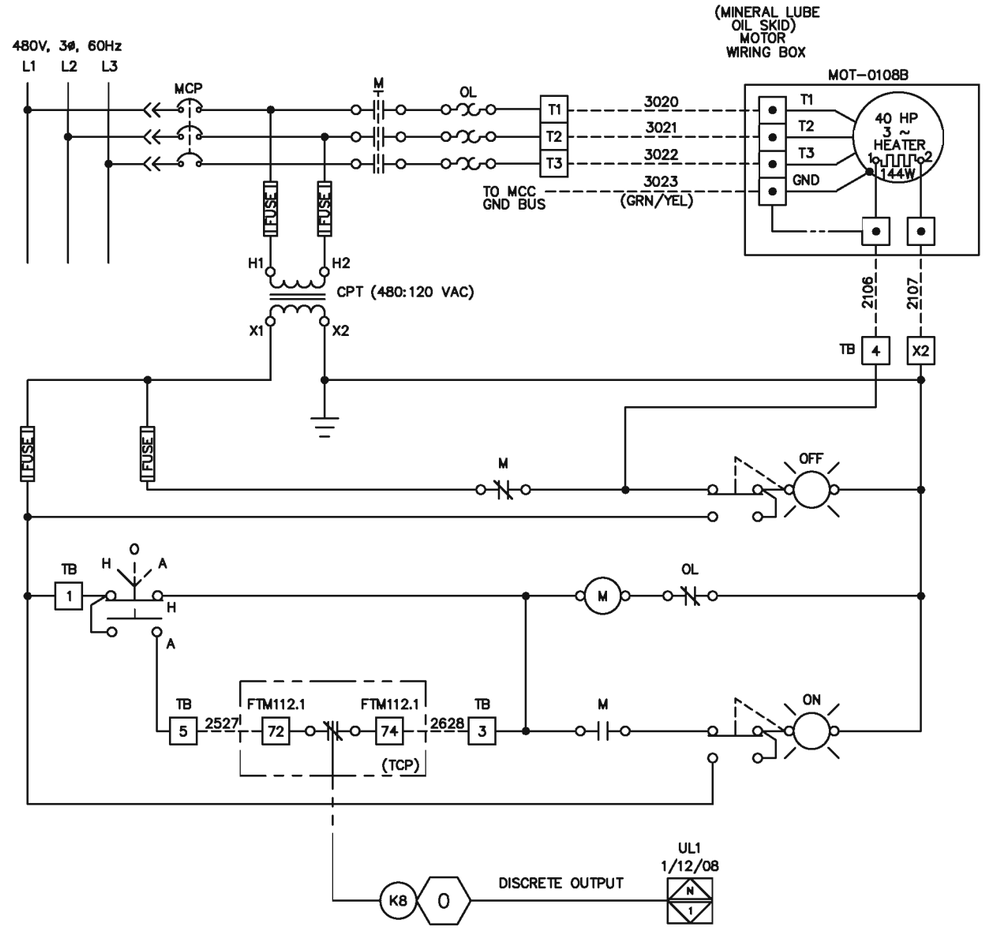
SCALE NONE

SHEET 10 OF 23

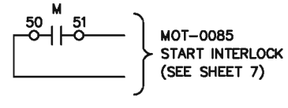


MOTOR–MINERAL LUBE OIL AC PUMP (A)





MOTOR–MINERAL LUBE OIL AC PUMP (B)



REFERENCE DRAWING ONLY
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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

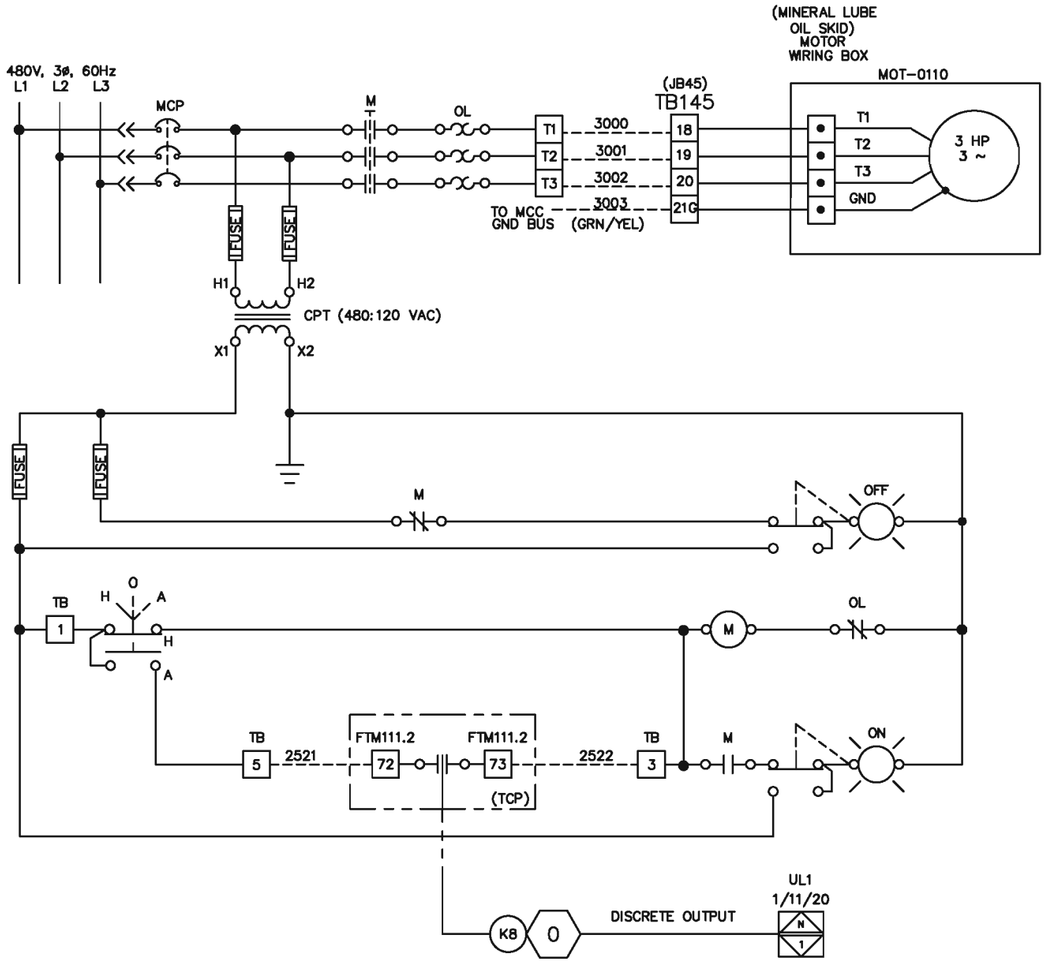
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 11 OF 23



MOTOR–MINERAL LUBE OIL AIR/OIL SEPARATOR FAN

REFERENCE DRAWING ONLY
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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 12 OF 23

480V, 3ø, 60Hz
L1 L2 L3 SEE NOTE 12
OCPD
3091
3092
3093
TO MCC GND BUS
3094 (GRN/YEL)

SR DRIVE ENCLOSURE (SRD1)

AX3: L1, L2, L3, Y/G GND

(AUX SKID) MOTOR WIRING BOX

MOTOR ROTOR POSITION: AX17 1, 15, 3 — 1412, 1413, 1414 — 1, 2, 3, 4
CHASSIS: AX17 G
MOTOR TEMP: AX17 16, 4 — 1415, 1416 — 5, 6
PWR STACK: A1, B1, A2, B2, GND Y/G — 3095, 3096, 3097, 3098, GND — A1, B1, A2, B2, GND

175 HP 3 ~ HEATER 1 2 157W — MOT-2181

PWR CNVTR: X15, X14 — 2132, 2133 — MT2: 1, 2

CONTROL-SPEED ADJUST: AX17 5, 17 — 1417, 1418 — (TCP) TB12 54, 55, 55S — 1417, 1418 — 51, 52 — IE11

ISO1: 11, 21, 22, 12 — 41, 42

24+21 — TO SHT 14
(TCP) TB12 52: 24+21
(TCP) TB12 53: 24-21COM
24-21COM — TO SHT 14

41: 1417A — (TCP) FTM103.1 18
42: 1418A — (TCP) FTM103.1 55
(TCP) FTM103.1 0: 4-20mADC OUTPUT — UL1 1/03/14
(TCP) FTM103.1 IE11

START/STOP: AX17 7, AX17 20 — 1480, 1482 — (TCP) TB12 12, TB12 14 — 1480 — (TCP) FTM110.1 57 — TB12 14 — K3 11 — 7 — 1481 — 6304 — (TCP) FTM110.1 58
(TCP) FTM110.1 K3 0: DISCRETE OUTPUT — UL1 1/10/03

DRIVE READY: AX17 22 NO — 1462 — (TCP) FTM110.2 6; AX17 23 COM — 24+9 — 30
(TCP) FTM110.2 I: DISCRETE INPUT — UL1 1/10/30 — HMI DISPLAY

DRIVE FAULT: AX17 11 NC — 1463 — (TCP) FTM110.2 7; AX17 24 COM — 24+9 — 31
(TCP) FTM110.2 I: DISCRETE INPUT — UL1 1/10/31 — HMI DISPLAY

MOTOR-TURBINE NOX WATER INJECTION PUMP (NO. 1)
(NOT PART OF MCC)

REFERENCE DRAWING ONLY
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REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING
TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.
UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)
GE PACKAGED POWER, L.P.
TITLE: SCHEMATIC DIAGRAM MOTOR CONTROL CENTER
DWG NO. 7253049-969044
REV. A
SCALE NONE
SHEET 13 OF 23

480V, 3ø, 60Hz
L1 L2 L3 SEE NOTE 12
OCPD
3099 3100 3101
TO MCC GND BUS 3102 (GRN/YEL)

SR DRIVE ENCLOSURE (SRD2)

AX3: L1, L2, L3, Y/G GND

(AUX SKID) MOTOR WIRING BOX

MOTOR ROTOR POSITION: AX17 1, 15, 3 — 1421, 1422, 1423 — 1, 2, 3
CHASSIS: G — 4
MOTOR TEMP: AX17 16, 4 — 1424, 1425 — 5, 6
PWR STACK: A1, B1, A2, B2, GND Y/G — 3103, 3104, 3105, 3106 — A1, B1, A2, B2, GND

175 HP 3 ~ HEATER 157W — MOT-2193

PWR CNVTR: X15, X14 — 2134, 2135 — MT2 1, 2

CONTROL-SPEED ADJUST: AX17 5, 17 — 1426, 1427 — (TCP) TB12 56, 57, 57S — 1426, 1427 — 51, 52

24+21, 24-21COM — FROM SHT 13

ISO2: 21, 22 — 41, 42

1426A, 1427A — (TCP) FTM104.1 18, 55 — 0 — 4-20mADC OUTPUT — UL1 1/04/14

IE12

START/STOP: AX17 7, AX17 20 — 1483, 1485 — (TCP) TB12 36, 37 — 1483, K3 12, 8, 1484 — (TCP) FTM110.2 57, 58 — K3 0 — DISCRETE OUTPUT — UL1 1/10/15

K3 6304

DRIVE READY: AX17 22, AX17 23 — NO 1464, COM 24+9 — (TCP) FTM111.2 6, 30 — DISCRETE INPUT — UL1 1/11/30 — HMI DISPLAY

DRIVE FAULT: AX17 11, AX17 24 — NC 1465, COM 24+9 — (TCP) FTM111.2 7, 31 — DISCRETE INPUT — UL1 1/11/31 — HMI DISPLAY

MOTOR-TURBINE NOX WATER INJECTION PUMP (NO. 2)
(NOT PART OF MCC)

REFERENCE DRAWING ONLY
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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

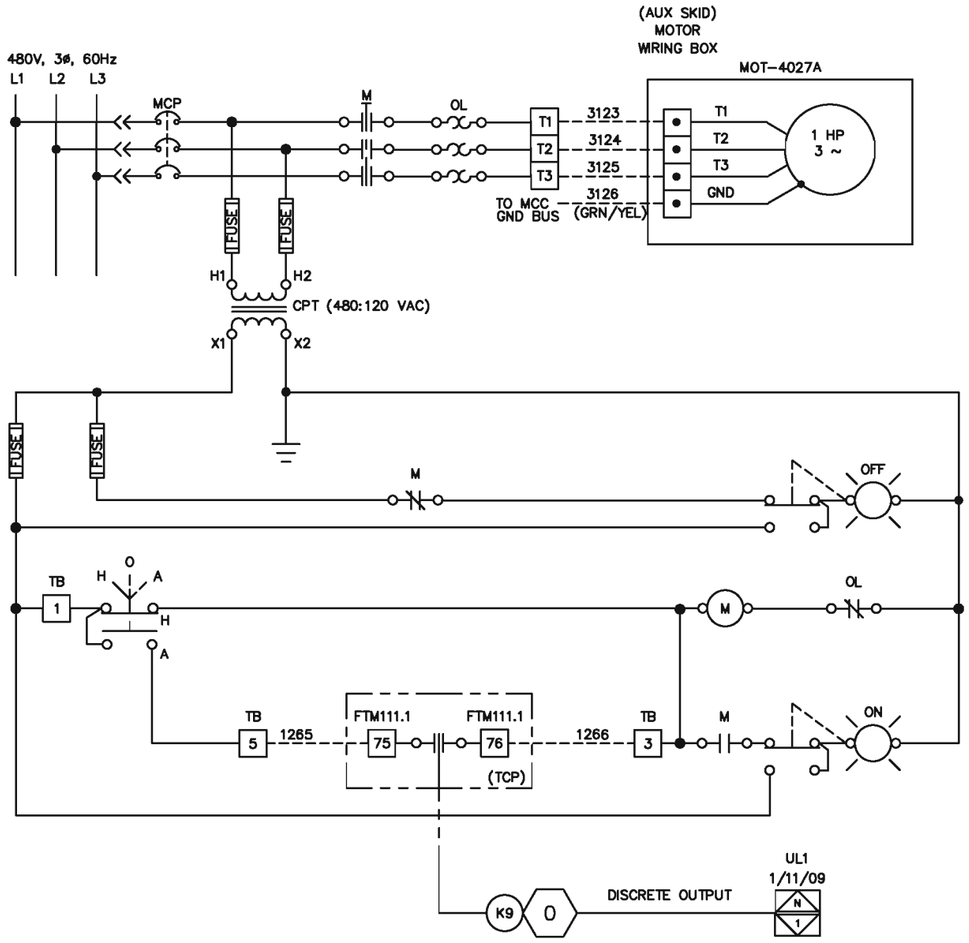
TITLE: SCHEMATIC DIAGRAM MOTOR CONTROL CENTER

DWG NO. 7253049-969044

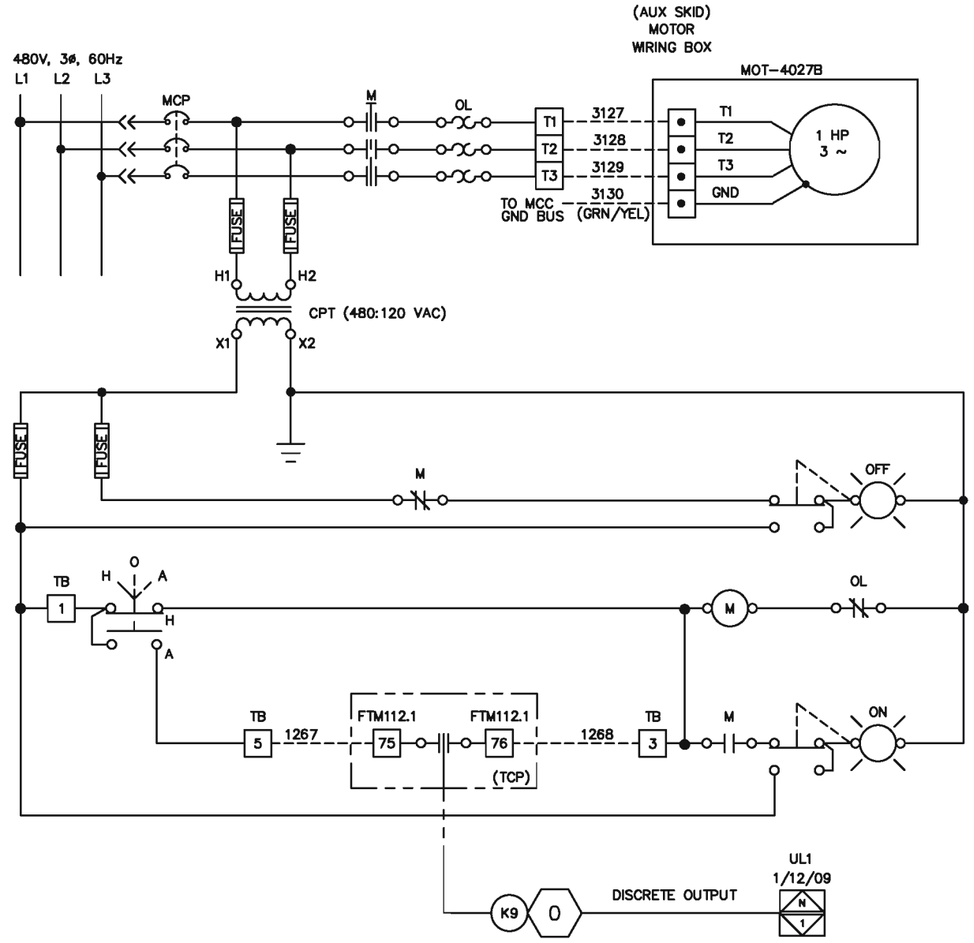
REV. A

SCALE NONE

SHEET 14 OF 23



MOTOR–AUXILIARY SKID ENCLOSURE VENTILATION FAN (A)



MOTOR–AUXILIARY SKID ENCLOSURE VENTILATION FAN (B)

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

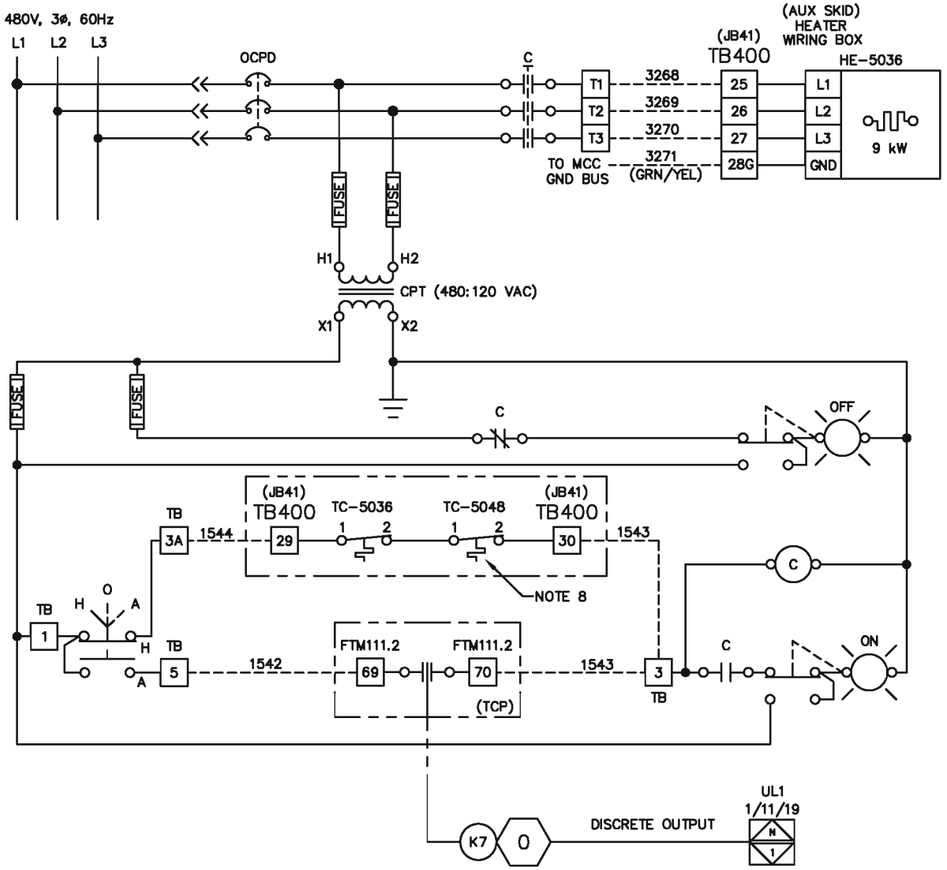
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

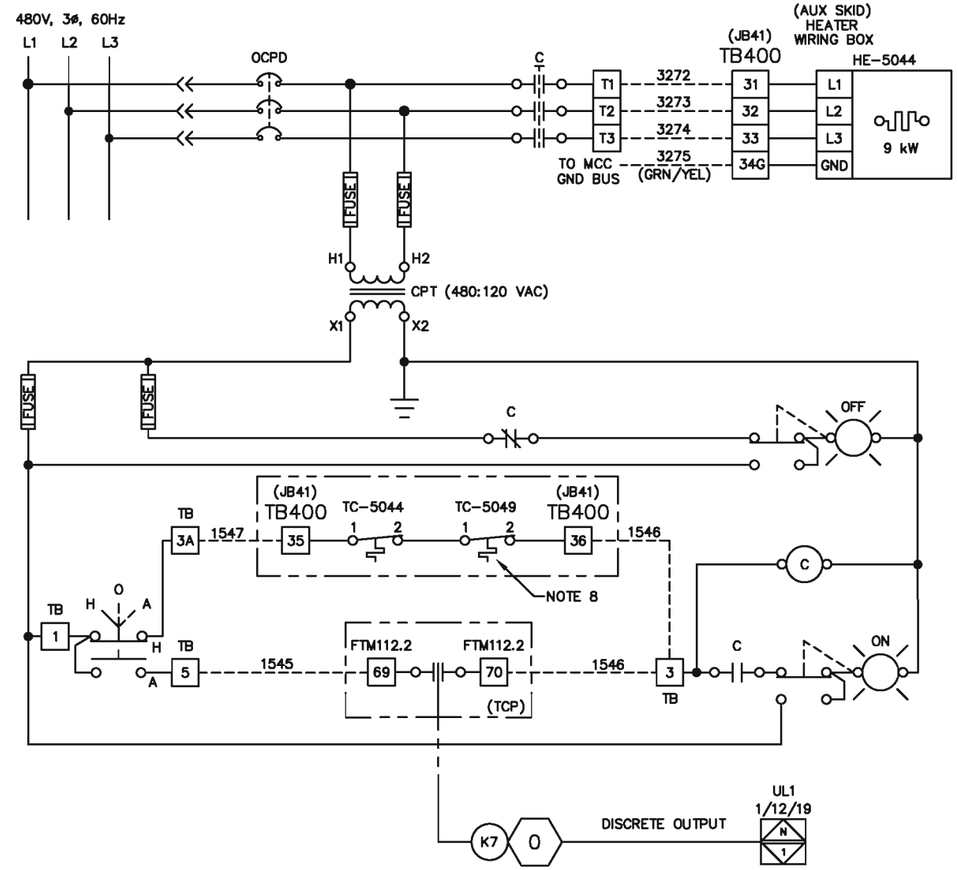
REV. A

SCALE NONE

SHEET 15 OF 23



HEATER ELEMENT–TURBINE WATER WASH TANK (NO. 1)



HEATER ELEMENT–TURBINE WATER WASH TANK (NO. 2)

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
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ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

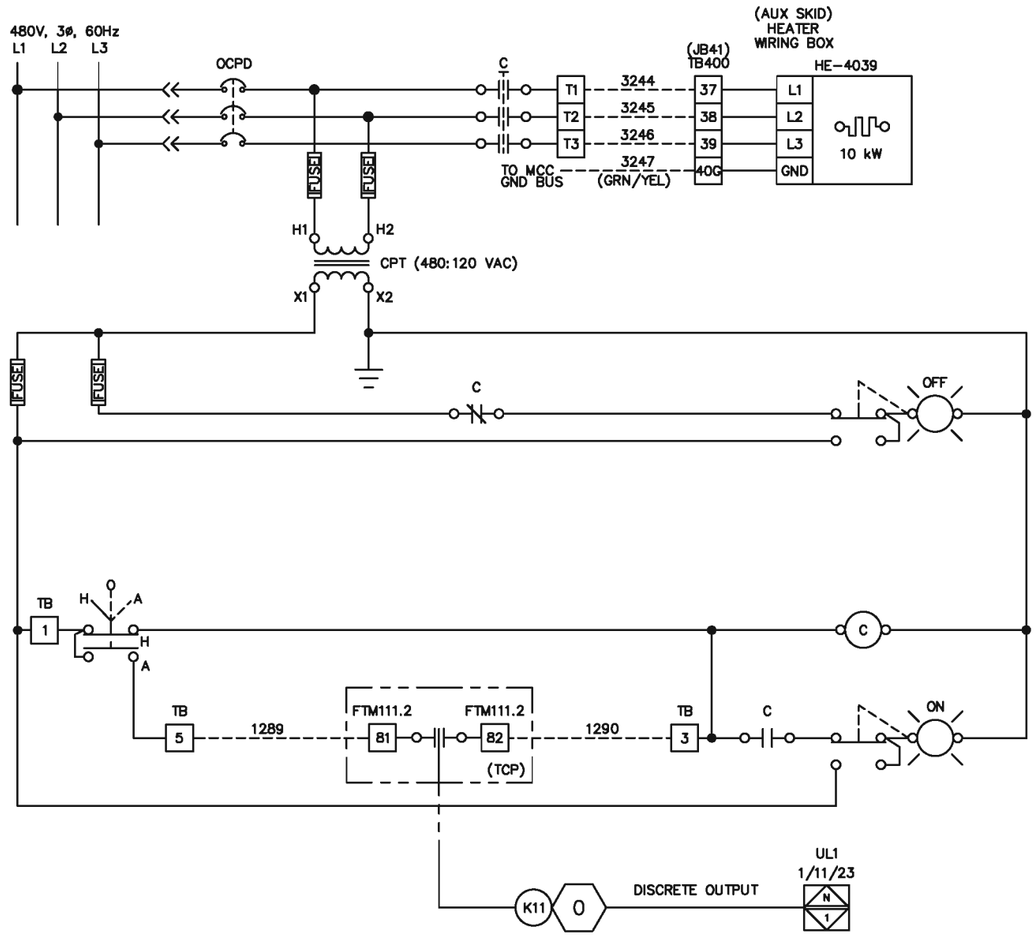
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

REV. A

SCALE NONE

SHEET 16 OF 23



HEATER ELEMENT–AUXILIARY SKID ENCLOSURE SPACE

REFERENCE DRAWING ONLY
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

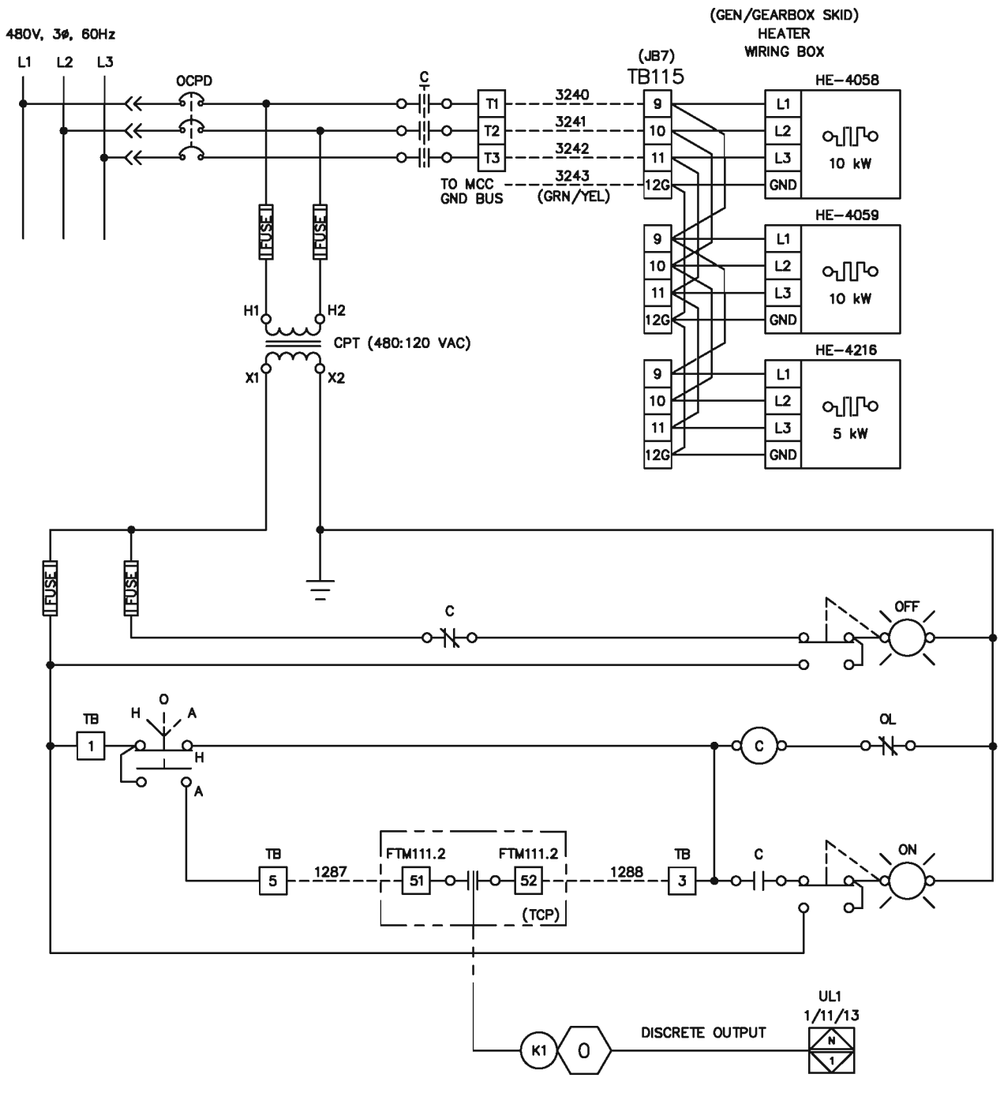
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

REV. A

SCALE NONE

SHEET 17 OF 23



REFERENCE DRAWING ONLY
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FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

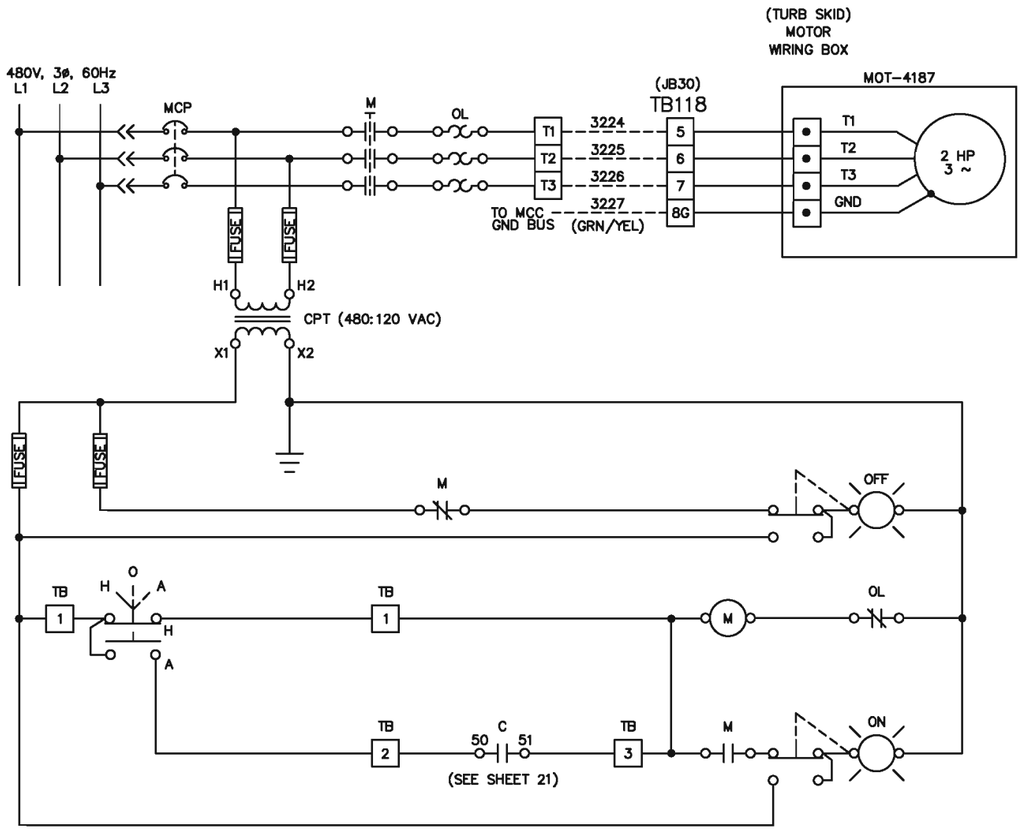
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049–969044

REV. A

SCALE NONE

SHEET 18 OF 23



MOTOR-TURBINE ENCLOSURE HEATED AIR FLOW DISTRIBUTION BLOWER

REFERENCE DRAWING ONLY
MOTOR CONTROL CENTER IS NOT IN
GEPPLP SCOPE OF SUPPLY

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

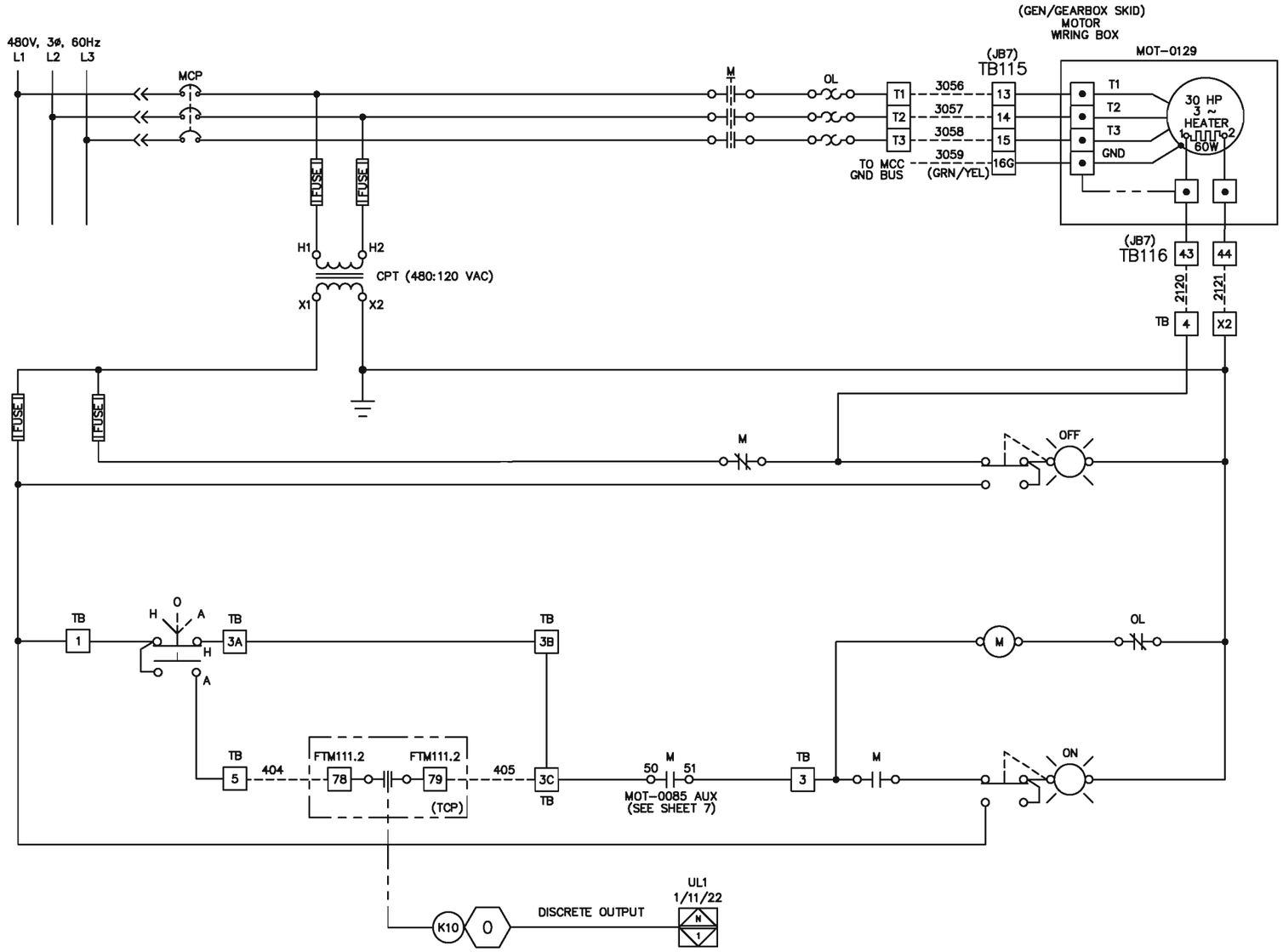
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 19 OF 23



MOTOR-GEARBOX TURNING GEAR

REFERENCE DRAWING ONLY
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GEPPLP SCOPE OF SUPPLY

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REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

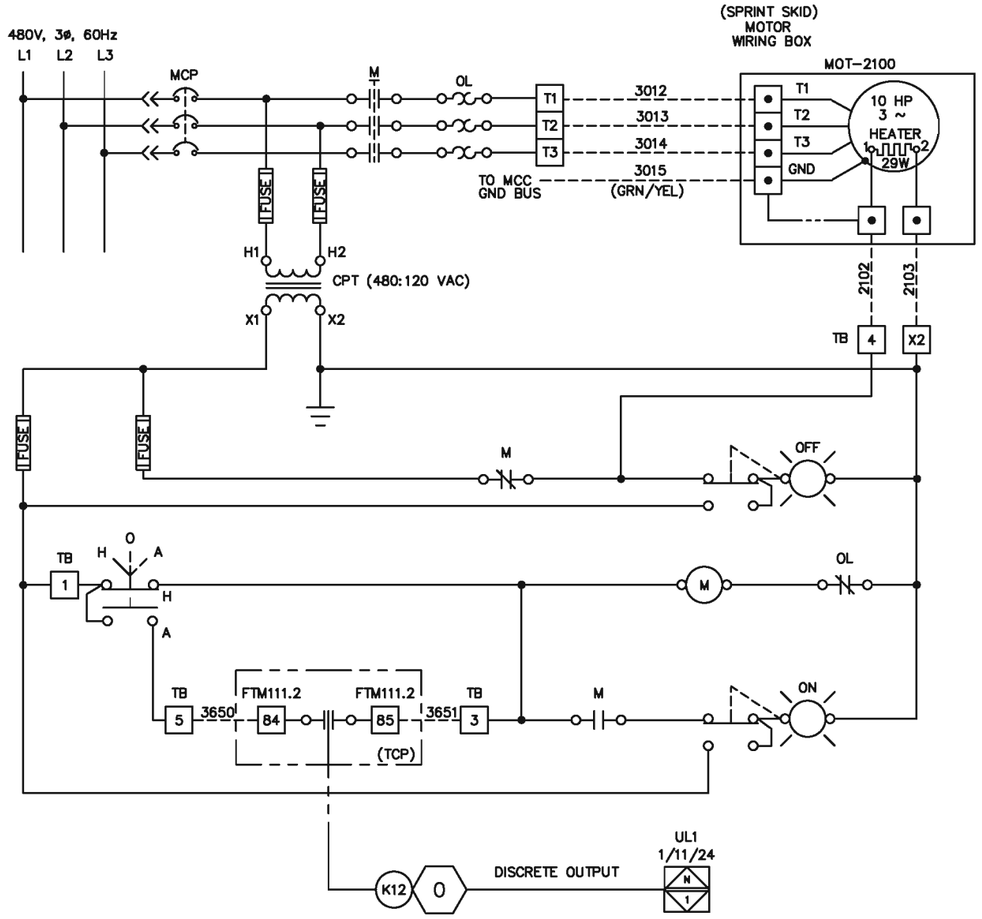
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MOTOR CONTROL CENTER

DWG NO. 7253049-969044

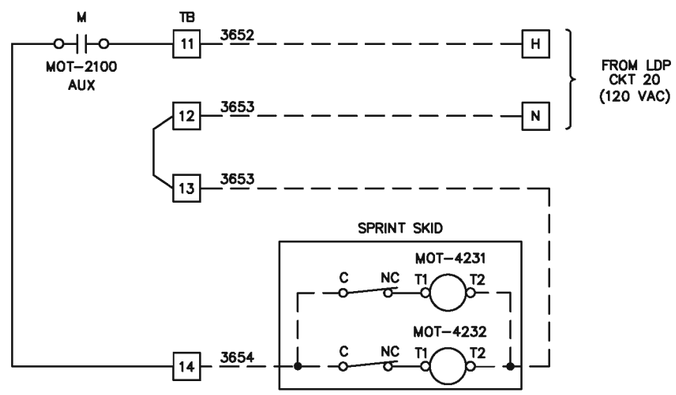
REV. A

SCALE NONE

SHEET 20 OF 23



MOTOR–SPRINT WATER SUPPLY PUMP



SPRINT SKID ENCLOSURE DAMPERS

REFERENCE DRAWING ONLY
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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

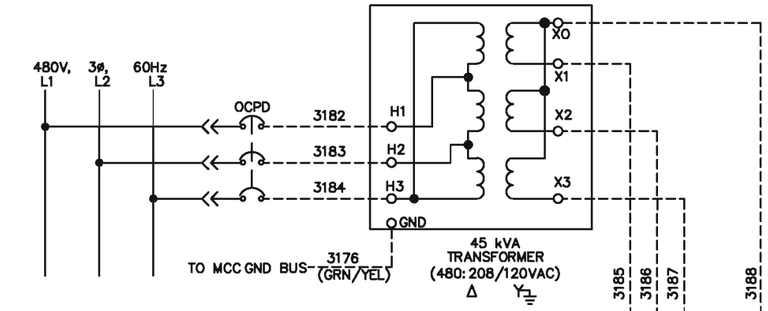
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MOTOR CONTROL CENTER

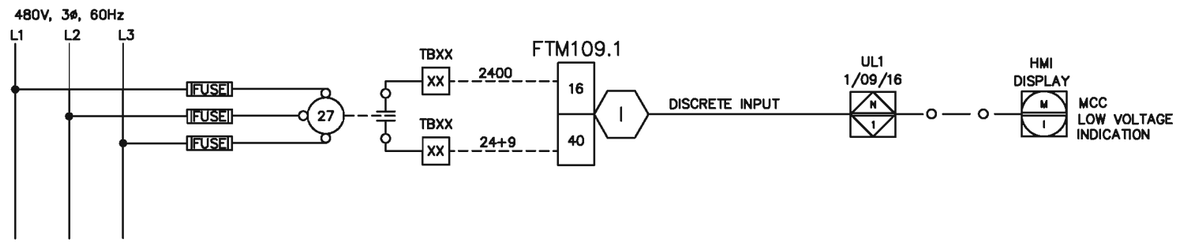
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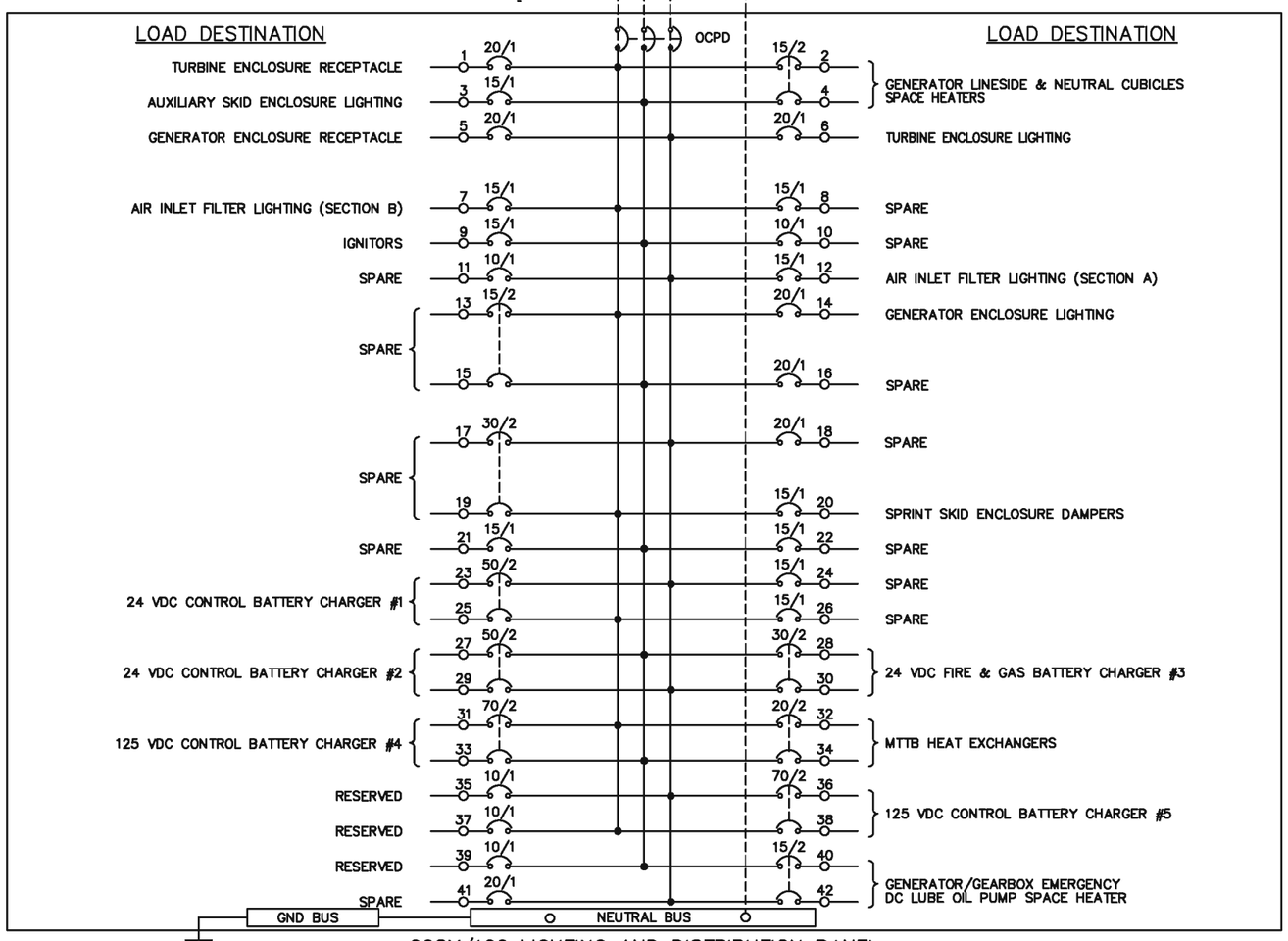
REV. A

SCALE NONE

SHEET 21 OF 23







208Y/120 LIGHTING AND DISTRIBUTION PANEL

REFERENCE DRAWING ONLY
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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

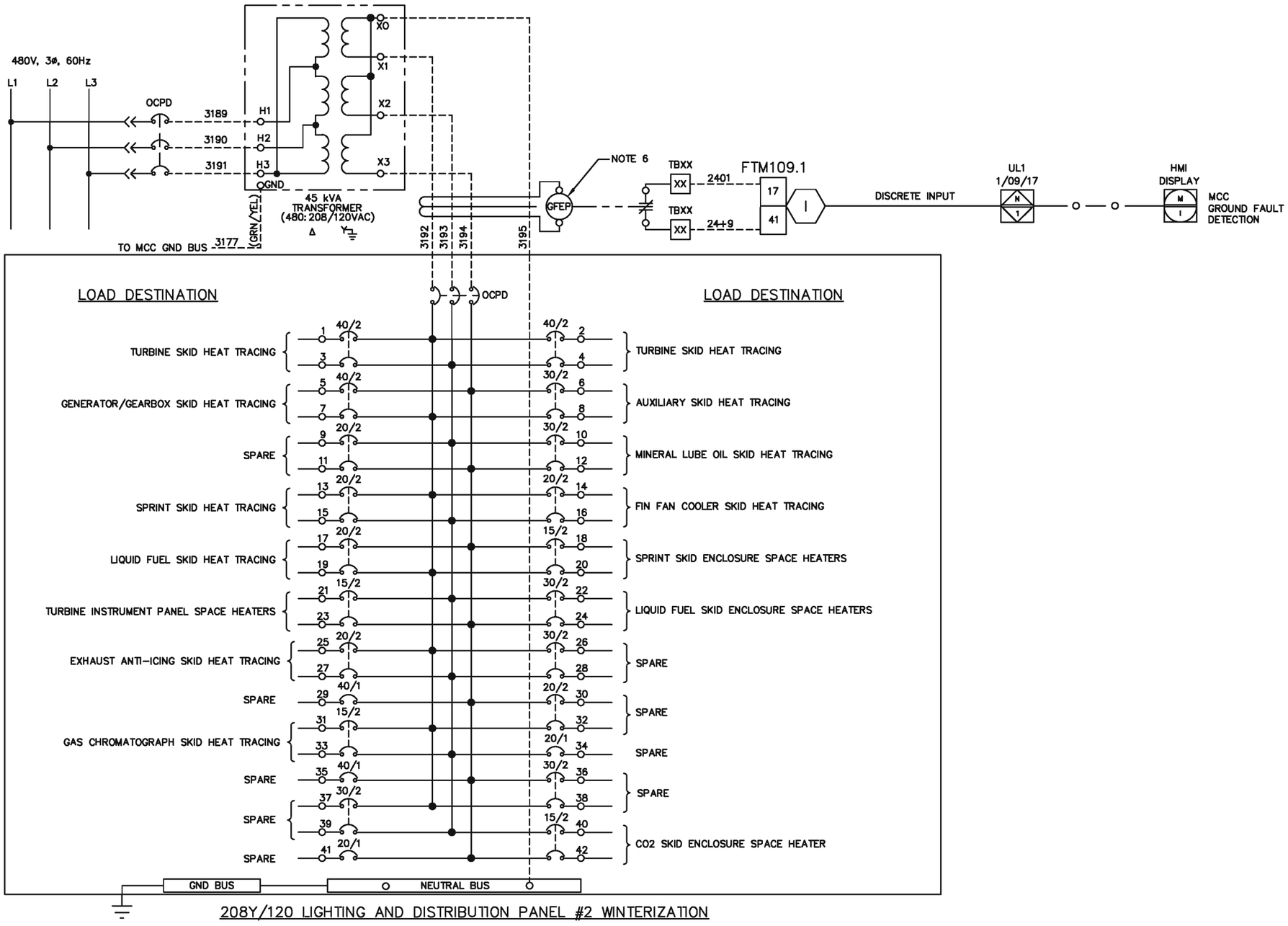
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO. 7253049-969044

REV. A

SCALE NONE

SHEET 22 OF 23



208Y/120 LIGHTING AND DISTRIBUTION PANEL #2 WINTERIZATION

REFERENCE DRAWING ONLY
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

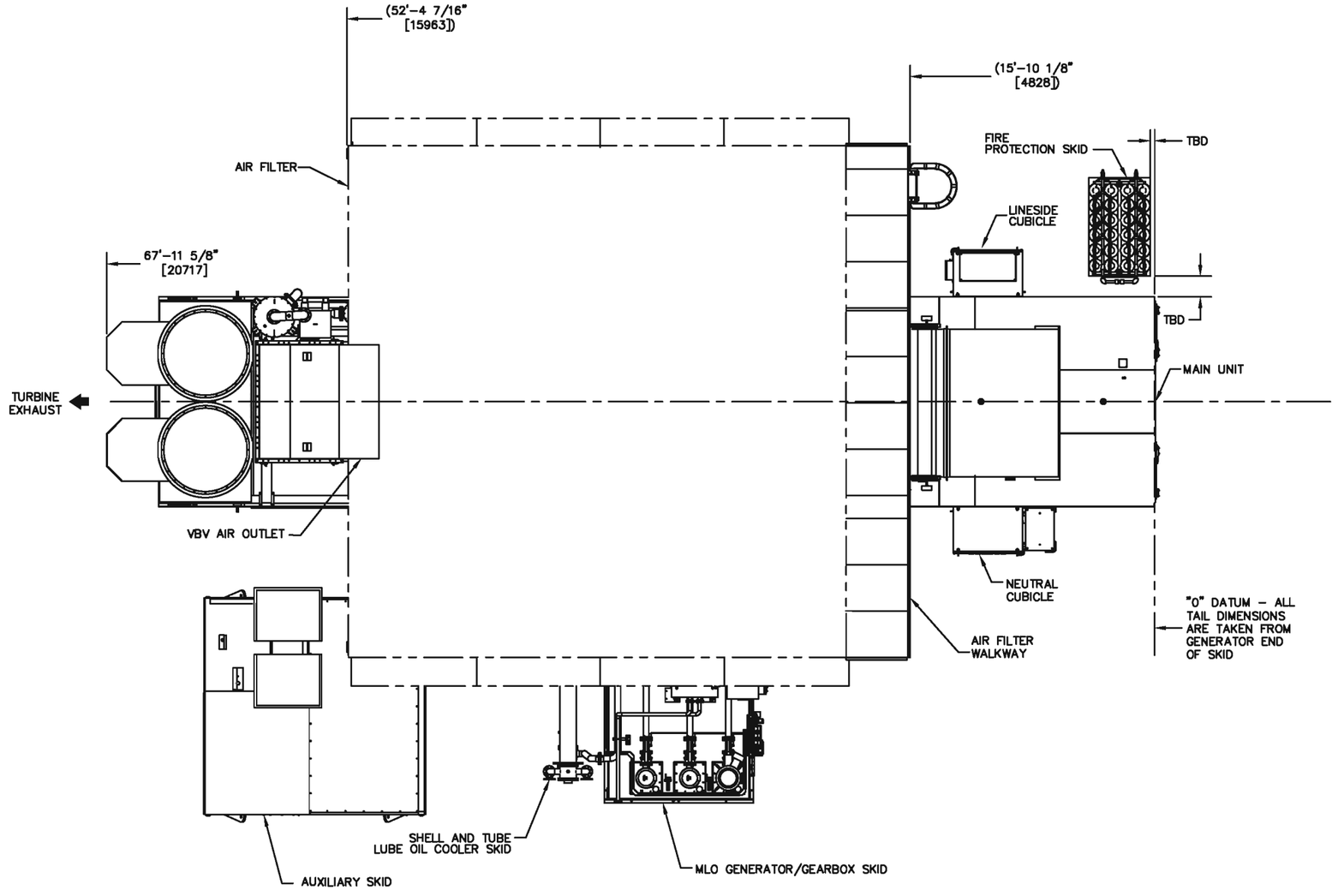
TITLE
SCHEMATIC DIAGRAM
MOTOR CONTROL CENTER

DWG NO.
7253049-969044

REV.
A

SCALE NONE

SHEET 23 OF 23



PLAN VIEW

NOTES:

1. TOLERANCE ON FLANGE CONNECTIONS ±1/8" [3]
   TOLERANCE ON ELECTRICAL CONNECTIONS ±1/8" [3]
   TOLERANCE ON BOLT HOLES ±1/16" [2] TRUE POSITION
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. ADDITIONAL EXTERIOR LIGHTING TO BE SUPPLIED BY CUSTOMER.
4. MAXIMUM LOAD ON EACH ENGINE REMOVAL FOOT PAD IS 10,000 LBS [4536 kg], (20,000 LBS [9072 kg] TOTAL ENGINE REMOVAL LOAD). MAXIMUM LOAD ON EACH GEARBOX REMOVAL PAD IS 28,000 LBS [12700 kg]
5. AUXILIARY SKID, SPRINT SKID & FIRE PROTECTION SKID FOUNDATIONS MUST BE AT THE SAME ELEVATION AS THE MAIN SKID FOUNDATION. MLO SKID FOUNDATION MUST BE 1'-6 1/2" [471] LOWER.
6. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
7. TOLERANCES:
   LINEAR DIMENSION: ±1/8" [3]
   ANGULAR: ±0.5°
8. PIPING AND/OR TUBING MATERIAL SPECIFICATION LISTED IN CONNECTION LEGEND SHALL BE USED BY CUSTOMER AS A RECOMMENDATION IN DESIGN OF THEIR PLANT INTERCONNECT PIPING SYSTEM.

SAFETY NOTE: CAUTION

1. GEPPLP SHALL NOT BE LIABLE FOR DAMAGE CAUSED BY EXCESSIVE FLANGE LOADS OR INADEQUATE EXPANSION JOINT DESIGN. FAILURE TO PROVIDE FOR ADEQUATE THERMAL EXPANSION OR EXCEEDING ALLOWABLE FLANGE LOADS MAY RESULT IN DAMAGE TO OR DESTRUCTION OF FASTENERS AND ENGINE/EXHAUST SYSTEM RELATED HARDWARE RESULTING IN EXHAUST LEAKS AND ACCELERATED WEAR ON THE EXHAUST DIFFUSER ASSEMBLY. IT IS THE CUSTOMER'S RESPONSIBILITY TO ALLOW A CONSERVATIVE AMOUNT OF EXPANSION CAPABILITY TO ACCOMMODATE INSTALLATION ERRORS AND TOLERANCE STACK-UPS FOR THE COMPLETE EXHAUST SYSTEM.
2. IN THE REMOTE CHANCE OF A HP ROTOR FAILURE THE ENGINE CASING MAY NOT CONTAIN THE ENTIRE FAILURE. IT IS HIGHLY RECOMMENDED THAT NO PERMANENTLY MANNED SPACES BE LOCATED IN THE PLANE OF THE HP TURBINE. IT IS ALSO HIGHLY RECOMMENDED THAT ALL POTENTIALLY HAZARDOUS LINES (i.e. FUEL) OR EQUIPMENT (i.e. SHUTOFF VALVES, CONTROL VALVES) ALSO BE LOCATED OUTSIDE THE PLANE OF THE HP TURBINE.

REFERENCE DRAWINGS:

X-969204	GENERAL ARRANGEMENT, AIR FILTER
X-969219	GENERAL ARRANGEMENT, AUXILIARY SKID, LH
X-969221	GENERAL ARRANGEMENT, GENERATOR/GEARBOX MINERAL LUBE OIL SKID

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A	ORIGINAL ISSUE	11914	DLC	11/12/13	DT

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

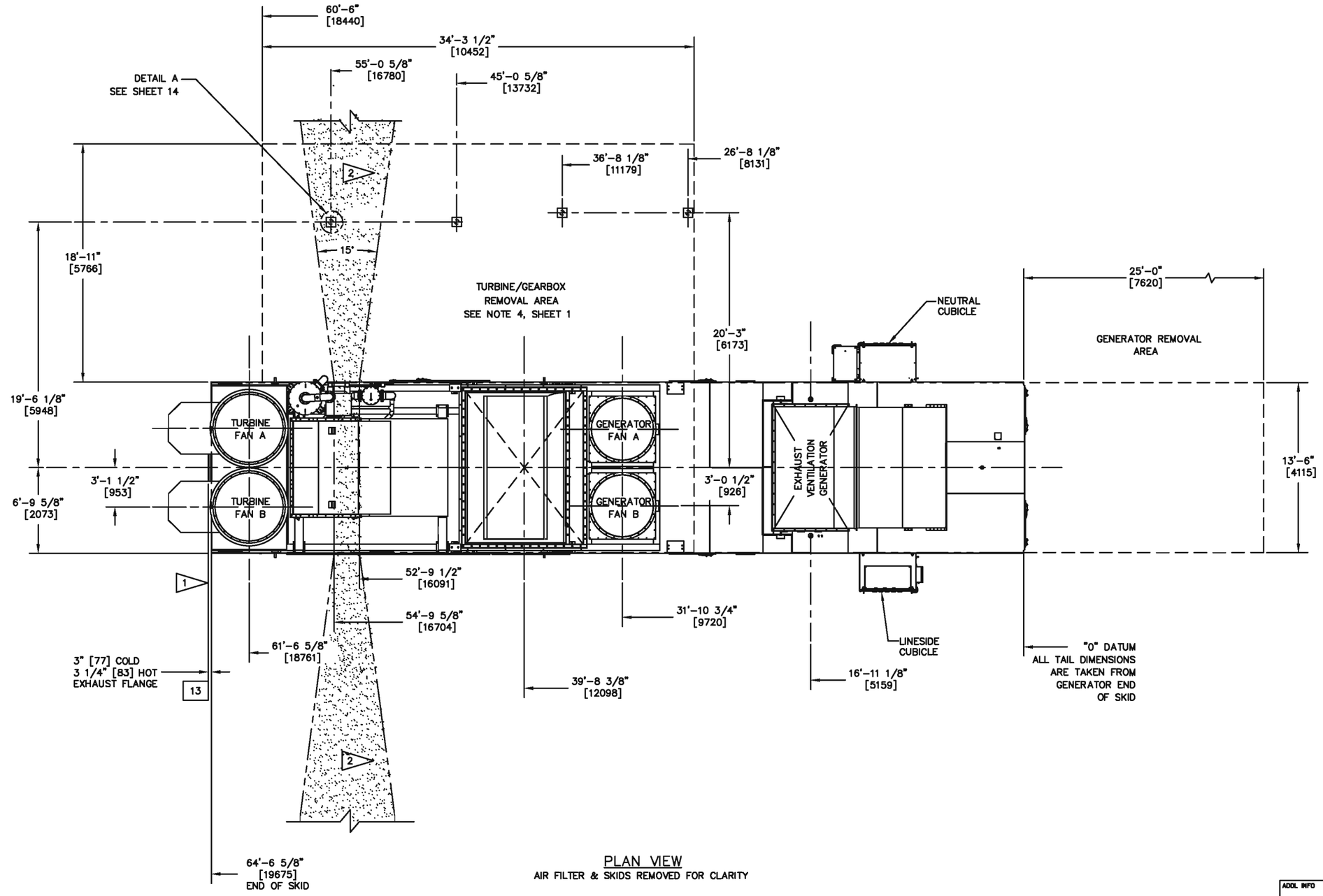
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 1 OF 14



PLAN VIEW
AIR FILTER & SKIDS REMOVED FOR CLARITY

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DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

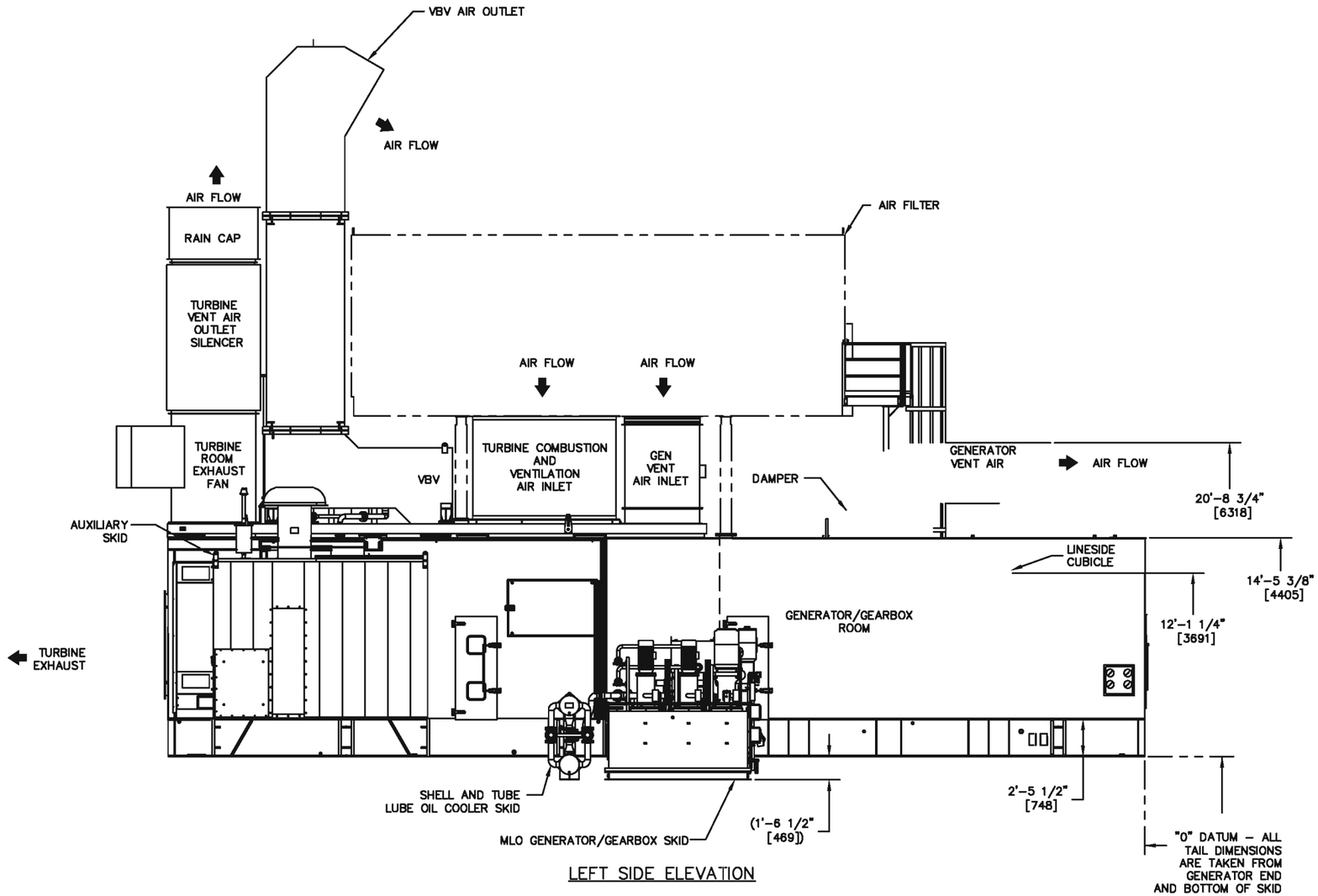
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 2 OF 14



LEFT SIDE ELEVATION

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

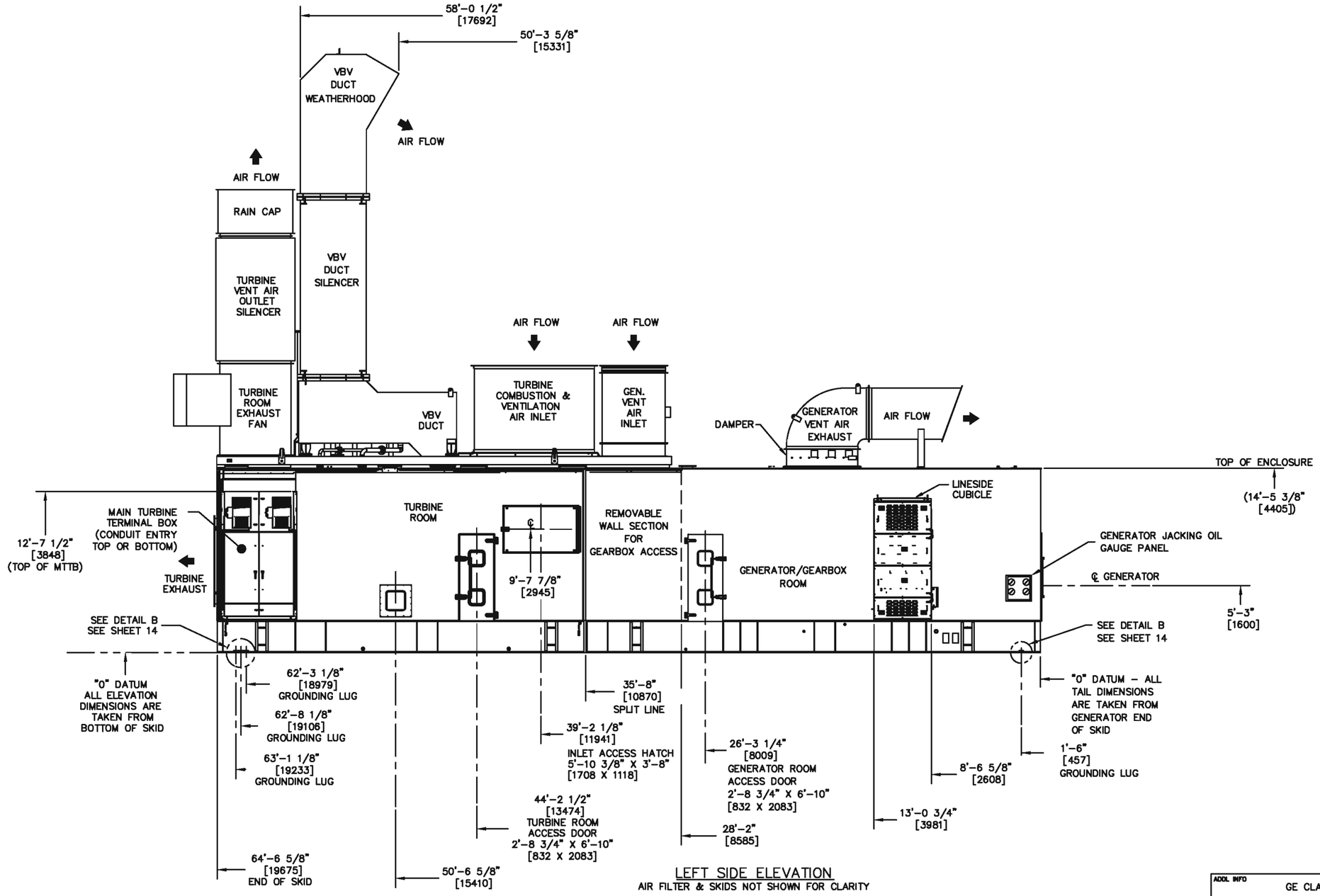
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 3 OF 14



LEFT SIDE ELEVATION

AIR FILTER & SKIDS NOT SHOWN FOR CLARITY

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

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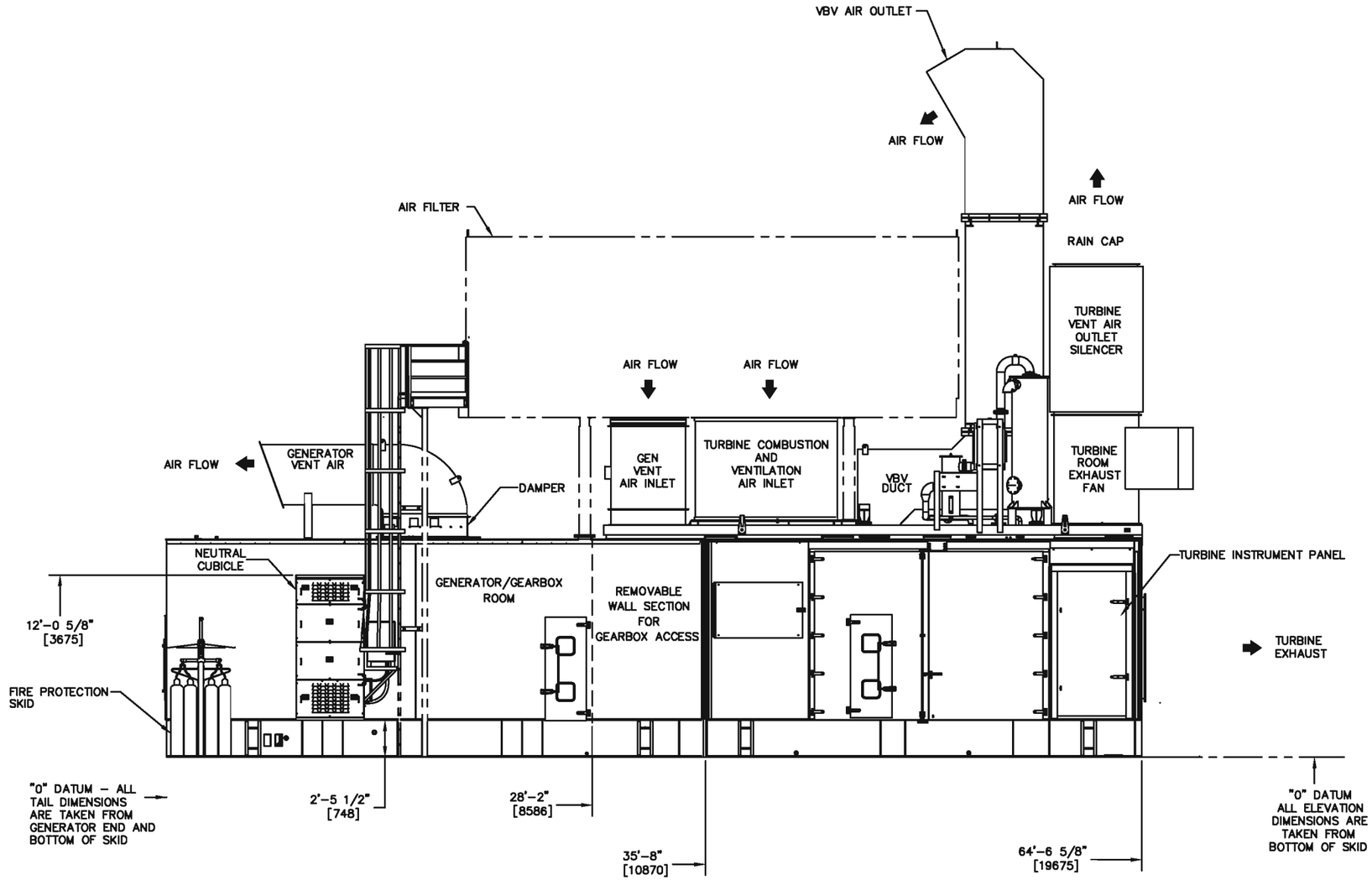
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 4 OF 14



RIGHT SIDE ELEVATION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

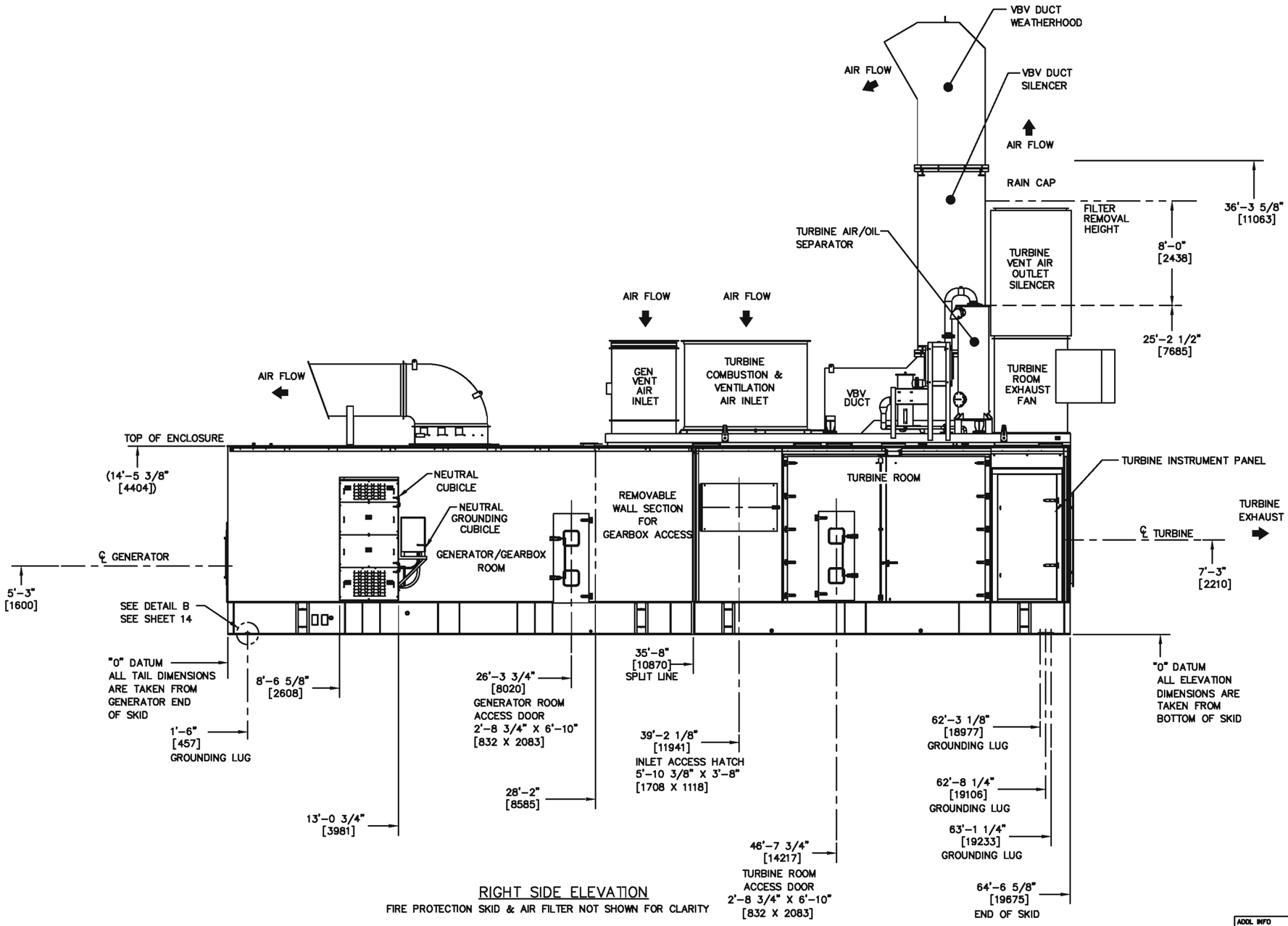
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 5 OF 14



RIGHT SIDE ELEVATION

FIRE PROTECTION SKID & AIR FILTER NOT SHOWN FOR CLARITY

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THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

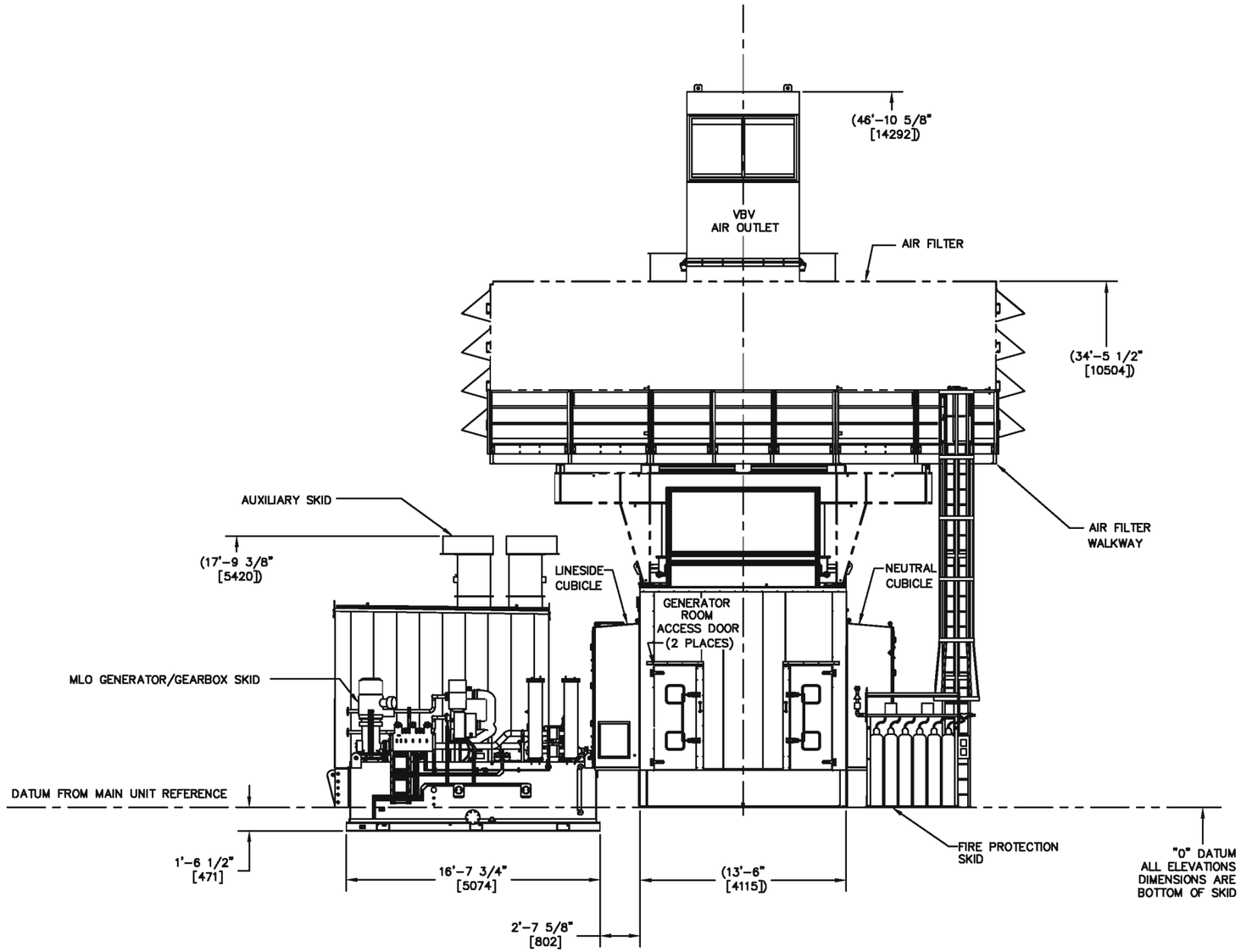
TITLE: GENERAL ARRANGEMENT MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 6 OF 14



GENERATOR END VIEW

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

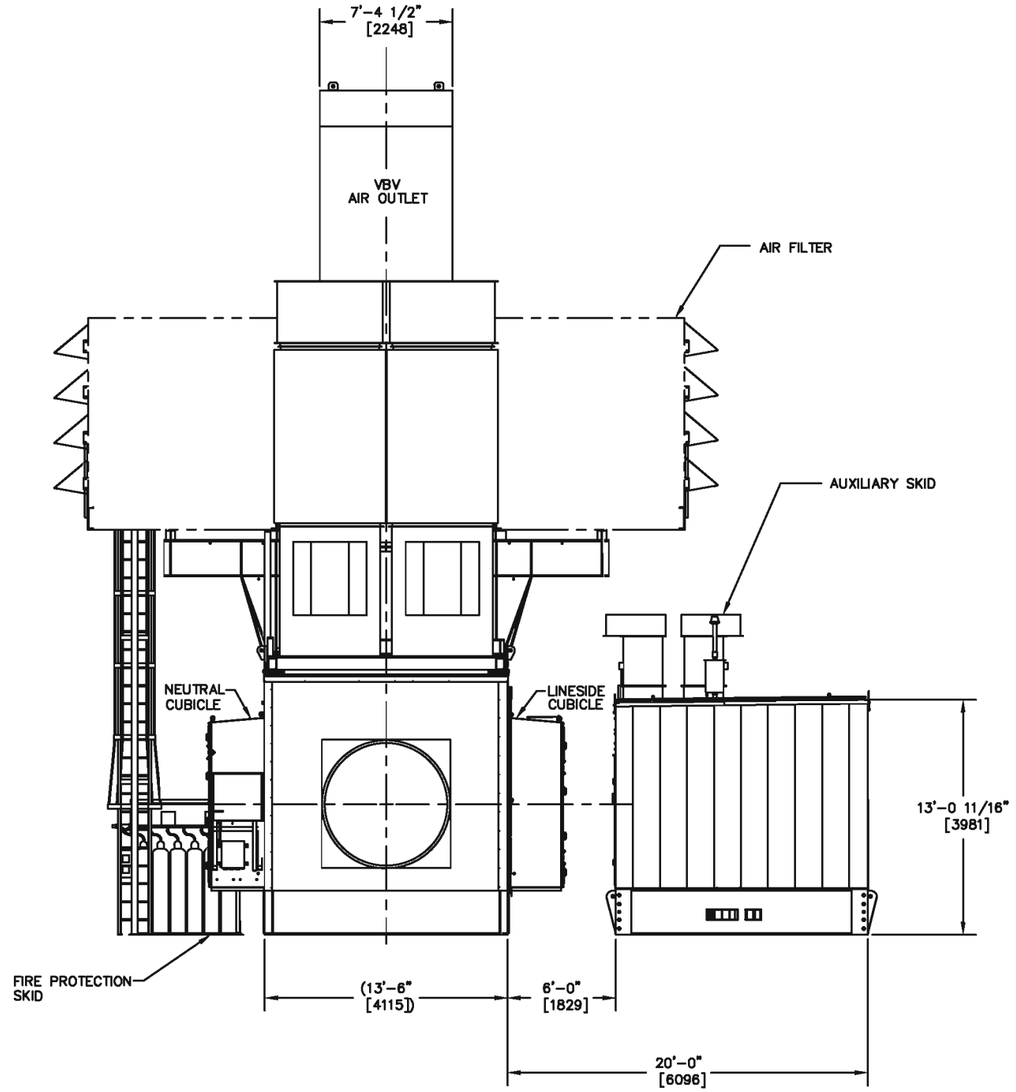
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 7 OF 14



EXHAUST END VIEW

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	11/12/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

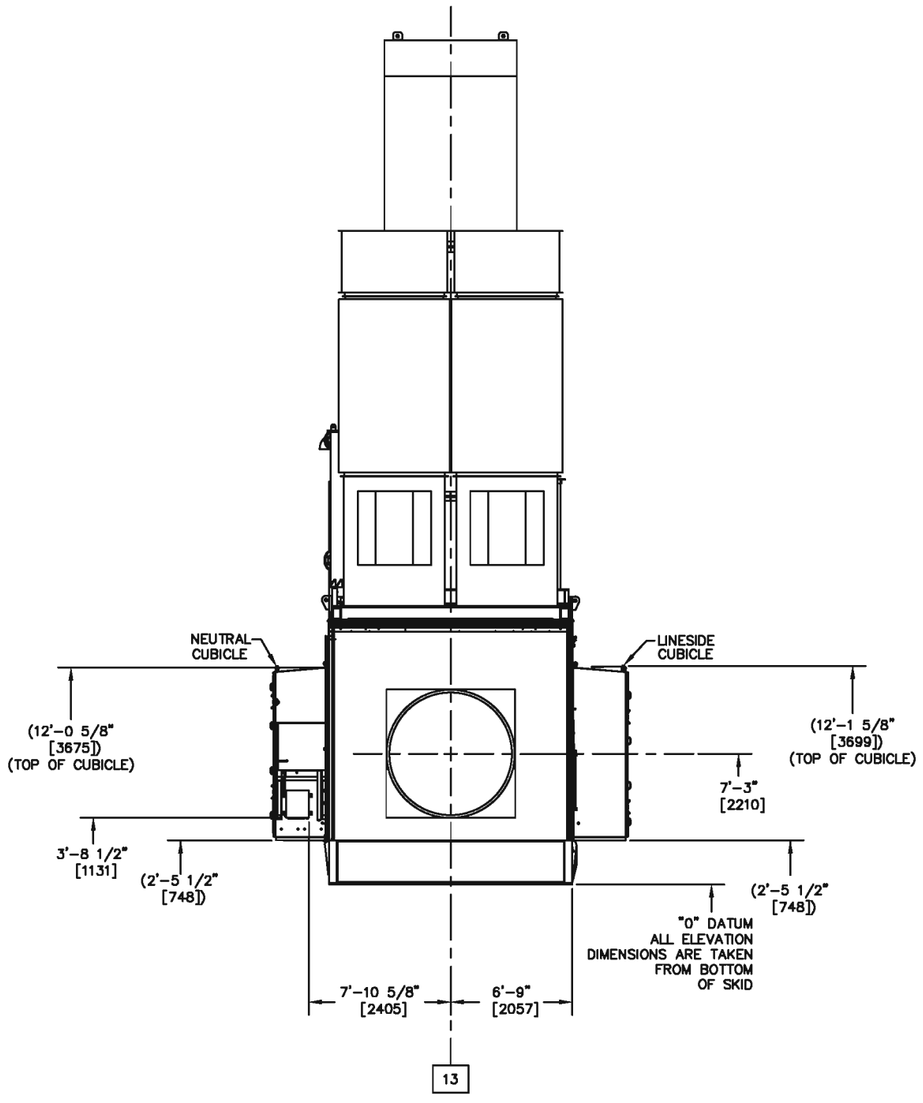
TITLE: GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

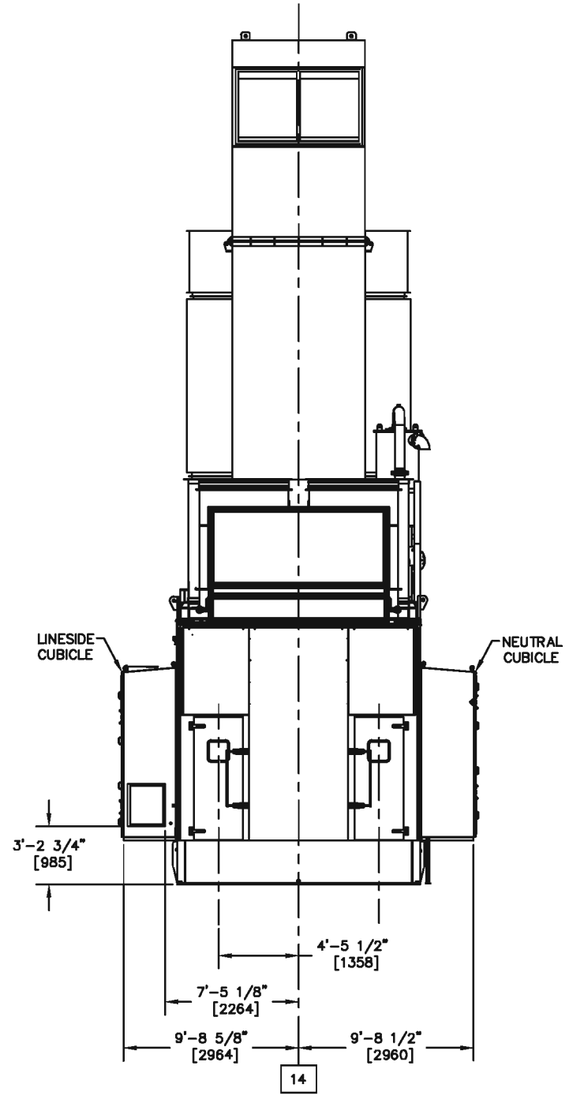
REV. A

SCALE 1/4" = 1'-0"

SHEET 8 OF 14



VIEW FROM EXHAUST END
AIR FILTER AND SKIDS NOT SHOWN FOR CLARITY



VIEW FROM GENERATOR END
AIR FILTER AND SKIDS NOT SHOWN FOR CLARITY

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

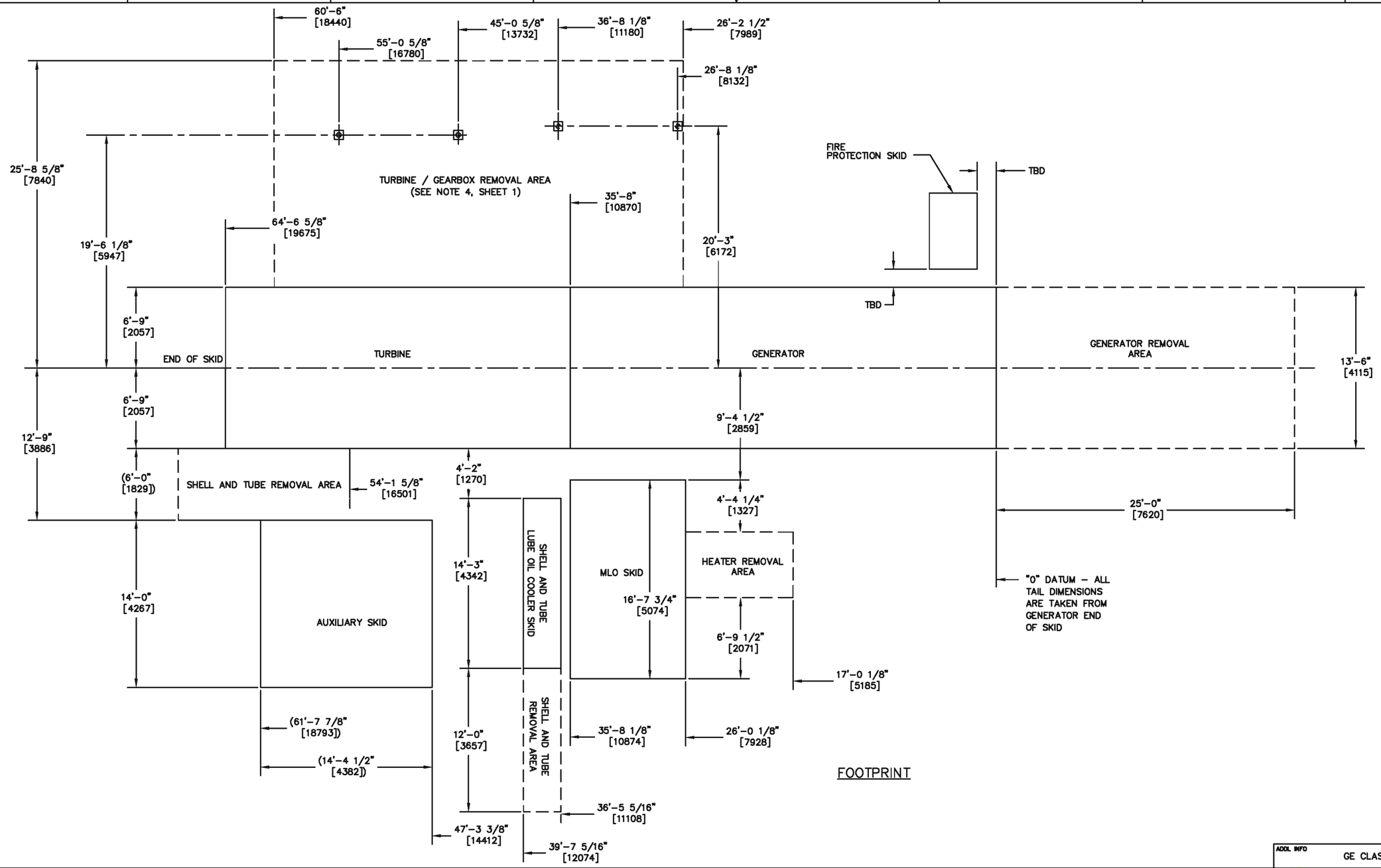
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049–969201

REV. A

SCALE 1/4" = 1'–0"

SHEET 9 OF 14



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

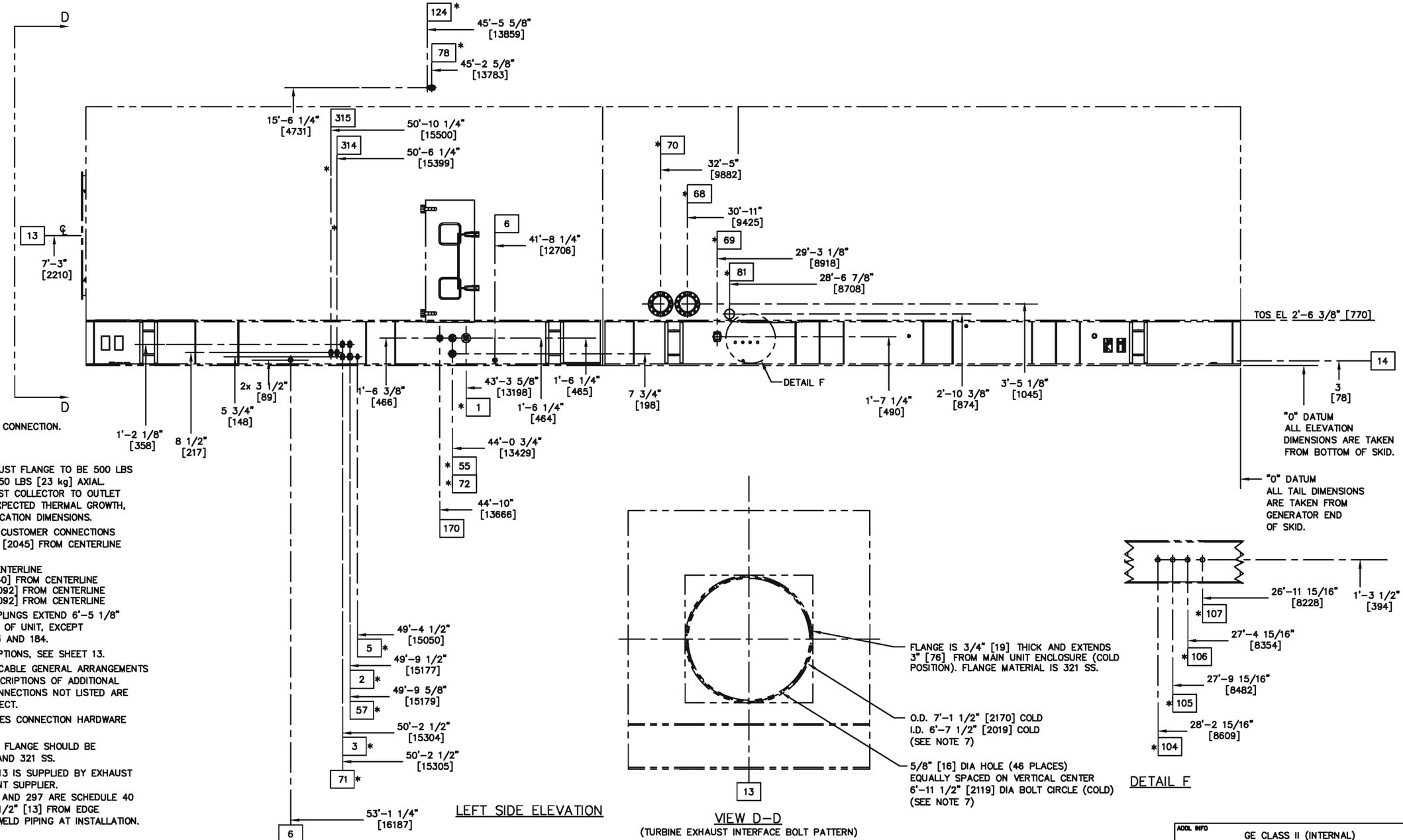
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 1/4" = 1'-0"

SHEET 10 OF 14



LEGEND

INDICATES CUSTOMER CONNECTION.

NOTES:

1. MAXIMUM LOAD ON EXHAUST FLANGE TO BE 500 LBS [227 kg] VERTICAL AND 50 LBS [23 kg] AXIAL. TRANSITION FROM EXHAUST COLLECTOR TO OUTLET FLANGE IS SOLID. FOR EXPECTED THERMAL GROWTH, SEE EXHAUST OUTLET LOCATION DIMENSIONS.
2. ALL MAIN UNIT FLANGED CUSTOMER CONNECTIONS ARE LOCATED 6'-8 1/2" [2045] FROM CENTERLINE OF UNIT, EXCEPT:
   14: ALIGNED WITH CENTERLINE
   149: 7'-0 1/4" [2140] FROM CENTERLINE
   228: 6'-10 3/8" [2092] FROM CENTERLINE
   229: 6'-10 3/8" [2092] FROM CENTERLINE
3. ALL MAIN UNIT NPT COUPLINGS EXTEND 6'-5 1/8" [1959] FROM CENTERLINE OF UNIT, EXCEPT CONNECTION 14, 161, 183 AND 184.
4. FOR CONNECTION DESCRIPTIONS, SEE SHEET 13.
5. REFERENCE OTHER APPLICABLE GENERAL ARRANGEMENTS FOR LOCATIONS AND DESCRIPTIONS OF ADDITIONAL CONNECTIONS. THOSE CONNECTIONS NOT LISTED ARE NOT USED ON THIS PROJECT.
6. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
7. "HOT" INTERFACE MATING FLANGE SHOULD BE EXTERNALLY INSULATED AND 321 SS.
8. HARDWARE CONNECTION 13 IS SUPPLIED BY EXHAUST STACK / EXPANSION JOINT SUPPLIER.
9. CONNECTIONS 10, 11, 24 AND 297 ARE SCHEDULE 40 304 SS PIPE RECESSED 1/2" [13] FROM EDGE OF SKID. CUSTOMER TO WELD PIPING AT INSTALLATION.

LEFT SIDE ELEVATION

VIEW D-D
(TURBINE EXHAUST INTERFACE BOLT PATTERN)

DETAIL F

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

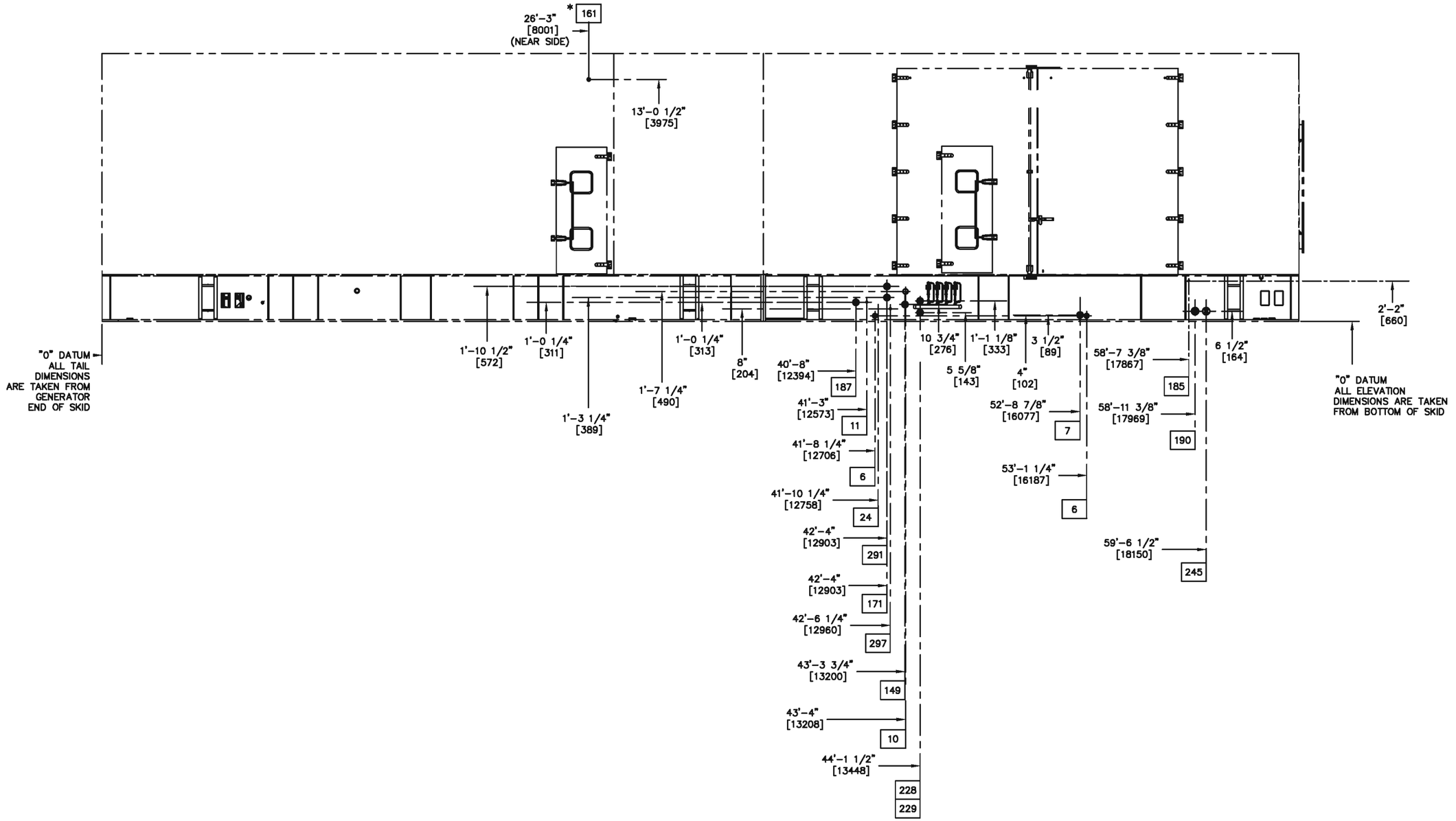
TITLE: GENERAL ARRANGEMENT MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 3/8" = 1'-0"

SHEET 11 OF 14



RIGHT SIDE ELEVATION

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 3/8" = 1'-0"

SHEET 12 OF 14

CUSTOMER CONNECTION LEGEND:

*	1	DEMINERALIZED WATER SUPPLY FOR WATER INJECTION – 1 1/2"–600# RF, TP316 PIPE SCH 40S
*	2	HYDRAULIC STARTER SUPPLY – 1 1/2"–6000# FF, SAE CODE 62, TP304 PIPE SCH XXS
*	3	HYDRAULIC STARTER RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	5	HYDRAULIC STARTER CASE DRAIN – 1"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
	6	TURBINE SUMP DRAIN – 2" FNPT 3000#, CPLG, 304SS
	7	EXHAUST DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
	10	GAS FUEL INLET – 3" PIPE, TP304 SCH 40S
	11	GAS FUEL VENT – 1" PIPE, TP304 SCH 40S
	13	TURBINE EXHAUST DUCT CONNECTION – N/A
	14	GENERATOR/GEARBOX SUMP DRAIN – 1" FNPT 3000#, CPLG, 304SS
	24	GAS FUEL VENT – 1" PIPE, TP304 SCH 40S
*	55	INSTRUMENT AIR SUPPLY – 1"–600# RF, TP304 PIPE SCH 40S
*	57	SCAVENGE LUBE OIL FILTER/COOLER SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	68	GEARBOX LUBE OIL RETURN LINE – 10" PIPE, TP304 SCH 10S
*	69	GENERATOR LUBE OIL SUPPLY – 4"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	70	GEARBOX LUBE OIL RETURN LINE – 10" PIPE, TP304 SCH 10S
*	71	TURBINE LUBE OIL PUMP SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	72	WATER WASH SUPPLY – 1"–600# RF, TP304 PIPE SCH 40S
*	78	TURBINE LUBE OIL AIR/OIL PRE–SEPARATOR RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 SCH 40S
*	81	GENERATOR LUBE OIL DRAIN LINE – 6" PIPE, TP304 SCH 10S
*	104	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
*	105	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
*	106	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
*	107	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
*	124	TURBINE LUBE OIL AIR/OIL SEPARATOR RETURN – 1/2" JIC, TP304 TUBING 0.049" WT MINIMUM
	149	INLET VOLUTE DRAIN – 2"–150# RF, TP304 PIPE SCH 40S
*	161	CO2 – 1 1/4" FNPT 3000#, CPLG, 304SS
	170	SPRINT WATER SUPPLY – 1"–150# RF, TP316 PIPE SCH 40S
	171	SPRINT DRAIN – 1"–150# RF, TP316 PIPE SCH 40S
	185	INSTRUMENT AIR FOR DAMPER RESET – 1/4" FNPT, 304SS
	187	VBV DUCT DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
	190	WATER INJECTION BYPASS – 1"–600# RF, TP304 PIPE SCH 40S
	228	TURBINE LUBE OIL OVERBOARD DRAIN VENT – 1"–150# RF, TP304 PIPE SCH 40S
	229	TURBINE LUBE OIL OVERBOARD DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
	245	WATER INJECTION OVERBOARD DRAIN – 1"–150# RF, TP316 PIPE SCH 40S
	291	STARTER CLUTCH SEAL TELL–TALE DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
	297	GAS FUEL VENT – 1" PIPE, TP304 SCH 40S
*	314	TURBINE LUBE OIL DISCHARGE TO COOLER – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	315	TURBINE LUBE OIL RETURN FROM COOLER – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S

NOTE:

1. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049–969201

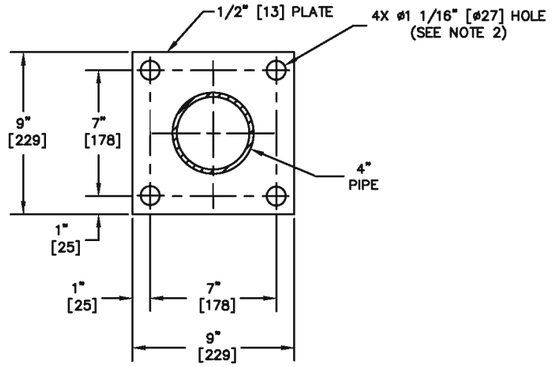
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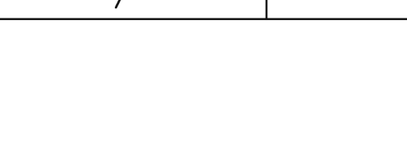
SCALE NONE

SHEET 13 OF 14

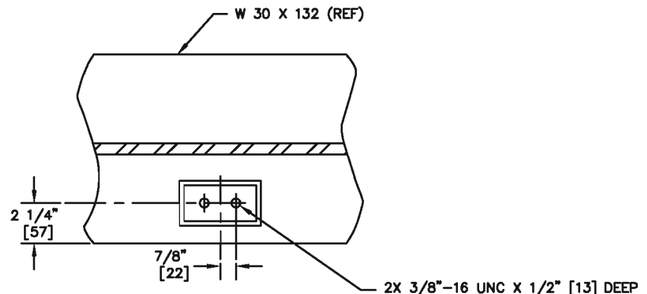
NOTES:

1. ALL ANCHORING HARDWARE TO BE SUPPLIED BY CUSTOMER.
2. BOLT HOLE TOLERANCE ± 1/8" [3], TRUE POSITION.





DETAIL A
ENGINE & GEARBOX REMOVAL FOOT PAD
SEE SHEET 2
(SEE NOTE 4, SHEET 1)



DETAIL B
GROUNDING LUG
SEE SHEETS 4 & 6

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

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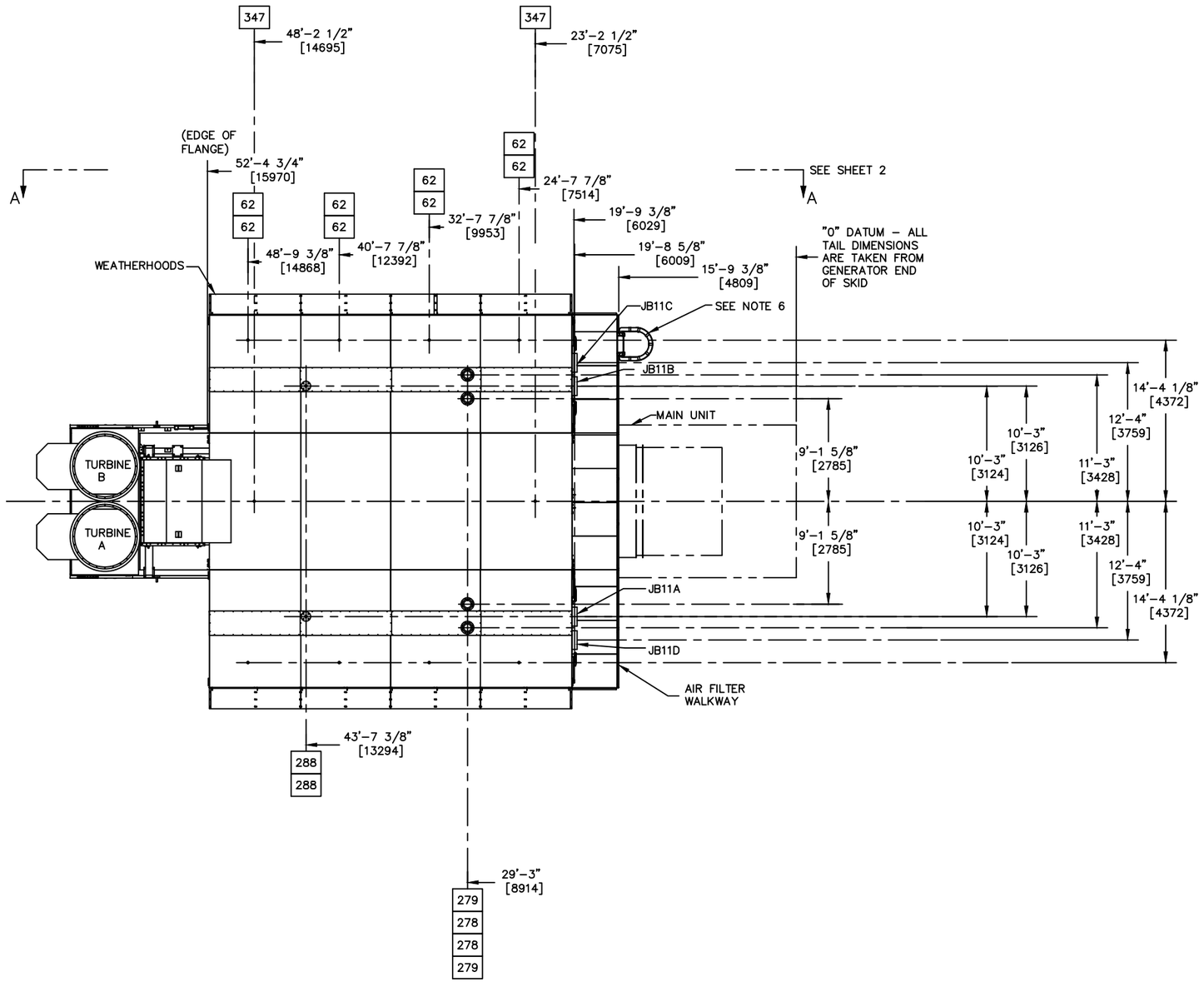
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – LH

DWG NO. 7253049-969201

REV. A

SCALE 3" = 1'-0"

SHEET 14 OF 14



PLAN VIEW

NOTES:

1. TOLERANCE ON FLANGE CONNECTIONS ±1/8" [3].
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. NOT USED.
4. MAIN UNIT REPRESENTATION IS TYPICAL AND MAY VARY FROM ACTUAL LAYOUT. SEE GENERAL ARRANGEMENT, MAIN UNIT FOR ACTUAL CONFIGURATION.
5. CONNECTIONS 278, 279, & 288 ARE NOT DESIGNED TO SUPPORT CUSTOMER PIPE LOADS.
6. LADDER IS SHOWN FOR LEFT HAND CONFIGURATION, WILL RELOCATE TO OPPOSITE SIDE FOR RIGHT HAND CONFIGURATION.
7. NOT USED
8. NOT USED
9. NOT USED
10. NOT USED
11. NOT USED
12. APPLICABLE STANDARD/SPECIFICATION: ASME Y14.5M-1994, DIMENSIONING AND TOLERANCING.
13. MAXIMUM ALLOWABLE LOAD ON W24 X 84 BEAMS AT COIL MODULES A AND B IS 3000 LBS/EACH. LOADS OVER OTHER COMPONENTS ARE FORBIDDEN. LOAD DISTRIBUTION NEEDS TO BE VERIFIED AND AGREED BY GE ENGINEERING.
14. PIPING AND/OR TUBING MATERIAL SPECIFICATION LISTED IN CONNECTION LEGEND SHALL BE USED BY CUSTOMER AS A RECOMMENDATION IN DESIGN OF THEIR PLANT INTERCONNECT PIPING SYSTEM.

CONNECTION LEGEND:

62	FLOOR DRAIN – 2" PIPE, TP304, SCH 40S
278	COMBUSTION COIL WATER SUPPLY – 8"–150# RF, TP304 PIPE SCH 40S
279	COMBUSTION COIL WATER RETURN – 8"–150# RF, TP304 PIPE SCH 40S
288	CONDENSATION DRAIN – 3"–150# RF, TP304 PIPE SCH 40S
347	AIR FILTER INLET PLENUM/CONDENSATE DRAIN – 1 1/2" NPT, TP304 PIPE SCH 40S

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

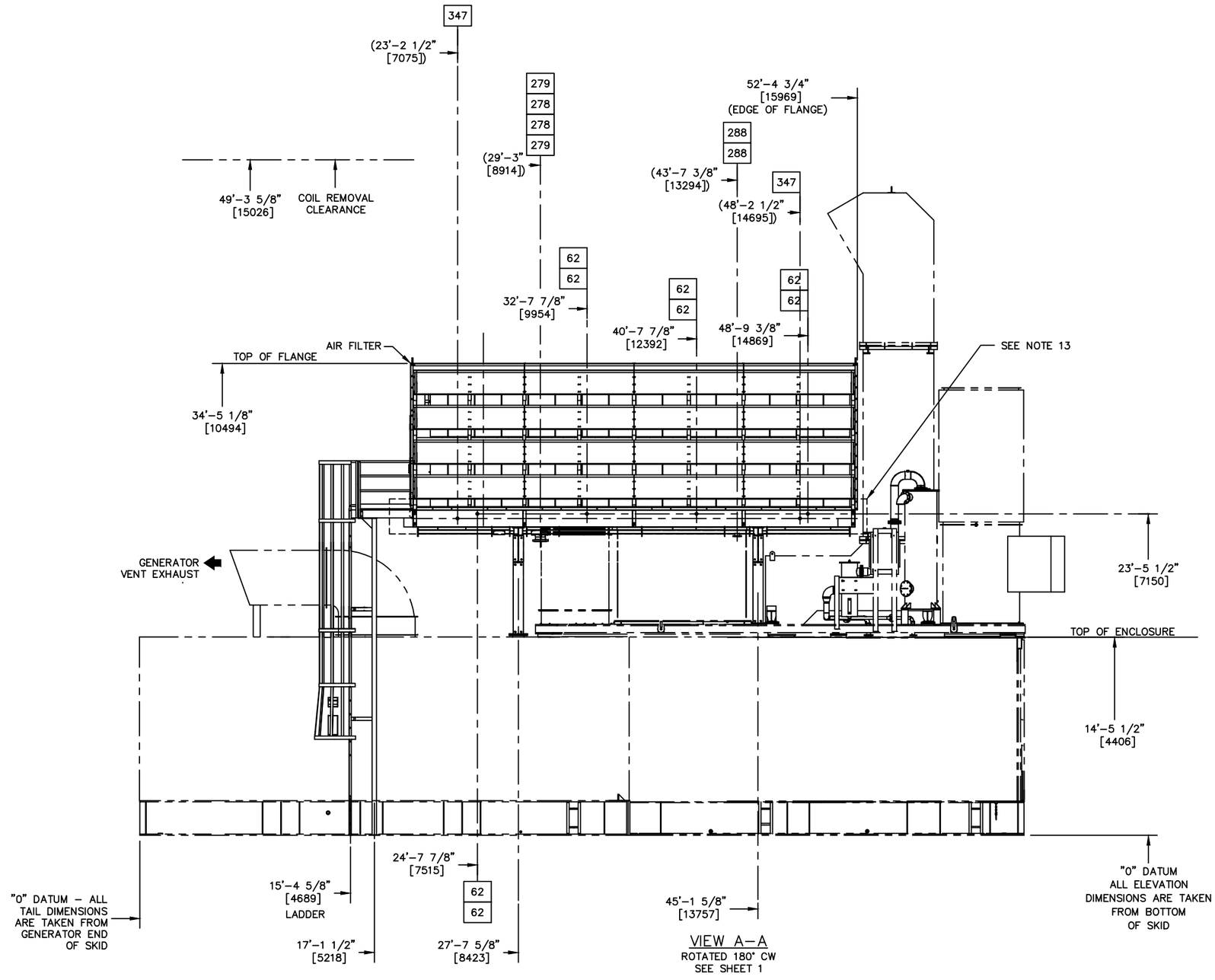
TITLE
GENERAL ARRANGEMENT
AIR FILTER

DWG NO. 7253049-969204

REV. A

SCALE 3/16" = 1'-0"

SHEET 1 OF 4



VIEW A-A
ROTATED 180° CW
SEE SHEET 1

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

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ADDL INFO
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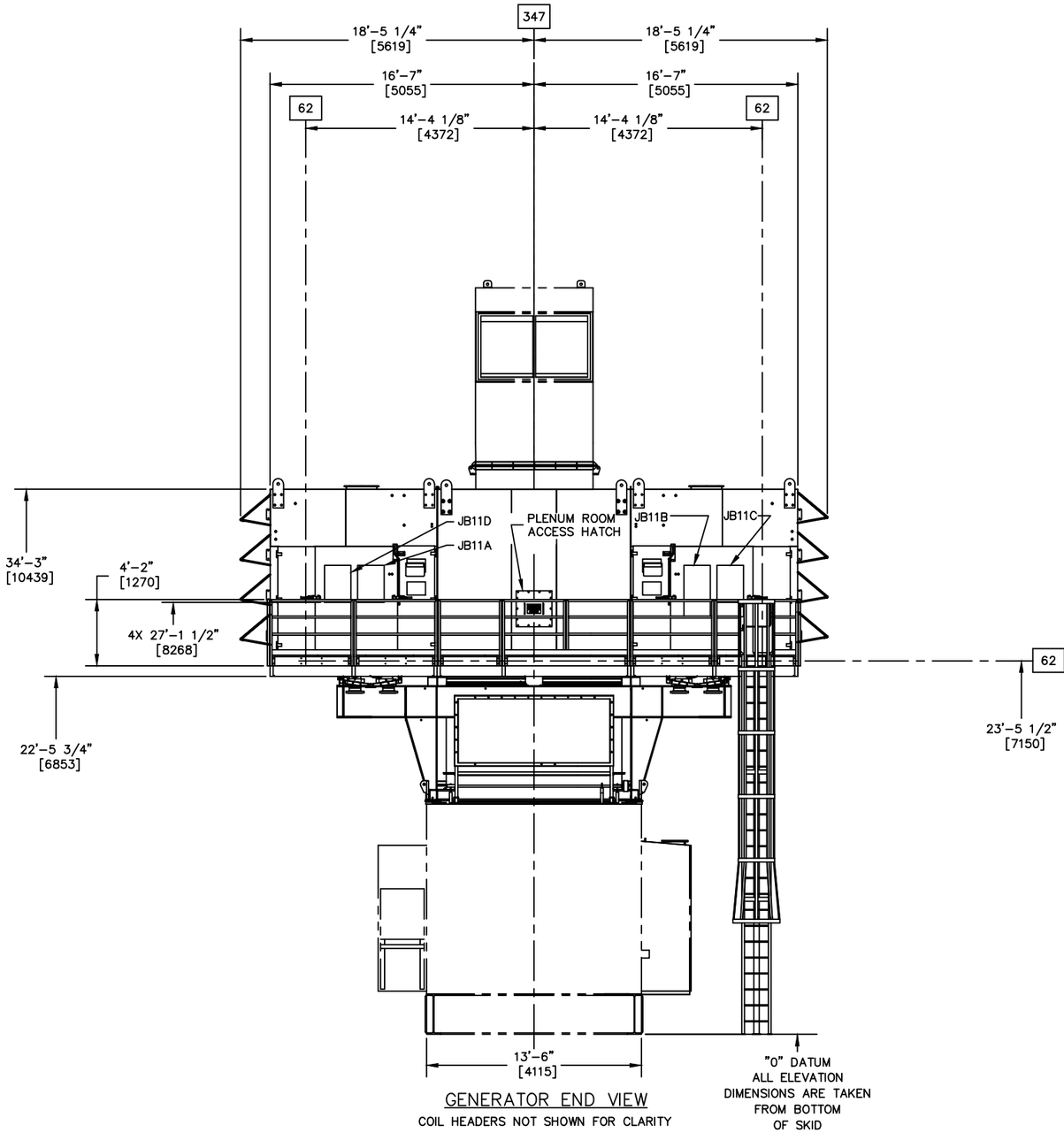
TITLE
GENERAL ARRANGEMENT
AIR FILTER

DWG NO. 7253049-969204

REV. A

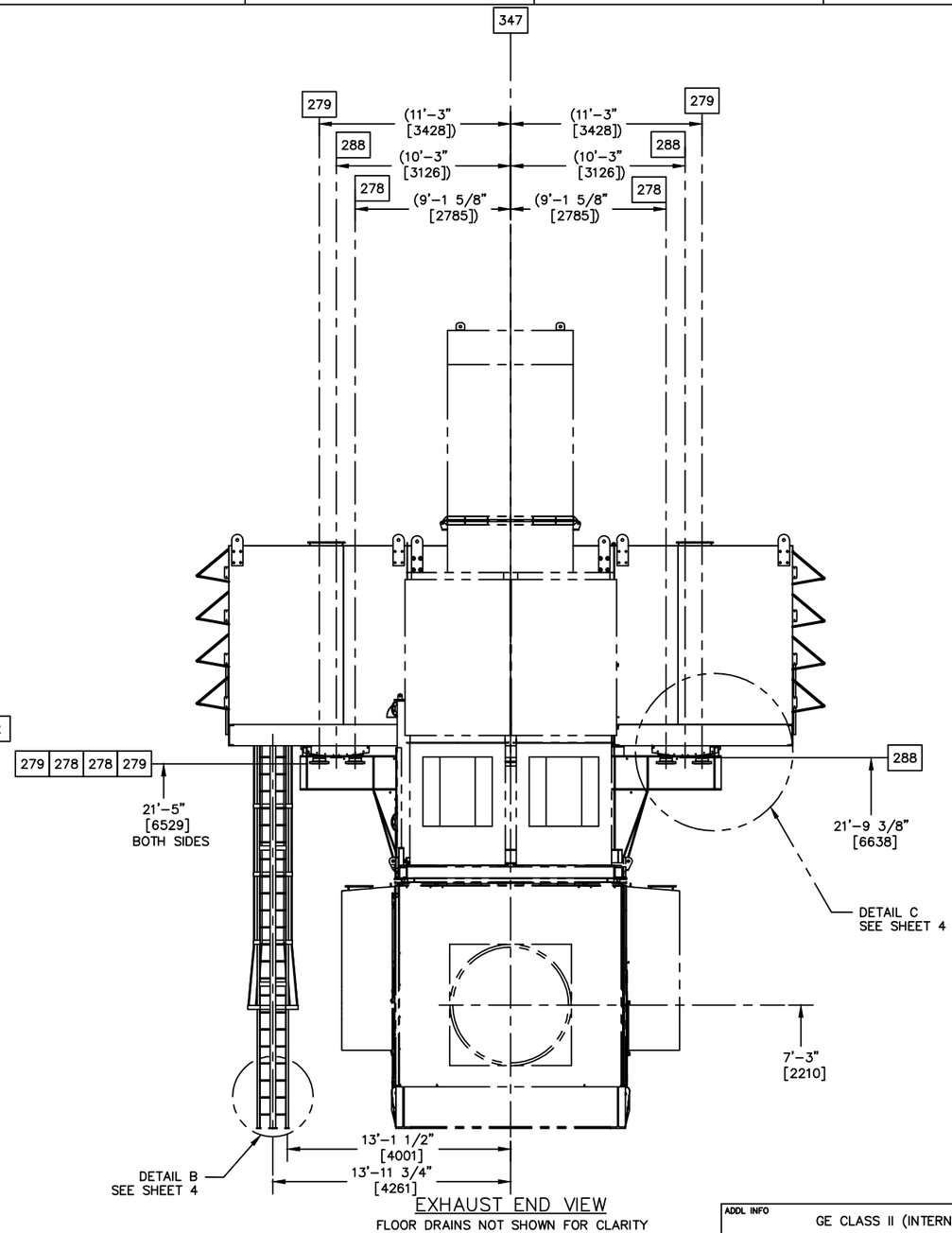
SCALE 1/4" = 1'-0"

SHEET 2 OF 4



GENERATOR END VIEW

COIL HEADERS NOT SHOWN FOR CLARITY



EXHAUST END VIEW

FLOOR DRAINS NOT SHOWN FOR CLARITY

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/8"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE

LM6000®

ADDL INFO

GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

GENERAL ARRANGEMENT
AIR FILTER

DWG NO. 7253049-969204

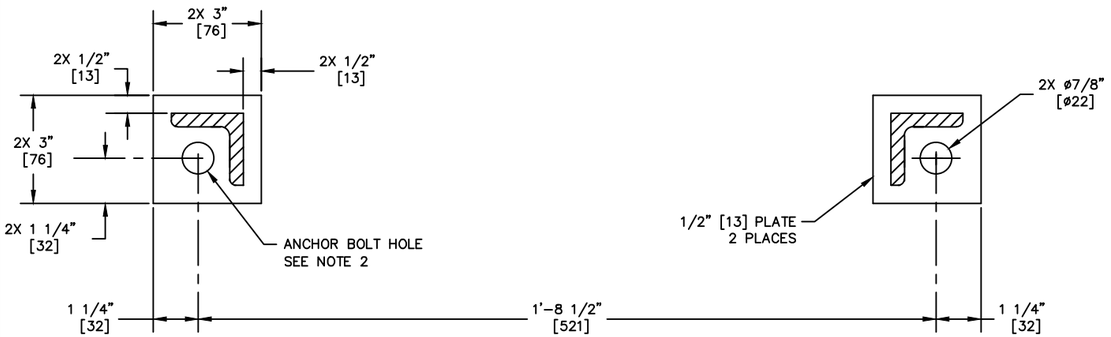
REV. A

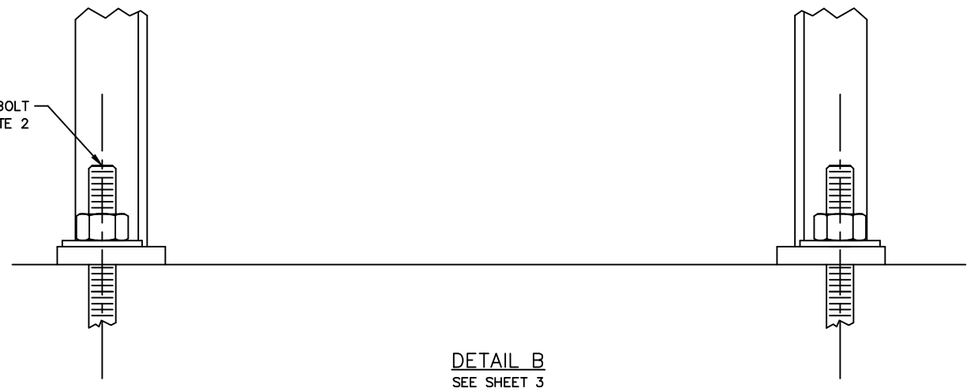
SCALE 1/4" = 1'-0"

SHEET 3 OF 4

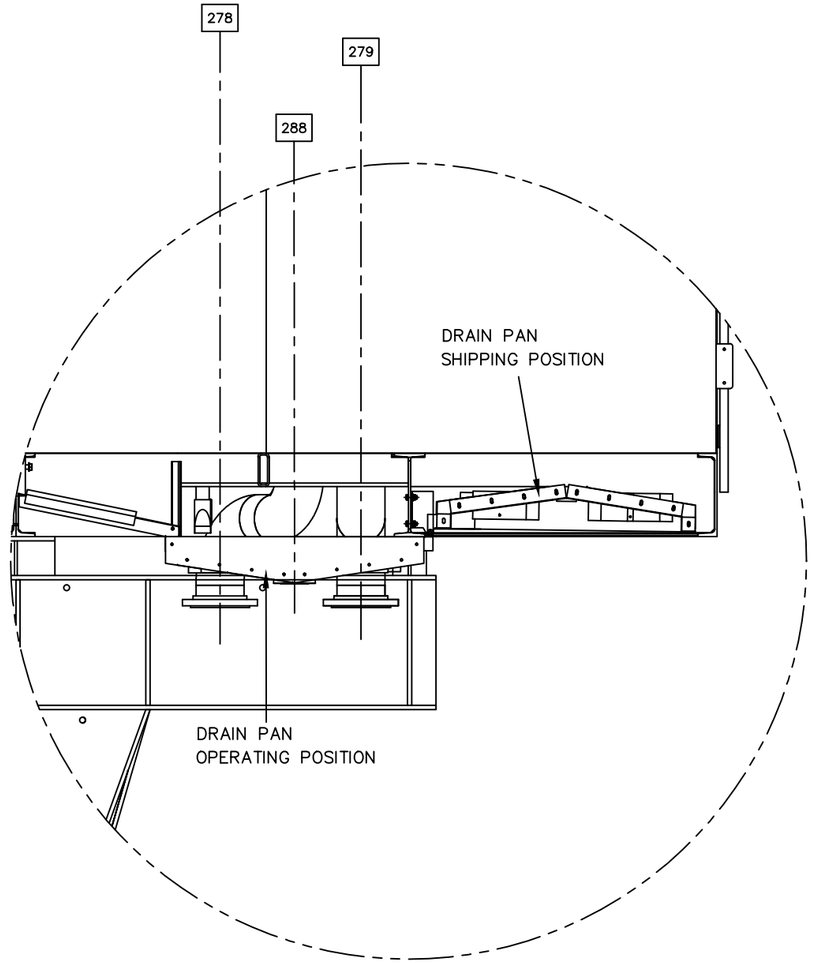
NOTES:

1. BOLT HOLE TOLERANCE ± 1/8" [3], TRUE POSITION.
2. ALL ANCHORING HARDWARE TO BE SUPPLIED BY CUSTOMER.





DETAIL B
SEE SHEET 3



DETAIL C
SEE SHEET 3

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/8"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

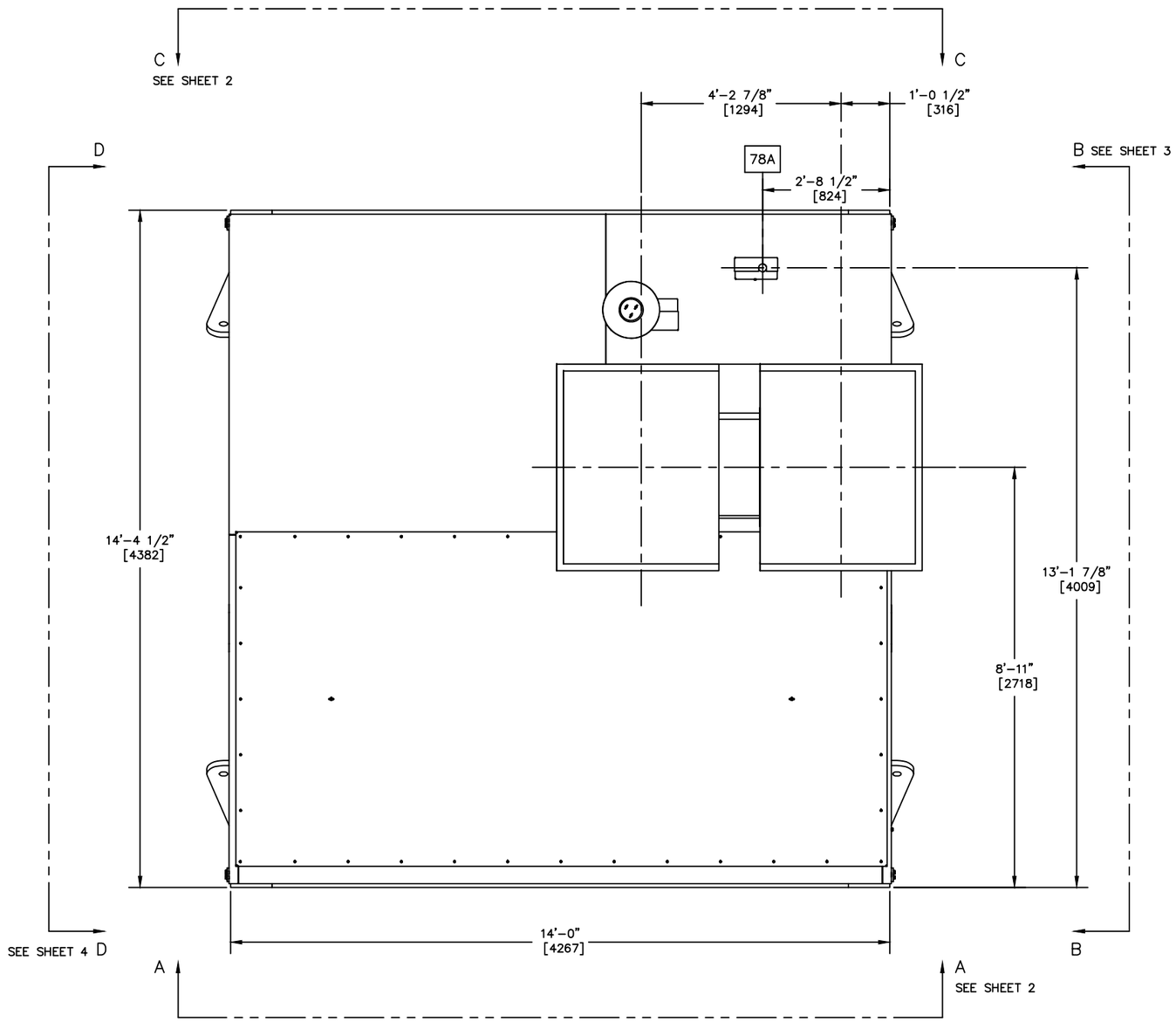
TITLE
GENERAL ARRANGEMENT
AIR FILTER

DWG NO. 7253049-969204

REV. A

SCALE 6" = 1'-0"

SHEET 4 OF 4



PLAN VIEW

LEGEND:

INDICATES CUSTOMER CONNECTION

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: ASME Y14.5M–1994, DIMENSIONING AND TOLERANCING.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
4. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
5. ALL AUXILIARY SKID FLANGED CUSTOMER CONNECTIONS ARE LOCATED 1/2" [12.7] FROM EDGE OF SKID.

REFERENCE DRAWINGS:

X–969201	GENERAL ARRANGEMENT, MAIN UNIT – LH
X–969232	F & ID, HYDRAULIC START SYSTEM
X–969244	F & ID, TURBINE LUBE OIL SYSTEM
X–969260	F & ID, FUEL SYSTEM
X–969262	F & ID, WATER WASH SYSTEM
X–969269	F & ID, WATER INJECTION PUMP
X–969270	F & ID, SPRINT SYSTEM, SPRINT SKID

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

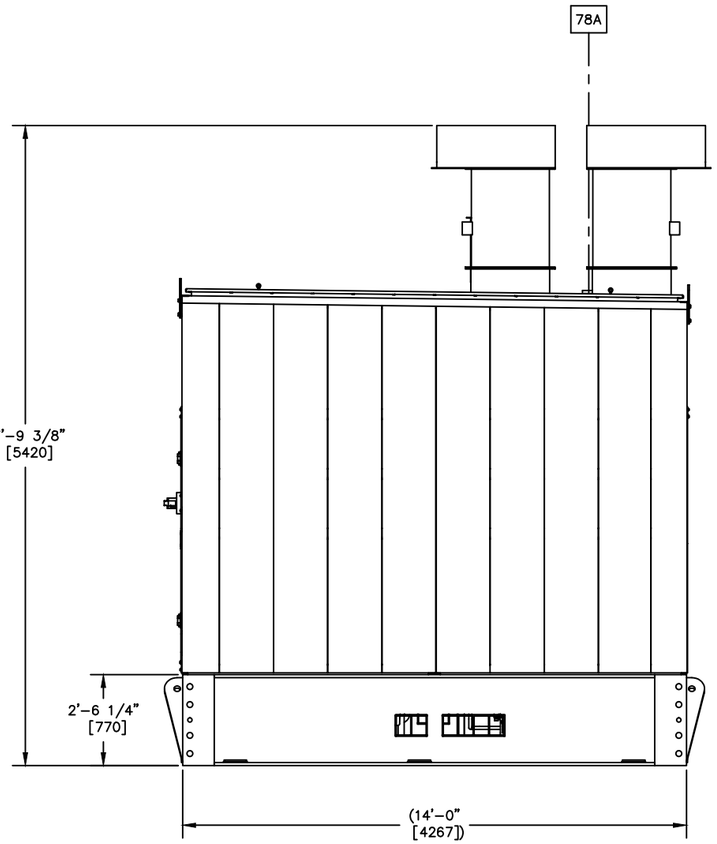
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049–969219

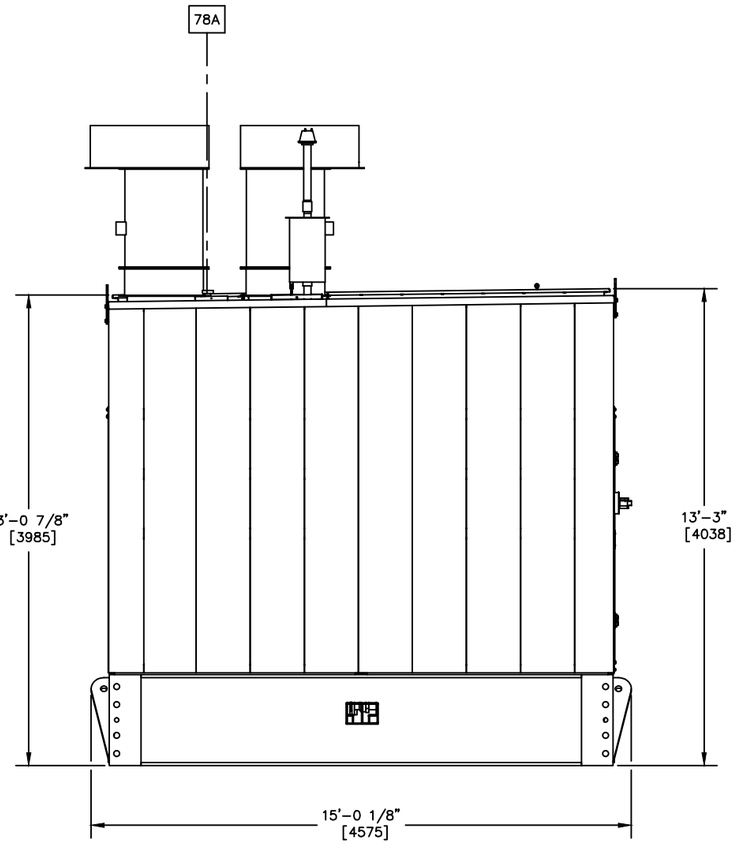
REV. A

SCALE 3/4" = 1'–0"

SHEET 1 OF 7



VIEW A–A
SEE SHEET 1



VIEW C–C
SEE SHEET 1

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000PF

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

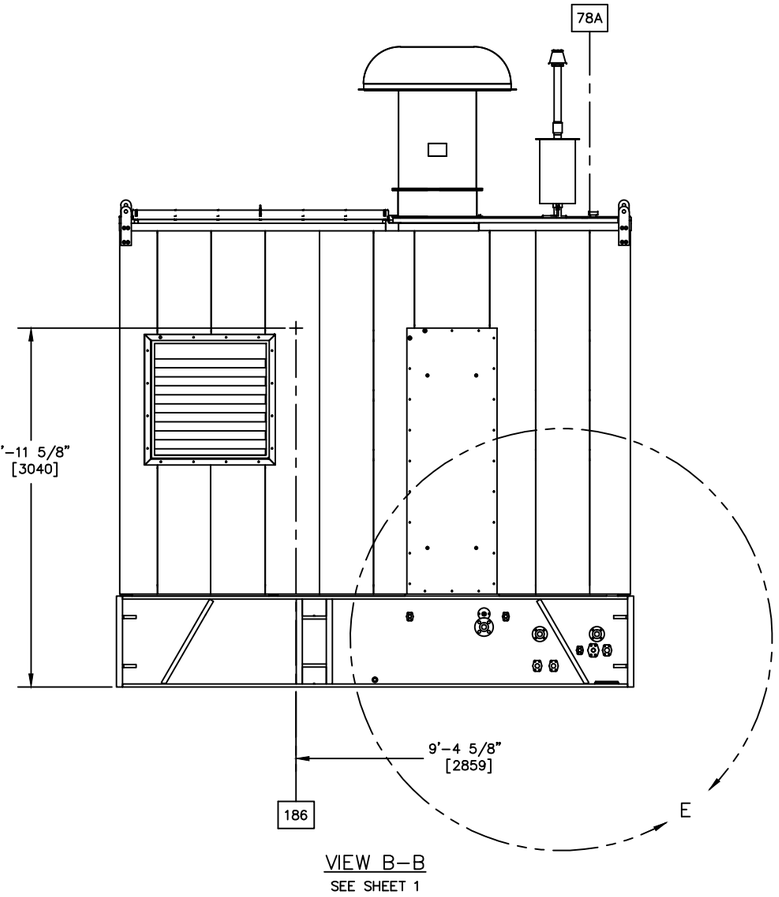
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049–969219

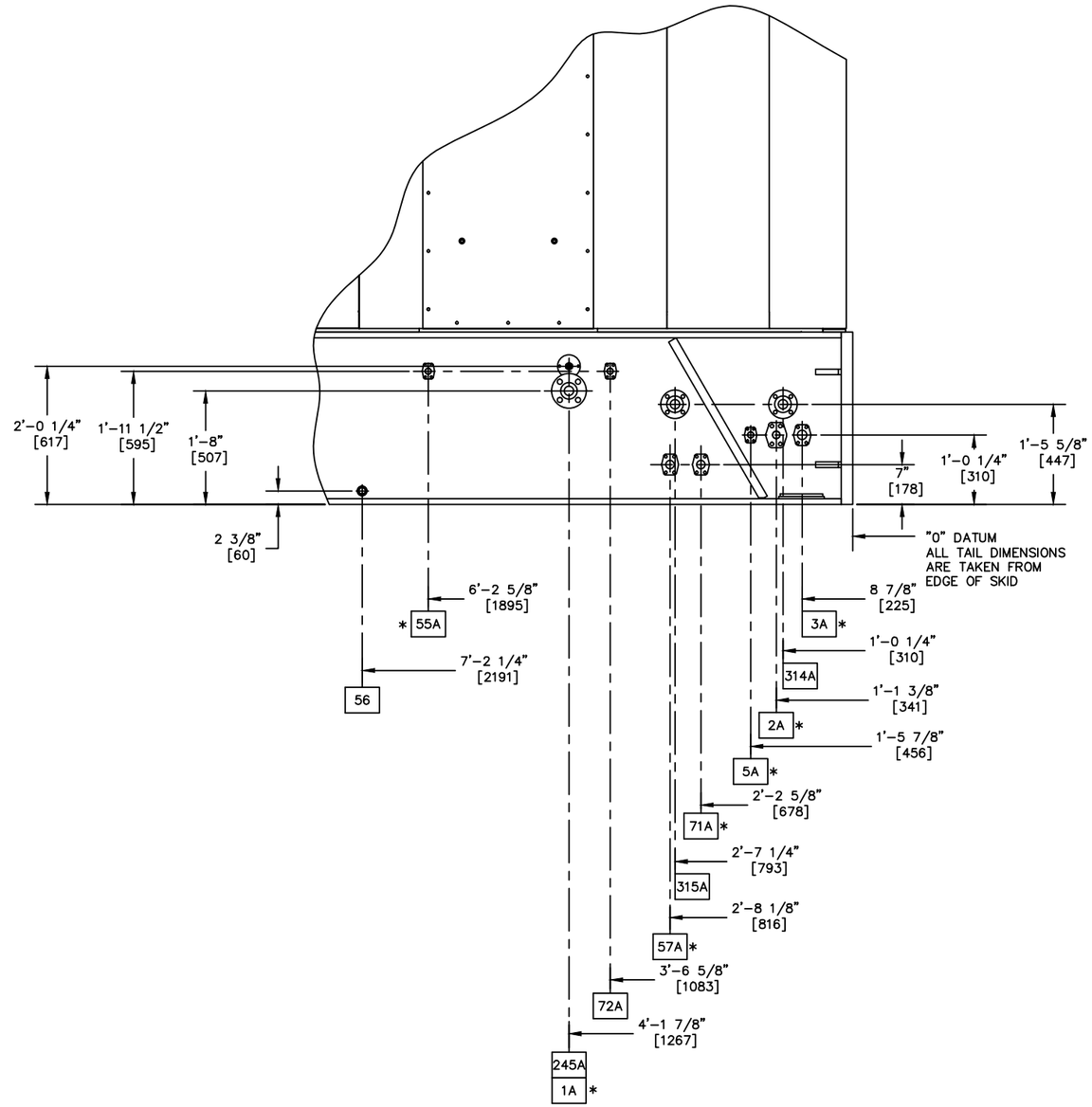
REV. A

SCALE 1/2" = 1'–0"

SHEET 2 OF 7



VIEW B-B
SEE SHEET 1



DETAIL E

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

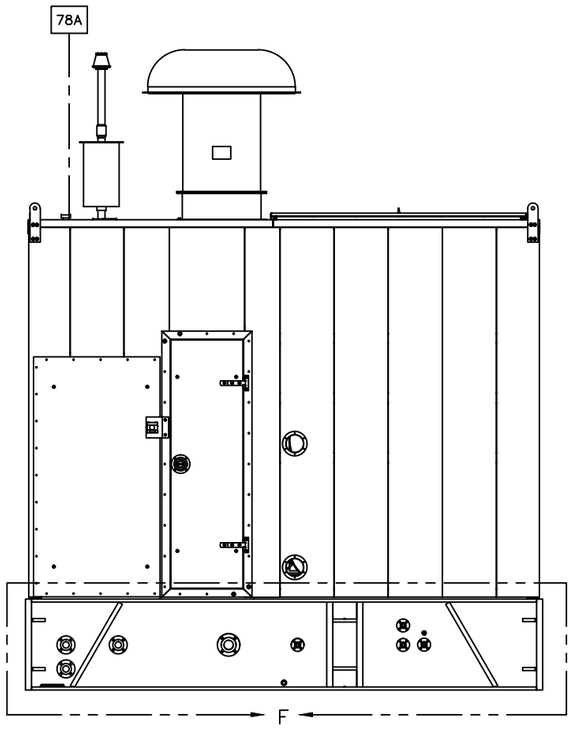
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049-969219

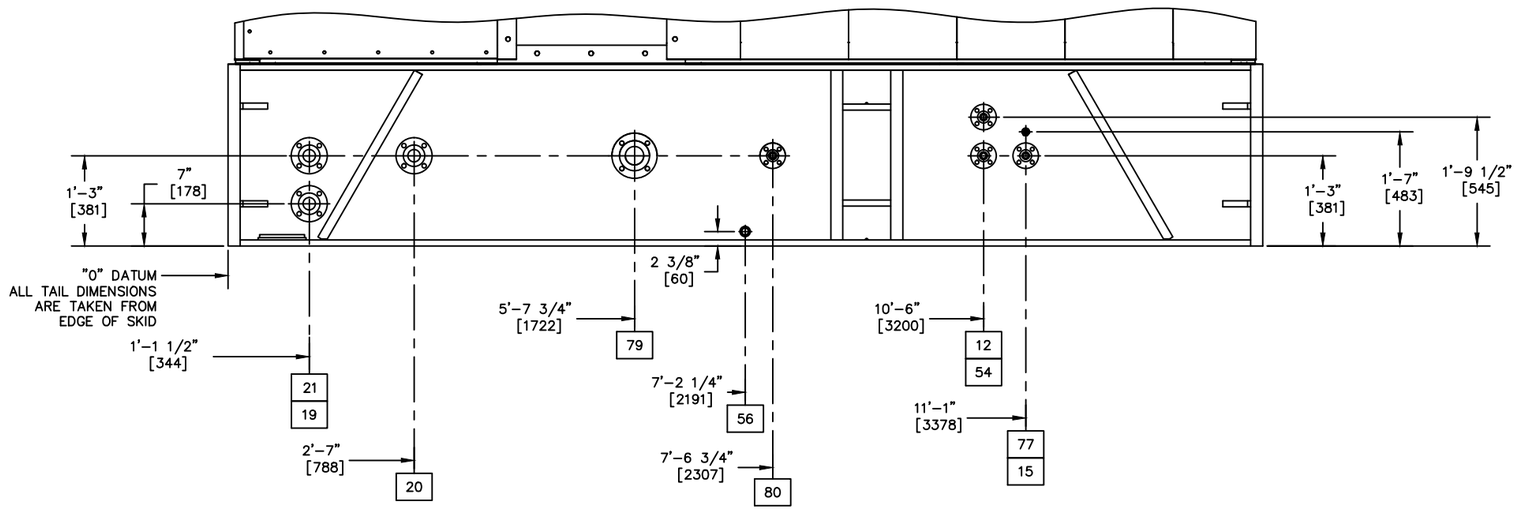
REV. A

SCALE 1/2" = 1'-0"

SHEET 3 OF 7



VIEW D–D
SEE SHEET 1



DETAIL F

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049–969219
REV. A

SCALE 1/2" = 1'–0"
SHEET 4 OF 7

CUSTOMER CONNECTION LEGEND:

*	1A	WATER INJECTION SUPPLY – 1 1/2"–600# RF, TP316 PIPE SCH 40S
*	2A	HYDRAULIC STARTER SUPPLY – 1 1/2"–6000# FF, SAE CODE 62, TP304 PIPE SCH XXS
*	3A	HYDRAULIC STARTER RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	5A	HYDRAULIC STARTER CASE DRAIN – 1"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
	12	INSTRUMENT AIR SUPPLY – 1"–150# RF, TP304 TUBING 0.083" WT MINIMUM
	15	WASH WATER INLET – 1"–150# RF, TP304 TUBING 0.083" WT MINIMUM
	19	TURBINE LUBE OIL TANK DRAIN – 2"–150# RF, TP304 PIPE SCH 40S
	20	TURBINE LUBE OIL SHELL & TUBE COOLING WATER SUPPLY – 2"–150# RF, TP304 PIPE SCH 40S
	21	TURBINE LUBE OIL SHELL & TUBE COOLING WATER RETURN – 2"–150# RF, TP304 PIPE SCH 40S
	54	WATER WASH TANK DRAIN – 1"–150# RF, TP304 TUBING 0.083" WT MINIMUM
*	55A	INSTRUMENT AIR SUPPLY – 1"–3000# FF, SAE CODE 61, TP316 PIPE SCH 40S
	56	AUXILIARY SKID DRIP PAN DRAIN – 1" NPT CS–3000# CPLG
*	57A	SCAVENGE LUBE OIL FILTER/COOLER SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
*	71A	TURBINE LUBE OIL PUMP SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
	72A	WATER WASH SUPPLY – 1"–3000# FF, SAE CODE 61, TP304 TUBING 0.083" WT MINIMUM
	77	ON LINE WATER WASH CHEMICAL INLET – 1/2" QUICK DISCONNECT, TP304 TUBING 0.083" WT MINIMUM
	78A	TURBINE LUBE OIL AIR/OIL PRE–SEPARATOR RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
	79	WATER INJECTION DEMINERALIZED WATER SUPPLY 3"–150# RF, TP316 PIPE SCH 40S
	80	WATER INJECTION DRAIN 1"–150# RF, TP304 PIPE SCH 40S
	186	INSTRUMENT AIR – 1/4" MNPT, TP304 TUBING 0.035" WT MINIMUM
	245A	WATER INJECTION DRAIN 3/4" MNPT, TP 304 PIPE SCH 40S
	314A	TURBINE LUBE OIL DISCHARGE TO COOLER – 1 1/2"–150# RF, TP304 PIPE SCH 40S
	315A	TURBINE LUBE OIL RETURN FROM COOLER – 1 1/2"–150# RF, TP304 PIPE SCH 40S

NOTE:

1. * CUSTOMER INTERFACE–MATING FLANGES FURNISHED BY GEPPLP ENERGY PRODUCTS.
2. PIPING AND/OR TUBING MATERIAL SPECIFICATION LISTED IN CONNECTION LEGEND SHALL BE USED BY CUSTOMER AS A RECOMMENDATION IN DESIGN OF THEIR PLANT INTERCONNECT PIPING SYSTEM.

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

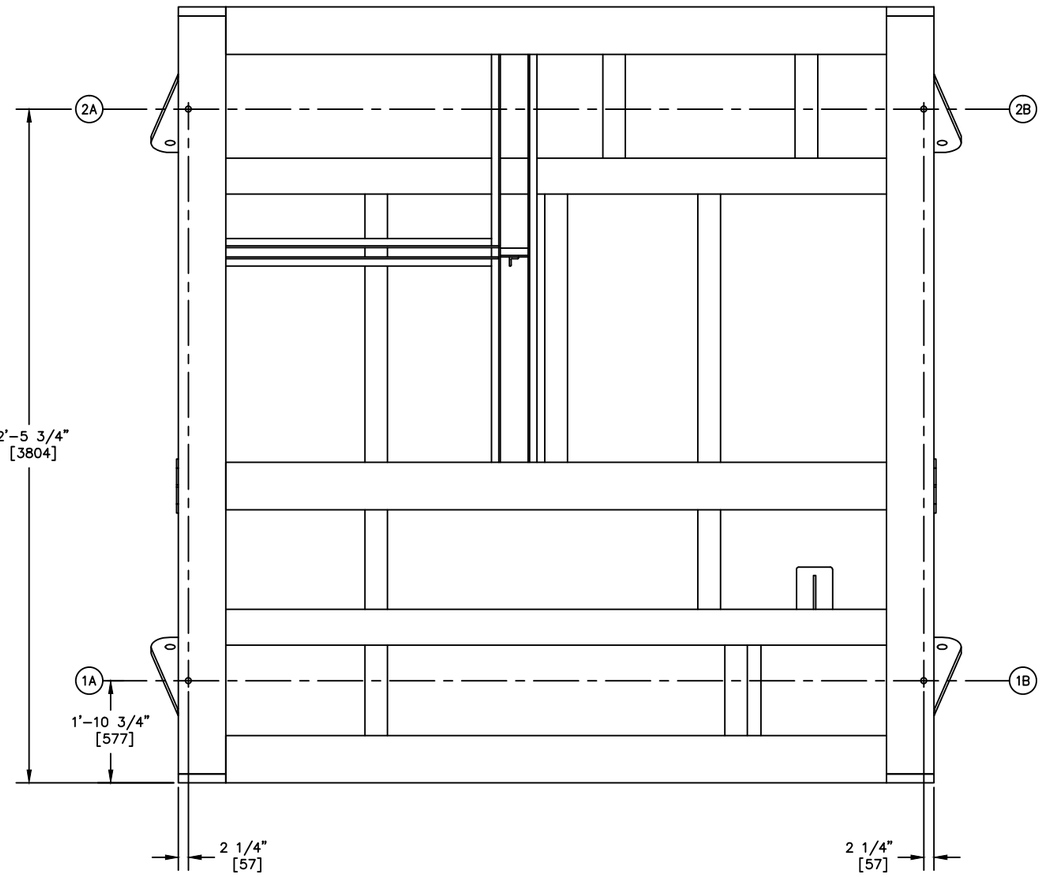
TITLE: GENERAL ARRANGEMENT AUXILIARY SKID LEFT HAND

DWG NO. 7253049–969219

REV. A

SCALE NONE

SHEET 5 OF 7



BOTTOM VIEW

RESERVED

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REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049-969219

REV. A

SCALE 3/4" = 1'-0"

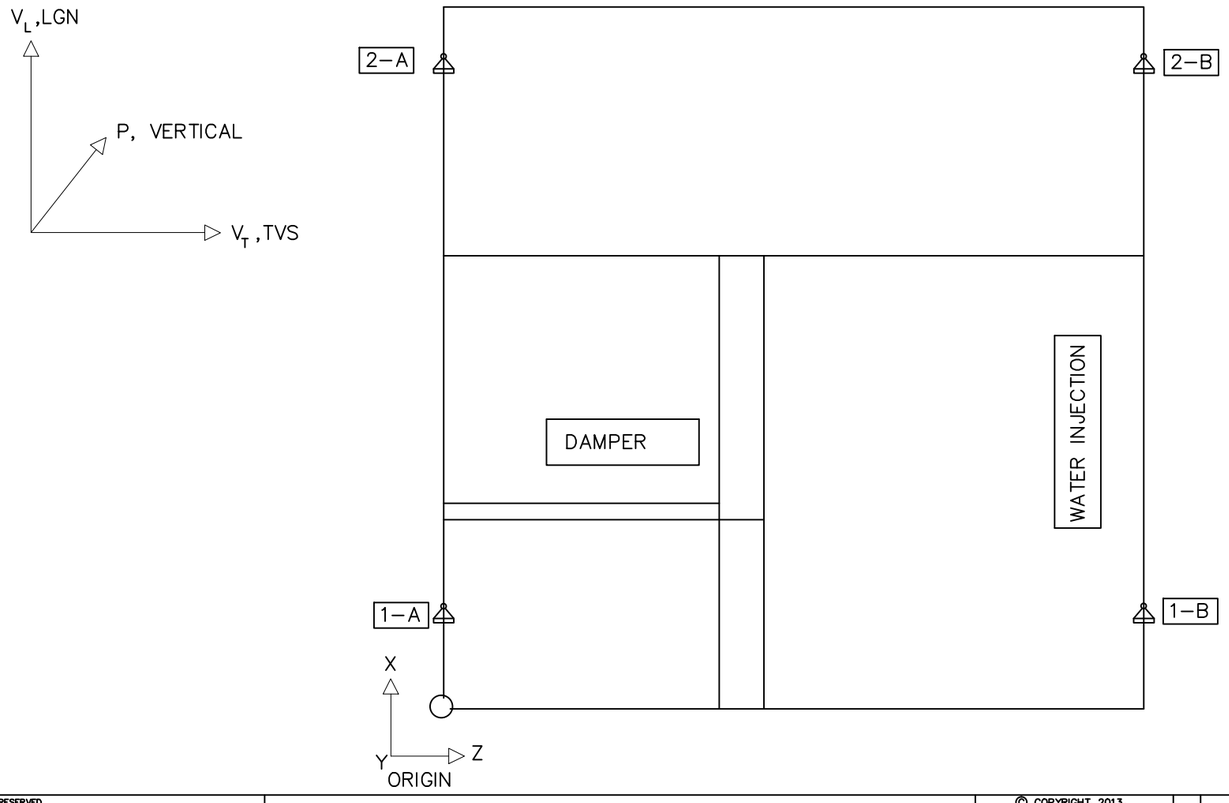
SHEET 6 OF 7

LM6000 PG 60Hz – AUXILIARY SKID (WITH ENCLOSURE)
FOUNDATION LOADS (KIPS)

ANCHOR POINT	DEAD LOAD			LIVE LOAD 60 PSF			SEISMIC TRANSVERSE			SEISMIC LONGITUDINAL			WIND LOAD TRANSVERSE			WIND LOAD LONGITUDINAL		
	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT
1–A	11.1	0.2	0.3	2.9	0.0	0.0	−7.9	0.0	−9.7	−10.5	−10.1	0.6	−2.8	0.2	−1.6	−3.7	−1.8	0.0
1–B	11.7	0.5	−0.3	3.3	−0.1	0.0	7.9	−0.1	−9.8	−8.4	−10.8	−0.3	0.6	−0.2	−1.6	−3.3	−1.6	0.0
2–A	12.5	−0.3	0.1	3.2	0.0	0.0	−7.3	−0.3	−10.5	10.5	−9.6	−0.2	−3.3	0.0	−1.6	1.5	−1.6	0.0
2–B	12.8	−0.5	−0.1	3.0	0.1	0.0	7.3	0.3	−10.7	8.4	−10.2	0.0	1.1	0.1	−1.7	1.0	−1.5	0.0
TOTAL	48.2	0.0	0.0	12.5	0.0	0.0	0.0	0.0	−40.7	0.0	−40.7	0.0	−4.4	0.0	−6.6	−4.4	−6.5	0.0

LM6000 PG 60Hz – AUXILIARY SKID (WITH ENCLOSURE)
FOUNDATION LOADS (KN)

ANCHOR POINT	DEAD LOAD			LIVE LOAD 60 PSF			SEISMIC TRANSVERSE			SEISMIC LONGITUDINAL			WIND LOAD TRANSVERSE			WIND LOAD LONGITUDINAL		
	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT
1–A	49.3	1.1	1.3	13.0	0.0	−0.1	−35.3	0.1	−43.2	−46.6	−45.0	2.5	−12.6	0.8	−7.2	−16.4	−7.8	0.2
1–B	52.0	2.3	−1.4	14.8	−0.5	0.1	35.3	−0.4	−43.8	−37.3	−47.8	−1.3	2.9	−0.8	−7.2	−14.7	−7.2	0.1
2–A	55.8	−1.1	0.3	14.5	0.0	−0.1	−32.5	−1.1	−46.6	46.6	−42.9	−1.0	−14.8	−0.2	−7.2	6.8	−7.2	−0.2
2–B	57.0	−2.3	−0.3	13.5	0.6	0.1	32.5	1.4	−47.7	37.3	−45.2	−0.2	4.9	0.2	−7.8	4.7	−6.7	−0.1
TOTAL	214.2	0.0	0.0	55.7	0.0	0.0	0.0	0.0	−181.2	0.0	−181.0	0.0	−19.6	0.0	−29.4	−19.6	−28.9	0.0



NOTES:

1. FOR P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENTS A LOAD AT EACH ANCHOR LOCATION.
   ROOF LIVE LOAD IS APPLIED AS PER CBC 2010 TABLE 1607.1, REPRESENTS A UNIFORM LOAD OF 60 PSF APPLIED AT EXPOSED SECTION ON ROOF OF THE AUX SKID.
4. SEISMIC LOADS ARE DUE TO 0.85g STATIC ACCELERATION APPLIED IN THE LONGITUDINAL AND TRANSVERSE DIRECTION AS PER EQUIVALENT LATERAL FORCE PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER CBC 2010 CODE SECTION 1613 THAT REFERENCES ASCE 7–05.

SITE CLASS	D
OCCUPANCY CATEGORY, TABLE 1604.5	III
SEISMIC DESIGN CATEGORY –SECTION 1613.5.6	D
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7–05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7–05, TABLE 15.4–1	2.50
S_{DS} – SPECTRAL RESPONSE ACCEL. AT 0.2 SEC – G	1.69
S_{D1} – SPECTRAL RESPONSE ACCEL. AT 1 SEC – G	0.85
G–LEVELS FOR BASE ACCELERATIONS FOR DESIGN	0.85

SEISMIC LOADS MAY BE POSITIVE OR NEGATIVE.
CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT Ev=+/–0.2SDS D = 0.338 D IN THE FOUNDATION LOADS AS PER ASCE 7–05 SECTION 12.4

5. WIND LOAD ARE PER ASCE 7–05 CODE, 85 MPH 3 SEC GUSTS FOR LOW RISE BUILDING, H <60 FT

WIND PRESSURE (PSF), EQ 6–18	$p = q_h (GC_{pf} - GC_{pi})$	$24.25 (GC_{pf} - GC_{pi})$
EXTERNAL PRESSURE COEF., FIGURE 6–10	GC_{pf}	
INTERNAL PRESSURE COEF., FIGURE 6–5	GC_{pi}	+ OR –0.18
VELOCITY PRESSURE (psf) , Eq 6–15	$q_h = 0.00256\ K_z K_{zt} K_d V^2 I$	24.25
VELOCITY PRESSURE EXPOSURE COEF. – TABLE 6–3	K_z	0.98
TOPOGRAPHIC FACTOR, Eq. 6–3	$Kzt = (1 + K_1 K_2 K_3)^2$	1.37
FIGURE 6–4	K_1	0.17
FIGURE 6–4	K_2	1.00
FIGURE 6–4	K_3	1.00
WIND DIRECTIONALITY FACTOR, TABLE 6–4	K_d	0.85
WIND VELOCITY (MPH)	V	85
IMPORTANCE FACTOR, TABLE 6–1	I	1.15
EXPOSURE CATEGORY	C	C

6. RECOMMENDED ANCHOR BOLT (DESIGNED AND PROVIDED BY OTHERS) IS ASTM F1554 GR 105 OF DIA 1 1/8 INCH.
7. SIGNS CAN BE REVERSED ON ACCELERATION AND WIND LOADS.

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

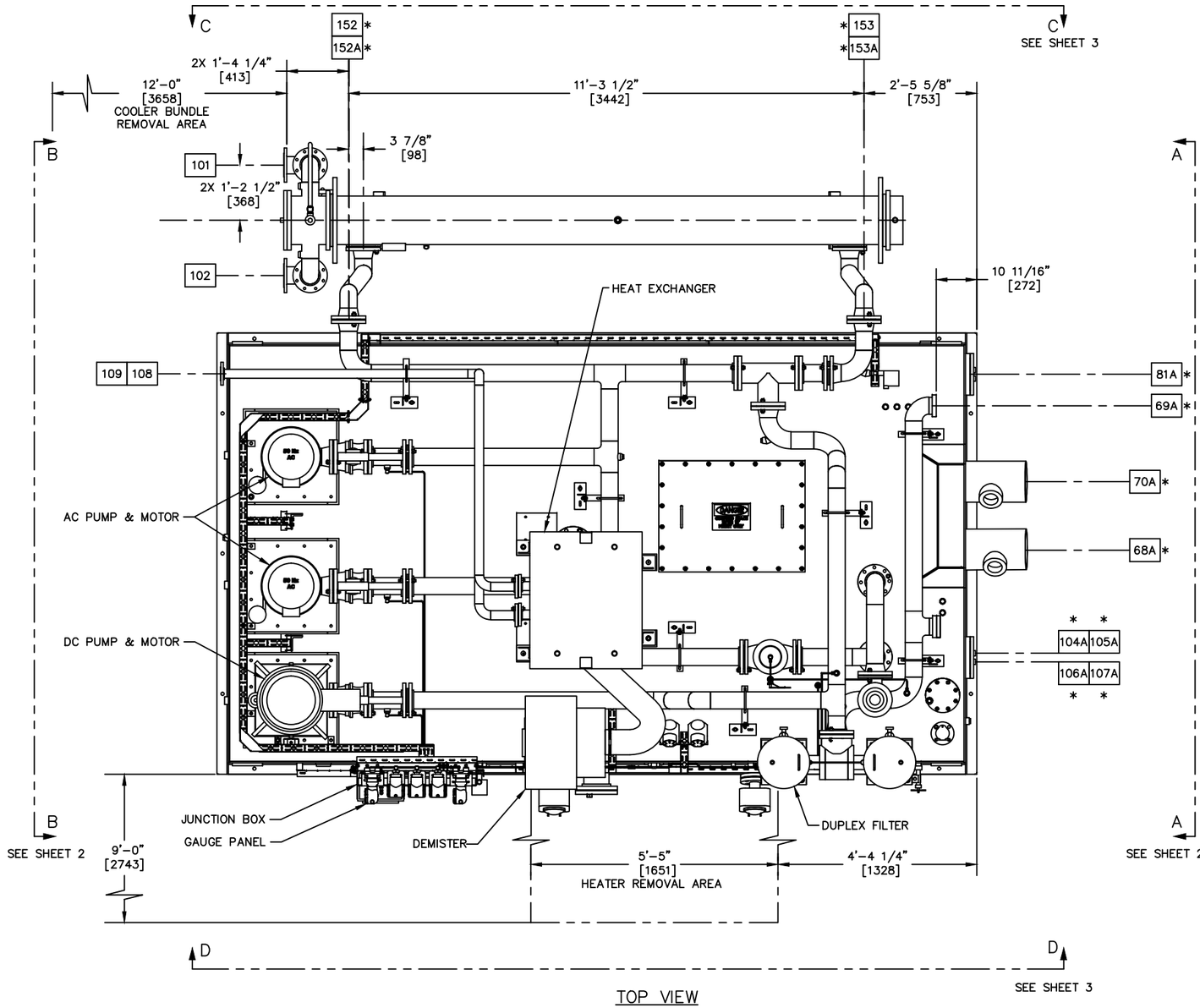
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
LEFT HAND

DWG NO. 7253049–969219

REV. A

SCALE NONE

SHEET 7 OF 7



TOP VIEW

LEGEND:

[ ] INDICATES CUSTOMER CONNECTION LOCATION

NOTES:

1. CUSTOMER PIPING CONNECTIONS ARE DEFINED AND DIMENSIONED ON THE MAIN UNIT GENERAL ARRANGEMENT DRAWING.
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
5. PIPING AND/OR TUBING MATERIAL SPECIFICATION LISTED IN CONNECTION LEGEND SHALL BE USED BY CUSTOMER AS A RECOMMENDATION IN DESIGN OF THEIR PLANT INTERCONNECT PIPING SYSTEM.

REFERENCE DRAWINGS:

X–969200 GENERAL ARRANGEMENT, MAIN UNIT – RH
X–969248 FLOW & INSTRUMENT DIAGRAM, GENERATOR LUBE OIL SYSTEM

CUSTOMER CONNECTION LEGEND:

*	68A	GEARBOX LUBE OIL RETURN – 10"–TP304 PIPE, SCH 10S
*	69A	LUBE OIL SUPPLY – 4"–3000# ORF, SAE CODE 61, TP304 PIPE SCH 40S
*	70A	GEARBOX LUBE OIL RETURN – 10"–TP304 PIPE, SCH 10S
*	81A	GENERATOR LUBE OIL DRAIN – 6"–TP304 PIPE, SCH 40S
	101	GENERATOR/GEARBOX LUBE OIL COOLING WATER SUPPLY – 4"–150# RF, TP304 PIPE SCH 10S
	102	GENERATOR/GEARBOX LUBE OIL COOLING WATER RETURN – 4"–150# RF, TP304 PIPE SCH 10S
*	104A	JACKING OIL RELIEF VALVE RETURN, PSV–6053A – 3/4" NPT 3000# CPLG, TP304 TUBING 0.065" WT MIN.
*	105A	JACKING OIL RELIEF VALVE RETURN, PSV–6053B – 3/4" NPT 3000# CPLG, TP304 TUBING 0.065" WT MIN.
*	106A	JACKING OIL RELIEF VALVE RETURN, PSV–6054A – 3/4" NPT 3000# CPLG, TP304 TUBING 0.065" WT MIN.
*	107A	JACKING OIL RELIEF VALVE RETURN, PSV–6054B – 3/4" NPT 3000# CPLG, TP304 TUBING 0.065" WT MIN.
	108	GENERATOR/GEARBOX LUBE OIL TANK DEMISTER COOLER WATER SUPPLY – 2"–150# RF,TP304 PIPE SCH 10S
	109	GENERATOR/GEARBOX LUBE OIL TANK DEMISTER COOLER WATER RETURN – 2"–150# RF,TP304 PIPE SCH 10S
*	152	GENERATOR LUBE OIL, COOLER SUPPLY – 4"–150# RF, TP304 PIPE SCH 40S
*	152A	GEARBOX GENERATOR LUBE OIL SUPPLY TO COOLER – 4"–150# RF, TP304 PIPE SCH 40S
*	153	GENERATOR LUBE OIL, COOLER RETURN – 4"–150# RF, TP304 PIPE SCH 40S
*	153A	GEARBOX GENERATOR LUBE OIL RETURN FROM COOLER – 4"–150# RF, TP304 PIPE SCH 40S
*	200	GENERATOR LUBE OIL DECK DRAIN – 3/4" FNPT, 3000#, CPLG 304SS
*	201	GENERATOR LUBE OIL RESERVOIR DRAIN – 2" FNPT 3000#, CPLG 304SS

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

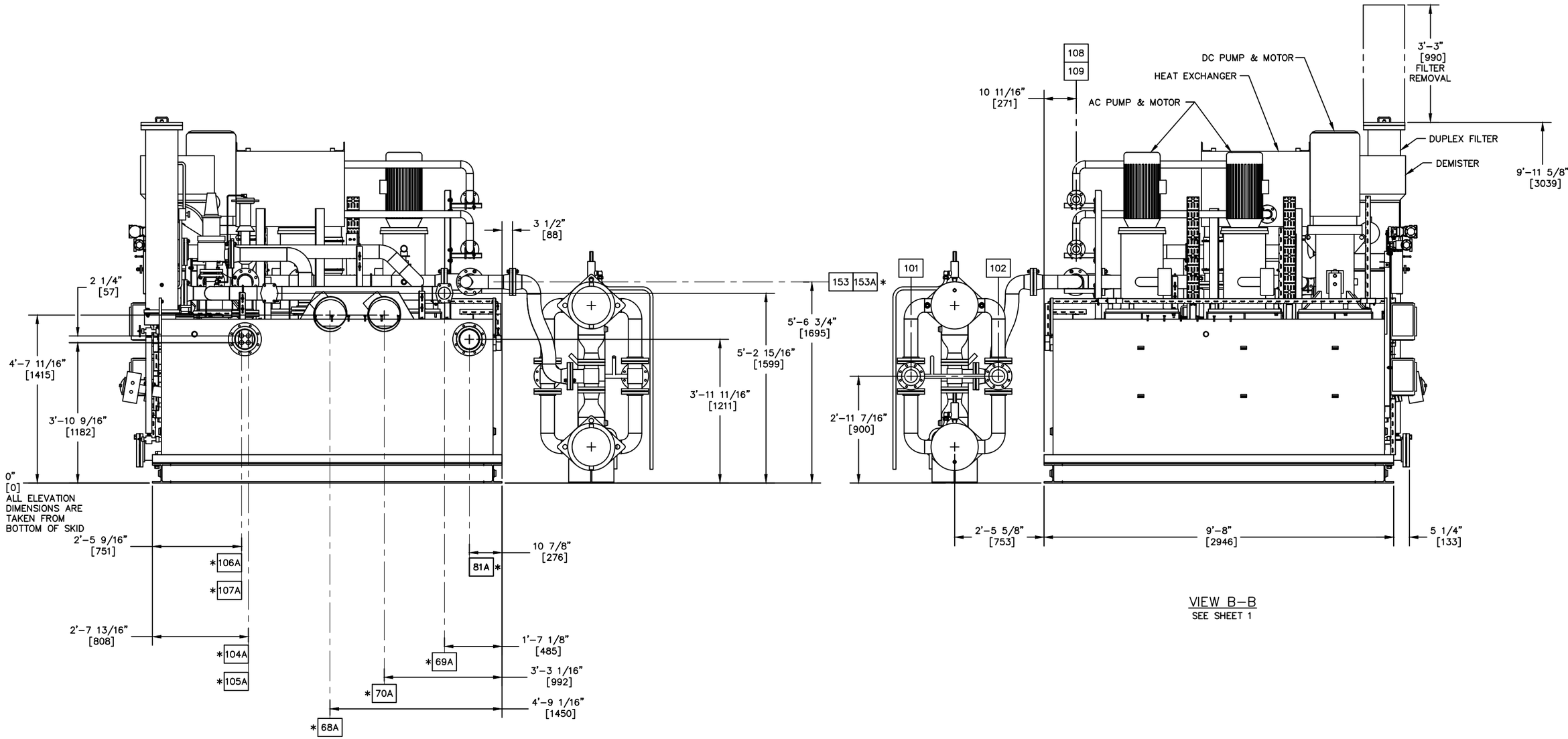
ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT GENERATOR/GEARBOX MINERAL LUBE OIL SKID

DWG NO. 7253049–969221 REV. A

SCALE 3/4" = 1'–0" SHEET 1 OF 6



VIEW A–A
SEE SHEET 1

VIEW B–B
SEE SHEET 1

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THIRD ANGLE PROJECTION

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DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

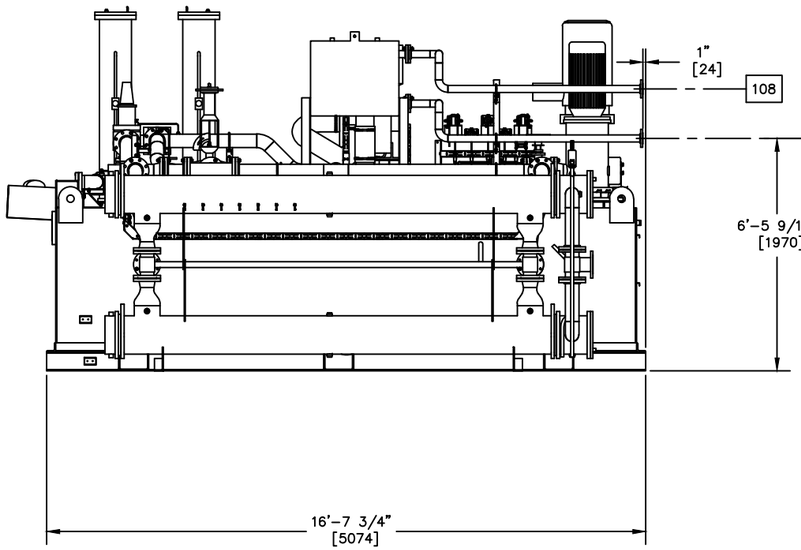
UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

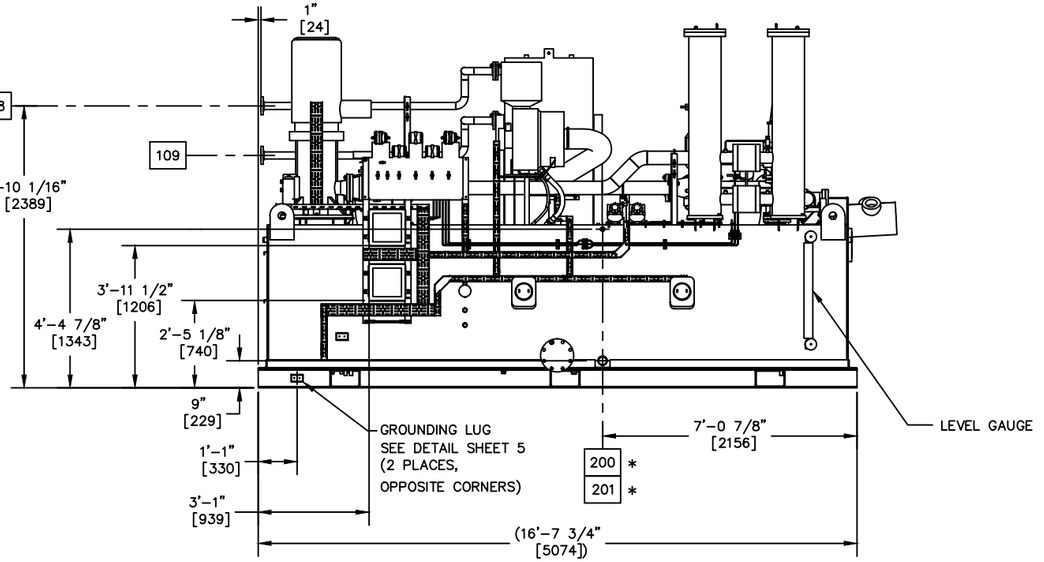
GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

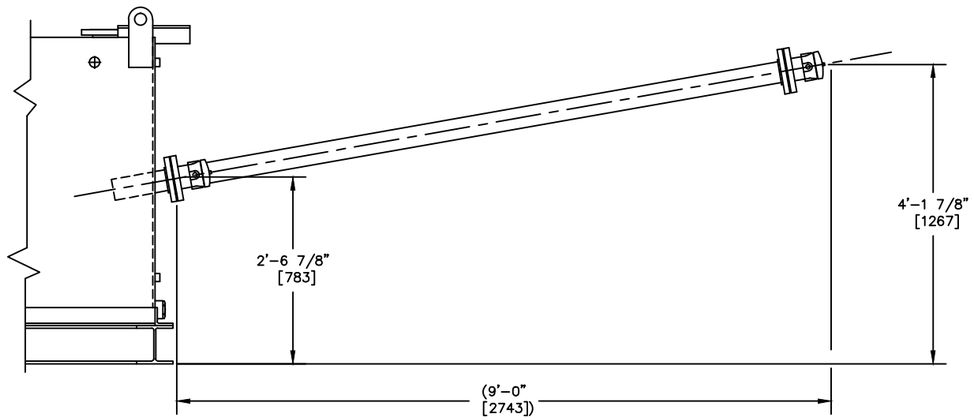
DWG NO. 7253049–969221
REV. A
SCALE 3/4" = 1'–0"
SHEET 2 OF 6



VIEW C–C
SEE SHEET 1



VIEW D–D
SEE SHEET 1



HEATER REMOVAL DETAIL

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

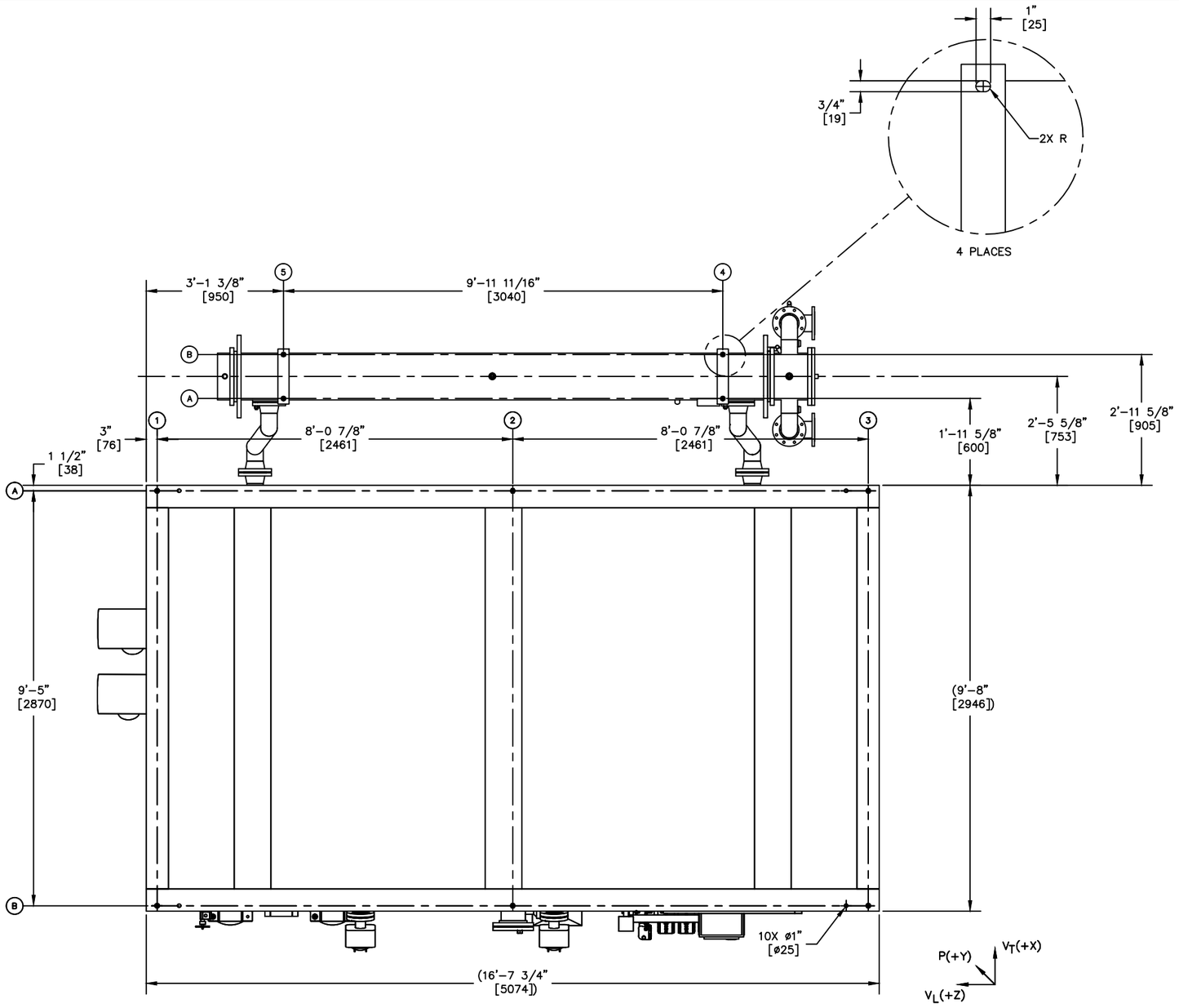
TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. 7253049–969221

REV. A

SCALE 1/2" = 1'–0"

SHEET 3 OF 6



INSTALLATION FOOTPRINT

LEGEND:

● ANCHOR BOLT

NOTES:

1. FOR VERTICAL P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENTS A LOAD AT EACH ANCHOR LOCATION.
3. LIVE LOAD REPRESENTS A UNIFORM LOAD OF 60 PSF APPLIED AT EXPOSED SECTION ON THE ROOF OF GLO TANK.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE TRANSVERSE OR LONGITUDINAL DIRECTION AS PER EQUIVALENT LATERAL PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER IBC 2009/CBC 2010 CODE SECTION 1613 THAT REFERENCES ASCE 7-05.

SITE CLASS	D
OCCUPANCY CATEGORY	III
SEISMIC DESIGN CATEGORY – TABLE 1613.5.6	E
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7-05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7-05, TABLE 15.4-2	3.00
S_{DS} – SPECTRAL RESPONSE ACCEL. AT 0.2 SEC – G	1.44
S_{D1} – SPECTRAL RESPONSE ACCEL. AT 1 SEC – G	0.75
G – LEVELS FOR BASE ACCELERATIONS FOR DESIGN	0.60

SEISMIC LOAD MAY BE POSITIVE OR NEGATIVE.

CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT $Ev=+/-\ 0.2 S_{DS} D$ IN THE FOUNDATION LOADS AS PER ASCE 7-05 SECTION 12.4.

NOTES CONTINUED ON SHEET 6

LM6000-PG GENERATOR LUBE OIL TANK
FOUNDATION LOADING (KIPS)

ANCHOR	DEAD LOAD			ROOF LL (60 PSF)			SEISMIC (TRANSVERSE)			SEISMIC (LONGITUDINAL)			WIND (150 MPH) (TRANSVERSE)		
	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT
1–A	9.6	–4.5	–3.2	1.6	–0.8	–0.5	4.4	–1.9	–6.7	3.2	–5.5	–1.2	1.7	–0.7	–2.0
1–B	9.7	–4.5	2.5	1.4	–0.7	0.4	–4.1	1.8	–6.5	3.3	–5.8	1.2	–1.6	0.6	–1.9
2–A	5.3	–0.3	–1.7	0.8	0.0	–0.1	2.1	–0.3	–2.9	0.0	–6.2	–0.4	0.8	–0.1	–0.9
2–B	7.7	1.2	2.4	1.1	0.2	0.3	–2.7	0.3	–3.0	0.0	–6.8	0.3	–1.1	0.0	–0.8
3–A	11.1	4.4	–4.4	1.5	0.7	–0.5	4.7	1.3	–7.0	–3.2	–4.1	1.3	1.8	0.5	–2.1
3–B	11.2	3.7	4.1	1.4	0.6	0.5	–4.4	–1.2	–6.8	–3.3	–4.5	–1.1	–1.7	–0.4	–2.1
TOTAL	54.7	0.1	–0.3	7.8	0.0	–0.1	0.0	0.0	–32.8	0.0	–32.8	0.0	0.0	0.0	–9.8

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

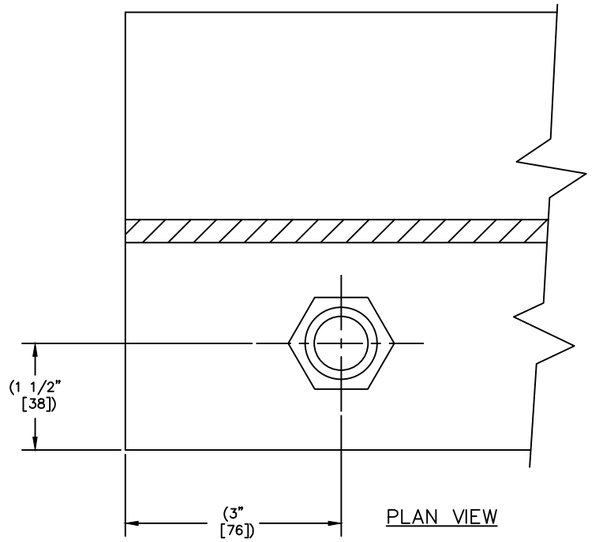
TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. 7253049-969221

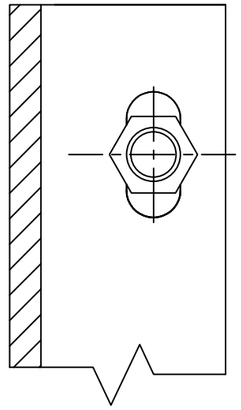
REV. A

SCALE 3/4" = 1'-0"

SHEET 4 OF 6



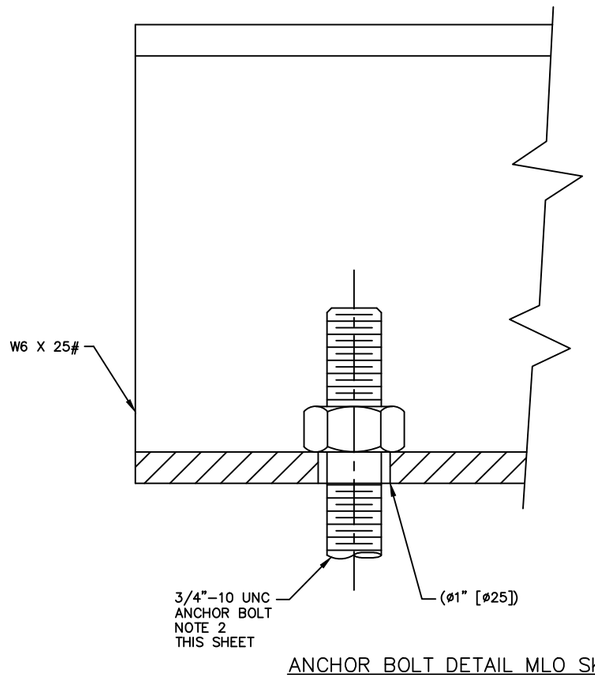
PLAN VIEW



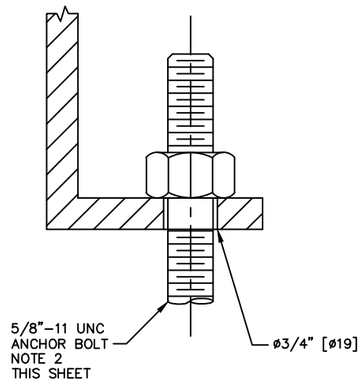
PLAN VIEW

NOTES:

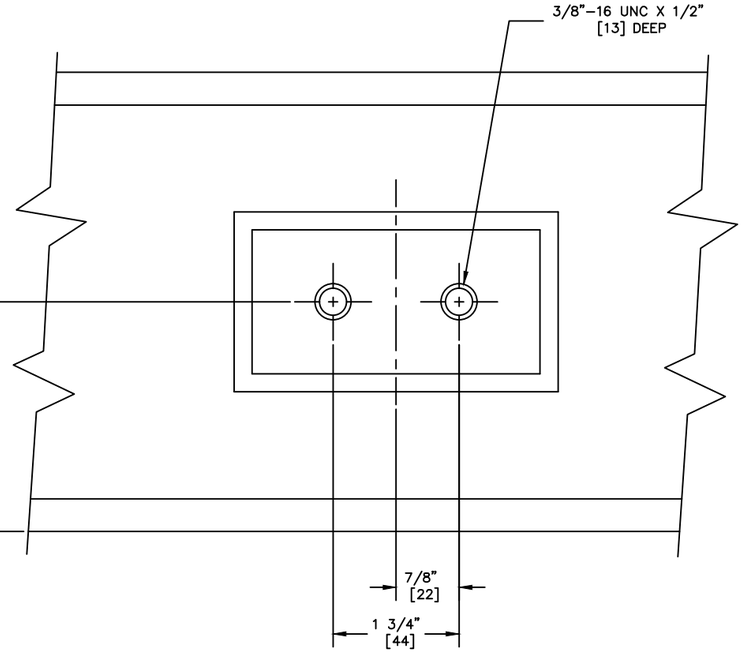
1. LEVELING AND GROUTING TO BE PERFORMED PER GUIDELINES OF INSTALLATION MANUAL.
2. ALL ANCHORING HARDWARE AND EMBEDDED STEEL TO BE SUPPLIED BY OTHERS.



ANCHOR BOLT DETAIL MLO SKID



ANCHOR BOLT DETAIL SHELL & TUBE



GROUNDING LUG DETAIL

(SEE SHEET 3)

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. 7253049–969221

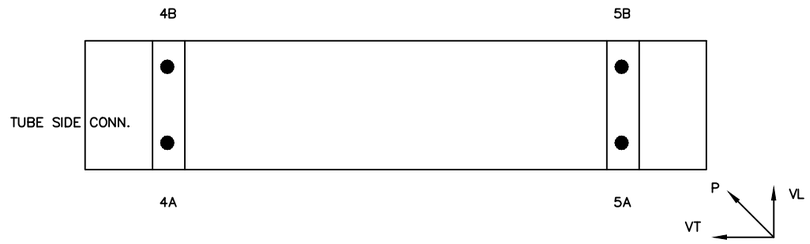
REV. A

SCALE NONE

SHEET 5 OF 6

HEAT EXCHANGER FOUNDATION LOADING (KIPS)

ANCHOR POINTS	DEAD LOAD			SEISMIC TRANSVERSE 0.6g			SEISMIC LONGITUDINAL 0.6g		
	P	VT	VL	P	VT	VL	P	VT	VL
4–A	1.2	0.0	0.0	5.9	−0.8	0.2	−0.6	0.0	−0.8
4–B	1.2	0.0	0.0	−5.9	−0.8	−0.2	−0.6	0.0	−0.8
5–A	1.6	0.0	0.0	7.3	−0.9	−0.2	0.6	0.0	−0.8
5–B	1.6	0.0	0.0	−7.3	−0.9	0.2	0.6	0.0	−0.8
TOTAL	5.6	0.0	0.0	0.0	−3.4	0.0	0.0	0.0	−3.4



NOTES: (CONT. FROM SHEET 4)

5. APPLIED WIND LOADS FOR DESIGN ARE PER ASCE 7–05 CODE, 150 MPH PER SECTION 6.5.15.

DESIGN WIND PRESSURE (PSF)	$p=qz\ G\ Cf$	96.30
FORCE COEFF, FIGURE 6–19	Cf	1.5
GUST FACTOR, SEC 6.5.8	G	0.85
VELOCITY PRESSURE (PSF) , EQ 6–15	$q_z = 0.00256\ K_z\ K_{zt}\ K_d\ V^2\ I$	75.53
VELOCITY PRESSURE EXPOSURE COEF., TABLE 6–3	K_z	0.98
TOPOGRAPHIC FACTOR, EQ 6–3	$K_{zt} = (1+K_1*K_2*K_3)^2$	1.37
WIND DIRECTIONALITY FACTOR, TABLE 6–4	K_d	0.85
K3, FIGURE 6–4	K_3	1
K2, FIGURE 6–4	K_2	1
K1, FIGURE 6–4	K_1	0.17
EXPOSURE CATEGORY	C	C
WIND VELOCITY (MPH) FOR DESIGN	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15

6. FOUNDATION DESIGNER MUST COMBINE LOAD CASES WITH PROPER SIGNS.
7. SIGNS CAN BE REVERSED ON ACCELERATION AND WIND LOADS.
8. RECOMMENDED ANCHOR BOLTS ARE ASTM F1554 GR 105 WITH A DIA OF 3/4 IN.

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
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NEXT ASSY.

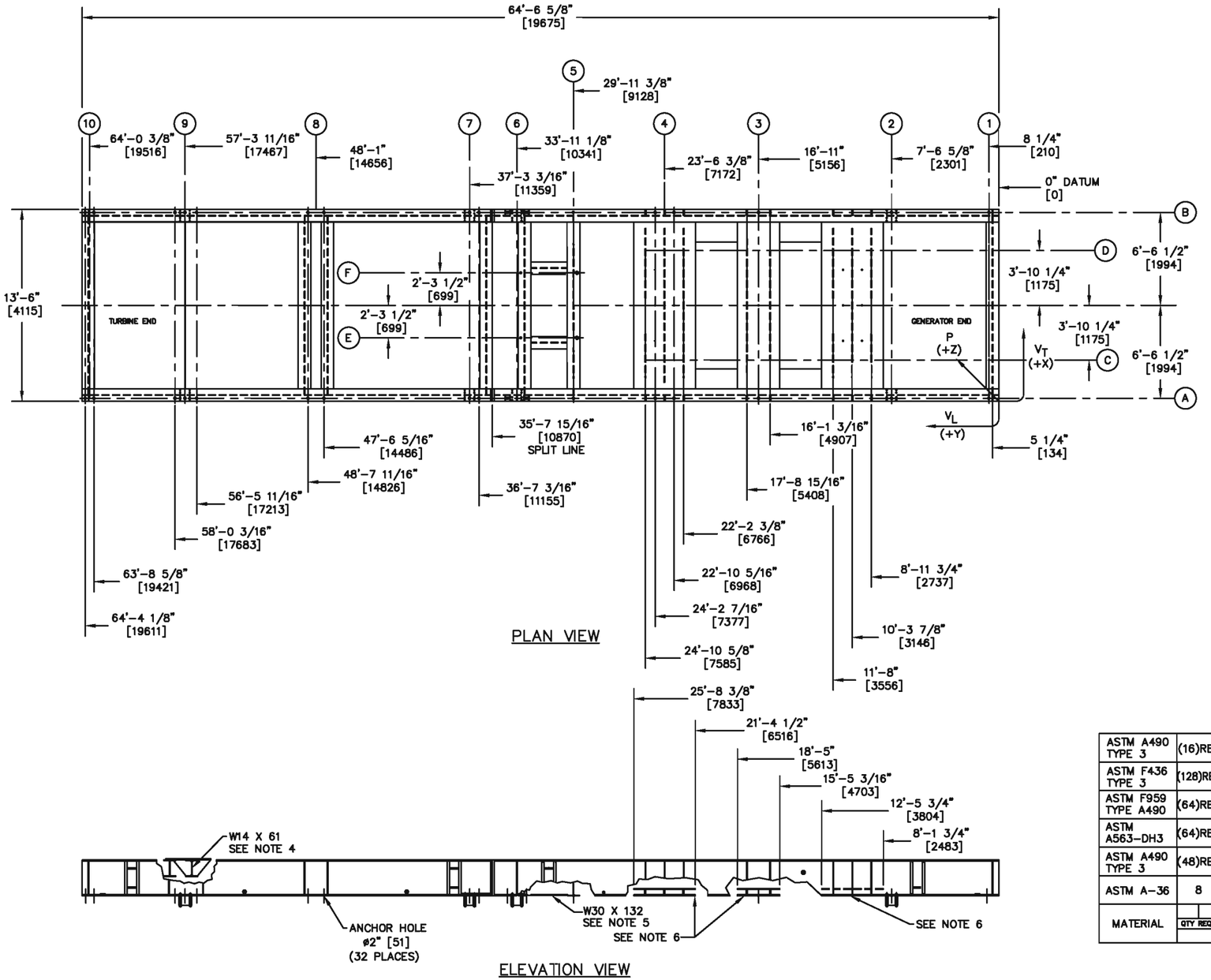
UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. 7253049–969221
REV. A
SCALE NONE
SHEET 6 OF 6



PLAN VIEW

ELEVATION VIEW

LEGEND:

- ● ANCHOR BOLT
- P VERTICAL LOAD
- V_T TRANSVERSE SHEAR
- V_L LONGITUDINAL SHEAR

NOTES:

1. BOLT HOLE TOLERANCE: ± 1/8" [3], TRUE POSITION.
2. LEVELING AND GROUTING TO BE PERFORMED PER GUIDELINES OF INSTALLATION MANUAL.
3. ALL ANCHORING HARDWARE AND EMBEDDED STEEL TO BE SUPPLIED BY CUSTOMER AND SHALL BE ASTM F1554 Gr. 105 ANCHOR BOLT WITH A MIN. YIELD STRENGTH OF 105,000 PSI.
4. W14 X 61# BEAMS ILLUSTRATED AT ANCHOR POINT 10 DO NOT EXTEND TO BOTTOM OF SKID. ALL OTHER BEAMS SHOWN ARE W30 X 132#.
5. W30 X 132# BEAMS ILLUSTRATED AT ANCHOR POINTS 5 AND 6 ARE JOINED BY PLATE AT BOTTOM FLANGES. GROUTING BENEATH PLATE AND BEAMS IS REQUIRED. SEE SHEET 2.
6. FLAT PLATES ILLUSTRATED AT ANCHOR POINTS 2, 3 AND 4 EXTEND TO THE BOTTOM OF SKID. GROUTING OF THESE PLATES IS REQUIRED. SEE SHEET 2.
7. SHEAR LUGS ARE SHIPPED LOOSE FOR FIELD INSTALLATION. HOLES FOR SHEAR LUGS NOT SHOWN FOR CLARITY.
8. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
9. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
10. TOLERANCES: LINEAR DIMENSION: ± 1/8" [3 mm] ANGULAR: ±0.5°
11. LIFTING PINS ARE NOT SHOWN ON PLAN VIEW FOR CLARITY.
12. FOR GROUT INFORMATION AND SHIM LOCATIONS, REFER TO GEPPLP LM6000 60HZ INSTALLATION MANUAL.
13. BOLT TORQUE CAN BE VERIFIED BY ENSURING THAT THE PROTRUSIONS ON THE LOAD INDICATING WASHERS HAVE BEEN COMPRESSED. SUFFICIENT TORQUE WILL COMPRESS THE PROTRUSIONS TO THE EXTENT THAT A MAXIMUM GAP OF 0.005" [0.127 mm] EXISTS BETWEEN THE PROTRUSIONS. NOTE THAT THE MAXIMUM GAP MAY BE INCREASED TO 0.015" [0.381 mm] IF THE LOAD INDICATING WASHER IS USED UNDER THE UNTURNED ELEMENT.
14. DATUM DIMENSIONS ARE FROM GENERATOR END OF SKID.
15. CUSTOMER SUPPLIED GENERATOR AND GEARBOX ANCHOR BOLTS TO BE EMBEDDED INTO FOUNDATION. SEE SHEETS 7 & 8.

MATERIAL	QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	DESCRIPTION	ITEM NO.
		PARTS LIST			
ASTM A490 TYPE 3	(16)REF	A490P37184T3	BOLT, HEAVY HEX	7/8"–9NC X 11 1/2" LG	6
ASTM F436 TYPE 3	(128)REF	386A6980P0001	WASHER	7/8"	5
ASTM F959 TYPE A490	(64)REF	386A6976P0001	WASHER	7/8", LOAD INDICATING	4
ASTM A563–DH3	(64)REF	386A6979P0001	NUT, HEAVY HEX	7/8"–9NC	3
ASTM A490 TYPE 3	(48)REF	386A6978P0001	BOLT, HEAVY HEX	7/8"–9NC X 10 1/2" LG	2
ASTM A–36	8	287728	SHEAR LUG		1

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

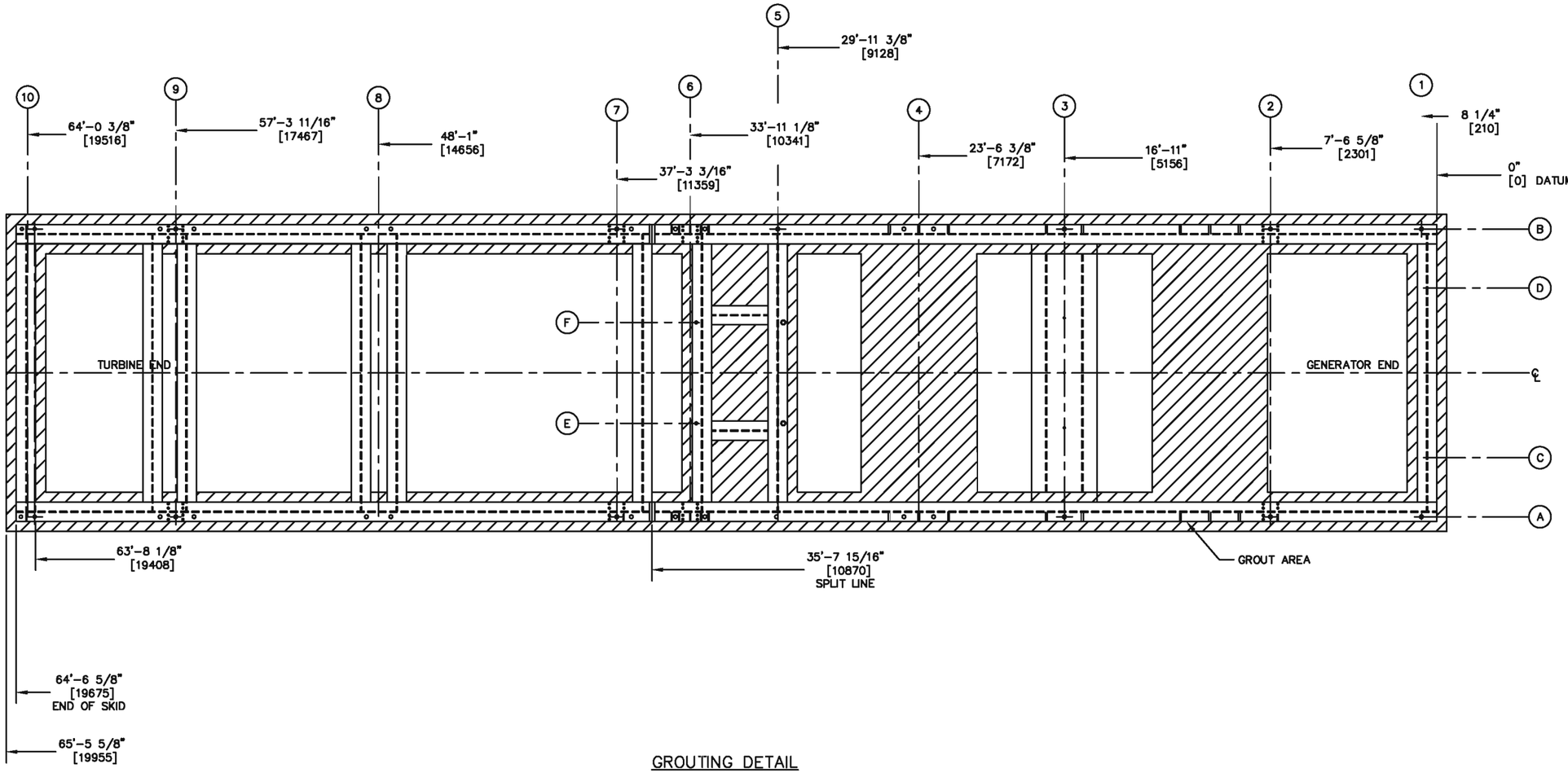
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049–969224

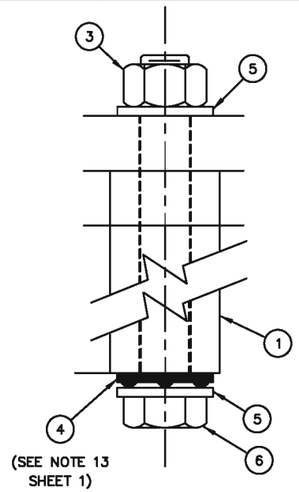
REV. A

SCALE 1/4" = 1'–0"

SHEET 1 OF 12



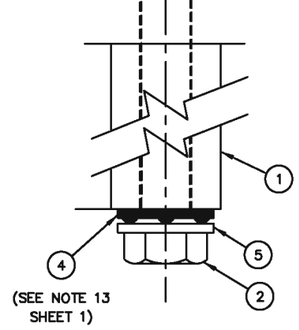
GROUTING DETAIL



(SEE NOTE 13 SHEET 1)

LOAD INDICATING WASHER DETAIL

(DETAIL SHEET 6, ANCHOR POINTS 7A & 7B)



(SEE NOTE 13 SHEET 1)

LOAD INDICATING WASHER DETAIL

(TYPICAL DETAILS SHEETS 3, 5 & 6)

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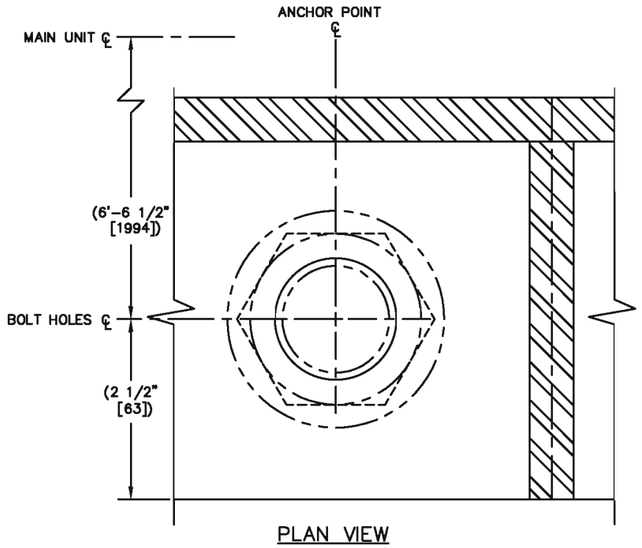
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DWG NO. 7253049-969224

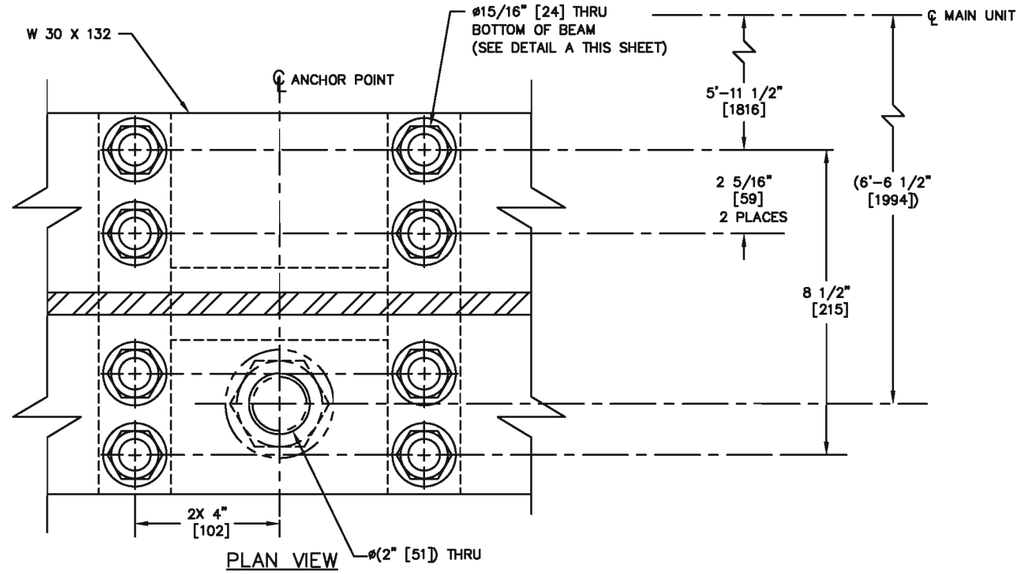
REV. A

SCALE 3/8" = 1'-0"

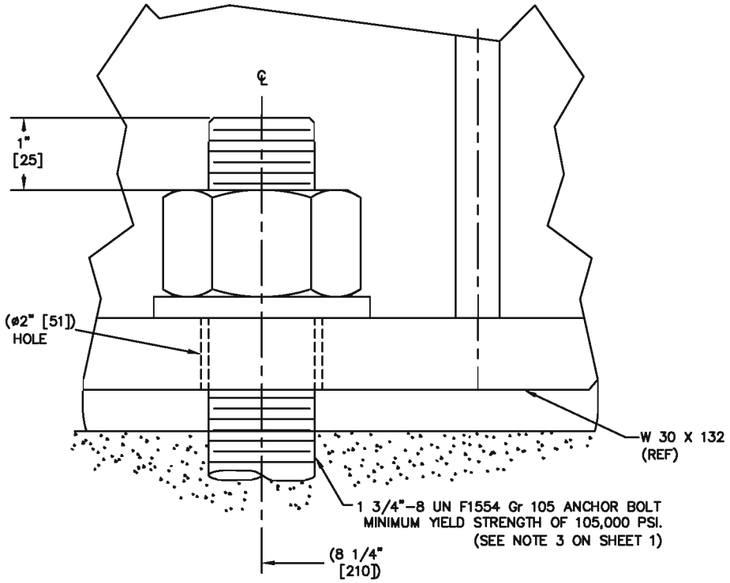
SHEET 2 OF 12



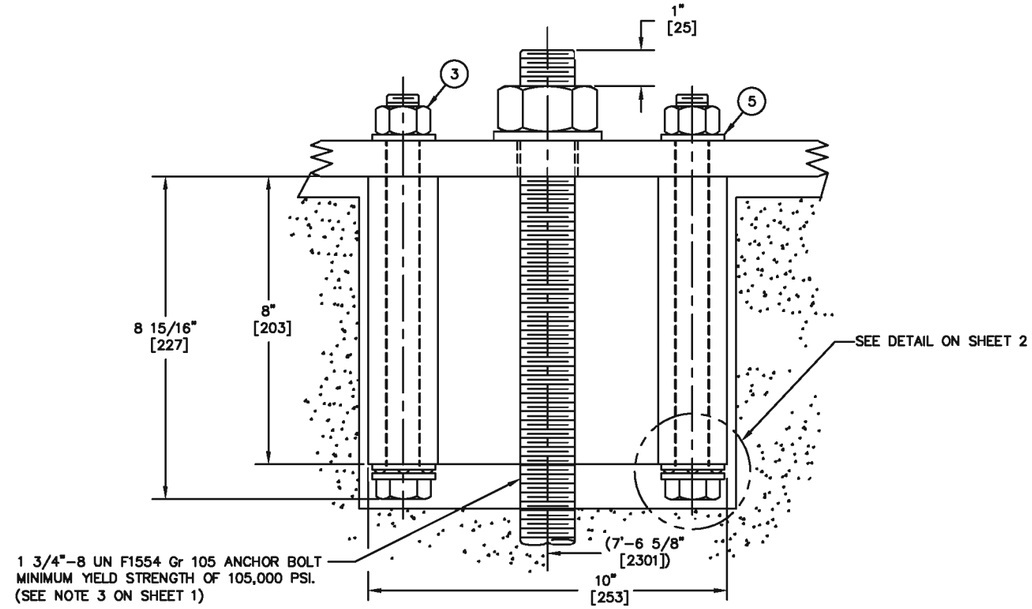
PLAN VIEW
ANCHOR POINTS 1A & 1B



PLAN VIEW
ANCHOR POINTS 2A & 2B



ELEVATION



ELEVATION

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

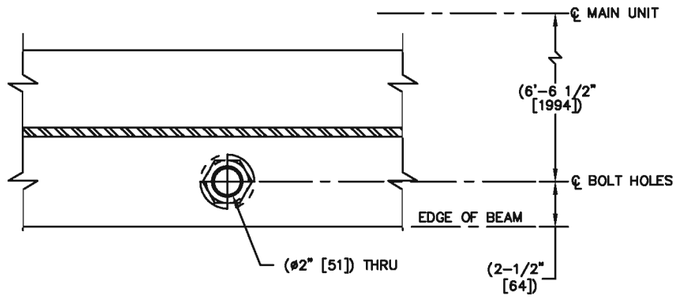
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GE PACKAGED POWER, L.P.

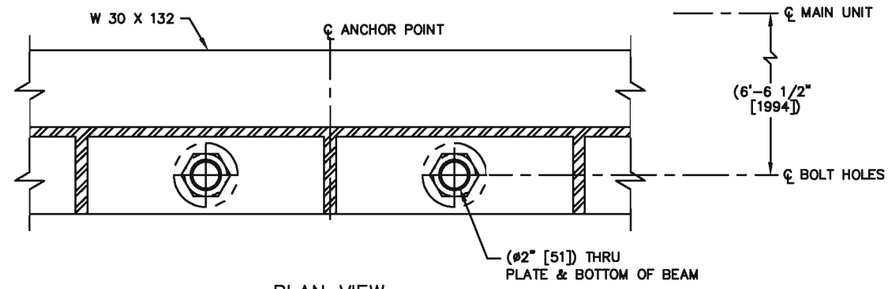
TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG
LOCATION

DWG NO. 7253049-969224
REV. A

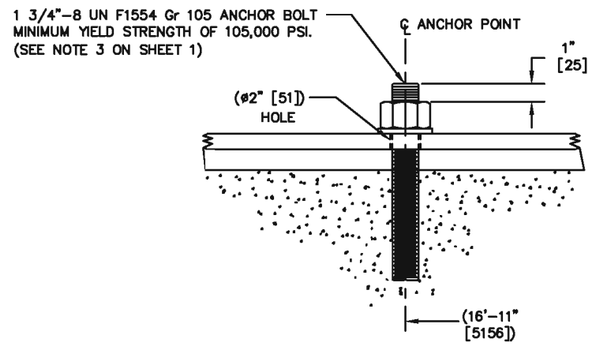
SCALE 1 1/2" = 1'-0"
SHEET 3 OF 12



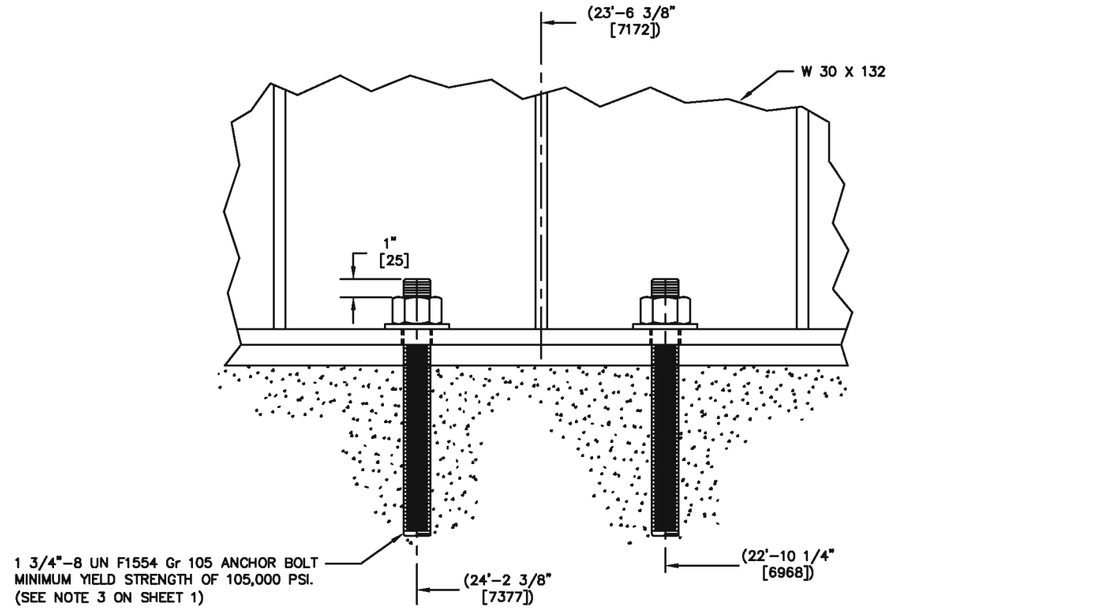
PLAN VIEW
ANCHOR POINTS 3A & 3B



PLAN VIEW
ANCHOR POINTS 4A & 4B



ELEVATION



ELEVATION

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NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

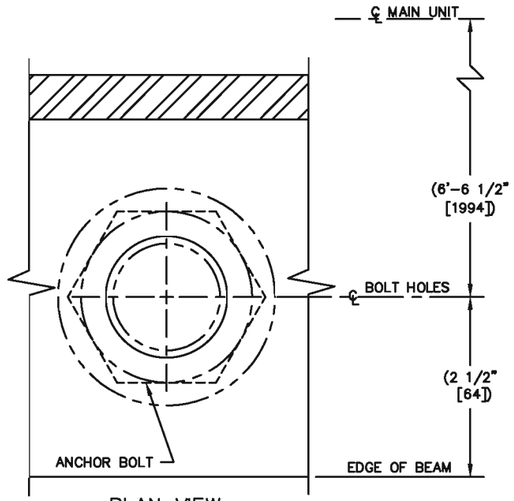
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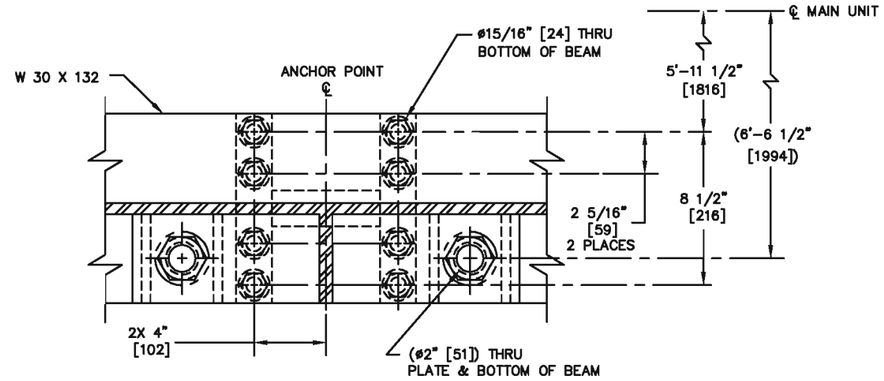
REV. A

SCALE 1 1/2" = 1'-0"

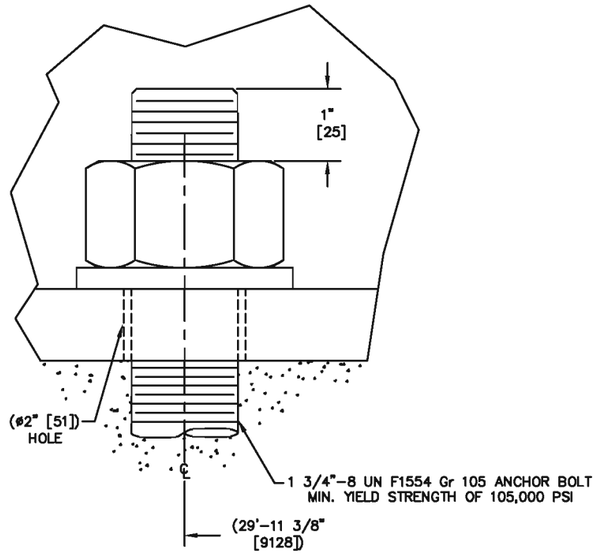
SHEET 4 OF 12



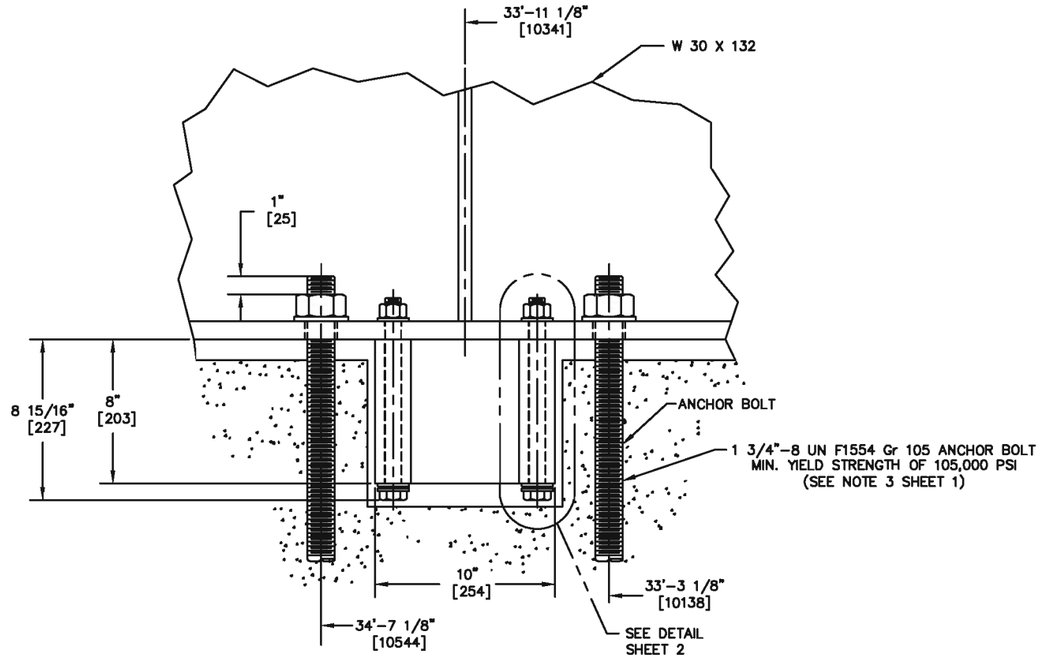
PLAN VIEW
ANCHOR POINTS 5A & 5B



PLAN VIEW
ANCHOR POINTS 6A & 6B



ELEVATION
SCALE 4:1



ELEVATION

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THIRD ANGLE PROJECTION

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NEXT ASSY.

UNIT TYPE: LM6000℗

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

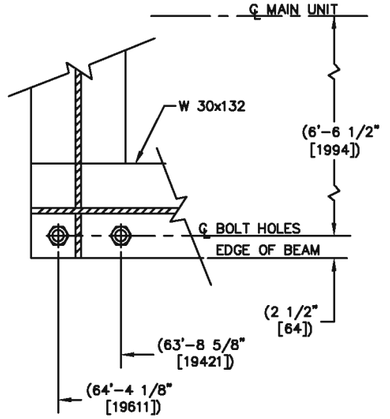
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049-969224

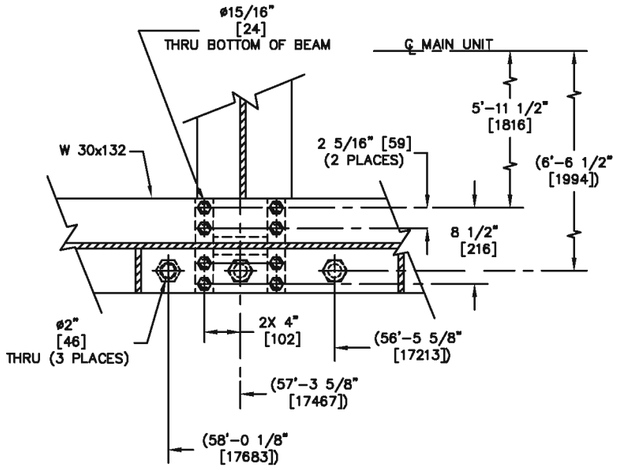
REV. A

SCALE 1 1/2" = 1'-0"

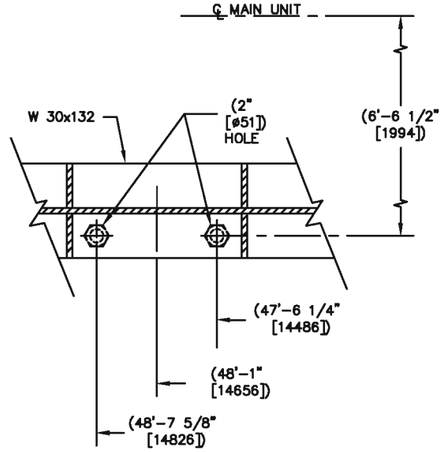
SHEET 5 OF 12



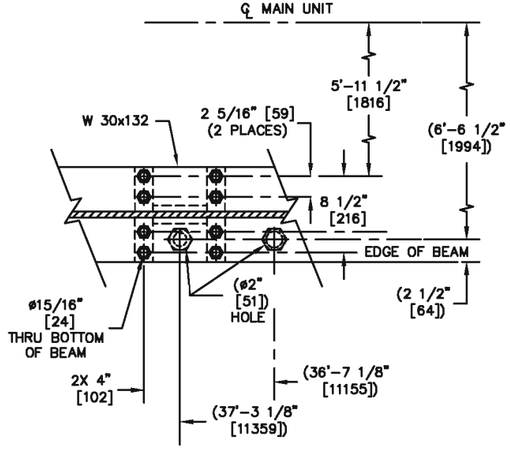
PLAN VIEW
ANCHOR POINTS 10A & 10B



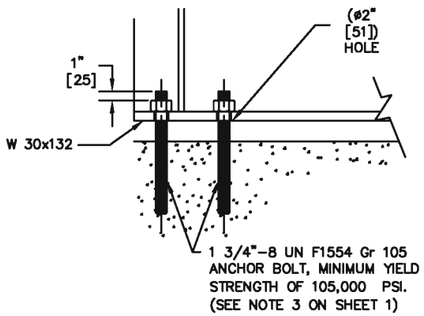
PLAN VIEW
ANCHOR POINTS 9A & 9B



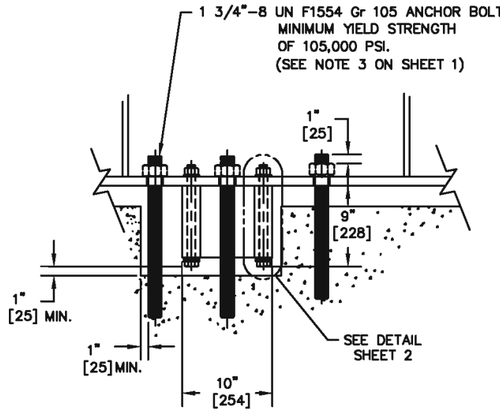
PLAN VIEW
ANCHOR POINTS 8A & 8B



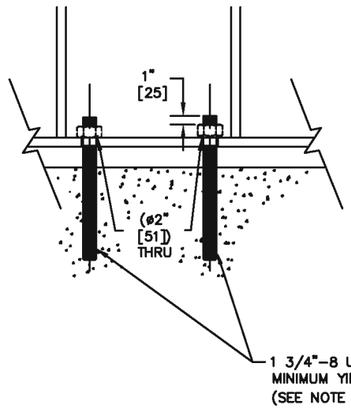
PLAN VIEW
ANCHOR POINTS 7A & 7B



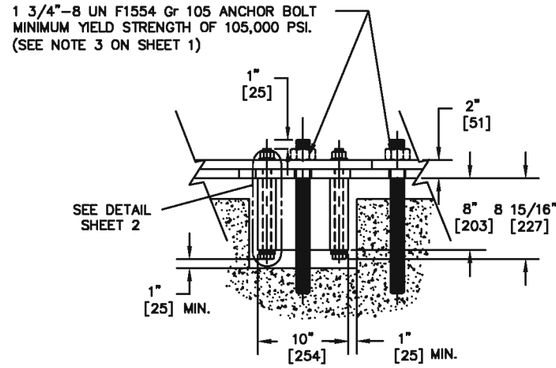
ELEVATION



ELEVATION



ELEVATION



ELEVATION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000©

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

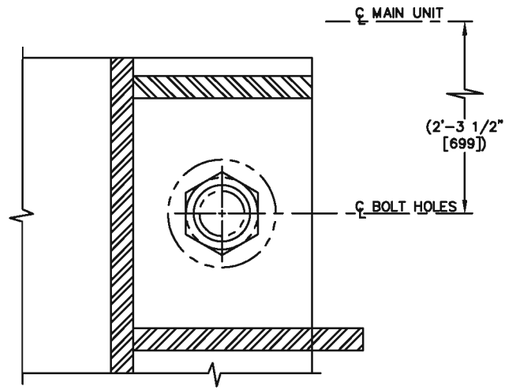
TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG
LOCATION

DWG NO. 7253049-969224

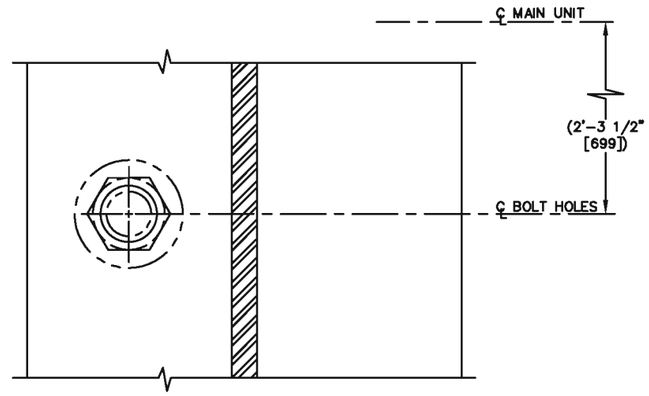
REV. A

SCALE 1 1/2" = 1'-0"

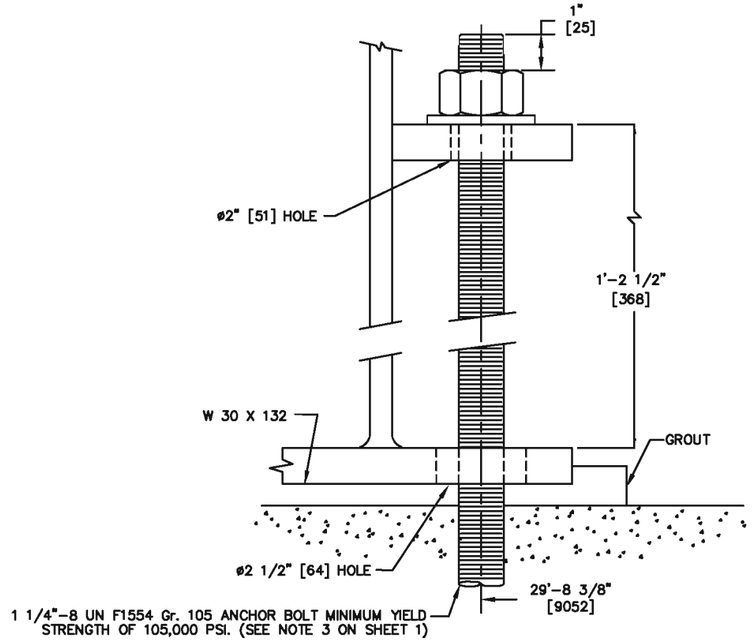
SHEET 6 OF 12



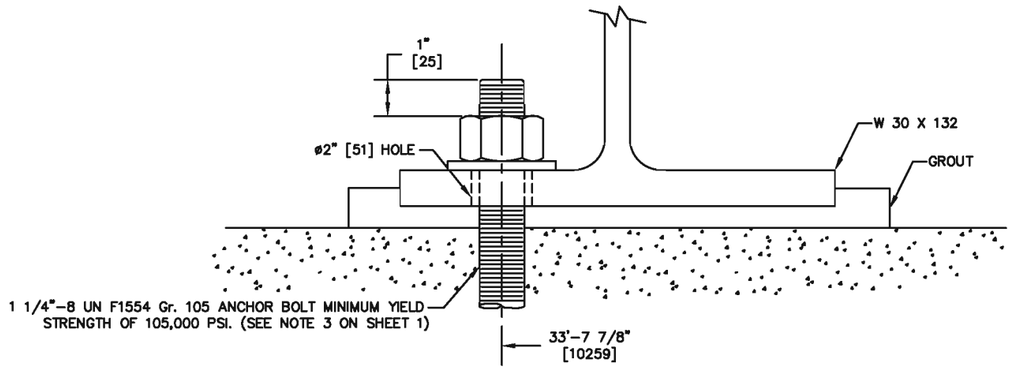
PLAN VIEW
ANCHOR POINTS 5E & 5F



PLAN VIEW
TYPICAL AT ANCHOR POINTS 6E & 6F



ELEVATION
SCALE 2:1



ELEVATION
SCALE 2:1

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

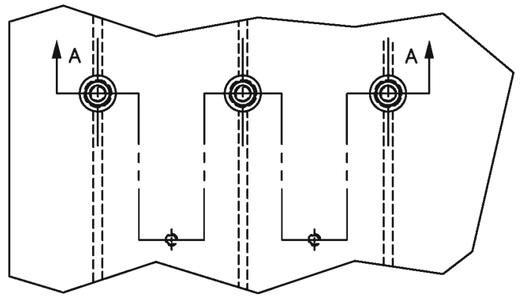
TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG
LOCATION

DWG NO.
7253049-969224

REV.
A

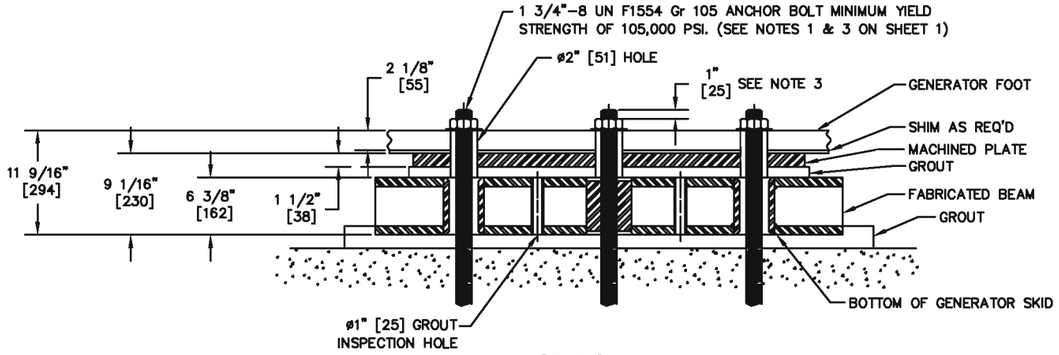
SCALE 1/4" = 1'-0"

SHEET 7 OF 12



PLAN VIEW

TYPICAL AT ANCHOR POINTS 2C, 2D, 4C & 4D



SECTION A–A

NOTES:

1. GENERATOR ANCHOR BOLT LENGTH SHOULD HAVE ADDITIONAL 3/8" [10] FOR SHIM ALLOWANCE.
2. BOLTS MUST WITHSTAND LOADS REPRESENTED ON SHEET 10 & 11. CLEARANCE REQUIRED FOR SETTING DOWN MAIN UNIT AND GENERATOR ALIGNMENT.
3. RECOMMENDED ANCHOR BOLT EXTENSION LENGHT.

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NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049–969224

REV. A

SCALE 1/4" = 1'–0"

SHEET 8 OF 12

LM6000 PG – PACKAGE MOUNTED AIR FILTER 60Hz (7-290 ERJT)

STATIC FOUNDATION LOAD TABLE (KIPS)

ANCHOR POINTS	DEAD LOAD			ROOF LL (60 PSF)			SEISMIC (TRANSVERSE)			SEISMIC (LONGITUDINAL)			SEISMIC (VERTICAL)			WIND (150 MPH) (TRANSVERSE)			WIND (150 MPH) (LONGITUDINAL)			GENERATOR FAULT TORQUE (Brush Method)			GEN+ENG+GEAR OPERATING LOAD			ENGINE SEIZURE LOADS		
	VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ	
	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL
1–A	7.4	0.0	0.0	2.4	0.0	0.0	–42.1	0.0	0.0	–10.0	0.0	0.0	2.2	0.0	0.0	–30.8	0.0	0.0	–9.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1–B	7.8	0.0	0.0	2.5	0.0	0.0	41.2	0.0	0.0	–10.6	0.0	0.0	2.3	0.0	0.0	24.1	0.0	0.0	–7.8	0.0	0.0	–0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–A*	10.5	0.0	0.0	1.8	0.0	0.0	–11.8	–20.0	–5.9	5.9	1.5	–33.8	2.9	0.1	0.4	–12.9	–7.2	–3.0	1.5	–0.3	–10.8	–7.4	0.1	0.0	–0.1	0.1	–0.1	0.0	0.2	–0.2
2–B*	10.4	0.0	0.0	1.6	0.0	0.0	11.9	–19.5	5.8	4.1	1.4	–33.0	2.9	–0.1	–0.4	5.9	–6.9	3.1	1.8	–0.3	–11.0	7.4	0.1	0.0	0.1	0.1	0.1	0.0	0.2	0.2
3–A	11.4	0.0	0.0	0.9	0.0	0.0	–3.2	0.0	0.0	1.0	0.0	0.0	2.7	0.0	0.0	–6.0	0.0	0.0	–0.9	0.0	0.0	–4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3–B	11.3	0.0	0.0	0.9	0.0	0.0	3.2	0.0	0.0	0.5	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	–0.9	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–A	21.6	0.0	0.0	9.5	0.0	0.0	–32.3	0.0	0.0	–27.8	0.0	0.0	6.6	0.0	0.0	–27.2	0.0	0.0	–16.8	0.0	0.0	–8.7	0.0	0.0	–0.6	0.0	0.0	–0.1	0.0	0.0
4–B	22.7	0.0	0.0	9.9	0.0	0.0	26.3	0.0	0.0	–25.5	0.0	0.0	6.1	0.0	0.0	9.0	0.0	0.0	–17.1	0.0	0.0	8.7	0.0	0.0	0.5	0.0	0.0	0.1	0.0	0.0
5–A	21.5	0.0	0.0	10.9	0.0	0.0	–34.3	0.0	0.0	–40.8	0.0	0.0	7.4	0.0	0.0	–26.9	0.0	0.0	–23.2	0.0	0.0	–7.4	0.0	0.0	–2.8	0.0	0.0	–0.1	0.0	0.0
5–B	24.3	0.0	0.0	11.5	0.0	0.0	28.9	0.0	0.0	–36.3	0.0	0.0	6.7	0.0	0.0	9.2	0.0	0.0	–23.6	0.0	0.0	7.4	0.0	0.0	2.6	0.0	0.0	0.1	0.0	0.0
6–A*	16.7	0.0	0.0	3.9	0.0	0.0	–36.9	–35.8	–6.2	–49.6	0.7	–33.9	4.5	–0.2	0.4	–27.3	–19.8	–3.3	–28.8	0.1	–10.9	–5.9	0.1	0.0	–2.5	–0.3	–0.1	–0.3	–0.5	–0.2
6–B*	19.9	0.0	0.0	4.6	0.0	0.0	40.1	–35.8	6.0	–42.9	–0.6	–33.1	3.9	0.2	–0.4	18.3	–19.8	3.3	–28.8	0.1	–11.1	5.9	0.1	0.0	2.6	–0.3	0.1	0.3	–0.5	0.2
7–A*	43.9	0.0	0.0	7.0	0.0	0.0	–97.8	–28.0	–6.3	10.1	–0.5	–33.7	7.5	0.1	0.4	–64.5	–15.8	–3.3	–13.6	0.1	–10.9	–1.9	0.0	0.0	–0.2	–0.3	–0.1	–0.2	–0.5	–0.2
7–B*	46.8	0.0	0.0	7.7	0.0	0.0	117.7	–28.0	6.1	20.6	–0.4	–33.0	7.4	–0.1	0.4	44.5	–15.8	3.3	–10.3	0.1	–11.0	1.9	0.0	0.0	1.5	–0.3	0.1	0.2	–0.5	0.2
8–A	62.9	0.0	0.0	8.4	0.0	0.0	–95.6	0.0	0.0	128.8	0.0	0.0	10.7	0.0	0.0	–55.4	0.0	0.0	33.1	0.0	0.0	–0.2	0.0	0.0	3.7	0.0	0.0	–2.9	0.0	0.0
8–B	38.1	0.0	0.0	4.2	0.0	0.0	81.4	0.0	0.0	96.2	0.0	0.0	6.9	0.0	0.0	21.1	0.0	0.0	36.5	0.0	0.0	0.1	0.0	0.0	6.4	0.0	0.0	2.3	0.0	0.0
9–A*	18.4	0.1	0.0	1.5	0.0	0.0	–47.5	–59.4	–6.4	0.9	–1.4	–34.0	4.8	0.2	–0.4	–33.2	–35.0	–3.4	–1.7	0.5	–10.9	0.0	0.0	0.0	–4.9	–0.9	–0.1	–15.8	–2.0	–0.2
9–B*	19.2	–0.1	0.0	1.6	0.0	0.0	47.0	–59.3	6.2	–2.4	–1.4	–33.2	4.6	–0.2	–0.3	27.7	–35.0	3.4	–5.6	0.5	–11.1	0.0	0.0	0.0	8.2	–0.8	0.1	11.6	–1.7	0.2
10–A	15.7	0.0	0.0	2.1	0.0	0.0	–115.2	0.0	0.0	12.3	0.0	0.0	5.8	0.0	0.0	–77.9	0.0	0.0	13.7	0.0	0.0	–0.1	0.0	0.0	–0.6	0.0	0.0	–1.2	0.0	0.0
10–B	21.4	0.0	0.0	3.4	0.0	0.0	120.1	0.0	0.0	18.5	0.0	0.0	5.8	0.0	0.0	73.7	0.0	0.0	9.8	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.6	0.0	0.0
AT BRUSH GENERATOR																														
2–C*	40.4	0.0	0.3	0.1	0.0	0.0	–31.8	–26.3	–3.7	–13.0	1.7	–32.9	10.8	0.1	0.4	13.3	–8.8	–1.8	–3.1	–0.3	–10.3	–143.3	–0.1	0.0	–2.1	0.1	–0.1	0.4	0.2	–0.1
2–D*	40.4	0.0	0.3	0.1	0.0	0.0	30.9	–26.3	3.5	–15.7	1.7	–32.6	10.7	–0.1	0.4	–11.4	–8.8	1.8	–3.7	–0.3	–10.4	143.2	–0.1	0.0	2.1	0.1	0.1	–0.4	0.2	0.1
4–C*	40.8	0.0	–0.3	0.6	0.0	0.0	–35.9	–30.2	–3.5	12.6	0.9	–33.0	10.8	0.1	–0.4	–1.9	–14.4	–1.7	–3.7	–0.1	–10.3	–143.0	–0.1	0.0	–2.5	–0.1	–0.1	–0.4	–0.2	–0.1
4–D*	40.8	0.0	–0.3	0.7	0.0	0.0	36.9	–30.2	3.3	13.2	–0.9	–32.6	10.7	–0.1	–0.4	1.8	–14.4	1.7	–3.6	–0.1	–10.5	142.9	–0.1	0.0	2.4	–0.1	0.1	0.4	–0.2	0.1
AT LUFKIN GEAR BOX																														
5–E	12.8	0.0	0.0	2.7	0.0	0.0	–10.2	0.0	0.0	–17.9	0.0	0.0	3.2	0.0	0.0	–6.6	0.0	0.0	–5.8	0.0	0.0	–14.2	0.0	0.0	–5.8	0.0	0.0	0.0	0.0	0.0
5–F	13.5	0.0	0.0	2.9	0.0	0.0	8.8	0.0	0.0	–17.1	0.0	0.0	3.2	0.0	0.0	2.1	0.0	0.0	–5.9	0.0	0.0	14.2	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0
6–E	11.7	0.0	0.0	1.0	0.0	0.0	–8.8	0.0	0.0	–6.2	0.0	0.0	3.0	0.0	0.0	–5.5	0.0	0.0	–7.8	0.0	0.0	–14.0	0.0	0.0	–5.8	0.0	0.0	–0.1	0.0	0.0
6–F	12.5	0.0	0.0	1.2	0.0	0.0	9.8	0.0	0.0	–3.9	0.0	0.0	2.8	0.0	0.0	3.4	0.0	0.0	–7.6	0.0	0.0	14.1	0.0	0.0	5.8	0.0	0.0	0.1	0.0	0.0
TOTAL	664.5	0.0	0.0	105.6	0.0	0.0	0.9	–398.7	–1.2	5.0	2.6	–398.7	159.5	0.0	0.1	–133.3	–201.6	0.0	–133.3	0.0	–129.4	–0.2	0.0	0.0	14.2	–2.7	–0.1	–5.4	–5.0	0.1

* SHEAR LUG LOCATIONS

NOTES:

1. REFER SHEET 10 FOR ADDITIONAL DESIGN INFORMATION.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049–969224

REV. A

SCALE NONE

SHEET 9 OF 12

NOTES:

1. FOR P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENT A LOAD AT EACH ANCHOR LOCATION.
3. ROOF LIVE LOAD IS APPLIED AS PER IBC 2009 TABLE 1607.1, REPRESENTS A UNIFORM LOAD OF 60 PSF ON PACKAGE AND AIR FILTER AND 100 PSF ON WALKWAYS APPLIED AT EXPOSED SECTION OF THE MAIN UNIT AND ON THE AIR FILTER ROOF.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE LONGITUDINAL AND TRANSVERSE DIRECTION AS PER EQUIVALENT LATERAL FORCE PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER IBC 2009 CODE SECTION 1613 THAT REFERENCES ASCE 7–05.

SITE CLASS	D
OCCUPANCY CATEGORY, TABLE 1604.5	III
SEISMIC DESIGN CATEGORY – SECTION 1613.5.6	E
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7–05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7–05, TABLE 15.4–1	2.50
SDS – SPECTRAL RESPONSE ACCEL.AT 0.2 SEC – G	1.20
SD1 – SPECTRAL RESPONSE ACCEL.AT 1 SEC – G	0.70
G–LEVELS FOR BASE ACCELERATIONS FOR DESIGN PER IBC 2009	0.60

SEISMIC LOAD MAY BE POSITIVE OR NEGATIVE
CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT Ev = +/–0.2SDS D = 0.24 D IN THE FOUNDATION LOADS AS PER ASCE 7–05 SECTION 12.4.

5. WIND LOAD ARE PER ASCE 7–05 CODE, 150 MPH FOR LOW RISE BUILDING, H <60 FT

WIND PRESSURE (PSF), EQ 6–18	p = qh (GCpf – GCpi)	75.533(GCpf–GCpi)
EXTERNAL PRESSURE COEF., FIGURE 6–10	GCpf	
INTERNAL PRESSURE COEF., FIGURE 6–5	GCpi	+/–0.18
VELOCITY PRESSURE (psf) , Eq 6–15	qh = 0.00256 Kz Kzt Kd V2 I	75.53
VELOCITY PRESSURE EXPOSURE COEF. – TABLE 6–3	Kz	0.98
TOPOGRAPHIC FACTOR, Eq. 6–3	Kzt = (1 + K1 K2 K3)2	1.369
FIGURE 6–4	K1	0.17
FIGURE 6–4	K2	1
FIGURE 6–4	K3	1
WIND DIRECTIONALLITY FACTOR, TABLE 6–4	Kd	0.85
WIND VELOCITY (MPH)	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15
EXPOSURE CATEGORY	C	C

6. OPERATING LOADS REPRESENT THE FOLLOWING:
   A. AXIAL THRUST – DUE TO THE MOMENTUM CHANGE THROUGH THE TURBINE.
   B. PRESSURE DIFFERENCE – DUE TO THE PRESSURE DIFFERENCE BETWEEN THE INLET AND THE EXHAUST.
   C. NORMAL OPERATION TORQUE – DUE TO THE OVERTURNING TORQUE PRODUCED BY THE FLUID COUPLING.
   D. THERMAL EXPANSION – DUE TO THE MECHANICAL RESISTANCE TO THE THERMAL GROWTH OF THE TURBINE.
7. GENERATOR FAULT TORQUE IS DECOUPLED INTO UPWARD AND DOWNWARD COMPONENTS. GENERATOR FAULT CAN BE CONSIDERED AS EMERGENCY LOAD CASE.
8. GENERATOR FAULT AND ENGINE SEIZURE CAN BE CONSIDERED AS EMERGENCY LOAD CASE.
9. THE PEAK VIBRATION VELOCITY AT ANY POINT OF THE FOUNDATION SHOULD BE LESS THAN 0.06 IN/SEC AT THE RATED TURBINE SPEED OF 3600 RPM.
10. FOUNDATION SHALL NOT EXCEED +/– 1/8" FLATNESS AND +/– 1/4" SLOPE. FOUNDATION SHALL NOT BOW MORE THAN 1/8" AT ANY LOCATION ON THE SKID.
11. ONE END OF THE FOUNDATION MUST NOT BE 1/4" HIGHER OR LOWER THAN THE OTHER END OF THE SKID.

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049–969224

REV. A

SCALE NONE

SHEET 10 OF 12

LM6000 PG – PACKAGE MOUNTED AIR FILTER 60Hz (7–290 ERJT)
DYNAMIC FOUNDATION LOADS (KIPS)

ANCHOR POINTS	HPC STAGE 1 SHORT TERM			HPT STAGE 2 SHORT TERM			LPC STAGE 0 SHORT TERM			LPT STAGE 5 SHORT TERM			GENERATOR CONTINUOUS UNBALANCE			GEAR BOX CONTINUOUS UNBALANCE			HPC STAGE 1 CONTINUOUS UNBALANCE			HPT STAGE 2 CONTINUOUS UNBALANCE			LPC STAGE 0 CONTINUOUS UNBALANCE			LPT STAGE 5 CONTINUOUS UNBALANCE		
	VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ	
	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL
1–A	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–A*	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.5	0.1	0.0	1.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2–B*	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.9	0.1	0.0	1.7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
3–A	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–A	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–A	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	1.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–B	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6–A*	0.1	0.4	0.1	0.2	0.7	0.2	0.8	1.7	2.7	2.3	8.6	4.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.1
6–B*	0.1	0.4	0.1	0.2	0.7	0.1	0.7	1.9	1.9	2.3	8.3	3.7	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.1
7–A*	0.3	0.2	0.3	0.2	0.1	0.3	4.9	16.7	4.5	14.2	66.4	10.2	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.2	0.5	2.4	0.4
7–B*	0.2	0.2	0.2	0.2	0.2	0.2	3.3	16.0	2.7	15.3	65.7	5.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.1	0.6	2.4	0.2
8–A	11.7	0.0	0.0	12.4	0.0	0.0	34.1	0.0	0.0	94.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.5	0.0	0.0	1.2	0.0	0.0	3.4	0.0	0.0
8–B	11.2	0.0	0.0	9.4	0.0	0.0	29.0	0.0	0.0	82.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.0	0.0	1.1	0.0	0.0	3.0	0.0	0.0
9–A*	17.7	8.2	2.5	23.6	8.1	0.6	34.9	15.5	4.1	123.9	75.0	9.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.3	0.1	0.9	0.3	0.0	1.3	0.6	0.2	4.5	2.7	0.3
9–B*	4.6	5.8	2.1	8.3	7.0	1.0	16.0	18.8	1.7	104.7	129.6	6.3	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.2	0.1	0.3	0.3	0.0	0.6	0.7	0.1	3.8	4.7	0.2
10–A	1.4	0.0	0.0	0.8	0.0	0.0	0.5	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
10–B	2.1	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
AT BRUSH GENERATOR																														
2–C*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–D*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–C*	0.1	0.0	0.0	0.3	0.0	0.0	1.0	0.0	0.0	1.7	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
4–D*	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	1.6	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
AT LUFKIN GEAR BOX																														
5–E	2.7	0.0	0.0	5.4	0.0	0.0	8.5	0.0	0.0	4.3	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0
5–F	1.9	0.0	0.0	3.6	0.0	0.0	7.1	0.0	0.0	6.9	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0
6–E	3.2	0.0	0.0	5.6	0.0	0.0	6.3	0.0	0.0	8.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0
6–F	4.8	0.0	0.0	7.9	0.0	0.0	10.9	0.0	0.0	10.6	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0

* SHEAR LUG LOCATION

NOTES:

1. REFER SHEET 12 FOR ADDITIONAL DESIGN INFORMATION.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. 7253049–969224

REV. A

SCALE NONE

SHEET 11 OF 12

NOTES:

1. P IS VERTICAL LOAD (TENSION/COMPRESSION), VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. SHORT TERM LOAD CASES ARE THE RESULT OF THE FOLLOWING BLADE-OUT CONDITIONS AT THE INDICATED ROTOR POSITION.
   A. TWO STAGE 0 LOW PRESSURE COMPRESSOR AIRFOILS: 27840 gm-in (982.03 OZ.-in), SPEED RANGE 0-4300 RPM FOR 50 Hz UNIT AND 60 Hz UNIT.
   B. TWO STAGE 1 HIGH PRESSURE COMPRESSOR AIRFOILS: 2752 gm-in (97.07 OZ-in), SPEED RANGE 0-10800 RPM.
   C. THREE STAGE 2 HIGH PRESSURE TURBINE AIRFOILS: 4911 gm-in (173.23 OZ-in), SPEED RANGE 0-10800 RPM.
   D. TWO STAGE 5 LOW PRESSURE TURBINE AIRFOILS: 41158 gm-in (1451.81 OZ-in), SPEED RANGE 0-4300 RPM FOR 50 Hz UNIT AND 60 Hz UNIT.
3. SHORT TERM IS DEFINED AS FIVE SECONDS FOR TURBINE LOAD DECAY DURING COASTDOWN.
4. THE CONTINUOUS UNBALANCE LOAD CASES ARE THE RESULT OF THE ALLOWABLE ROTOR UNBALANCE AT THE INDICATED ROTOR POSITION.
   A. TWO STAGE 0 LOW PRESSURE COMPRESSOR AIRFOILS: 300 gm-in (10.58 OZ-in), DESIGN SPEED 3911 RPM FOR 50 Hz UNIT AND 3905 RPM FOR 60 Hz UNIT.
   B. TWO STAGE 1 HIGH PRESSURE COMPRESSOR AIRFOILS: 100 gm-in (3.53 OZ-in), DESIGN SPEED 10600 RPM.
   C. THREE STAGE 2 HIGH PRESSURE TURBINE AIRFOILS: 150 gm-in (5.29 OZ-in), DESIGN SPEED 10600 RPM.
   D. TWO STAGE 5 LOW PRESSURE TURBINE AIRFOILS: 200 gm-in (7.05 OZ-in), DESIGN SPEED 3911 RPM FOR 50 Hz UNIT AND 3905 RPM FOR 60 Hz UNIT.
   E. GENERATOR, BRUSH 7-290ER, CONTINUOUS UNBALANCE LOAD OF 987 gm-in (34.82 OZ-in) AT MIDDLE OF ROTOR PER BRUSH SPECIFICATION.
   F. GEAR BOX, LUFKIN, CONTINUOUS UNBALANCE LOAD OF 152 gm-in (5.36 OZ-in) AT MIDDLE OF SHAFT AS PER LUFKIN SPECIFICATION.
5. THE LOADS IN THE DYNAMIC FOUNDATION LOAD TABLE ARE THE MAXIMUM (0 TO PEAK) LOADS OF EACH ANCHOR BOLT IN THE OPERATING RANGE THESE LOADS MAY OCCUR AT DIFFERENT FREQUENCIES OR PHASES, AND THEREFORE, IT MAY BE TOO CONSERVATIVE TO TREAT LOADS AS STATIC LOAD CASES.
6. DYNAMIC LOADS SHORT TERM: FROM MAX TO ZERO IN 5 SEC. THESE LOAD CASES ARE ASSUMED NOT TO ACT SIMULTANEOUSLY.



7. THE PEAK TO PEAK VIBRATION VELOCITY AT ANY POINT OF THE FOUNDATION SHOULD BE LESS THAN 0.06 In/SEC AT THE RATED TURBINE SPEED OF 3605 RPM FOR 60 Hz UNIT AND 3911 RPM FOR 50 Hz UNIT.

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG
LOCATION

DWG NO. 7253049-969224

REV. A

SCALE NONE

SHEET 12 OF 12

NOTES:

1. LIFTING EQUIPMENT IS SENT TO JOB SITE TO OFF–LOAD MAJOR ITEMS. EQUIPMENT IS TO BE CONSIDERED ON LOAN BY GEPPLP AND IS TO BE RETURNED IN GOOD WORKING ORDER.
2. ALL CABLE SLINGS TO HAVE GEPPLP DRAWING NUMBER REFERENCES WITH RESPECTIVE WEIGHT CAPACITIES AND LENGTHS PERMANENTLY STAMPED AT BOTH ENDS.
3. HOOK LOAD INCLUDES LIFT HARDWARE WEIGHT WHICH IS 3 KIPS FOR MAIN UNIT LIFTS AND 1 KIP FOR ALL OTHER LIFTS.
4. CABLE SLING DESIGNATED IWRC/EIPS IS AN ABBREVIATION FOR INDEPENDENT WIRE ROPE CORE/EXTRA IMPROVED PLOW STEEL.
5. APPROVED EQUAL MUST INCLUDE A MINIMUM RATED OR WORKING LOAD OF 6 TIMES THE MINIMUM ULTIMATE LOAD OR BREAKING STRENGTH. S.W.L. = SAFE WORKING LOAD.
6. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
7. TURBINE ROOM LIFT IS MADE WITH LM6000 ENGINE.
8. GENERATOR LIFT RIGGING ACCOUNTS FOR APPROXIMATELY 2 KIPS.
9. DO NOT LIFT GENERATOR ROOM ON SHEETS 2 AND 3 (LIFT ARRANGEMENT WITHOUT GENERATOR) WITH GENERATOR INSIDE.
10. MUST USE SWIVEL HOIST RINGS – NO SUBSTITUTIONS.
11. THIS DRAWING UTILIZES BILLS OF MATERIAL (BOMS) WHICH CONSIST OF (DRAWING NUMBER) (ITEM TYPE) (ITEM DESIGNATOR) AND IDENTIFIED AS XXXXXXYZZZZ WHERE XXXXXX = DRAWING NUMBER, Y = G (GROUP) OR P (PART) OR L (LIST), AND ZZZZ = ITEM DESIGNATOR (I.E. 0001).

LEGEND:

- CENTER OF GRAVITY
- HOOK LOCATION
- CENTER OF GRAVITY AND HOOK LOCATION COINCIDE

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ITEM NO.
2	393A3952P0001	SLING	1 1/4" DIA X 20'–3" B/B STD EYE BOTH ENDS – 15 TONS SWL	43
1	377A2698P0001	SLING	2 1/2" DIA X 14'–6" B/B STD EYE BOTH ENDS – 54 TONS SWL	42
1	390A0530P0001	SLING	2 1/2" DIA X 14'–10 1/2" B/B STD EYE BOTH ENDS – 54 TONS SWL	41
–	–	–	NOT USED FOR THIS PROJECT	40
–	–	–	NOT USED FOR THIS PROJECT	39
–	–	–	NOT USED FOR THIS PROJECT	38
–	–	–	NOT USED FOR THIS PROJECT	37
–	–	–	NOT USED FOR THIS PROJECT	36
–	–	–	NOT USED FOR THIS PROJECT	35
–	–	–	NOT USED FOR THIS PROJECT	34
–	–	–	NOT USED FOR THIS PROJECT	33
2	J04900	SLING	1 1/4" DIA X 20'–7 1/8", 15 TONS SWL	32
4	J02564	SLING	1 1/4 DIA X 20'–1", 15 TONS SWL	31
4	J01777	SLING	7/8 DIA X 10'–0", 7.6 TONS SWL	30
4	G–2130–3 1/4T	SHACKLE	CROSBY, 5/8" NOMINAL, G–2130, 3.25 TONS SWL, (CROSBY OR APPROVED EQUAL)	29
2	393A3968P0001	SLING	2" DIA X 28'–4 3/8" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 37 TONS SWL	28
2	393A3957P0001	SLING	2" DIA X 30'–3 1/8", B/B, STD EYE BOTH ENDS, 37 TONS SWL	27

PARTS LIST

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ITEM NO.
–	–	–	NOT USED FOR THIS PROJECT	26
–	–	–	NOT USED FOR THIS PROJECT	25
4	G–2140–40T	SHACKLE	CROSBY, 1 3/4" NOMINAL, G–2140, 40 TONS SWL (CROSBY OR APPROVED EQUAL)	24
4	386A3554P0001	SLING	2" DIA X 30'–0" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 37 TONS SWL	23
2	724180	SPREADER BAR	AIR FILTER ASSEMBLY SPREADER BAR	22
8	382A9356P0001	PIN	DRAW BAR HITCH PIN, 3/8" DIA X 2 3/8" LG.	21
8	724177	PIN	LIFTING PIN, FIXED FRAME	20
1	377A2450P0001	LIFT STABILIZER	CROSBY 5/8" X 35'–0" ALLOY CHAIN, CLEVIS HOOK, CHAIN SHORTENER, SHACKLE	19
4	J02566	SLING	2" DIA X 26'–0" B/B STD EYE BOTH ENDS (6X49 IWRC EIPS) 37 TONS SWL	18
–	–	–	NOT USED FOR THIS PROJECT	17
4	J01352	SLING	1 1/4" DIA X 11'–3" B/B STD EYE BOTH ENDS (6X49 IWRC EIPS) 15 TONS SWL	16
1	287336	SPREADER BAR	AIR FILTER HOUSE SPREADER BAR	15
4	J00475	NUT	HEX HEAD, 5/8"–11 NC, GR 5	14
4	J00410	WASHER	LOCK, 5/8"	13
4	J00401	WASHER	FLAT, 5/8"	12
4	567127	EYE BOLT	AUSTIN 5/8–11NC x 1 3/4" 1000# SWL @ 45°	11
4	G209–A 12–5T	SHACKLE	CROSBY, 1" NOMINAL, G–209A, 12.5 TONS SWL (CROSBY OR APPROVED EQUAL)	10
4	724175P0001	LIFTING TRUNNION	TRUNNION, TURBINE & GENERATOR SKIDS	9
1	285664P001	SPREADER BAR	GENERATOR LIFT SPREADER BAR	8
4	G–2130–17T	SHACKLE	CROSBY, 1 1/2" NOMINAL, G–2130, 17 TON SWL (CROSBY OR APPROVED EQUAL)	7
4	J02565	SLING	2" DIA X 14'–7" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 37 TONS SWL	6
12	386A3423P0001	SHACKLE	CROSBY, 2 1/2" NOMINAL, G–2140, 85 TON SWL (CROSBY OR APPROVED EQUAL)	5
1	270127	SPREADER BAR	UNIT LIFT SPREADER BAR	4
2	J04776	SLING	2" DIA X 23'–0" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 37 TONS SWL	3
4	J04775	SLING	2" DIA X 23'–8" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 37 TONS SWL	2
4	J04773	SLING	2 1/2" DIA X 15'–0" B/B STD EYE BOTH ENDS (6 X 49 IWRC EIPS) 54 TONS SWL	1

PARTS LIST

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

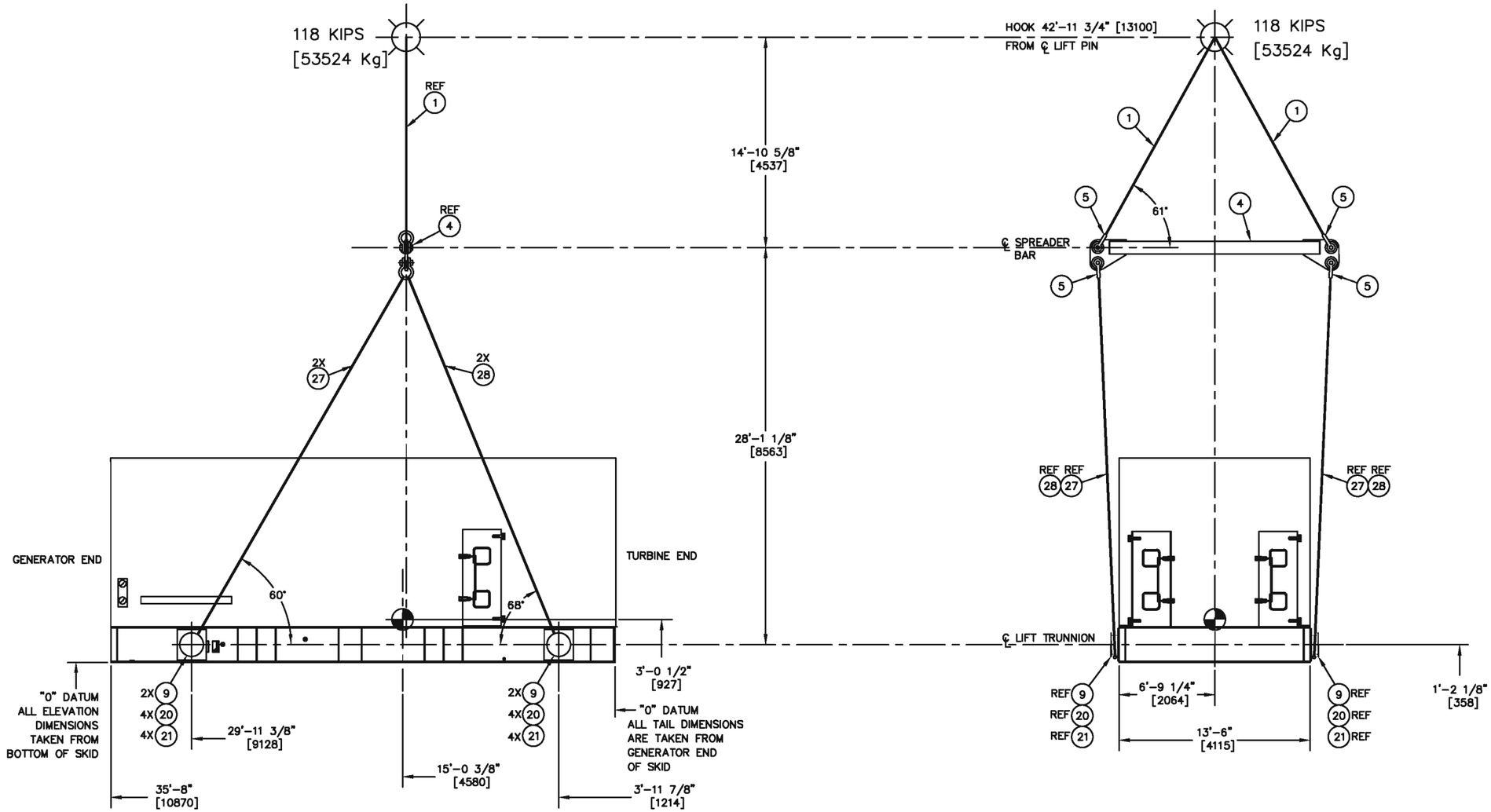
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049–969225

REV. A

SCALE NONE

SHEET 1 OF 22



9 GENERATOR ROOM (WITHOUT GENERATOR)

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

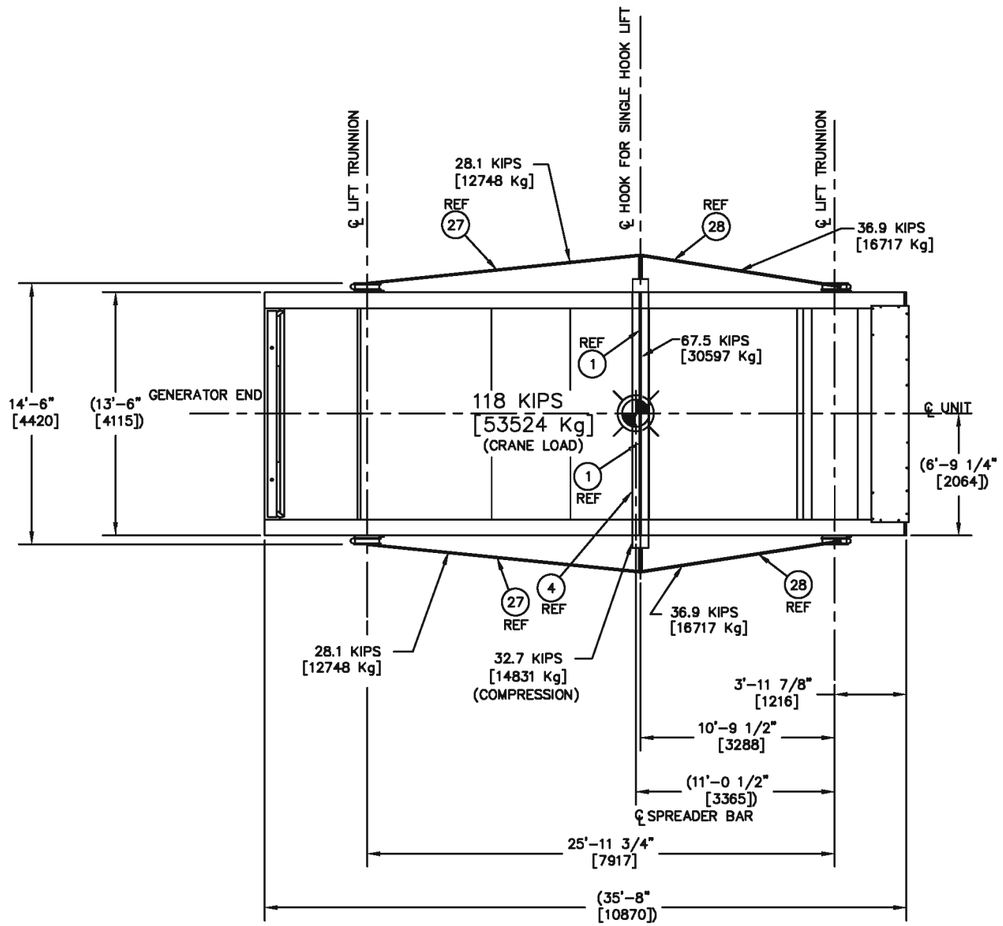
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 2 OF 22



PLAN VIEW

9 GENERATOR ROOM (WITHOUT GENERATOR)

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REVISIONS

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000℗

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

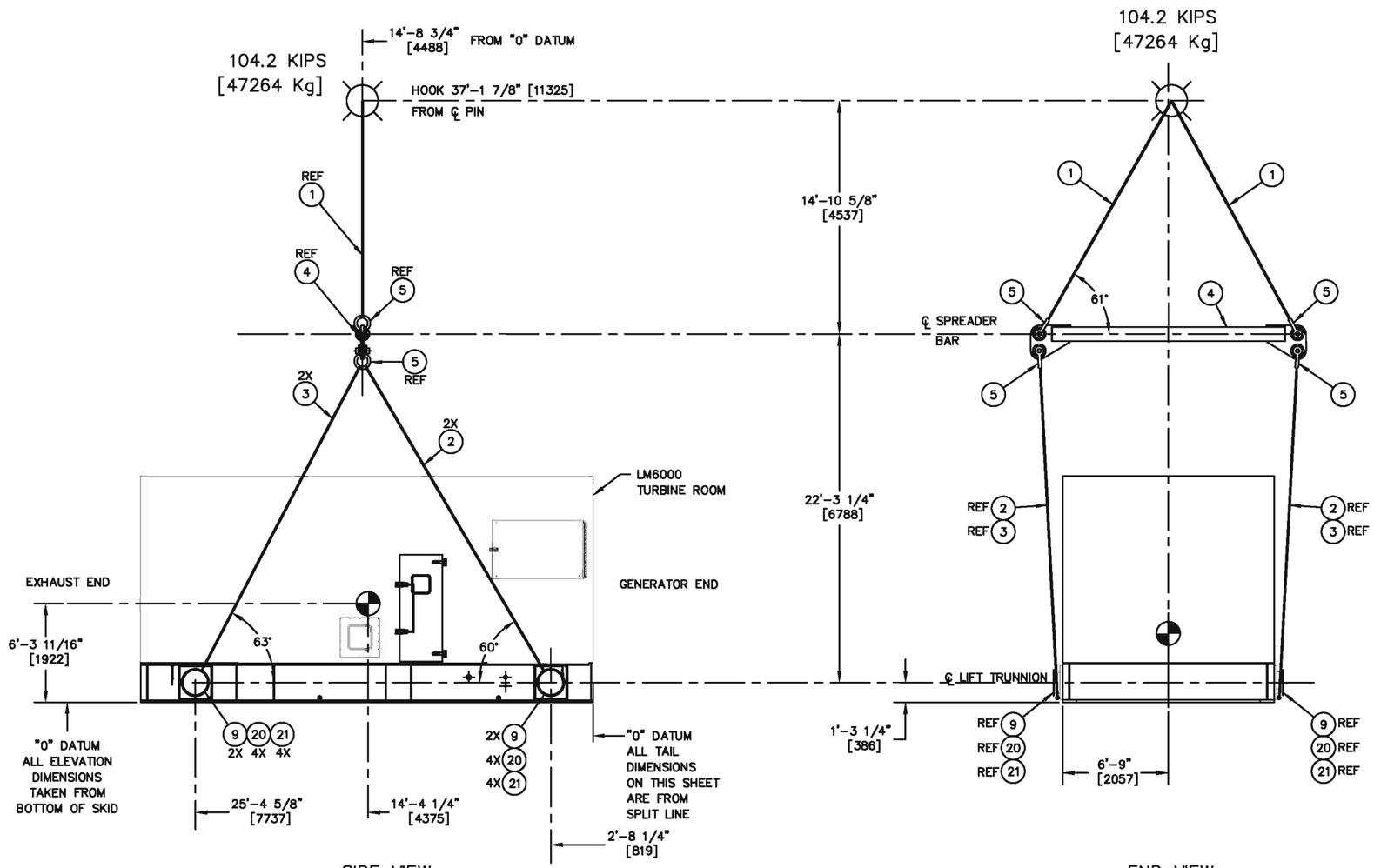
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 3 OF 22



SIDE VIEW

END VIEW

SINGLE POINT HOOK LIFT
TURBINE SKID

TURBINE ROOM (WITH ENGINE)

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DIMENSIONS ARE IN INCHES
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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

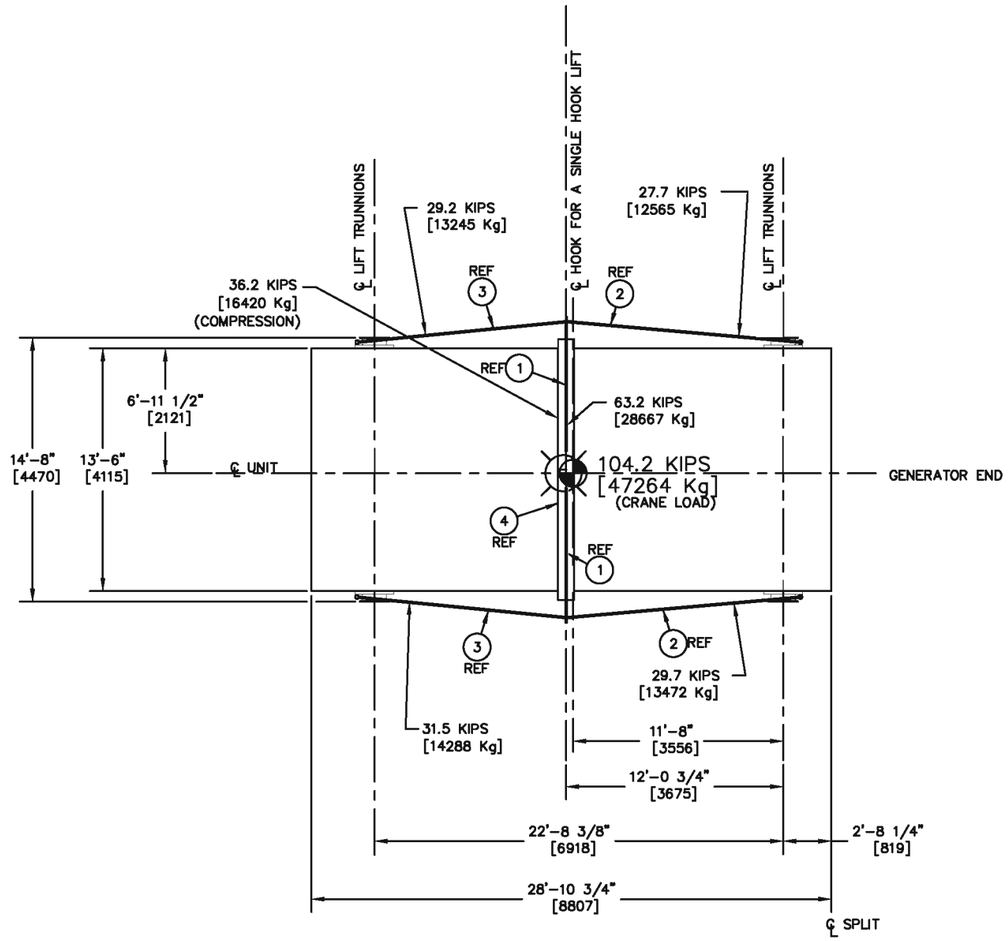
UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225
REV. A
SCALE 1/4" = 1'-0"
SHEET 4 OF 22



PLAN VIEW

TURBINE ROOM (WITH ENGINE)

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

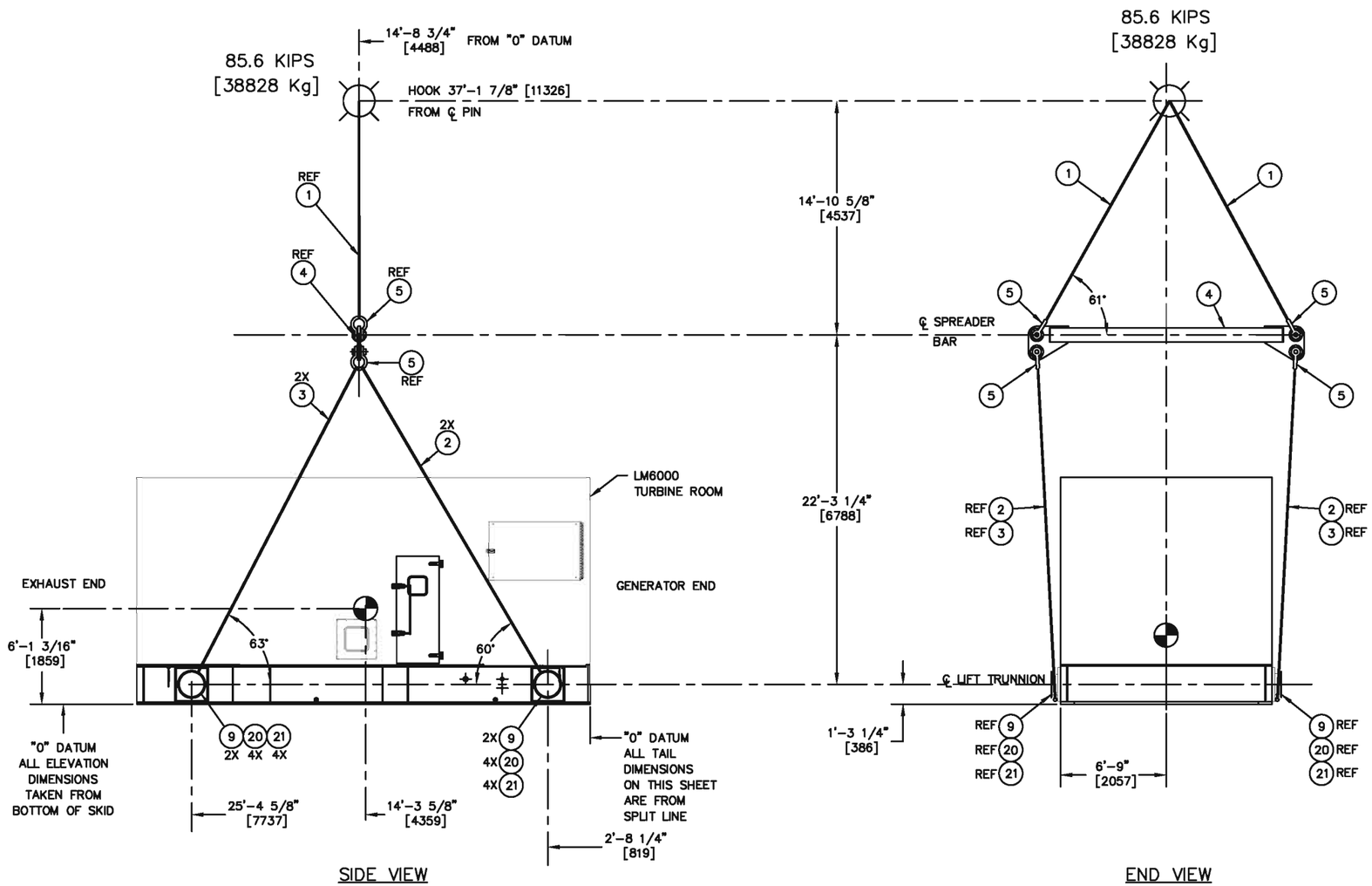
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 5 OF 22



TURBINE ROOM (WITHOUT ENGINE)

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

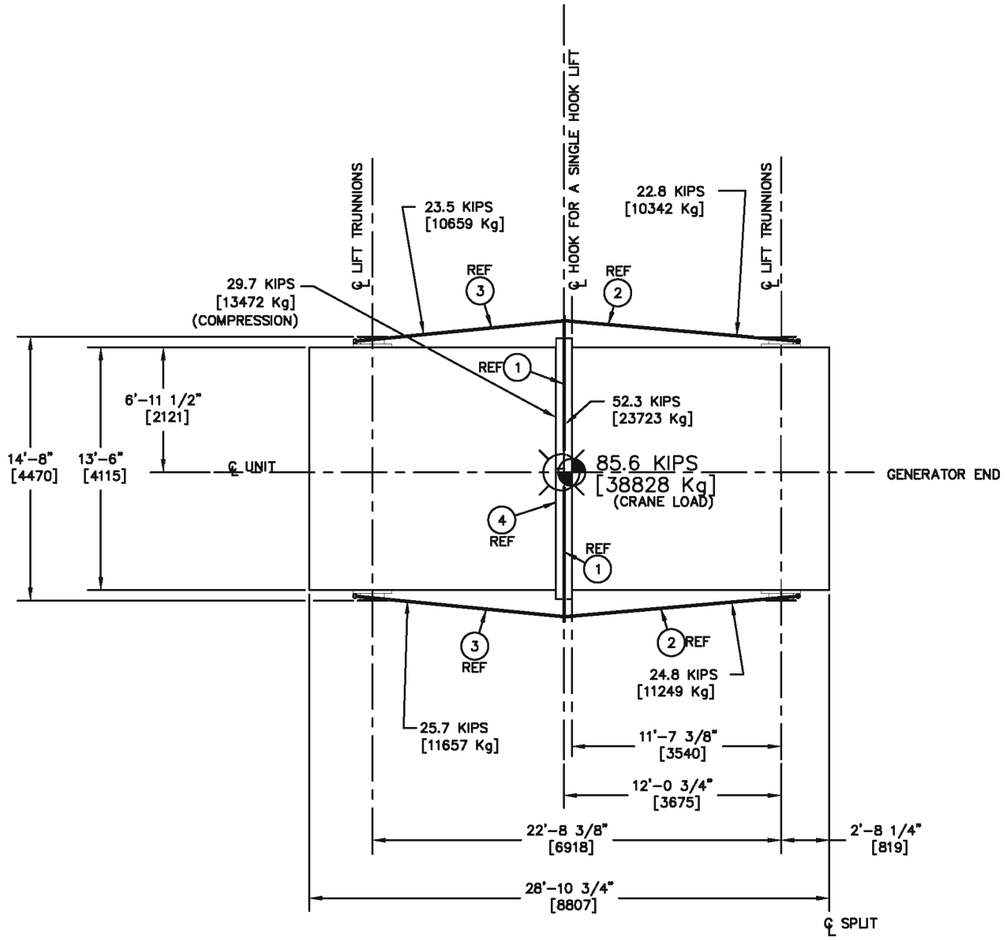
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 6 OF 22



PLAN VIEW

TURBINE ROOM (WITHOUT ENGINE)

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000℗

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

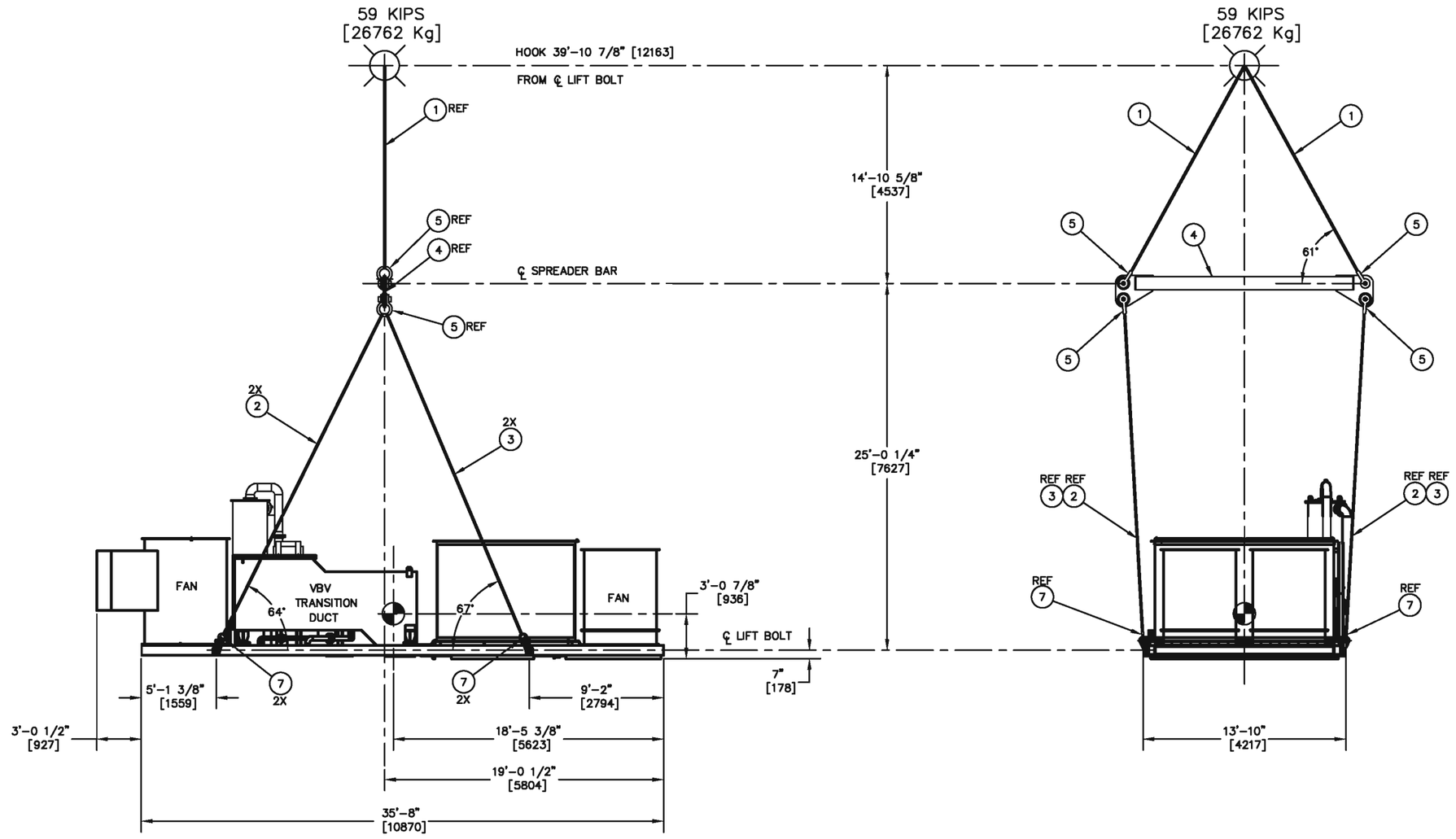
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 7 OF 22



SIDE VIEW

END VIEW

NOTE:

ROOF SKID IS NOT TO BE LIFTED WITH SILENCERS (REFERENCE SHEET 10) ASSEMBLED TO SKID.

ROOF SKID

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

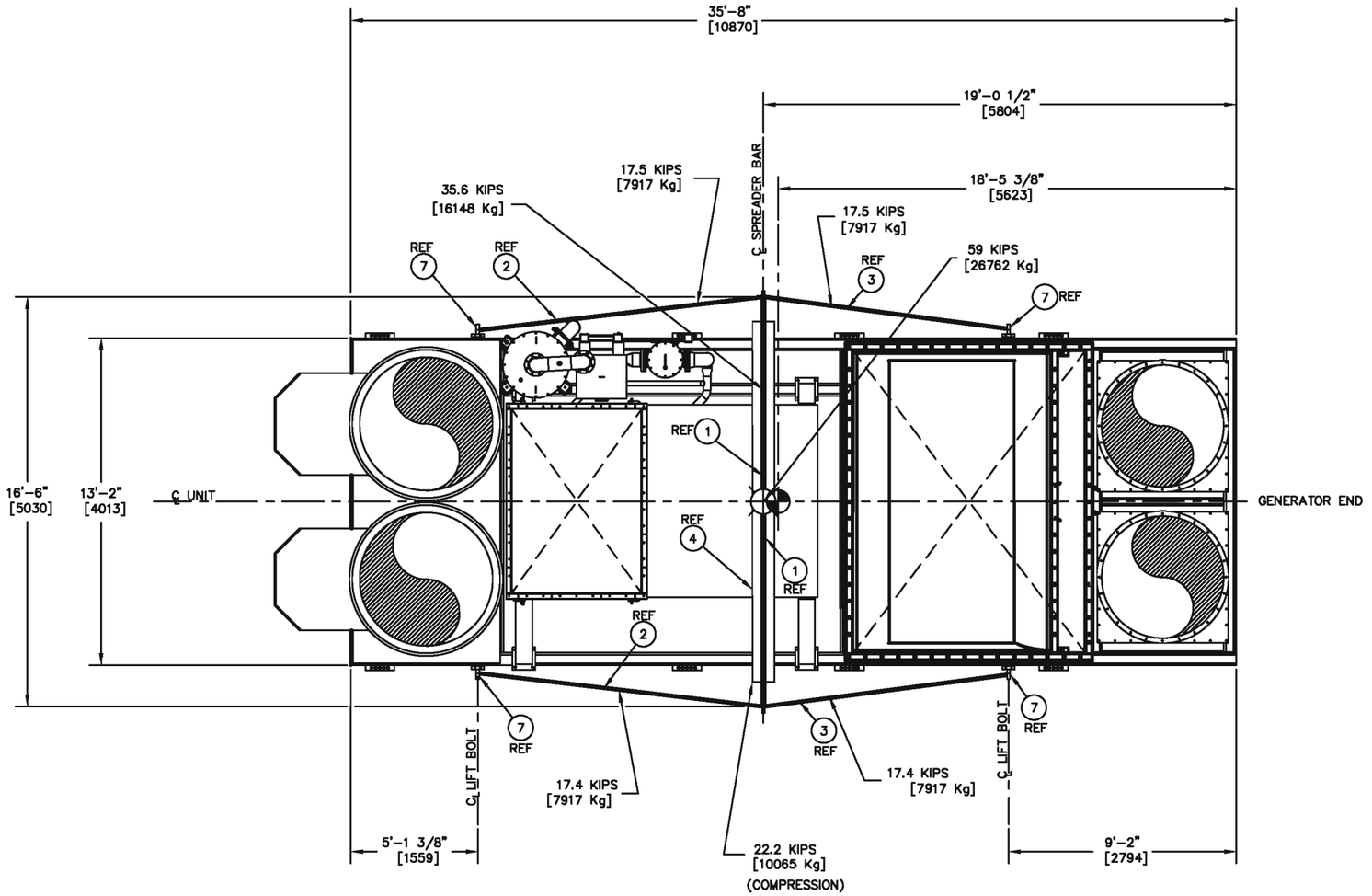
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 8 OF 22



PLAN VIEW

ROOF SKID

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS: .XX ± .03, .XXX ± .010
FRACTIONAL: ±1/16"
ANGULAR: ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: LIFT ARRANGEMENT

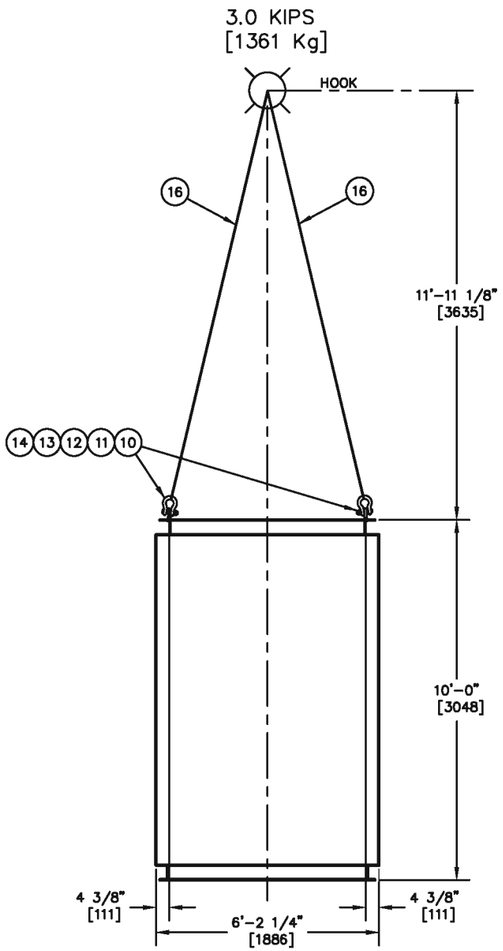
DWG NO. 7253049-969225

REV. A

SCALE 3/8" = 1'-0"

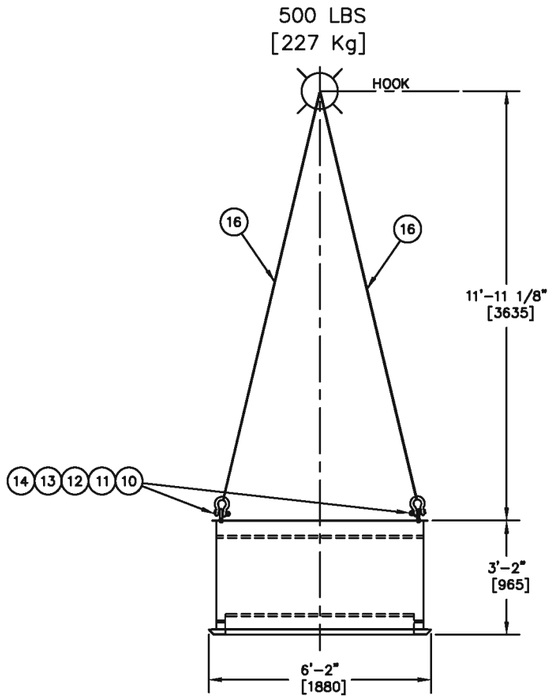
SHEET 9 OF 22

NOTE:
UTILIZE TWO (2) LIFTING SLINGS PER LIFT



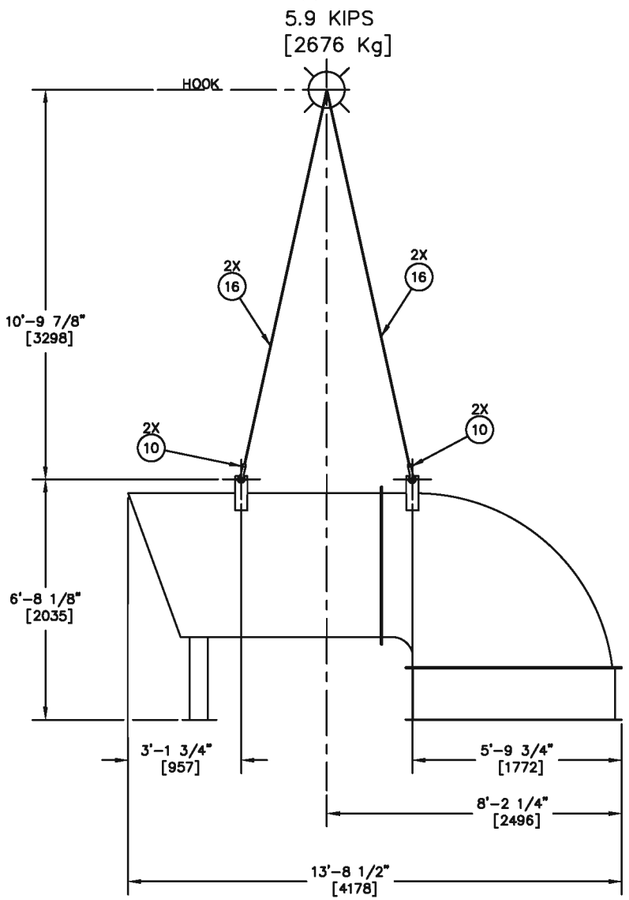
TURBINE VENTILATION
EXHAUST SILENCER

NOTE:
UTILIZE TWO (2) LIFTING SLINGS PER LIFT



TURBINE VENTILATION
EXHAUST STACK CAP

NOTE:
UTILIZE FOUR (4) LIFTING SLINGS PER LIFT



GENERATOR EXHAUST
DUCT/SILENCER

SILENCER

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

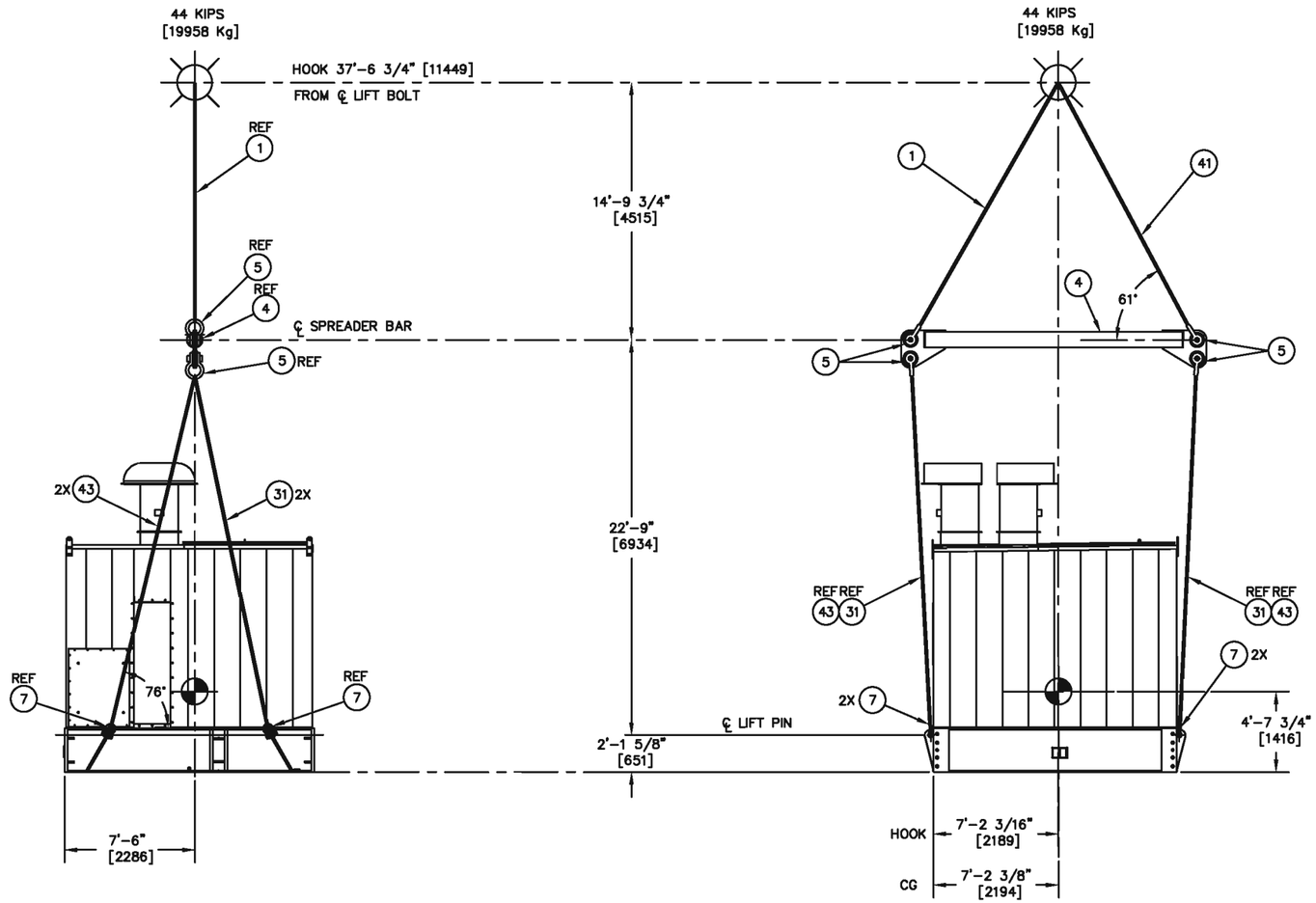
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/2" = 1'-0"

SHEET 10 OF 22



LEFT SIDE VIEW

FRONT VIEW

60 Hz, SAC, SHELL AND TUBE DUPLEX, WATER WASH

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

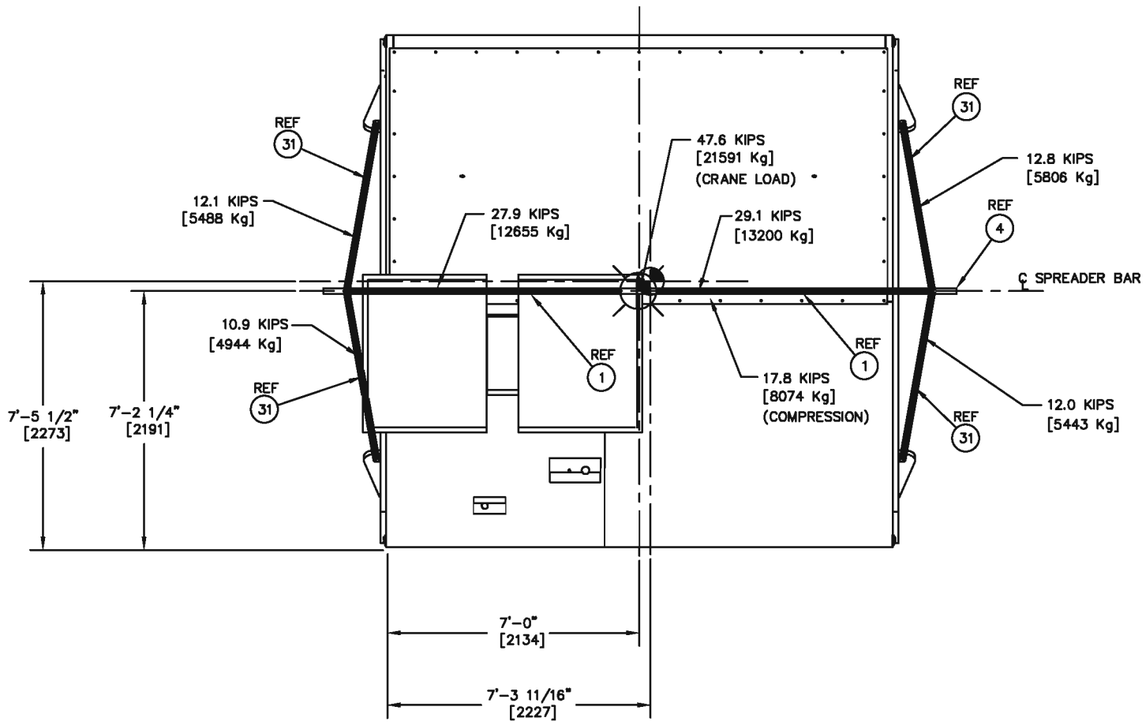
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 11 OF 22



PLAN VIEW

AUXILIARY SKID
(WITH DUPLEX COOLERS)

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

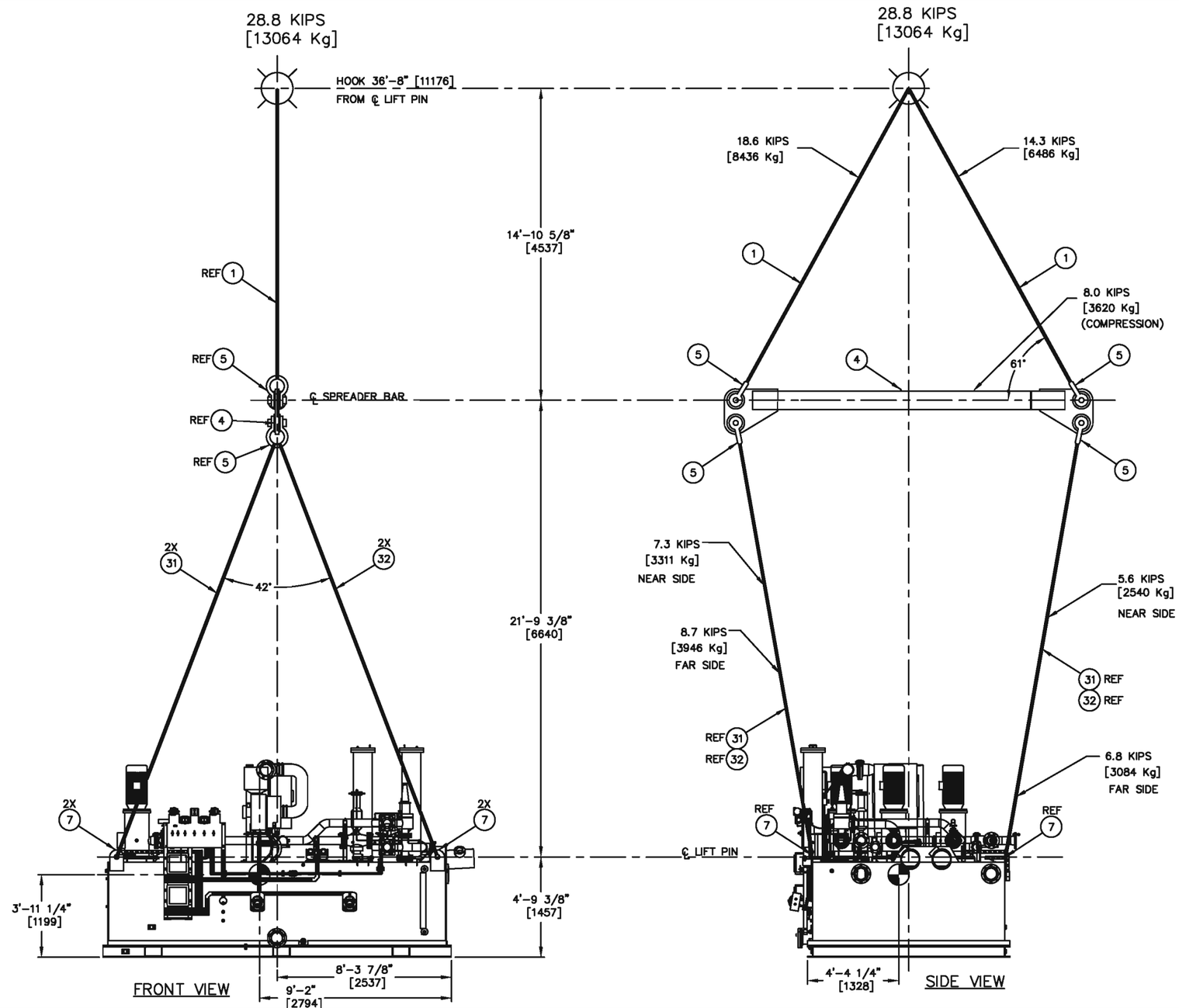
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/2" = 1'-0"

SHEET 12 OF 22



GLO SKID

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

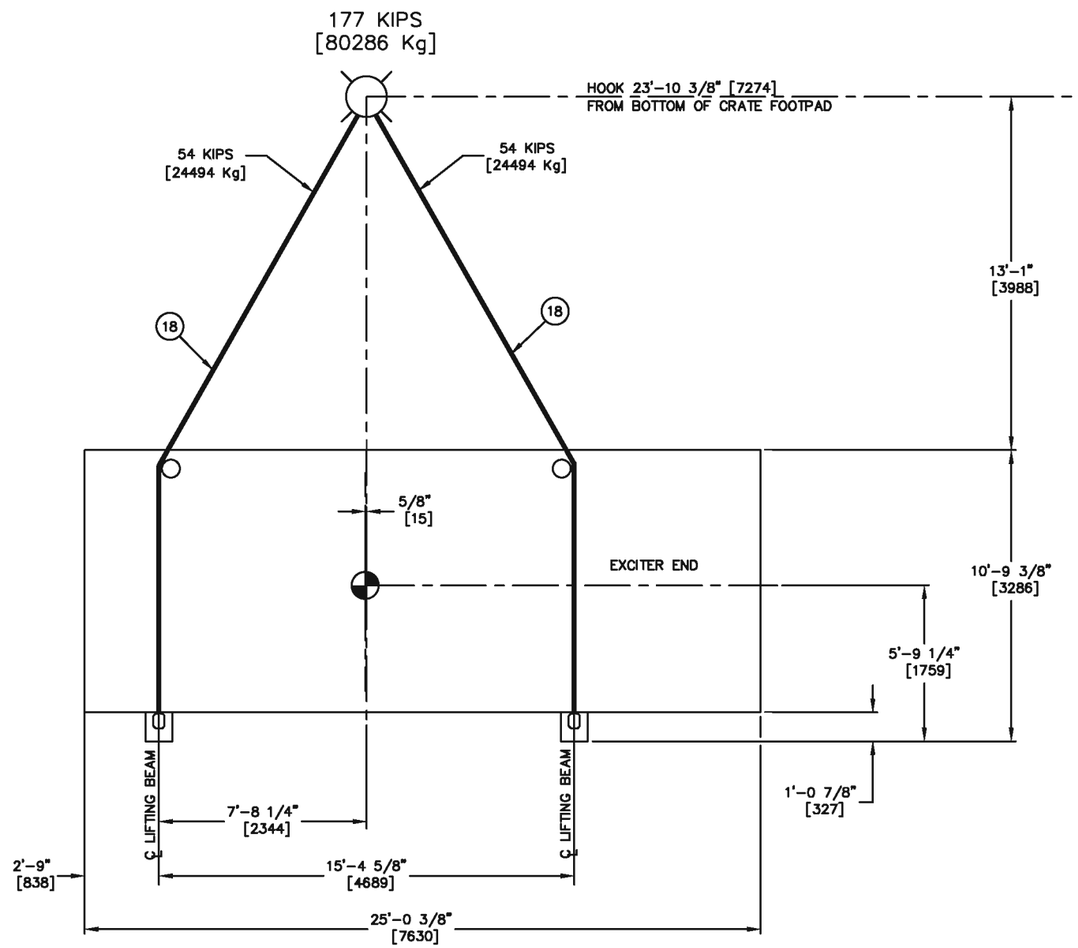
REV. A

SCALE 3/8" = 1'-0"

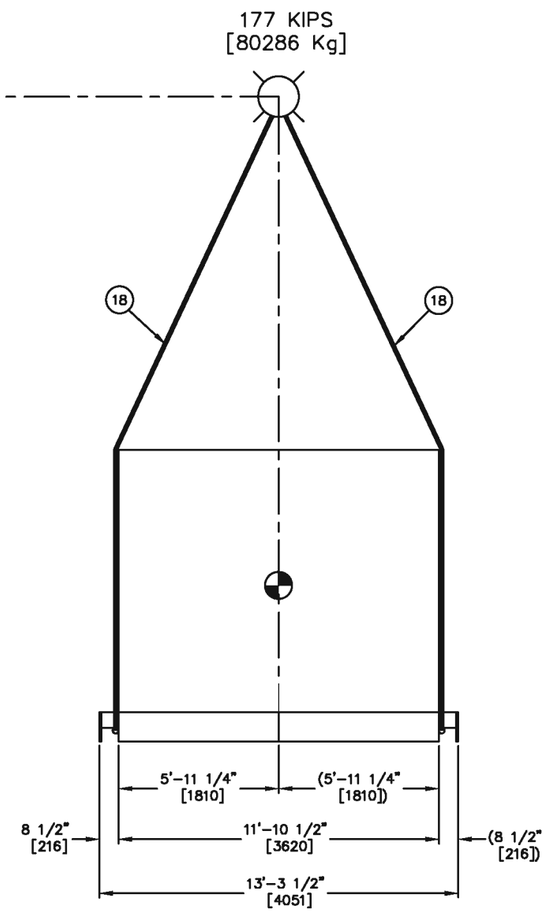
SHEET 13 OF 22

NOTE:

1.) UTILIZE FOUR (4) LIFTING SLINGS PER LIFT



SIDE VIEW



END VIEW

BDAX 7-290 ERJT
BRUSH GENERATOR IN CONTAINER

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

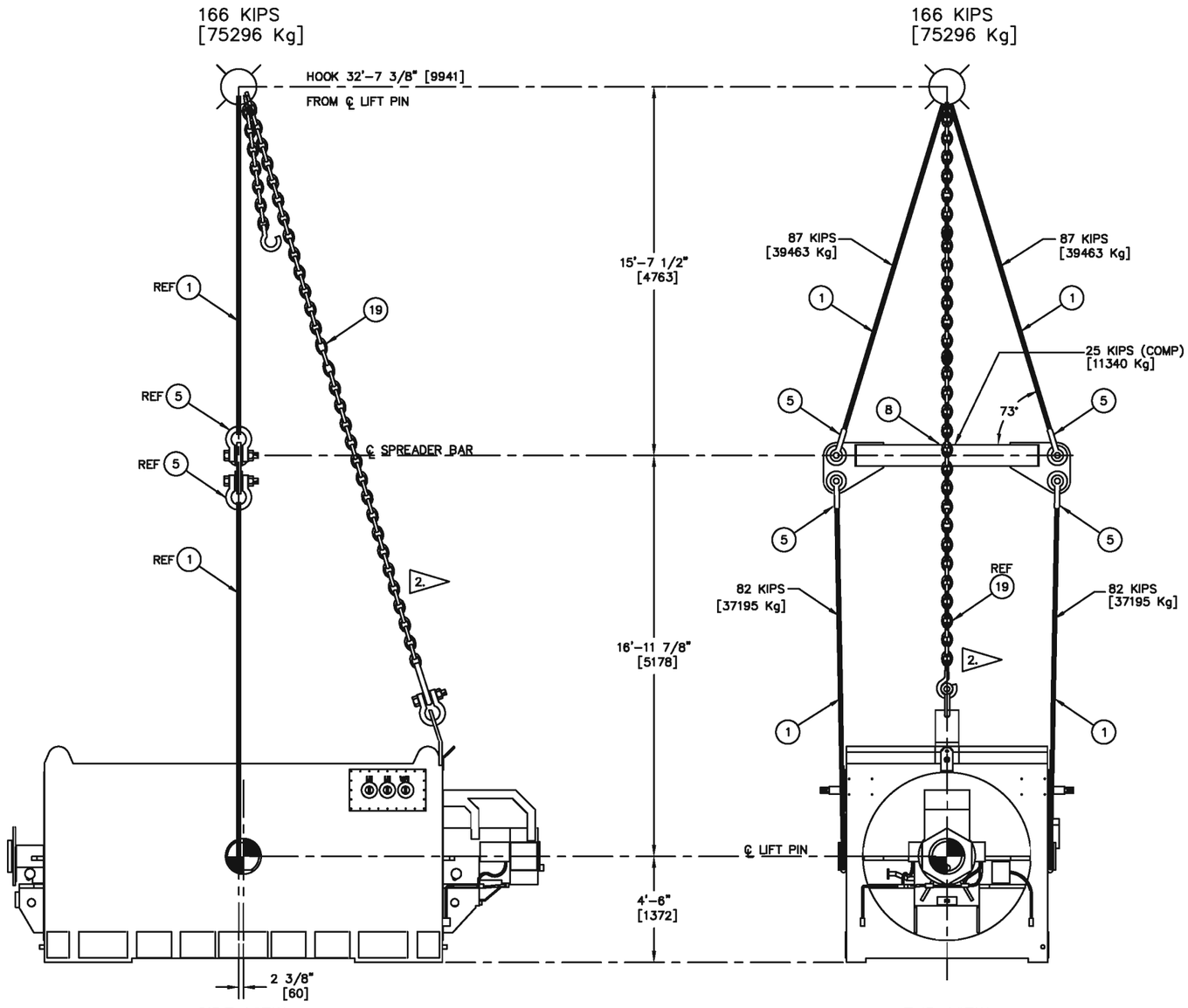
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GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225
REV. A

SCALE 3/8" = 1'-0"
SHEET 14 OF 22



NOTES:

1. GENERATOR TO BE LIFTED OUT OF CRATE AS CLOSE AS POSSIBLE (WITHIN 10') OF GENERATOR SKID TO MINIMIZE DISTANCE OF MOVEMENT AND DURATION OF LIFT.
2. THE STABILIZATION CHAIN (ITEM 19) MUST BE ADJUSTED TO LENGTH TO KEEP GENERATOR LEVEL WITHIN ±3".

BRUSH GENERATOR 1.

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

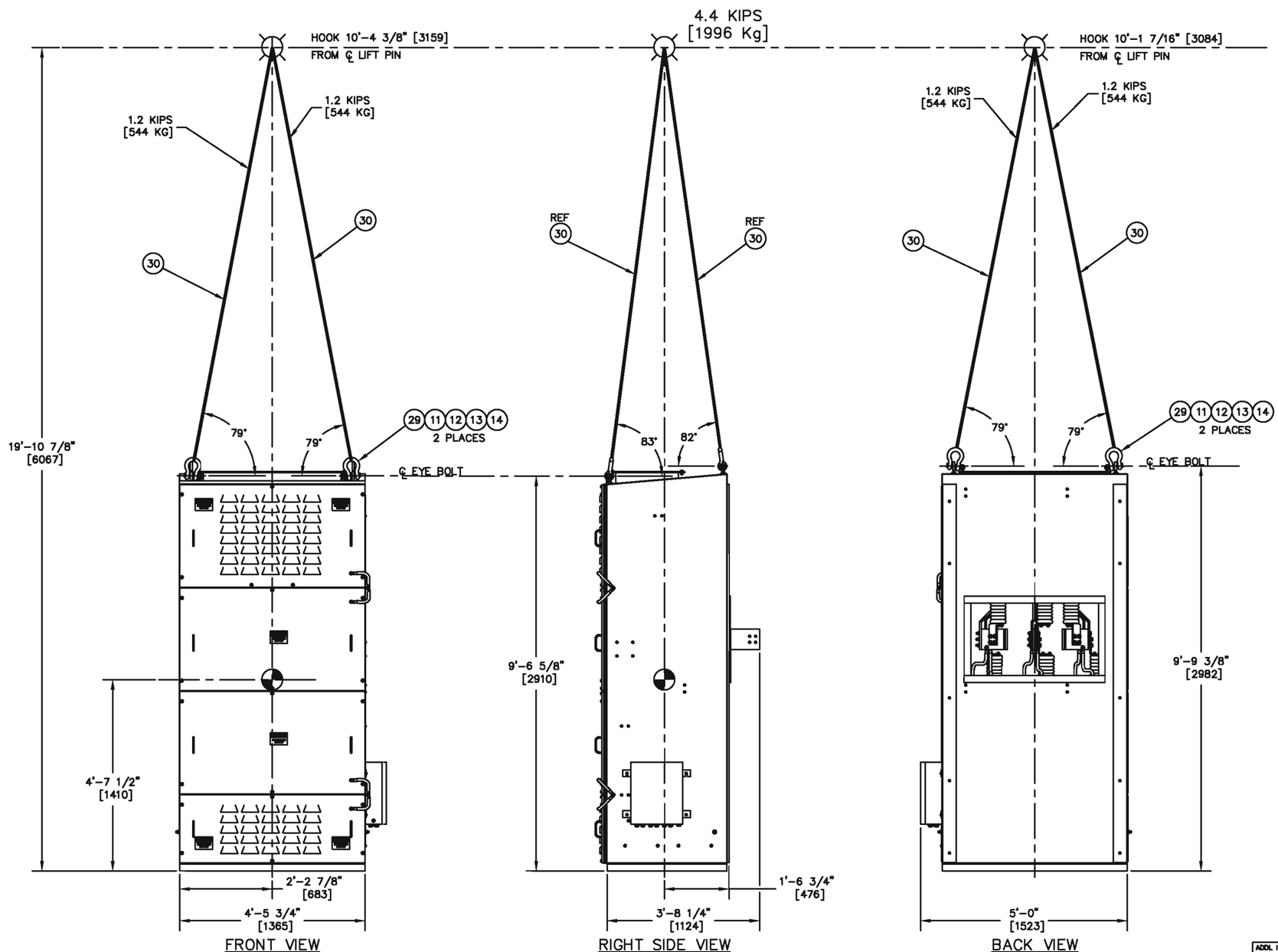
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 3/8" = 1'-0"

SHEET 15 OF 22



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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000℗

LINESIDE CUBICLE

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

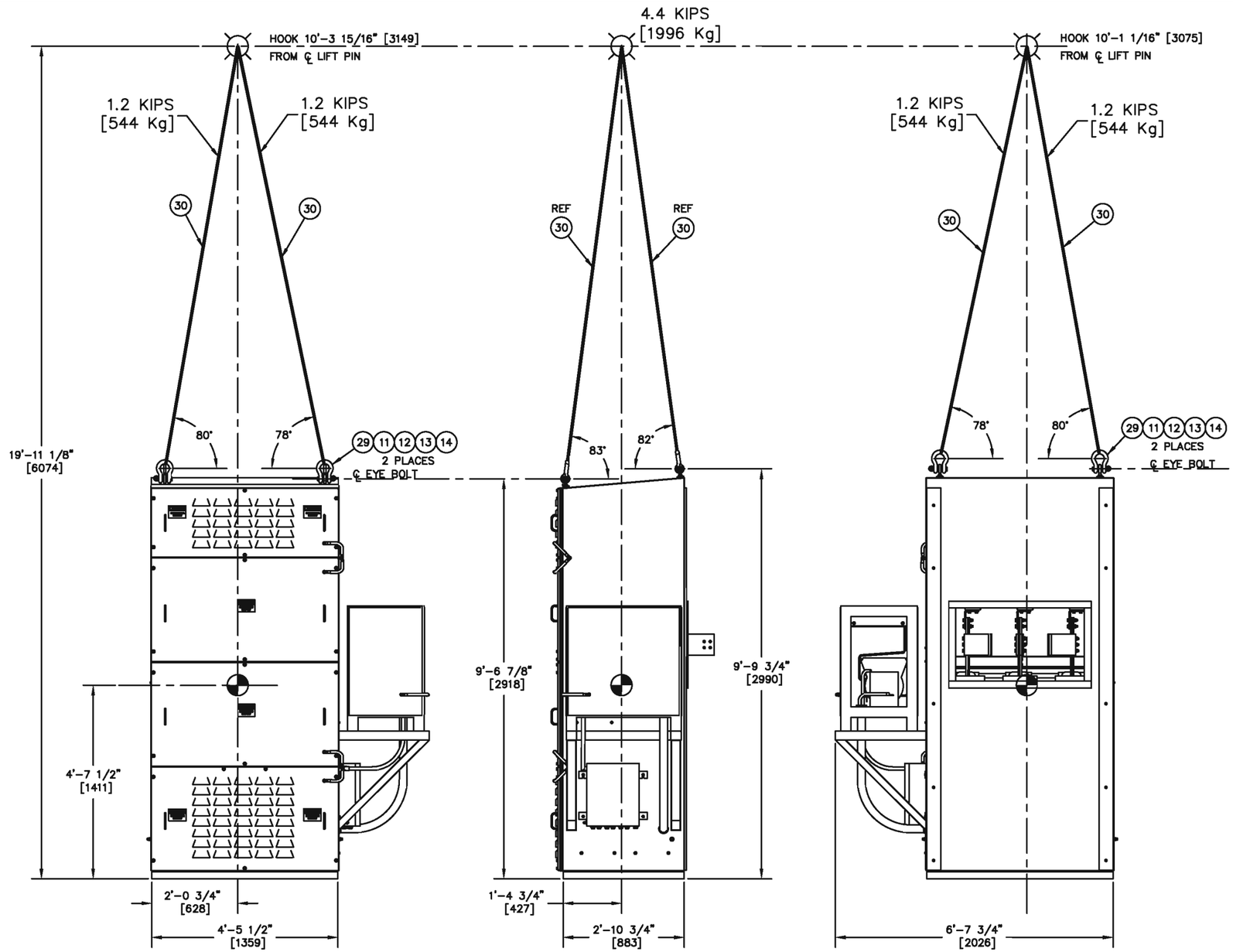
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 3/4" = 1'-0"

SHEET 16 OF 22



FRONT VIEW

RIGHT SIDE VIEW

BACK VIEW

NEUTRAL CUBICLE

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

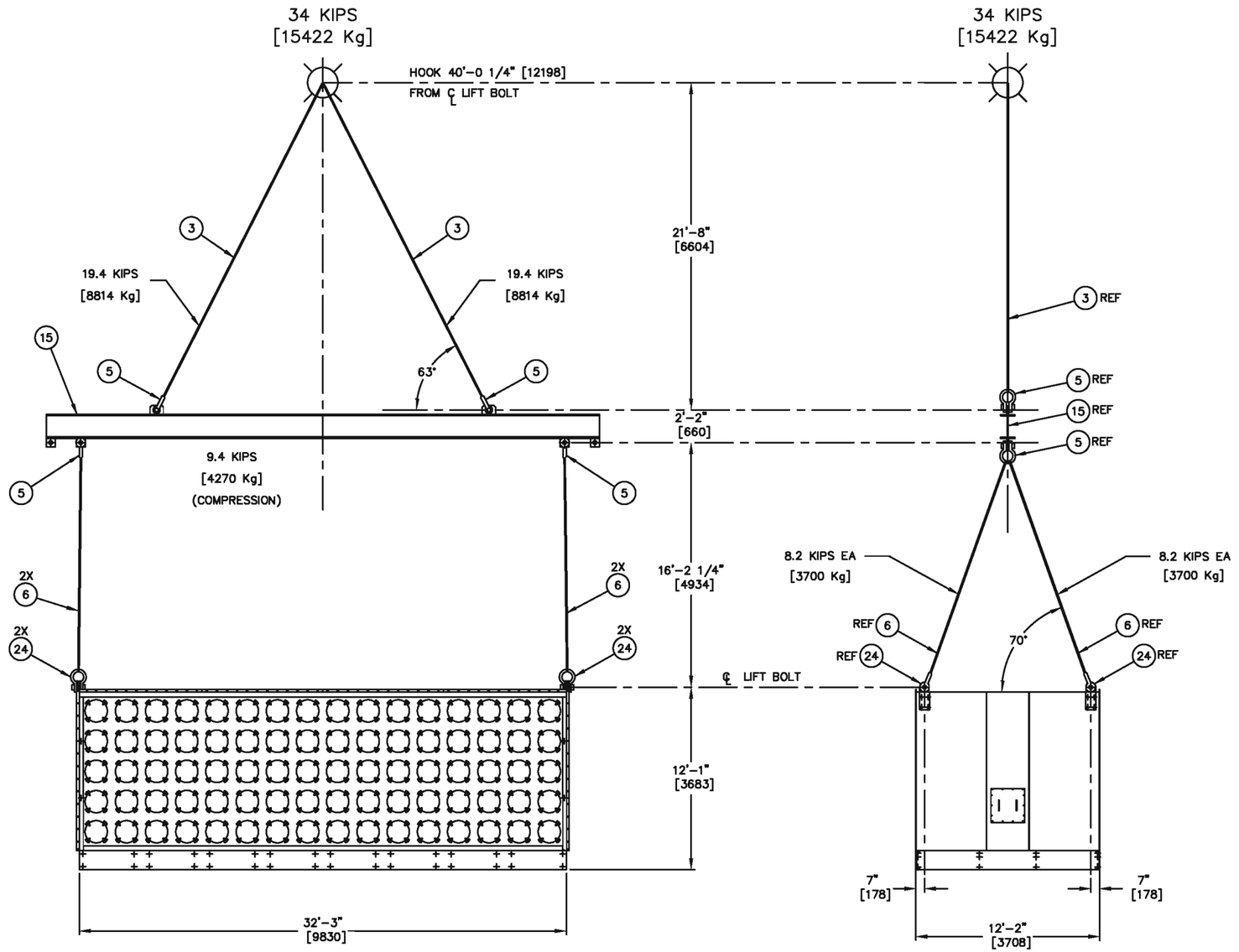
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 3/4" = 1'-0"

SHEET 17 OF 22



FRONT VIEW

SIDE VIEW

AIR FILTER HOUSE–PLENUM MODULE

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

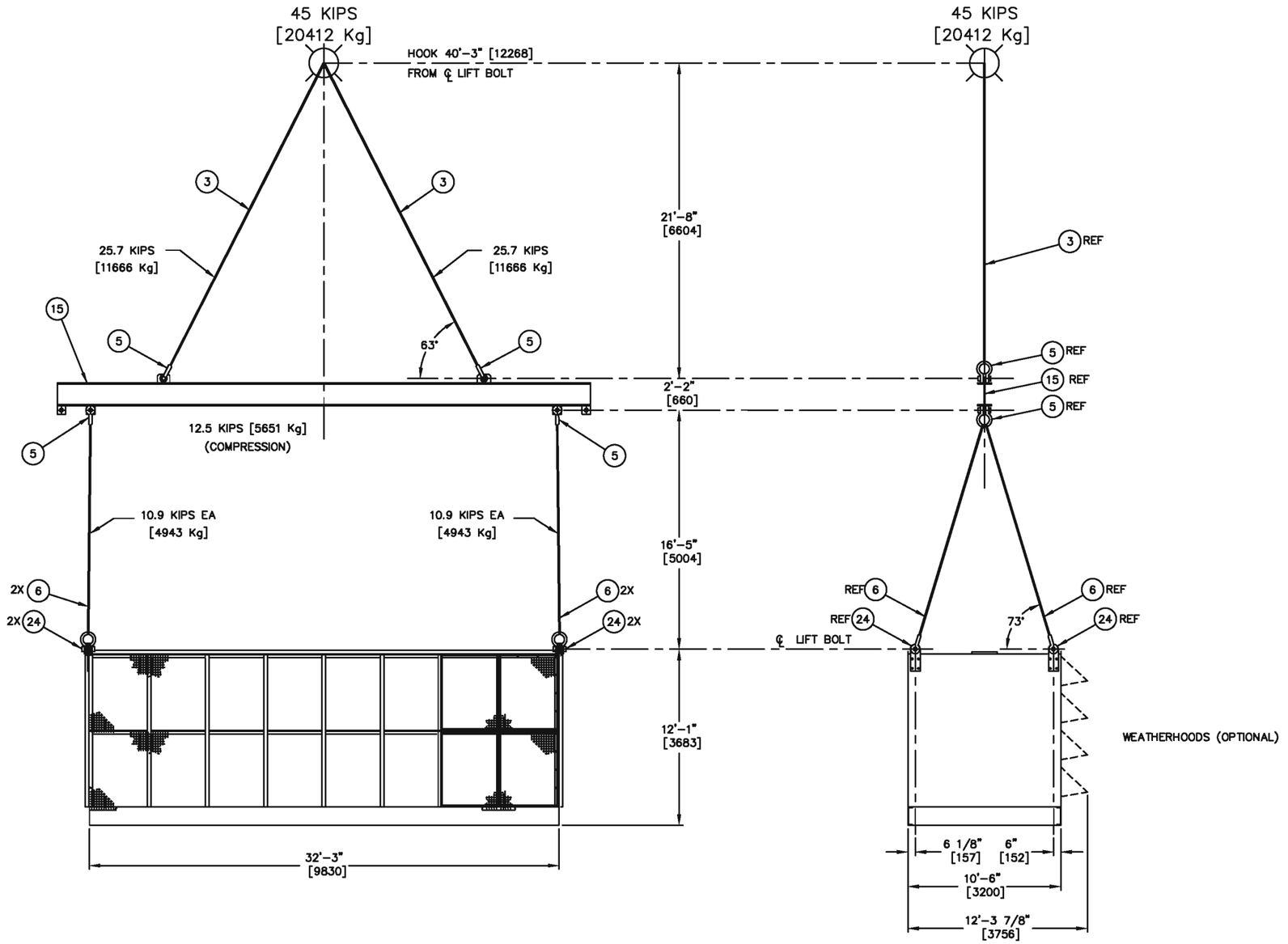
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 18 OF 22



FRONT VIEW

SIDE VIEW

AIR FILTER HOUSE-COIL MODULE

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

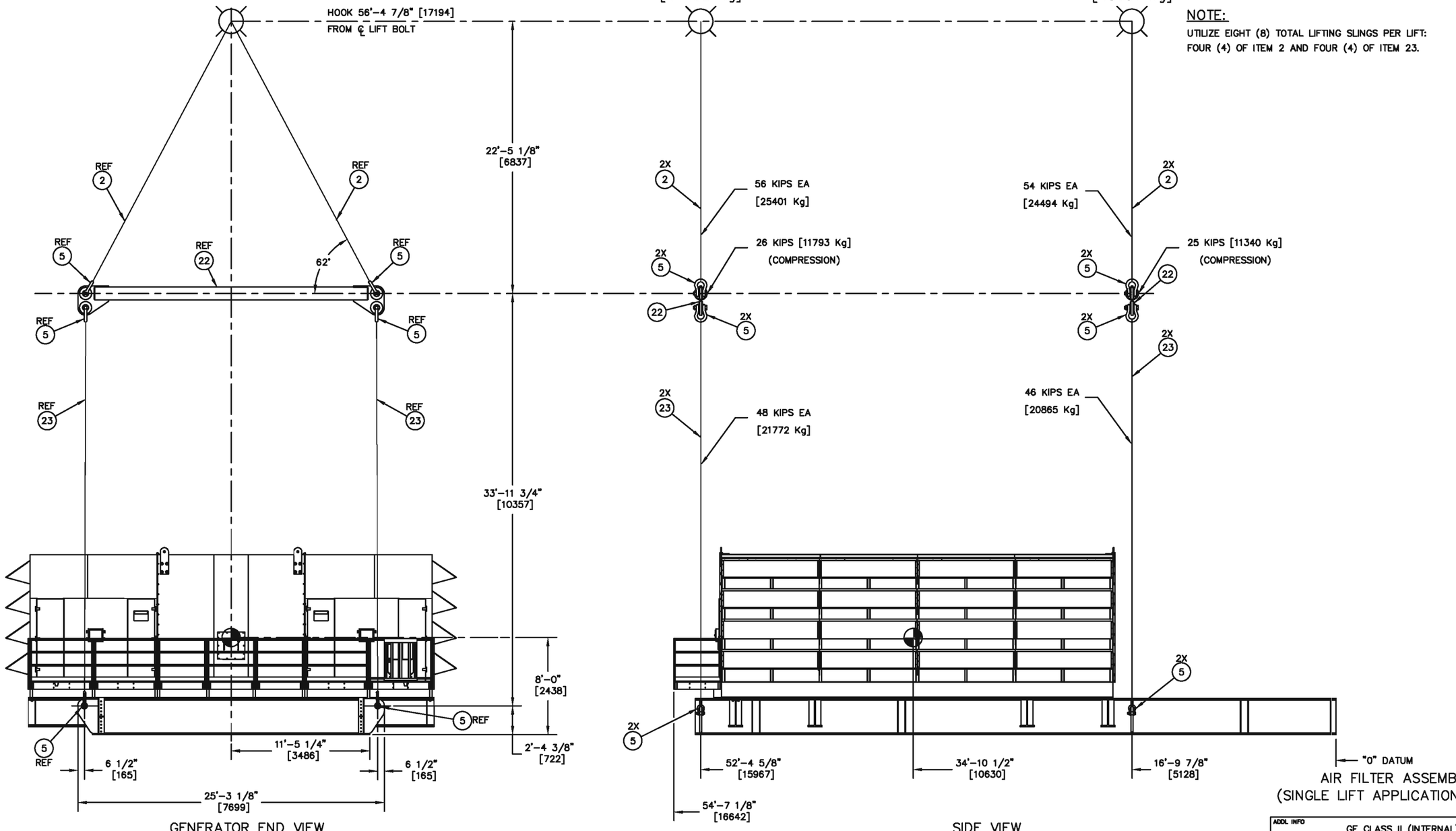
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 19 OF 22



NOTE:
UTILIZE EIGHT (8) TOTAL LIFTING SLINGS PER LIFT:
FOUR (4) OF ITEM 2 AND FOUR (4) OF ITEM 23.

GENERATOR END VIEW

SIDE VIEW

AIR FILTER ASSEMBLY
(SINGLE LIFT APPLICATIONS ONLY)

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UNIT TYPE LM6000

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GE PACKAGED POWER, L.P.

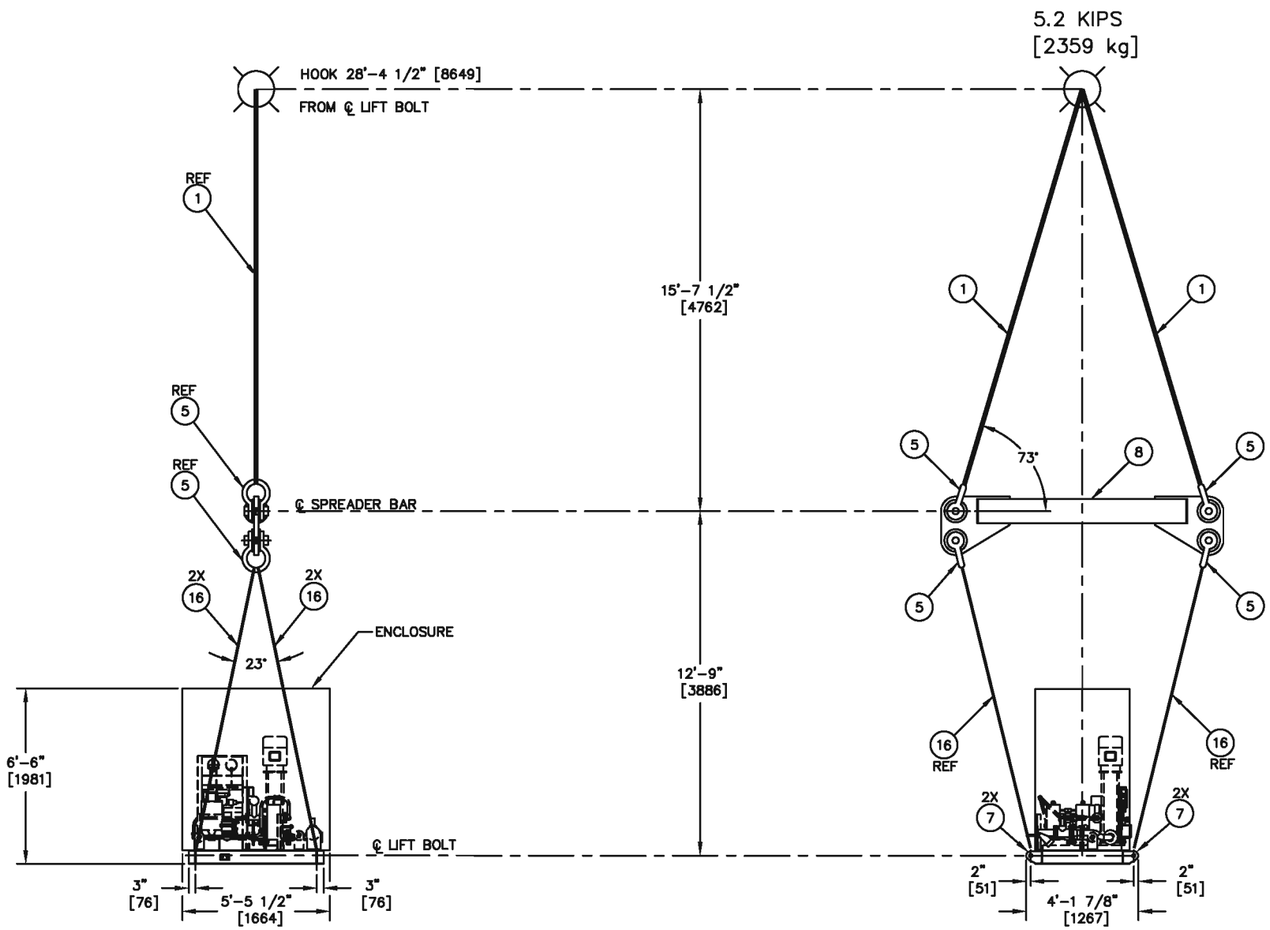
TITLE: LIFT ARRANGEMENT

DWG NO. 7253049-969225

REV. A

SCALE 1/4" = 1'-0"

SHEET 20 OF 22



FRONT VIEW

RIGHT SIDE VIEW

SPRINT SKID

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NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: LIFT ARRANGEMENT

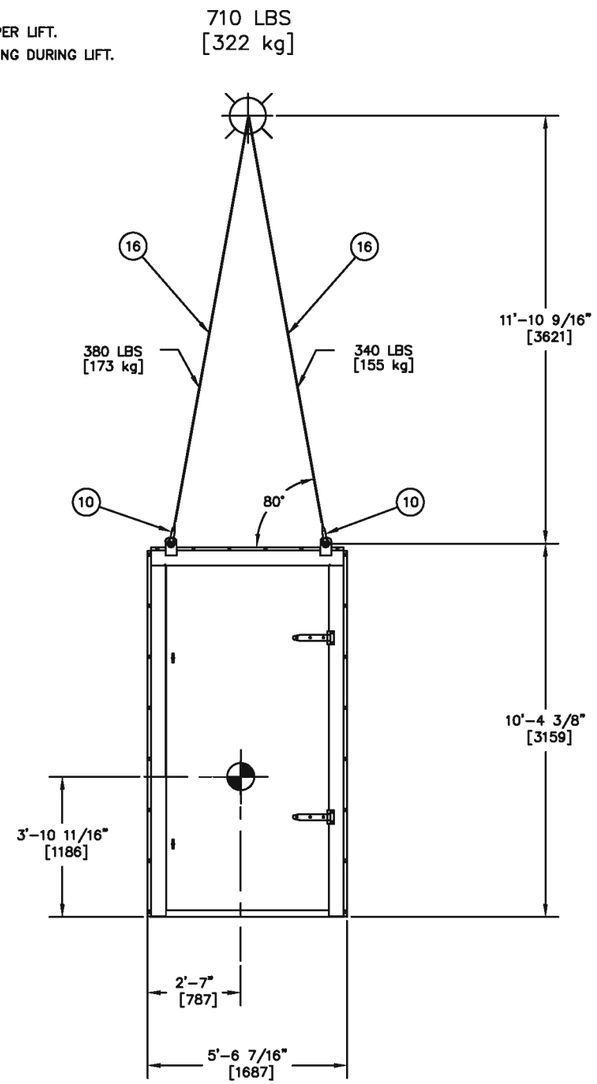
DWG NO. 7253049-969225

REV. A

SCALE 3/8" = 1'-0"

SHEET 21 OF 22

NOTE:
UTILIZE TWO (2) LIFTING SLINGS PER LIFT.
SECURE DOOR TO PREVENT OPENING DURING LIFT.



FRONT VIEW

TURBINE GAUGE PANEL DOOR

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

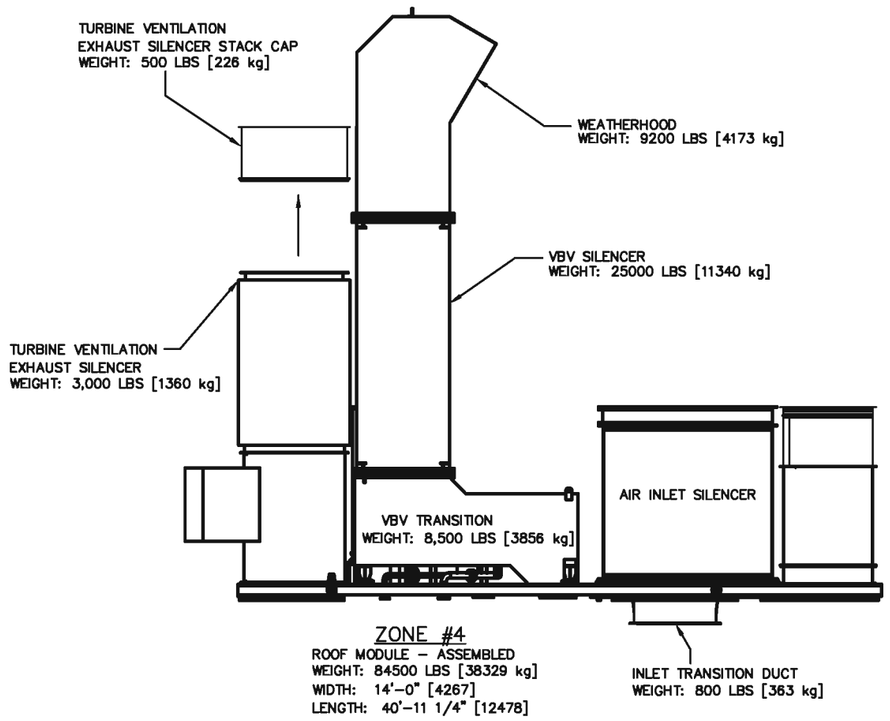
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GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

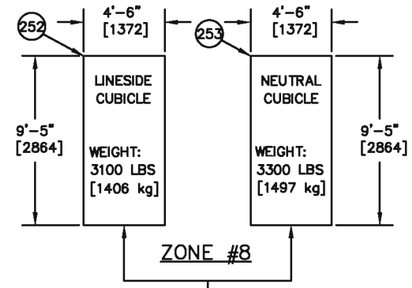
TITLE
LIFT ARRANGEMENT

DWG NO. 7253049-969225
REV. A

SCALE 1/2" = 1'-0"
SHEET 22 OF 22



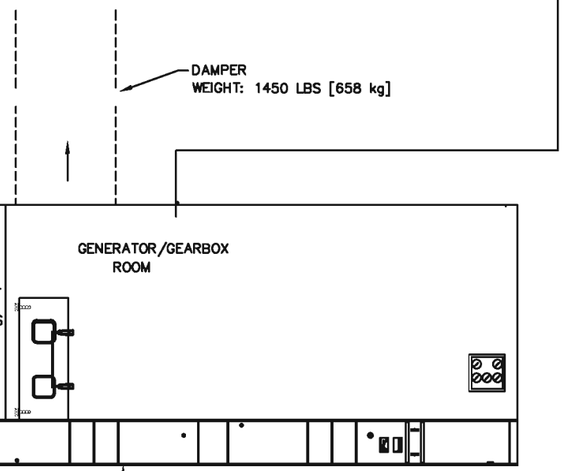
ZONE #4
ROOF MODULE – ASSEMBLED
WEIGHT: 84500 LBS [38329 kg]
WIDTH: 14'–0" [4267]
LENGTH: 40'–11 1/4" [12478]

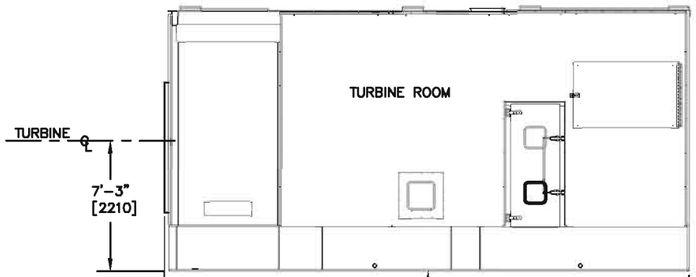


ZONE #8

GENERATOR EXHAUST SILENCER
WEIGHT: 6600 LBS [2994 kg]

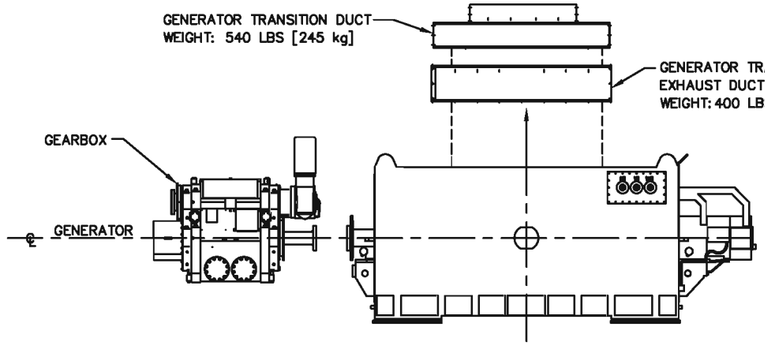
ZONE #3





ZONE #1
MAIN UNIT
WEIGHT: 100,000 LBS [45359 kg]
WIDTH: 13'–6" [4115]
HEIGHT: 14'–5 3/8" [4404]
LENGTH: 29'–1 5/8" [8880]
29'–1 3/4"
[8882]

ZONE #2
GENERATOR/GEARBOX ROOM SKID (WITHOUT GENERATOR)
WEIGHT: 123,000 LBS [55792 kg]
WIDTH: 13'–6" [4115]
HEIGHT: 14'–5 3/8" [4404]
LENGTH: 35'–8" [10871]



BRUSH GENERATOR
LENGTH: 22'–8 1/2" [6920]
WIDTH: 10'–8 3/4" [3270]
HEIGHT: 9'–1 7/8" [2790]
WEIGHT: 160,717 LBS [72900 kg]

NOTES:

1. ALL QUANTITIES SHOWN ON THE FOLLOWING SHEETS ARE PER UNIT.
2. UNLESS OTHERWISE NOTED,
   ALL BOLTS SHALL BE ASTM A325 (TYPE 1),
   ALL STUDS SHALL BE ASTM A193 GRADE B7,
   ALL HEX NUTS SHALL BE ASTM A563 GRADE C3 OR ASTM A194 GRADE 2H FOR A325 BOLTS.
   ALL PLAIN WASHERS SHALL BE ASTM F436 (HARDENED STEEL FOR A325 BOLTS),
   ALL LOCK WASHERS SHALL BE ASME B 18.21.1
3. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
4. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
5. DRAWING NUMBERS IN { } ARE GIVEN FOR REFERENCE ONLY. HARDWARE ARE REFERENCED FROM THIS DRAWING.

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TOLERANCES
DECIMALS: .XX ± .03, .XXX ± .010
FRACTIONAL: ±1/8"
ANGULAR: ±1°

NEXT ASSY.

UNIT TYPE: LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

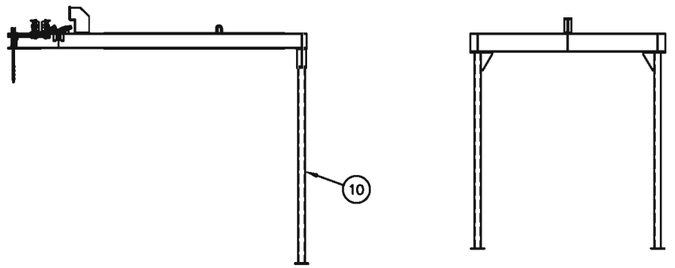
TITLE: SHIPPING DATA

DWG NO.: 7253049–969226

REV.: A

SCALE 1/4" = 1'–0"

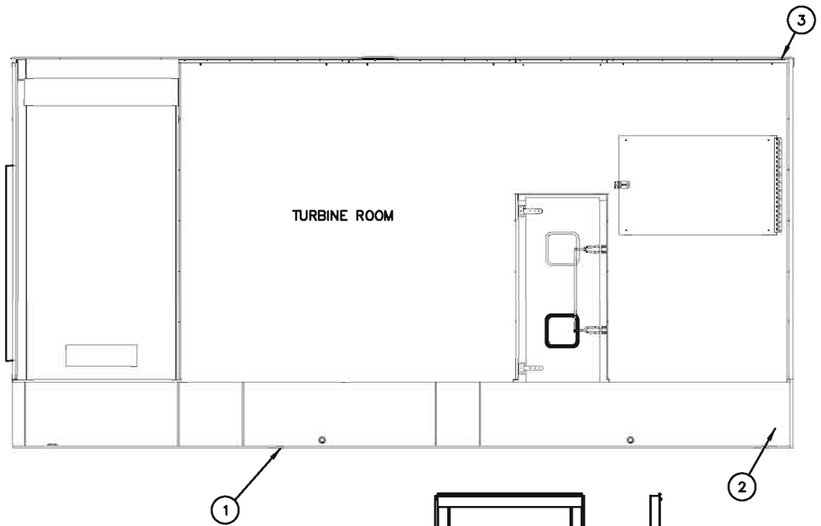
SHEET 1 OF 25

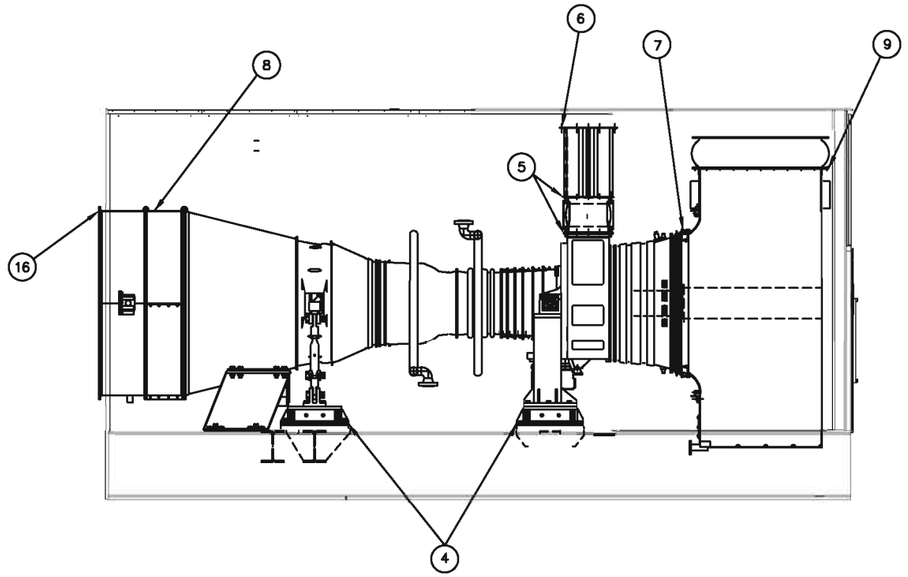


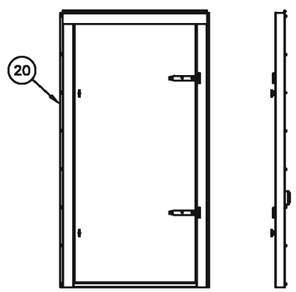
ENGINE HOIST EXTERIOR RAIL ASSEMBLY



ENGINE LIFT FIXTURE

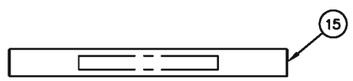






TURBINE GAUGE PANEL ENCLOSURE

ZONE #1
TURBINE ROOM



AXIAL ALIGNMENT TOOL
SCALE 6:1



ENGINE/GENERATOR ALIGNMENT TOOL

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NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SHIPPING DATA

DWG NO. 7253049-969226
REV. A
SCALE 3/8" = 1'-0"
SHEET 2 OF 25

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. FOR ANTI-SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER-SEEZ® PURE NICKEL SPECIAL 2400 °F (CAT. NO. NSBT-8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

TURBINE ROOM – ZONE #1

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	WASHERS QTY REQ'D	WASHERS QTY SHIP	WASHERS MATERIAL/SPECIFICATION
	1	SHEAR LUG (8 REQUIRED PER UNIT)	287728 969224	48	54	7/8"-9NC X 10 1/2" LG, HEX HD, ASTM A490 TYPE 3	48	54	7/8"-9NC, HEAVY HEX, ASTM A563-DH3				96	106	7/8" FLAT, ASTM F436 TYPE 3	48	54	LOAD INDICATING 7/8", ASTM F959 TYPE 490
				16	19	7/8"-9NC X 11 1/2" LG, HEX HD, ASTM A490 TYPE 3	16	19	7/8"-9NC, HEAVY HEX, ASTM A563-DH3				32	36	7/8" FLAT, ASTM F436 TYPE 3	16	19	LOAD INDICATING 7/8", ASTM F959 TYPE 490
	2	MAIN BASE SPLIT	868652	8	10	1 1/2"-6UNC X 5" HVY HEX, ASTM 490 TYPE 3	8	10	1 1/2"-6UNC, HVY HEX, ASTM A563-DH3									
	3	ROOF/INTERIOR WALL SPLIT	868652	25	28	7/8"-9UNC X 4" HVY HEX, ASTM A325, PL	25	28	7/8"-9UNC, HVY HEX, ASTM A563-DH3	24 FT	36 FT	1/8" X 4" NEOPRENE, CLOSED CELL FOAM ADHESIVE ONE SIDE	50	55	WASHER FLAT 7/8" CARBON STEEL	25	28	WASHER LOCK 7/8" HELICAL CARBON STEEL
	4	SHIM TEMP, REAR ISOLATE, TURB MT	570664															
		SHIM TEMP, REAR ISOLATE, TURB MT	570665															
		SHIM TEMP, REAR ISOLATE, TURB MT	570666															
		SHIM TEMP, REAR ISOLATE, TURB MT	570667															
		SHIM TEMP, FRONT ISOLATE, TURB MT	570668															
		SHIM TEMP, FRONT ISOLATE, TURB MT	570669															
		SHIM TEMP, FRONT ISOLATE, TURB MT	570670															
		SHIM TEMP, FRONT ISOLATE, TURB MT	570671															
	5	VBV DUCT EXPANSION JOINT TO GE ENGINE AND TO VBV INTERNAL DISCHARGE DUCT	747104	64	70	1/2"-20UNF X 1 1/2" LG, HEX, FLANGED PLATED	64	70	1/2"-20UNF, HEX FLG CAP SCREW, PLATED, (BOWMA-GRIP)	20 FT	23 FT	1/8" X 1" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE						
	6	VBV INTERNAL DISCHARGE DUCT TO TURBINE ENCLOSURE ROOF	747104	42	46	1/2" 13NC X 1 1/2" HX HD, GR 5, PLATED				20 FT	23 FT	1/8" X 1" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	42	46	1/2" FLAT, GR 5, PLATED WIDE	42	46	1/2" LOCK, GR 5, PLATED HELICAL
(SEE NOTE 3)	7	TURBINE INLET DUCT ASSEMBLY (INNER & OUTER BOOTS)	868613	92	100	1/4"-28UNF-2A X 1 1/4" LG., ASTM A286, MS9490-18, SS BOLT	92	100	1/4"-28UNF-2B, LOCK NUT 347SS SILVER PLATED									
(SEE NOTE 3)	8	ASSY EXHAUST DIFFUSER TO GAS TURBINE, PISTON RING SEAL FAB DETAILS, FLASHING, EXHAUST DUCT	701003	65	72	1/4"-28UNF X 1 3/4", HEX HD, (MS9490-26)	65	72	1/4"-28NF, HEX FLEXLOC, ASTM A194 GR 8C				65	72	1/4" CIRCULAR, TYPE B, NARROW SERIES, 18-8 SS			
			288890	48	56	1/4"-20UNC X 1", HEX HD, 316 SS	48	56	1/4"UNC, HEX FLEXLOC, 316 SS			ROPE SEAL, EXHAUST, 1 1/8 X 23FT (4900159-23)				48	56	1/4" HELICAL, REGULAR, 18-8 SS
(SEE NOTE 3)	9	INLET VOLUTE EXPANSION JOINT TO ENGINE	747025	64	70	1/2"-13NC X 1 1/2" LG, HEX HD, SS	64	70	1/2"-13NC, HEX, 18-8 SS	34 FT	40 FT	1/8" X 3" NEOPRENE CLOSED CELL FOAM, ADHESIVE ONE SIDE	128	140	1/2" FLAT, 18-8 SS	64	70	1/2" LOCK, 304 SS
	10	TURBINE REMOVAL CRANE ASSEMBLY	397A1118P0001	6	7	3/4"-10UNC X 8 1/2" LG, HEX HD, GR 8, PLATED	6	7	3/4"-10UNC, HEX, GR 8, PLATED									
(SEE NOTE 2)	11	TURBINE VGV PUMP FILTER ELEMENT, AIRCRAFT POROUS MEDIA P/N: AC-B244F-2440Y1 (QTY: ONE PER UNIT)	696244															
	12	ENGINE LIFT FIXTURE	288870															
(SEE NOTE 2)	13	BALL VALVE 3 INCH SCHEDULE 40 {382A7191P0001} BUTTWELD FULLPORT	969260															

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE SHIPPING DATA

DWG NO. 7253049-969226

REV. A

SCALE NONE

SHEET 3 OF 25

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TURBINE ROOM – ZONE #1

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	WASHERS QTY REQ'D	WASHERS QTY SHIP	WASHERS MATERIAL/SPECIFICATION
14	ENG/GEN ALIGNMENT TOOL	281886															
15	AXIAL ALIGNMENT TOOL	495684															
16	ASSEMBLY EXHAUST, TURBINE UNIVERSAL	701003	8	10	1/2"-13UNC X 6", JACK SCREW, SQ HD												
			8	10	1 1/8"-7UNC X 4", HEX HD, GR 8, BLK	8	10	1 1/8"-7UNC, HEX, GR 8, BLK				16	18	1 1/8" CIRCULAR, ASTM F436, TYPE 1, PL	8	10	1 1/8" HELICAL, EXTRA DUTY, PL
			4	5	1"-12UNF X 4 1/2", HEX HD, GR 8, PL	4	5	1"-12UNF, HEX, GR 8, PL									
	FAB DTL, JACKING PAD TURBINE EXHAUST	398362	4	5	3/8"-16UNC X 1 1/2", HEX HD, GR 5, PL	4	5	3/8"-16UNC, HEX, GR 5, PL				4	5	3/8" CIRCULAR, TYPE B, NARROW SERIES, PL			
(SEE NOTE 2) 17	EXTERNAL GAS FUEL VENT VALVE, 2-INCH SCH40S GE P/N: {393A3955P0001}	969260															
(SEE NOTE 2) 18	EXTERNAL GAS FUEL SHUT-OFF VALVE, 3-INCH SCH40S GE P/N: {393A3954P0001}	969260															
(SEE NOTE 2) 19	EXTERNAL GAS FUEL MANIFOLD	868739															
20	TURBINE INSTRUMENT PANEL DOOR	724768	16	18	3/8"-16NC X 1" LG GR 5, PLATED	16	18	3/8"-16NC, HEX, GR 5, PLATED				16	18	3/8" FLAT, GR 5, PLATED	16	18	3/8 LOCK, GR 5, PLATED
			6	10	1/4"-20NC X 3/4", SELF TAPPING SEAL ZINC PLATED												

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

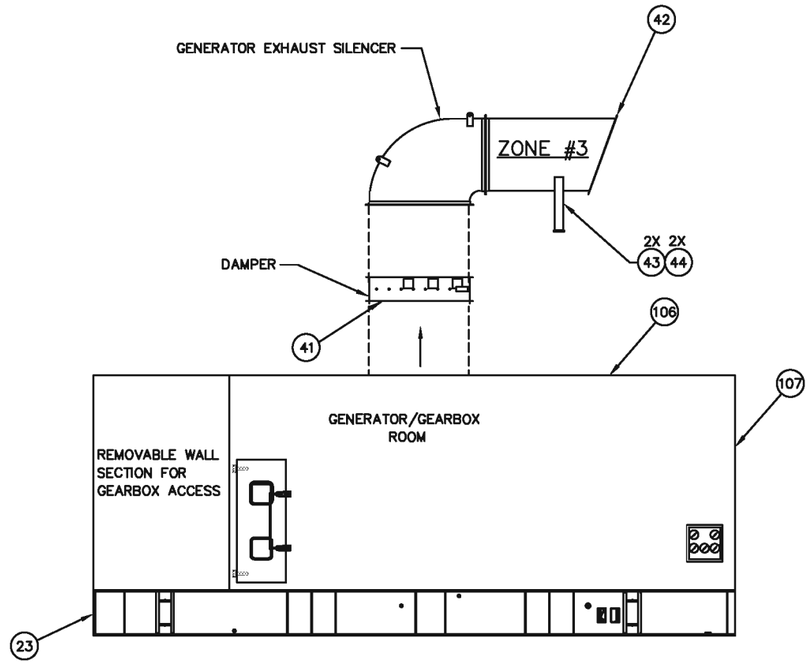
ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

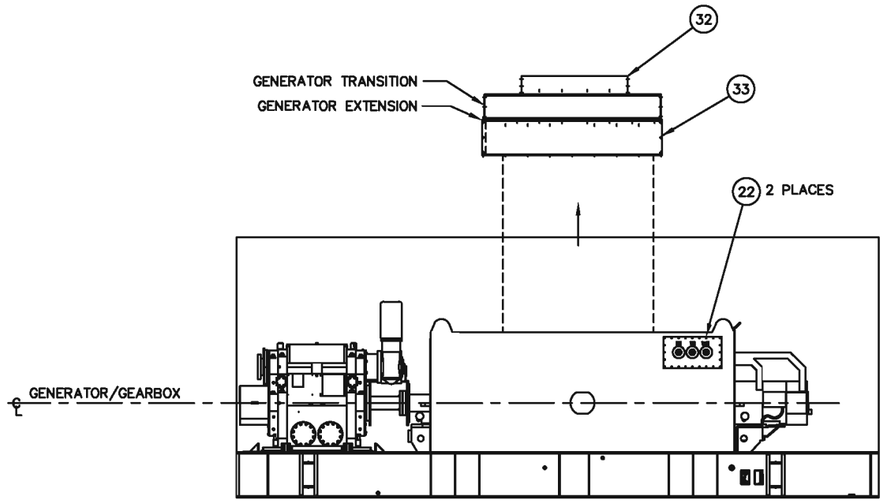
TITLE: SHIPPING DATA

DWG NO. 7253049-969226 REV. A

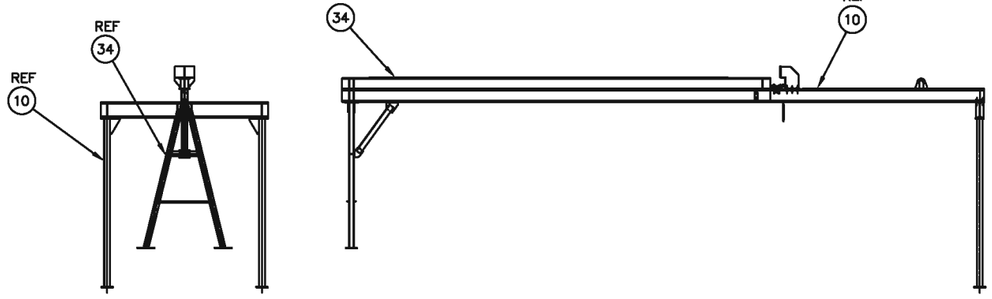
SCALE NONE SHEET 4 OF 25



ZONE #2
GENERATOR EXHAUST



ZONE #2
GENERATOR UNIT
(ENCLOSURE WALLS AND ROOF
ARE NOT SHOWN FOR CLARITY)



ZONE #2
GEARBOX LIFTING FRAME

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REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SHIPPING DATA

DWG NO. 7253049-969226

REV. A

SCALE 1/4" = 1'-0"

SHEET 5 OF 25

GENERATOR ROOM, BRUSH – ZONE #2

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	21	BRUSH GENERATOR HARDWARE FROM GROUT DETAIL	701802															
				16	18	1/2"–13NC X 3 1/4" LG, HEX HD, ASTM A325. PLATED												
	22	BUS DUCTING, LINE SIDE AND NEUTRAL CUBICLES	869219	16	18	3/8"–18UNC X 1" LG, HEX HD, GR 5, PLATED	16	18	3/8" HEAVY HEX 16NC 316SS				32	36	3/8" FLAT, NARROW B 316SS	16	18	3/8" LOCK, HELICAL 316SS
	23	MAIN BASE SPLIT BASE DOWEL PIN (2 PER UNIT)	868652 570657	8	10	1 1/2"–6UNC X 5" LG, A490, TYPE 3	8	10	1 1/2"–6UNC, A563–DH3, PLAIN									
	24 THRU 30	INTENTIONALLY LEFT BLANK																
(SEE NOTE 2)	31	GEN JACKING OIL FILTER ELEMENT DONALDSON–P/N P16–7185 (QTY: 4 PER UNIT)	969248															
	32	GENERATOR TRANSITION THROAT DUCTING TO ROOF (NEW BRUSH)	868504 {868505}	68	76	3/8"–16UNC X 1" LG, HEX HD, GR 5, PLATED							136	152	3/8" FLAT, GR 5, PLATED WIDE STANDARD	68	76	3/8" LOCK, GR 5, PLATED HELICAL
	33	GENERATOR TRANSITION THROAT DUCTING TO GENERATOR (NEW BRUSH)	701738 {868505}	36	40	M12 X 25MM, HEX HD, A4–80							36	40	M12 FLAT, GR 8.8, PLATED	36	40	M12 LOCK, GR 8.8, PLATED
	34	4 1/2 TON MONORAIL, 26 FT–6 3/4 INCH LG, RC 9000 LBS	398A4378P0001															
(SEE NOTE 2)	35	FAB DTL GENERATOR SHIM (QTY=4)	570646															
(SEE NOTE 2)	36	FAB DTL GENERATOR SHIM (QTY=4)	570647															
(SEE NOTE 2)	37	SHIM, GEARBOX, LM6000 (QTY=4)	570648															
(SEE NOTE 2)	38	SHIM, GEARBOX, LM6000 (QTY=4)	570649															
(SEE NOTE 2)	39	SHIM, GEARBOX, LM6000 (QTY=4)	570650															
	106	GENERATOR REMOVABLE ROOF GASKET								1	1	NEOPRENE, 1/2" THICK X 4 1/2" WIDE						
	107	GENERATOR END WALL GASKET								1	1	GASKET, WEATHERSTRIP, 1/8" X 1", NEOPRENE FOAM						

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 °F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

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THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 6 OF 25

50/60HZ GENERATOR ROOM, BRUSH LH WINTERIZED– ZONE #3

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	MISCELLANEOUS QTY REQ'D	MISCELLANEOUS QTY SHIP	MISCELLANEOUS MATERIAL/SPECIFICATION	BOX NO.
(SEE NOTE 2)	40	FABRICATION DETAIL BRUSH GENERATOR LH SPOOL 2	{868305} 868413 (2 PER UNIT)	8	10	M16 X 40MM LG				1	2	GASKET, FLG, 4"–150# RF, SWOR, 304 SS										
		FABRICATION DETAIL BRUSH GENERATOR SPOOL 1	868393 (2 PER UNIT)			HARDWARE SUPPLIED WITH GEARBOX																
		HOSE ASSEMBLY GLO SUPPLY TO GEARBOX	398074	8	10	STUD, 5/8"–11NC X 3 3/4 LG, B7, PLATED	16	18	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	1	2	GASKET, FLG, 4"–150# RF, SWOR, 304 SS										
		GENERATOR ACCUMULATOR BALL VALVE	J00016	8	10	STUD, 5/8"–11NC X 3 1/4 LG, B7, PLATED	16	18	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	2	3	GASKET, FLG, 2"–150# RF, SWOR, 304 SS										
		FABRICATION DETAIL BRUSH GENERATOR ACCUMULATOR SPOOL 3	868418	8	10	STUD, 5/8"–11NC X 4 1/2 LG, B7, PLATED	16	18	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	2	3	GASKET, FLG, 4"–150# RF, SWOR, 304 SS							1	2	VALVE, CHECK, 4"–150#, F/I, SS/VITON	
		FABRICATION DETAIL BRUSH GENERATOR LH SPOOL 11	868412	4	6	STUD, 5/8"–11NC X 3 3/4 LG, B7, PLATED	8	10	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	2	3	GASKET, FLG, 2"–150# RF, SWOR, 304 SS							1	2	VALVE, CHECK, 2"–150#, F/I, SS/VITON	
				4	6	STUD, 1/2"–13NC X 3 LG, B7, PLATED	8	10	NUT, HEAVY HEX, 1/2"–13NC A194 2H, PLATED	1	2	GASKET, FLG, 1 1/2"–150# RF, SWOR, 304 SS										
		FABRICATION DETAIL BRUSH GENERATOR LH SPOOL 5	702307	16	18	STUD, 5/8"–11NC X 3 3/4 LG, B7, PLATED	32	36	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	2	3	GASKET, FLG, 6"–150# RF, SWOR, 304 SS										
		FABRICATION DETAIL BRUSH GENERATOR LH SPOOL 8	868417	4	6	STUD, 5/8"–11NC X 3 3/4 LG, B7, PLATED	8	10	NUT, HEAVY HEX, 5/8"–11NC A194 2H, PLATED	2	3	GASKET, FLG, 2"–150# RF, SWOR, 304 SS							1	2	VALVE, CHECK, 2"–150#, F/I, SS/VITON	
				4	6	STUD, 1/2"–13NC X 3 LG, B7, PLATED	8	10	NUT, HEAVY HEX, 1/2"–13NC A194 2H, PLATED	1	2	GASKET, FLG, 1 1/2"–150# RF, SWOR, 304 SS										
		FABRICATION DETAIL BRUSH GENERATOR LH SPOOL 3	868396	8	10	STUD, 3/4"–10NC X 4 LG, B7, PLATED	16	18	NUT, HEAVY HEX, 3/4"–10NC A194 2H, PLATED	2	3	GASKET, FLG, 6"–150# RF, SWOR, 304 SS										
	41	DAMPER,FIRE,115 X 67 ID,LM6000	386A6937P0001	64	70	BOLT,HEX,9/16–12UNC X 1 1/2, GRADE 5, PLATED	64	70	NUT, HEX, 9/16"–12UNC, GRADE 5, PLATED				128	140	WASHER FLAT, 9/16", NARROW SERIES, PLATED	64	70	WASHER, LOCK, 9/16", HELICAL, CARBON STEEL, PLATED				
	42	ASSEMBLY GENERATOR EXHAUST BRUSH	868505	2	3	BOLT ,HEX, 5/8"–11NC X 1 1/4, G5, PL							2	3	WASHER FLAT, 5/8", SAE, CARBON STEEL, PL	2	3	WASHER, LOCK, 5/8", HELICAL, CARBON STEEL, PLATED				
	43	VENT SILENCER FOOT PAD (QTY=2)	702094																			
	44	VENT SILENCER FOOT PAD SHIM (QTY=2)	702095																			
	45	INTENTIONALLY LEFT BLANK																				
(SEE NOTE 2)	288	ACCUMULATOR PRECHARGE KIT, 300 PSI PRESSURE GAUGE (QTY=1)	393A3792P0001																			

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

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NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

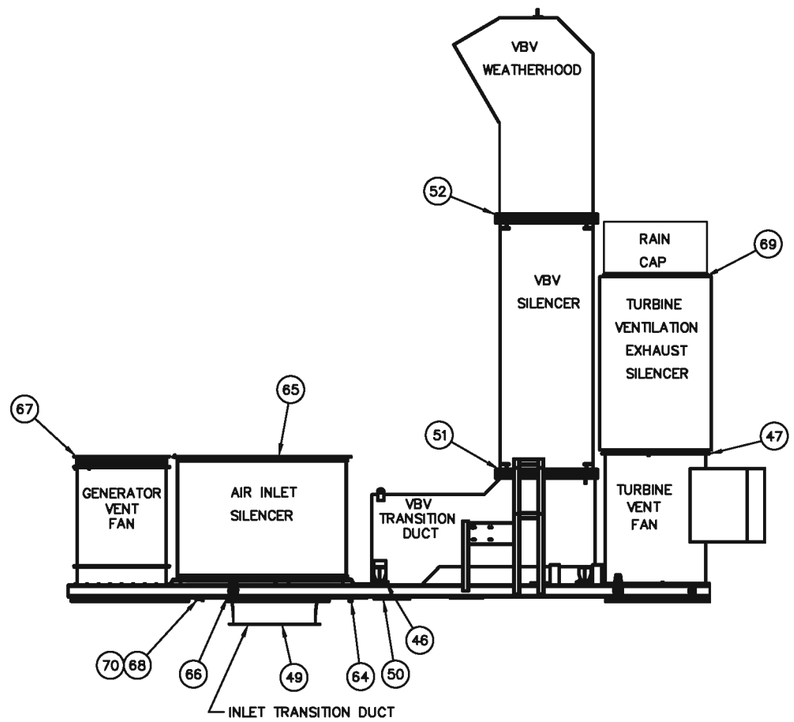
TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 7 OF 25



ZONE #4

ROOF MODULE ASSEMBLED–LEGLESS

LEGLESS GENERATOR FAN OPTIONS

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/8"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 8 OF 25

ROOF MODULE – ZONE #4 (UNIVERSAL)

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
	46	VBV SUPPORT SHIM PACK	724707	16	18	3/4"–10UNC X 3" LG, HEX HD, ASTM A325, PLATED	16	18	3/4"–10UNC, HVY HEX, ASTM A194, GR 2H, PLATED			ADHESIVE ONE SIDE	32	36	3/4" FLAT, ASTM F436, PLATED			
(SEE NOTES 3 AND 4)	47	SILENCER TO TURBINE VENTILATION FAN	868747	48	(52) REF	5/8"–11NC X 1 1/2" LG, HEX HD, GRADE 5, PLATED	48	(52) REF	5/8"–11NC, HEX, GRADE 5, PLATED	38 FT	42 FT	1/8" X 3" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	96	(107) REF	5/8" FLAT, N/S, PLATED	48	(52) REF	5/8" LOCK, HELICAL CARBON STEEL, PLATED
(SEE NOTE 2)	48	AIR OIL SEPARATOR PIPING – FROM D–E SUMP VENT TO SEPARATOR	724711	8	10	5/8"–11NC X 3 1/4" LG, HEX HD, ASTM A325, PLATED	16	18	5/8"–11NC, HEX, ASTM A194, GR 2H, PLATED	2	3	2"–150# RF, 1/8" THK CG–1G, FLEXITALLIC Ⓞ						
		– FROM A+B/C SUMP VENT TO SEPARATOR	724712	8	10	5/8"–11NC X 3 3/4" LG, HEX HD, ASTM A325, PLATED	16	18	5/8"–11NC, HEX, ASTM A194, GR 2H, PLATED	2	3	3"–150# RF, 1/8" THK CG–1J, FLEXITALLIC Ⓞ						
		– A+B/C SUMP VENT HOSE TO ROOF "A9"	723239	4	6	STUD 5/8"–11NC X 3 3/4" LG, ASTM A193, GR B7, PLATED	8	10	5/8"–11NC, HVY HEX, ASTM A194, GR 2H, PLATED	1	2	3"–150# RF, 1/8" THK CG–1J FLEXITALLIC Ⓞ						
		– D/C SUMP VENT HOSE TO ROOF "A10"	398018	4	6	STUD 5/8"–11NC X 3 1/4" LG, ASTM A193, GR B7, PLATED	8	10	5/8"–11NC, HVY HEX, ASTM A194, GR 2H, PLATED	1	2	2"–150# RF, 1/8" THK CG–1G FLEXITALLIC Ⓞ						
	49	SILENCER TRANSITION DUCT TO INLET VOLUTE EXPANSION JOINT	747104	64	72	1/2"–13NC X 1 1/2" LG, GR 5, PLATED	64	72	1/2"–13NC, HEX, GR 5, PLATED	34 FT	39 FT	1/8" X 2" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	128	142	1/2" FLAT, GR 5, PLATED	64	72	1/2" LOCK, GR 5, PLATED
(SEE NOTE 4)	50	VBV TRANSITION TO MAIN UNIT	696453	42	46	5/8"–11UNC X 1 1/2" LG, HEX HD, 304 SS	42	46	5/8"–11UNC, HEX, 304 SS	17 FT	20 FT	1/8" X 3" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	84	92	5/8" FLAT, 304 SS	42	46	5/8" LOCK, 304 SS
(SEE NOTES 3 AND 4)	51	VBV SILENCER TO VBV TRANSITION	696453	38	(42) REF	1/2"–13UNC X 2" LG, HEX HD, 304 SS	38	(42) REF	1/2"–13UNC, HEX, 304 SS	26 FT	(30 FT) REF	1/8" X 3" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	76	(84) REF	1/2" FLAT, 304 SS	38	(42) REF	1/2" LOCK, 304 SS
(SEE NOTES 3 AND 4)	52	VBV RAINHOOD TO VBV SILENCER	696453	38	(42) REF	1/2"–13UNC X 2" LG, HEX HD, 304 SS	38	(42) REF	1/2"–13UNC, HEX, 304 SS	26 FT	(30 FT) REF	1/8" X 3" NEOPRENE, CLOSED CELL FOAM,	76	(84) REF	1/2" FLAT, 304 SS	38	(42) REF	1/2" LOCK, 304 SS
	53 THRU 63	INTENTIONALLY LEFT BLANK																

NOTES:

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2. ITEM IS NOT SHOWN.
3. HARDWARE FURNISHED BY SUPPLIER.
4. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000Ⓞ

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 9 OF 25

ROOF MODULE – ZONE #4

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
64	ROOF SKID TO MAIN UNIT	747701 {868747} 724713	96	110	3/4"–10NC X 3 1/4" LG, HEX HD, ASTM A490, TYPE 3	96	110	3/4"–10NC, HEX, ASTM A194–2H, PLATED				108	120	3/4" FLAT, ASTM F436, TYPE 3, 5/16" THICK			
65	PLENUM TO INLET AIR SILENCER	868747	88	100	3/4"–10NC X 2 1/4" LG, HEX HD, GRADE 5, PLATED	88	100	3/4"–10NC, HEX, GRADE 5, PLATED	46 FT	50 FT	1/8" X 3" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	176	190	3/4" LOAD INDICATING ASTM F959 TYPE 325	88	100	3/4" LOCK, CS HELICAL PLATED
(SEE NOTE 3 AND 4) 66	INLET AIR SILENCER TO SILENCER TRANSITION DUCT	696458	64	70	1/2"–13UNC X 1 1/2" LG, 304 SS	64	70	1/2"–13UNC, HEX, GR 5, PLATED	34 FT	39 FT	1/8" X 2" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	64	70	1/2" FLAT, 304 SS	64	70	1/2" LOCK, 304 SS
67	GENERATOR VENTILATION FAN TO PLENUM (QTY: 2 PER UNIT)	747714	32	36	1/2"–13UNC X 2" LG, HEX HD, GR 5, PLATED	16	20	1/2"–13UNC, HEX, GR 5, PLATED	34 FT	38 FT	1/8" X 2" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	48	55	1/2" FLAT, GR 5, PLATED	32	36	1/2" LOCK, GR 5, PLATED
68	SILENCER MOUNTING FOOT TO ROOF	747675	10	12	7/8"–9UNC X 3 1/4" LG, HEX HD, ASTM 490, TYPE 3	10	12	7/8"–9UNC, HEX, ASTM A563–DH3				10	12	7/8" FLAT, ASTM F436, TYPE 3	10	12	7/8" LOADING INDICATING ASTM F959 TYPE 490
69	TURBINE VENTILATION SILENCER TO RAIN CAP (QTY: 2 PER UNIT)	R–25766–00	8	10	1/2"–13UNC X 1 1/2" LG, HEX HD, GR 5, PLATED	8	10	1/2"–13UNC, HEAVY HEX, GR 5, PLATED	35 FT	38 FT	NEOPRENE FOAM, ADHESIVE, BACK, 1/8" THK X 3" WIDE	16	20	1/2" FLAT, GR 5, PLATED	8	10	1/2" LOCK, GR 5, PLATED
70	SILENCER MOUNTING FOOT TO SILENCER	386A7351P0001	15	18	1"–8UNC X 3" HVY HEX, ASTM A325 TYPE 3	15	18	1"–8UNC, HVY HEX, ASTM A194 GR 2H, PL				15	18	1" CIRCULAR, ASTM F436 TYPE 3	15	18	1" LOAD INDICATING ASTM F959 TYPE 490
71 THRU 105	INTENTIONALLY LEFT BLANK																

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. HARDWARE FURNISHED BY SUPPLIER.
4. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

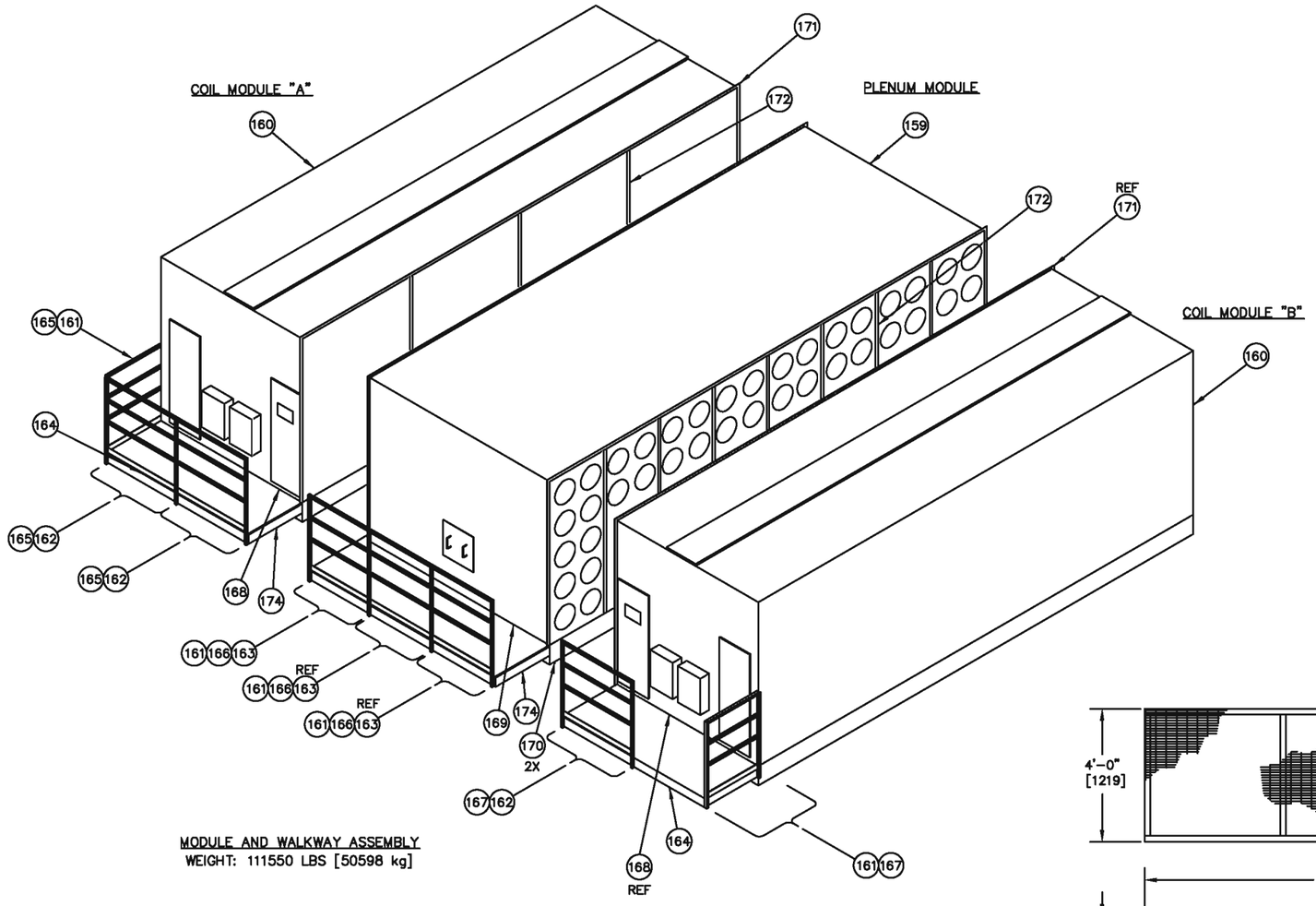
ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

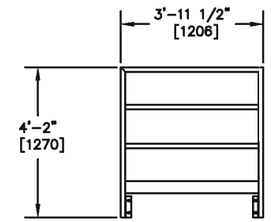
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DWG NO. 7253049–969226 REV. A

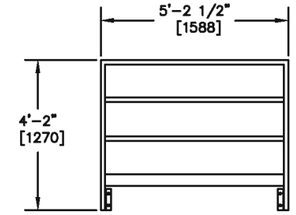
SCALE NONE SHEET 10 OF 25



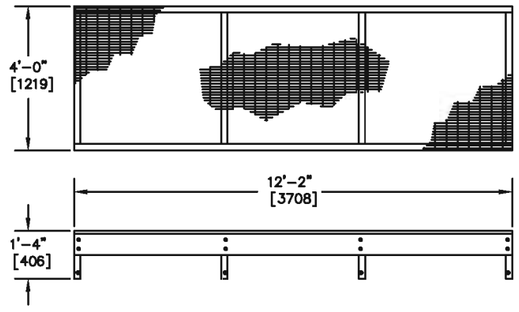
MODULE AND WALKWAY ASSEMBLY
WEIGHT: 111550 LBS [50598 kg]



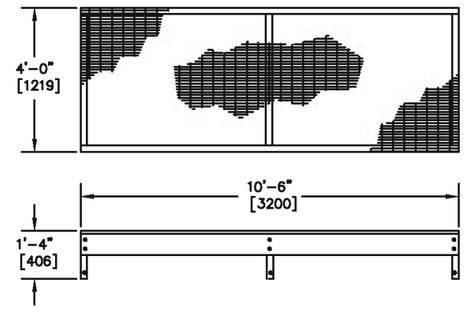
ITEM 161



ITEM 162



ITEM 163
(REF: MODULE MOUNTING HOLE PATTERN SHOWN, HANDRAIL MOUNTING ON OPPOSITE SIDE)



ITEM 164
(REF: MODULE MOUNTING HOLE PATTERN SHOWN, HANDRAIL MOUNTING ON OPPOSITE SIDE)

ZONE #5
AIR FILTER (UNIVERSAL)

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

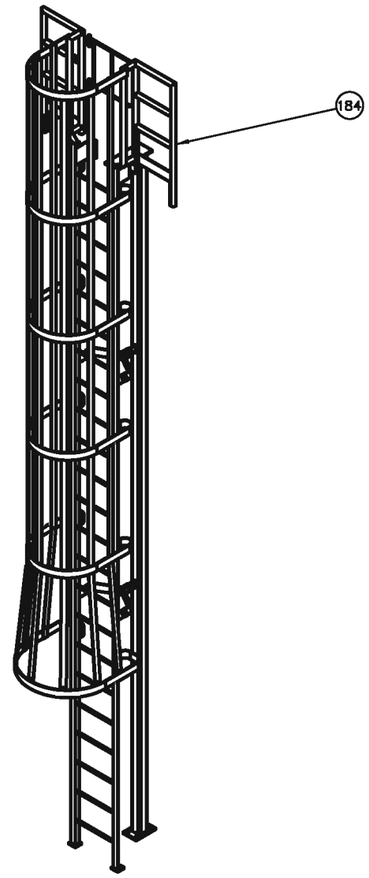
ADDL INFO
GE CLASS II (INTERNAL)

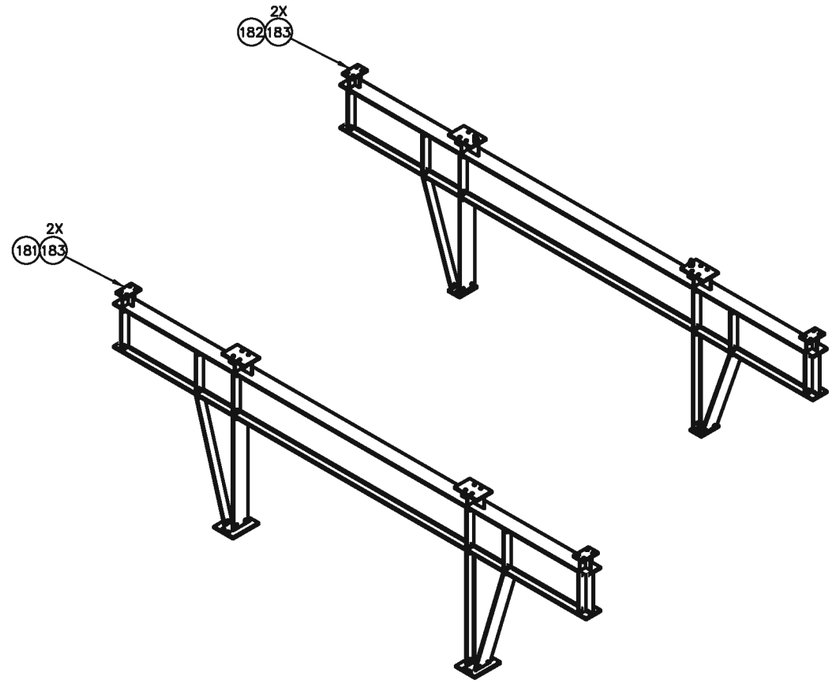
GE PACKAGED POWER, L.P.

TITLE
SHIPPING DATA

DWG NO. 7253049-969226
REV. A

SCALE 1/2" = 1'-0"
SHEET 11 OF 25





ZONE #5

AIR FILTER (LEGLESS OPTION)

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/8"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

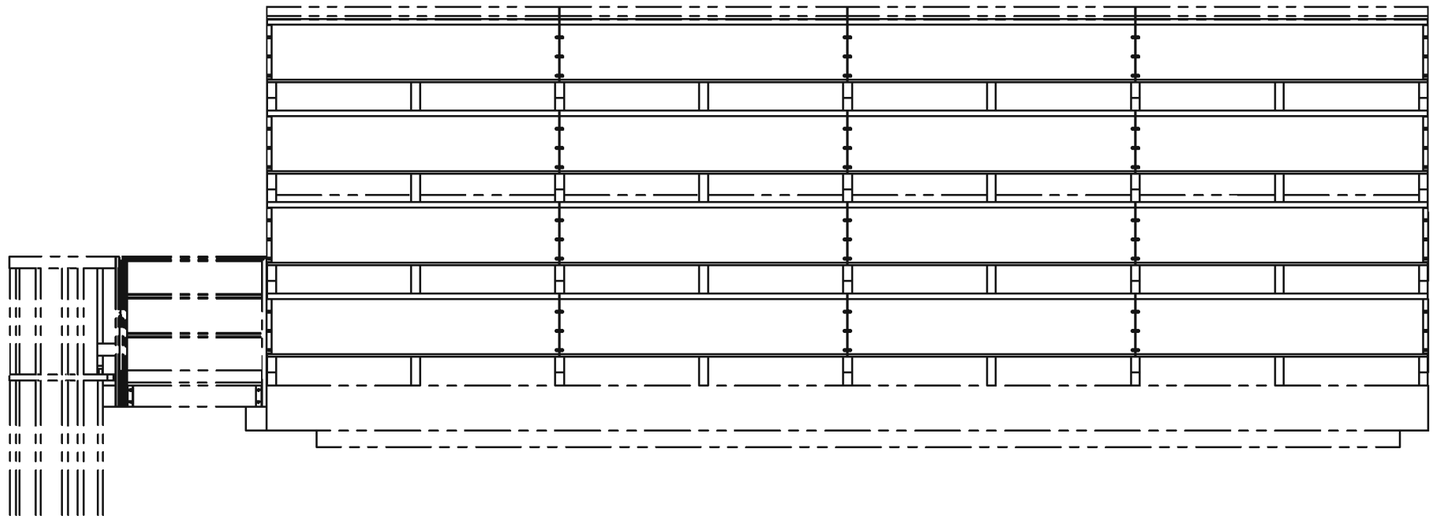
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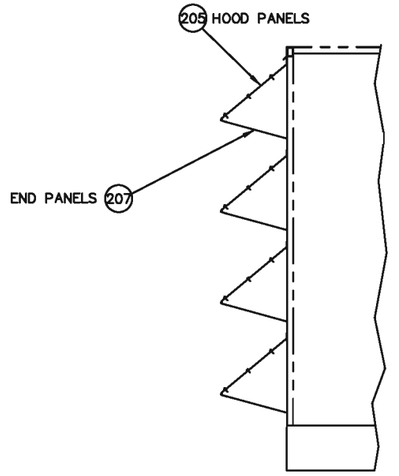
REV. A

SCALE NONE

SHEET 12 OF 25



ZONE #5
AIR FILTER
WEATHERHOOD WEIGHT: 3257 LBS [1477 kg]



END VIEW

WEATHERHOOD OPTION

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

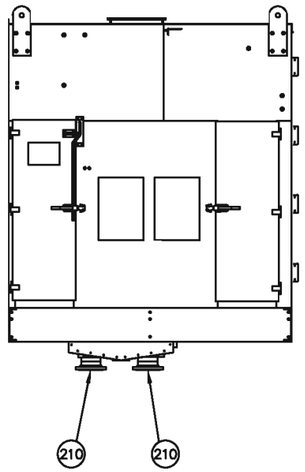
TITLE: SHIPPING DATA

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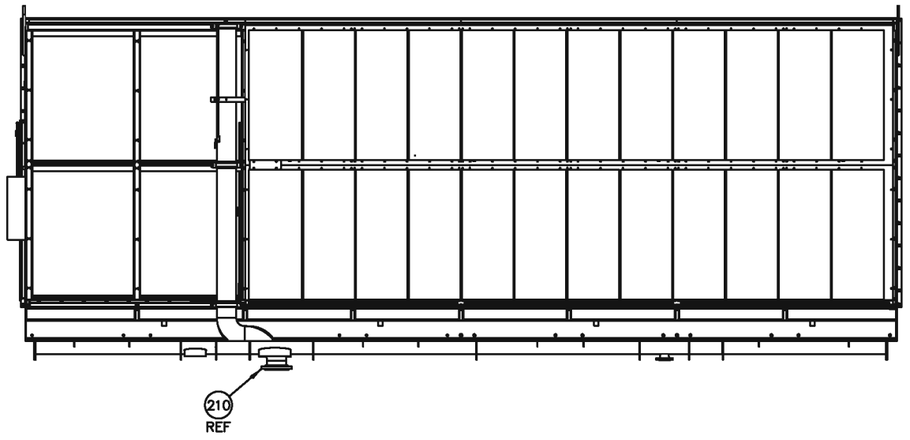
REV. A

SCALE NONE

SHEET 13 OF 25



LEFT SIDE VIEW



FRONT VIEW
12 ROW COMBUSTION COIL OPTION

HORIZONTAL CHILL COIL OPTIONS

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SHIPPING DATA

DWG NO. 7253049-969226

REV. A

SCALE 3/8" = 1'-0"

SHEET 14 OF 25

AIR FILTER – ZONE #5 (UNIVERSAL)

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	LOAD INDICATING WASHERS QTY REQ'D	LOAD INDICATING WASHERS QTY SHIP	LOAD INDICATING WASHERS MATERIAL/SPECIFICATION	BEVELED WASHERS QTY REQ'D	BEVELED WASHERS QTY SHIP	BEVELED WASHERS
159	PLENUM MODULE	748200																					
160	COIL MODULES, "A" & "B"	748200																					
161	HANDRAIL #1 (QTY=5)	733211																					
162	HANDRAIL #2 (QTY=3)	733212																					
163	PLENUM WALKWAY	733209																					
164	COIL WALKWAY (QTY=2)	733210																					
165	HANDRAILS TO COIL "A"	748207	12	13	1/2"–13UNC X 1 3/4" LG, HEX HD, ASTM A325 B7, PL	12	13	1/2"–13UNC, HVY HEX, ASTM A194 2H, PLATED				24	26	1/2" FLAT, WIDE, ASTM F436, PLATED									
166	HANDRAILS TO PLENUM WALKWAY		12	13	1/2"–13UNC X 1 3/4" LG, HEX HD, ASTM A325 B7, PL	12	13	1/2"–13UNC, HVY HEX, ASTM A194 2H, PLATED				24	26	1/2" FLAT, WIDE ASTM F436, PLATED									
167	HANDRAILS TO COIL "B" WALKWAY		8	9	1/2"–13UNC X 1 3/4" LG, HEX HD, ASTM A325 B7, PL	8	9	1/2"–13UNC, HVY HEX, ASTM A194 2H, PLATED				16	18	1/2" FLAT, WIDE ASTM F436, PLATED									
168	COIL WALKWAY TO COIL MODULE	748207	18	20	3/4"–10UNC X 2 1/2" LG, HEX HD, ASTM A325, PL	18	20	3/4"–10UNC, HVY HEX, ASTM A194 2H, PLATED				18	20	3/4" FLAT, WIDE ASTM F436, PLATED				18	20	3/4", ASTM F959 TYPE 325, PLATED	6	7	3/4", ASTM F436 TYPE 1, PLATED
169	PLENUM WALKWAY TO PLENUM MODULE		12	13	3/4"–10UNC X 2 1/2" LG, HEX HD, ASTM A325, PL	12	13	3/4"–10UNC, HVY HEX, ASTM A194 2H, PLATED				12	13	3/4" FLAT, WIDE ASTM F436, PLATED				12	13	3/4", ASTM F959 TYPE 325, PLATED	4	5	3/4", ASTM F436 TYPE 1, PLATED
170	COIL MODULE TO PLENUM MODULE BOTTOM FLANGE (QTY=2)		32	36	3/4"–10UNC X 2 1/2" LG, HEX HD, ASTM A325, PL	32	36	3/4"–10UNC, HVY HEX, ASTM A194 2H, PLATED.				64	72	3/4" FLAT, ASTM F436, PLATED				32	36	3/4", ASTM F959 TYPE 325, PLATED			
SEE NOTE 2	171 COIL MODULE FACE FLANGE		152	170	1/2"–13UNC X 1 3/4" LG, HEX HEAD, 304 SS	152	170	1/2"–13UNC, HEX, 304 SS				304	330	1/2" FLAT, 304 SS	152	170	1/2" HELICAL, REGULAR 304 SS						
	172 VERTICAL SUPPORTS, COILS "A" AND "B"		20	22	3/8"–16UNC X 6" LG, HEX HD, GR 5, PL							20	25	3/8" FLAT, GR 5, PLATED	20	25	3/8" HELICAL, GR 5, PLATED						
SEE NOTE 3	173 SEAM SEALANT								20	20	SIKAFLEX® – 221, GREY (ONLY) 250 ml												
174	PLENUM WALKWAY TO COIL WALKWAY	748207	8	9	1/2"–13UNC X 1 3/4" LG, HEX HD, ASTM A325 B7, PL	8	9	1/2"–13UNC, HVY HEX, ASTM 194 2H, PLATED				16	18	1/2" FLAT, WIDE, ASTM F436, PLATED									
175 THRU 180	INTENTIONALLY LEFT BLANK																						

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.
3. ITEM IS NOT SHOWN.

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REVISIONS

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 15 OF 25

AIR FILTER – ZONE #5 (LEGLESS OPTION)

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	LOAD INDICATING WASHERS QTY REQ'D	LOAD INDICATING WASHERS QTY SHIP	LOAD INDICATING WASHERS MATERIAL/SPECIFICATION	BEVELED WASHERS QTY REQ'D	BEVELED WASHERS QTY SHIP	BEVELED WASHERS MATERIAL/SPECIFICATION
181	LEG (TALL) SUPPORT (QTY=1) TO AIR FILTER TO GENERATOR ENCLOSURE	748200	16	18	7/8"–9NC X 3 1/2" LG, HEX HD, ASTM A490, TYPE 3	16	18	7/8"–9NC, HVY HEX, ASTM A563–DH3				16	18	7/8" FLAT ASTM F436, TYPE 3				16	18	7/8", ASTM F959 TYPE 490	16	18	7/8", ASTM F436, TYPE 3
			8	10	1"–9NC X 3" LG, HEX HD, ASTM A490, TYPE 3	8	10	1"–9NC, HVY HEX, ASTM A563–DH3				8	10	1" FLAT ASTM F436, TYPE 3				8	10	1", ASTM F959 TYPE 490	8	10	1", ASTM F436, TYPE 3
182	LEG (SHORT) SUPPORT (QTY=1) TO AIR FILTER TO ROOF SKID	748200	16	18	7/8"–9NC X 3 1/2"" LG, HEX HD, ASTM A490 TYPE 3	16	18	7/8"–9NC, HVY HEX, ASTM A563–DH3				16	18	7/8" FLAT ASTM F436, TYPE 3				16	18	7/8", ASTM F959 TYPE 490	16	18	7/8", ASTM F436, TYPE 3
			8	10	1"–9NC X 3 1/2" LG, HEX HD, ASTM A490, TYPE 3	8	10	1"–9NC, HVY HEX, ASTM A563–DH3				8	10	1" FLAT ASTM F436, TYPE 3				8	10	1", ASTM F959 TYPE 490	8	10	1", ASTM F436, TYPE 3
183	SHIM PACK (QTY=4)	287720																					
184	ACCESS LADDER TO WALKWAY	748207	8	10	1/2"–13NC X 1 3/4" LG, HEX HD, ASTM A325	8	10	1/2"–13NC, HVY HEX, ASTM A194, GR 2H, PLATED				16	20	1/2" FLAT ASTM F436, PLATED									
185 THRU 190	INTENTIONALLY LEFT BLANK																						

AIR FILTER – ZONE #5 (WEATHERHOOD OPTION)

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
205	HOOD PANELS, 8'–1 9/16" LG (QTY=16) 7'–11 7/8" LG (QTY=16)	748255	384	422	3/8"–16UNC X 1 1/2" LG, HEX HD, GR 5, PLATED	384	422	3/8"–16UNC, HEX, SAE GR 5, PLATED				384	422	3/8" FLAT, GR 5, PLATED	384	422	3/8" HELICAL, GR 5, PLATED
206	INTENTIONALLY LEFT BLANK		144	158	3/8"–16UNC X 1 1/2" LG, HEX HD, GR 5, PLATED	144	158	3/8"–16UNC, HEX, SAE GR 5, PLATED				144	158	3/8" FLAT, GR 5, PLATED	144	158	3/8" HELICAL, GR 5, PLATED
207	END PANELS, (QTY=4RH + 4LH) X 2		48	53	3/8"–16UNC X 1 1/2" LG, HEX HD, GR 5, PLATED	48	53	3/8"–16UNC, HEX, SAE GR 5, PLATED				48	53	3/8" FLAT, GR 5, PLATED	48	53	3/8" HELICAL, GR 5, PLATED

220 INTENTIONALLY LEFT BLANK

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.

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REVISIONS

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 16 OF 25

AIR FILTER – ZONE #5 (12 ROW COMBUSTION HORIZONTAL COIL OPTION)

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	CLAMPS QTY REQ'D	CLAMPS QTY SHIP	CLAMPS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
210	COMBUSTION COIL SUPPLY & RETURN PIPING (2 EACH PER UNIT)	{748388} 748202							4	8	VICTAULIC COUPLING, 8"						
	DRAIN PAN (QTY=1)	748203 748391	40	44	3/8" – 16UNC X 1 1/2, HEX BOLT, 316 SS	12	14	3/8"–16UNC, HEX, 18–8SS				44	48	3/8" CIRCULAR, 18–8SS	40	44	3/8" HELICAL, 18–8SS
			44	48	7/16" – 14UNC X 1 3/4, HEX BOLT, 316 SS	44	48	7/16"–14UNC, HEX, 316 SS				88	96	7/16" CIRCULAR, 316 SS	44	48	7/16" HELICAL, 316 SS

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. FOR ANTI–SEIZE THREAD COMPOUND, USE ONLY BOSTIK NEVER–SEEZ® PURE NICKEL SPECIAL 2400 °F (CAT. NO. NSBT–8N) OR A GE ENGINEERING APPROVED EQUIVALENT WHICH CONTAINS NO COPPER OR SULFUR.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

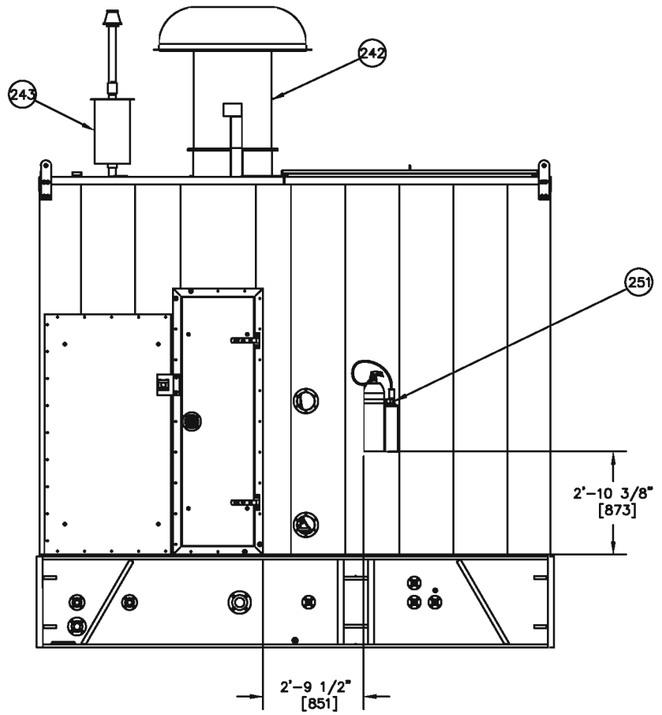
TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 17 OF 25



ZONE #6

AUXILIARY SKID

WEIGHT: 45,000 LBS [20412 kg]
WIDTH: 14'-0" [4268]
HEIGHT: 13'-3" [4039]
LENGTH: 14'-4 1/2" [4382]

AUX SKID

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049-969226

REV. A

SCALE 1/2" = 1'-0"

SHEET 18 OF 25

AUXILIARY SKID – ZONE #6

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	242	AUXILIARY SKID FAN	868001 868003	32	35	SOCKET HEAD SCREW, GR 5 3/8"–16NC X 1 1/2" LG	32	35	3/8"–16NC, HEX, GR 5 PLATED				64	70	3/8" FLAT CARBON STEEL, PLATED	32	35	3/8" LOCK, PLATED, HIGH COLLAR
	243	LUBE OIL MIST ELIMINATOR TO TURBINE LUBE OIL TANK	868017	4	5	5/8"–11NC X 3 1/2" LG STUD, ASTM A193 GR B7, PLATED	8	10	5/8"–11NC, HVY HEX ASTM A194 2H, PLATED	1	2	2"–150# RF, 1/8" THK 304 SS, CG–1G, FLEXITALLIC						
	244 THRU 250	INTENTIONALLY LEFT BLANK																
	251	FIRE EXTINGUISHER	B15V/ 143E3561L0001	2	3	1/4"–20 X 3/4", SCREW, SEAL, PL												

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. HARDWARE FURNISHED BY SUPPLIER.
3. ITEM IS NOT SHOWN.

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REVISIONS

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 19 OF 25

ELECTRICAL CUBICLES – ZONE #8

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
252	LINESIDE CUBICLE	969022	10	12	9/16"–12NC X 6 LG, HEX, A325, PL	10	12	9/16"–12NC, HEX, A194 2H,PL	18 FT	20 FT	1/8" X 2" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	20	24	9/16" FLAT, F436, PL			
253	NEUTRAL CUBICLE	969023	10	12	9/16"–12NC X 6 LG, HEX, A325, PL	10	12	9/16"–12NC, HEX, A194 2H,PL	18 FT	20 FT	1/8" X 2" NEOPRENE, CLOSED CELL FOAM, ADHESIVE ONE SIDE	20	24	9/16" FLAT, F436, PL			

LIFTING EQUIPMENT – ZONE #9

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	254	LIFT ARRANGEMENT	969225															

MISCELLANEOUS – ZONE #10

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2 AND 3)	255	FLEXIBLE COUPLING – TO TURBINE	334A5079P0001															
(SEE NOTE 2)	256	COUPLING GUARD (2 HALVES)	868498	20	22	1/2"–13UNC X 1" LG, HEX HD, GR 5, PLATED	20	22	1/2"–13UNC, NUT HEX, GR 5, PLATED				40	44	1/2" FLAT, GR5 PLATED	20	22	1/2" HELICAL, GR 5, PLATED
				22	25	1/4"–20UNC X 3/4" LG, HEX HD, GR 5, PLATED SELF–TAPPING SCREW												
	257 THRU 264	INTENTIONALLY LEFT BLANK																

GAS FUEL DUPLEX FILTER SKID – ZONE #11

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
	266	INTENTIONALLY LEFT BLANK																
(SEE NOTE 2)	284	DUPLEX GAS FUEL FILTER SKID, LM6000 PG GE P/N: {393A3960P0001}	969260	12	15	STUD, 1/2"–13NC X 2 1/2, B7, PLATED	24	26	NUT, HEAVY HEX, 1/2"–13NC, A194, 2H, PLATED	3	4	GASKET, FLG, 1"–150 RF, 304 SS, SWOR						
				8	10	STUD, 7/8"–9NC X 5 3/4, A193–B8C	16	18	NUT, HEAVY HEX, 7/8"–9NC, A194, 2H, PLATED	1	2	GASKET, FLG, 4"–600# RF, 304 SS, SWOR						
				8	10	STUD, 3/4"–10NC X 5, A193–B8C	16	18	NUT, HEAVY HEX, 3/4"–10NC, A194, 2H, PLATED	1	2	GASKET, FLG, 3"–300#/600# RF, SWOR						
	285	INTENTIONALLY LEFT BLANK																
	286	INTENTIONALLY LEFT BLANK																

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.
3. HARDWARE FURNISHED BY SUPPLIER.

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REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 20 OF 25

INTERCONNECT, UNIVERSAL

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	270	ASSEMBLY, INTERCONNECT LAYOUT MATRIX	868880									FLANGE BOLT KIT						
										4	5	1", 3000#, CODE 61, 304 SS, SKV-102SS						
										2	3	1 1/2", 3000#, CODE 61, 304 SS, SKV-106SS						
										2	3	1 1/2", 6000#, CODE 62, 304 SS, SKV-405SS						
				8	10	STUD 5/8"-11UNC X 3 1/2" LG, ASTM A193 GR B8, 304 SS	16	18	5/8"-11UNC, HEAVY HEX, ASTM A194 GR B8, 304SS	2	3	1"-600# RF, 1/8" THK, 304 SS, CG-6D						

INTERCONNECT, WATER INJECTION

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	271	ASSEMBLY, INTERCONNECT LAYOUT MATRIX	868880	8	10	STUD 3/4"-10UNC X 4 1/2" LG, ASTM A193 GR B8M, 316 SS	16	18	3/4"-10UNC, HEAVY HEX, ASTM A194 GR B8, 316 SS	2	3	1 1/2"-600# RF, 1/8" THK, 316 SS						

WATER INJECTION – DUPLEX

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	289	FABRICATION DETAIL WATER INJECTION PUMP REMOVAL BRACKET	868150	6	8	BOLT HEX, 3/8"-16NC X 1 1/2" GRADE 5, PLATED	6	8	NUT, HEX, 3/8"-16NC, CS, GRADE 5, PLATED				12	14	WASHER, FLAT, 3/8", CS, PLATED, WIDE STANDARD	6	8	WASHER, LOCK, 3/8", CS, PLATED, HELICAL

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049-969226 REV. A

SCALE NONE SHEET 21 OF 25

INTERCONNECT TURBINE LUBE OIL WITH SHELL AND TUBE

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	274	ASSEMBLY, INTERCONNECT LAYOUT MATRIX	868880							4 2	5 3	FLANGE BOLT KIT 1 1/2", 3000#, CODE 61, 304 SS, SKV-106SS 1", 3000#, CODE 61, 304 SS, SKV-102SS						
				8	10	STUD 1/2"-13UNC X 3" LG, ASTM A193 GR B8, 304 SS	16	20	1/2"-13UNC, HEAVY HEX, ASTM A194 GR B8, 304 SS	2	3	1"-150# RF, 1/8" THK, 304 SS						

INTERCONNECT AIR/OIL SEPARATOR PIPING

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION
(SEE NOTE 2)	275	ASSEMBLY, INTERCONNECT LAYOUT MATRIX	868880							4	5	FLANGE BOLT KIT 1 1/2", 3000#, CODE 61, 304 SS, SKV-106SS						
				8	10	STUD 1/2"-13UNC X 3" LG, ASTM A193 GR B8, 304 SS	16	20	1/2"-13UNC, HEAVY HEX, ASTM A194 GR B8, 304 SS	2	3	1"-150# RF, 1/8" THK, 304 SS						
				6	7	BOLT, WHIZ, 3/8"-16 UNC X 1" LG, PLATED												
				2	3	BOLT, HEX, 3/8"-16 UNC X 1 1/4" LG, GR 5, PLATED	2	3	3/8"-16NC HEX NUT, GR 5, PLATED				2	3	3/8" FLAT WIDE STANDARD PLATED	2	3	3/8" HELICAL, LOCK, GR 5, PLATED
	276 THRU 279	INTENTIONALLY LEFT BLANK																

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

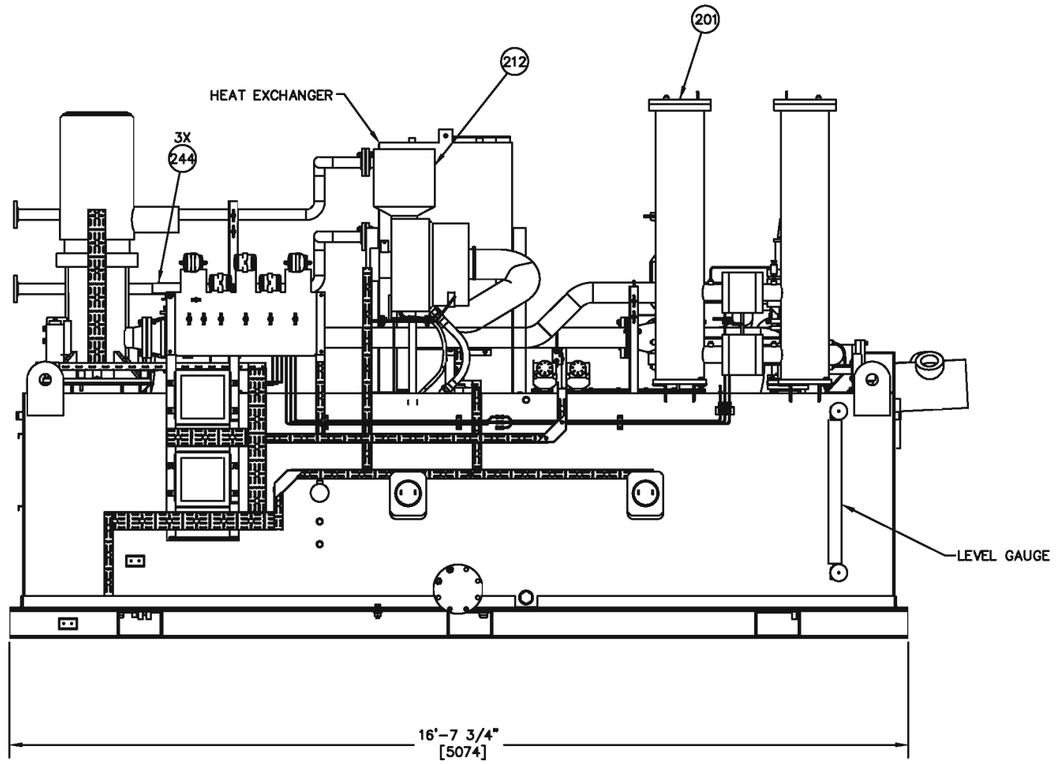
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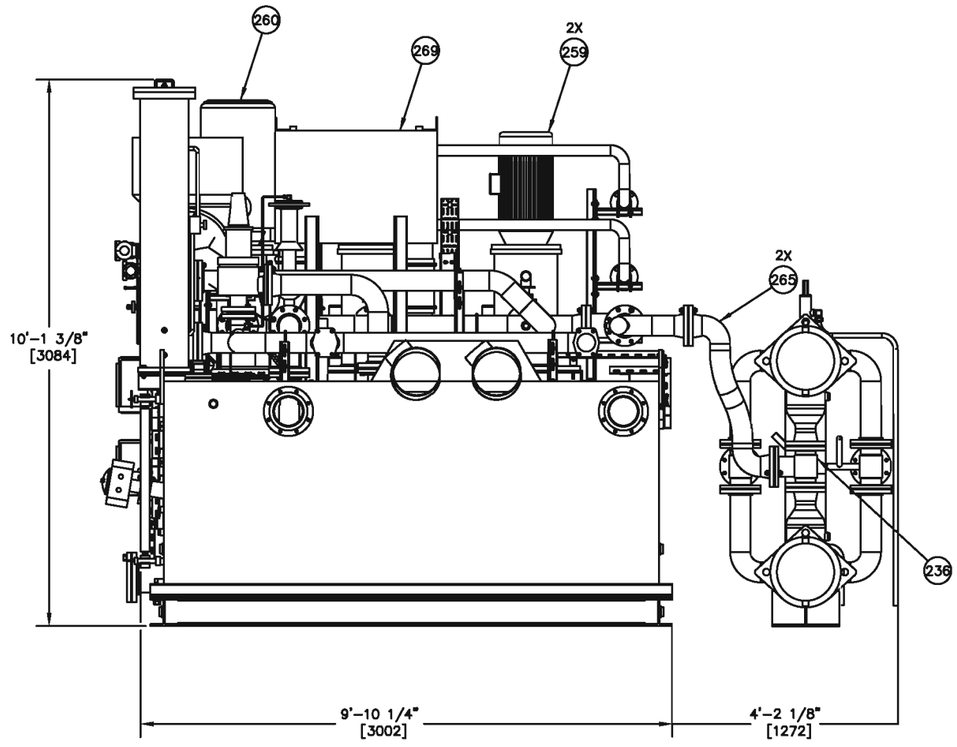
DWG NO. 7253049-969226

REV. A

SCALE NONE

SHEET 22 OF 25





ZONE #29

GENERATOR/GEARBOX LUBE OIL SKID

WEIGHT: 47,400 LBS [21,500 kg]

RESERVED

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REVISIONS

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A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/8"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE

LM6000

ADDL INFO

GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

SHIPPING DATA

DWG NO. 7253049-969226

REV. A

SCALE 3/4" = 1'-0"

SHEET 23 OF 25

GENERATOR/GEARBOX LUBE OIL SKID – ZONE #29

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	MISCELLANEOUS QTY REQ'D	MISCELLANEOUS QTY SHIP	MISCELLANEOUS MATERIAL/SPECIFICATION	BOX NO.
	GENERAL ARRANGEMENT GEN/GRBX LUBE OIL SKID	X–969221																			TBD
201	FILTER, DUPLEX, 4"–150 LB RF, 6MU PALL, P/N: HC8900FKN93Z	868343	8	10	BOLT, HEX, 1/2"–13NC X 2 1/2", GRADE 5, PLATED	8	10	NUT, HEX, 1/2"–13NC GRADE 5, PLATED				16	20	WASHER, FLAT WIDE, STANDARD, 1/2", CARBON STEEL, PLATED	8	10	WASHER, LOCK, 1/2", HELICAL CARBON STEEL, PLATED				TBD
212	COLLECTOR, MIST, OIL, CENTRIFUGAL, 50HZ W/ UV RES HOSE, DONALDSON P/N: AE–905–60HZ	868343	4	5	BOLT, HEX, 1/2"–13NC X 2 1/2", GRADE 5, PLATED	4	5	NUT, HEX, 1/2"–13NC GRADE 5, PLATED				8	10	WASHER, FLAT WIDE, STANDARD, 1/2", CARBON STEEL, PLATED	4	5	WASHER, LOCK, 1/2", HELICAL CARBON STEEL, PLATED				TBD
244	VALVE, BALL, 4"–150 LB RF, SS, FULL/PT P/N: 4INCHSF–2800–150 (QTY 3 PER UNIT)	868343	24	27	STUD 5/8"–11NC X 4 1/2" B7 PLATED	144	160	NUT, HEAVY HEX, 5/8"–11NC ASTM A194 2H, PLTD	12	15	GASKET, FLG, 4"–150# RF, 304 SS, SWOR							48	53	STUD, 5/8"–11NC X 3 3/4" B7, PLATED	TBD
259	MINERAL LUBE OIL PUMP LEISTRITZ P/N: 393A3532P0001 (QTY 2 PER UNIT) MOTOR, LM6000 PG MLO PUMP P/N: 393A3521P0001 (QTY 2 PER UNIT)	868343	24	27	BOLT, HEX, 1/2"–13NC X 3", GRADE 5, PLATED	24	27	NUT, HEX, 1/2"–13NC GRADE 5, PLATED	3	5	1/4" THICK X 3" WIDE GASKET BUNA–N	48	53	WASHER, FLAT WIDE, STANDARD, 1/2", CARBON STEEL, PLATED	24	27	WASHER, LOCK, 1/2", HELICAL CARBON STEEL, PLATED				TBD
260	MLO, DC PUMP, 93/132 W/DC MOTOR, 165 GPM, P/N: 393A3547P0001 MOTOR, LOW VOLTAGE INDUCTION, BELOW 400HP / 300kW, MLO PUMP SYSTEM (DC) P/N: 393A3615P0001	868343	12	14	BOLT, HEX, 1/2"–13NC X 3", GRADE 5, PLATED	12	14	NUT, HEX, 1/2"–13NC GRADE 5, PLATED				24	27	WASHER, FLAT WIDE, STANDARD, 1/2", CARBON STEEL, PLATED	24	27	WASHER, LOCK, 1/2", HELICAL CARBON STEEL, PLATED				TBD
(SEE NOTE 2) 280	GENERATOR LUBE OIL TANK DRAIN VALVE P/N: J00465 (QTY 1 PER UNIT)	868343	16	18	STUD,5/8–11NC X 3 1/2, ASTM A193 GRADE B7, ZINC PLATED	8	10	NUT, HEAVY HEX, 5/8–11NC, A194 2H,ZINC PLATED	2	3	GASKET, FLG TYPE, 2 IN, PRESSURE 150, RAISED AND FLAT FACE FLANGES, SPIRAL WOUND NON ASBESTOS OUTER RING 304SS										

LUBE OIL (SHELL/TUBE) COOLER – ZONE #31

ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	MISCELLANEOUS QTY REQ'D	MISCELLANEOUS QTY SHIP	MISCELLANEOUS MATERIAL/SPECIFICATION	BOX NO.
236	MINERAL LUBE OIL SHELL&TUBE COOLER, THERMAL & MECH EQUIPMENT P/N: 398A5196P0001	868343				96	106	NUT, HEAVY HEX, 5/8"–11NC, ASTM A194 GR 2H, PL	2	3	GASKET, FLG, 4"–150# RF, 304 SS, SWOR							8	10	STUD, 5/8"–11NC X 3 3/4" B7, PLATED	TBD
265	HOSE ASSEMBLY INTERCONNECT MLO SHELL & TUBE COOLER (QTY: 2)	868343																			
269	HEAT EXCH, WATER–COOLED THERMAL & MECHANICAL EQUIP P/N: 5096–W–18INCHX18INCH	868343	4	6	BOLT, HEX, 1/2"–13NC X 2", GRADE 5, PLATED	16	20	NUT, HEAVY HEX, 5/8"–11NC, ASTM A194 GR 2H, PL	2	3	GASKET, FLG, 2"–150# RF, 304 SS, SWOR	4	6	WASHER, FLAT WIDE, STD, 1/2", CARBON STEEL, PLATED	4	6	WASHER, LOCK, 1/2", HELICAL CARBON STEEL, PLATED	8	10	STUD, 5/8"–11NC X 3 1/2" B7, PLATED	TBD
(SEE NOTE 2) 282	GENERATOR LUBE OIL SHELL AND TUBE DRAIN/VENT VALVE P/N: 1/2INCH–S8000–LL (QTY 4 PER UNIT)	868343																			

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11915	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SHIPPING DATA

DWG NO. 7253049–969226 REV. A

SCALE NONE SHEET 24 OF 25

INTERCONNECT MINERAL LUBE OIL

	ITEM NO.	ITEM DESCRIPTION	REF DWG	BOLTS QTY REQ'D	BOLTS QTY SHIP	BOLTS MATERIAL/SPECIFICATION	NUTS QTY REQ'D	NUTS QTY SHIP	NUTS MATERIAL/SPECIFICATION	GASKETS QTY REQ'D	GASKETS QTY SHIP	GASKETS MATERIAL/SPECIFICATION	FLAT WASHERS QTY REQ'D	FLAT WASHERS QTY SHIP	FLAT WASHERS MATERIAL/SPECIFICATION	LOCK WASHERS QTY REQ'D	LOCK WASHERS QTY SHIP	LOCK WASHERS MATERIAL/SPECIFICATION	MISCELLANEOUS QTY REQ'D	MISCELLANEOUS QTY SHIP	MISCELLANEOUS MATERIAL/SPECIFICATION	BOX NO.
(SEE NOTE 2)	261	FABRICATION DETAIL MLO INTERCONNECT SPOOL 1	{868325} 868333	4	6	BOLT, 5/8"–11NC X 2 1/2", GR 5, PLATED										4	6	5/8", HELICAL, GR 5, PLATED				
		FABRICATION DETAIL MLO INTERCONNECT SPOOL 2 DRESSER COUPLING FOR 4" PIPE	868334 J00495 (2 PER UNIT)																			
		FABRICATION DETAIL MLO INTERCONNECT SPOOL 3	868327	4	6	BOLT, 5/8"–11NC X 2 1/2", GR 5, PLATED										4	6	5/8", HELICAL, GR 5, PLATED				
		FABRICATION DETAIL MLO INTERCONNECT SPOOL 4 DRESSER COUPLING FOR 10" PIPE	868335 (2 PER UNIT) 382A6629P000 (4 PER UNIT)																			
		FABRICATION DETAIL MLO INTERCONNECT SPOOL 5	868328	8	10	BOLT, 5/8"–11NC X 2 1/2", GR 5, PLATED				1	2	GASKET, FLG, 6"–150# RF, SWOR, 304 SS	8	10	5/8", FLAT, GR 5, PLATED	8	10	5/8", HELICAL, GR 5, PLATED				
		FABRICATION DETAIL MLO INTERCONNECT SPOOL 6 DRESSER COUPLING FOR 6" PIPE	868329 J00496 (2 PER UNIT)																			
		ASSEMBLY DETAIL MLO TUBING	868445																			

NOTES:

1. UNLESS OTHERWISE SPECIFIED, HARDWARE COATING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION TS000105.
2. ITEM IS NOT SHOWN.

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

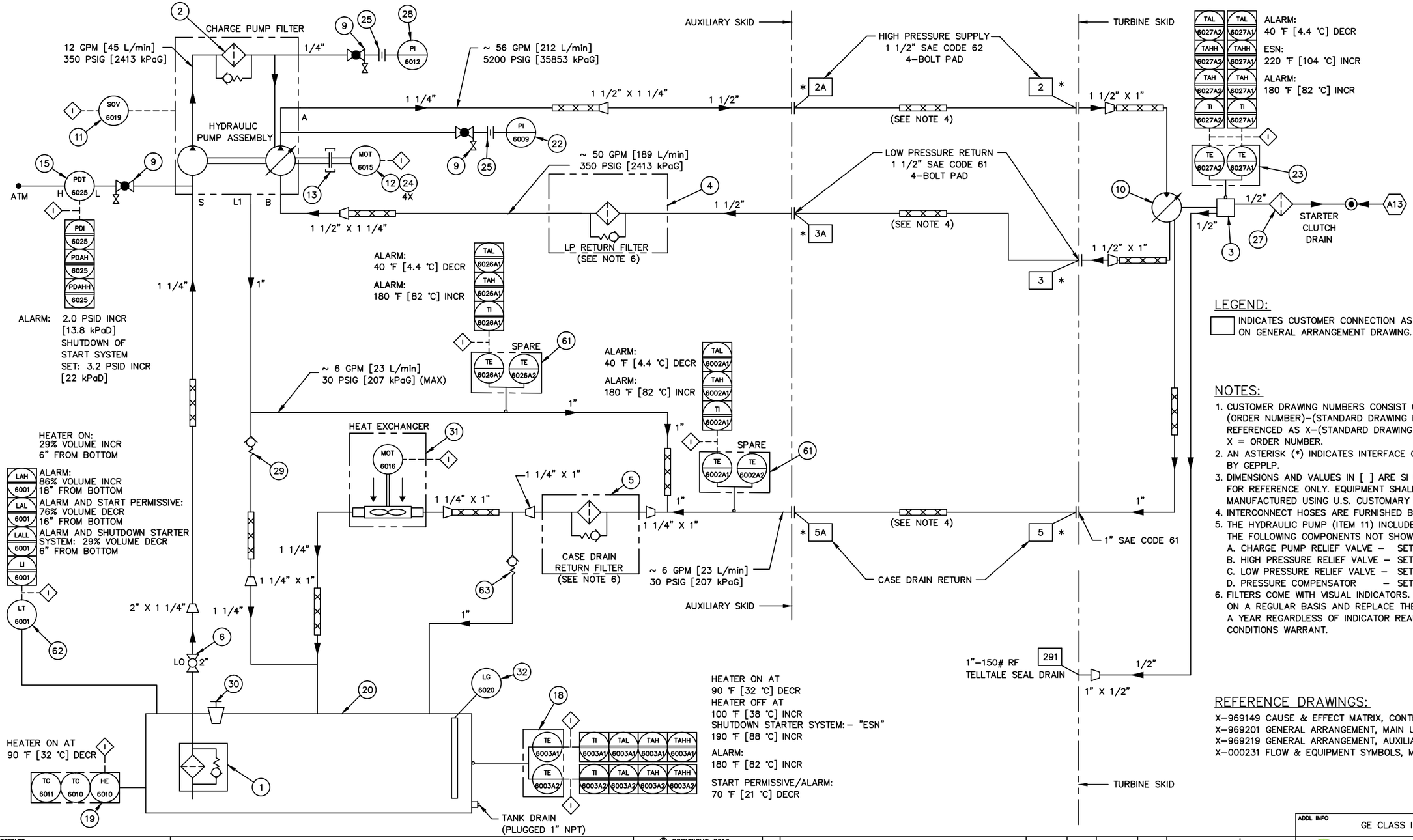
TITLE: SHIPPING DATA

DWG NO. 7253049–969226

REV. A

SCALE NONE

SHEET 25 OF 25



LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

NOTES:

1. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
2. AN ASTERISK (*) INDICATES INTERFACE CONNECTION HARDWARE BY GEPPLP.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. INTERCONNECT HOSES ARE FURNISHED BY GEPPLP.
5. THE HYDRAULIC PUMP (ITEM 11) INCLUDES VALVES AND THE FOLLOWING COMPONENTS NOT SHOWN:
   A. CHARGE PUMP RELIEF VALVE - SET 350 PSIG [2413 kPaG]
   B. HIGH PRESSURE RELIEF VALVE - SET 5700 PSIG [39300 kPaG]
   C. LOW PRESSURE RELIEF VALVE - SET 2000 PSIG [13790 kPaG]
   D. PRESSURE COMPENSATOR - SET 5200 PSIG [35853 kPaG]
6. FILTERS COME WITH VISUAL INDICATORS. CHANGE FILTER ELEMENTS ON A REGULAR BASIS AND REPLACE THEM AT LEAST ONCE A YEAR REGARDLESS OF INDICATOR READING, SOONER IF CONDITIONS WARRANT.

REFERENCE DRAWINGS:

X-969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X-969201 GENERAL ARRANGEMENT, MAIN UNIT-LH
X-969219 GENERAL ARRANGEMENT, AUXILIARY SKID
X-000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW AND INSTRUMENT DIAGRAM HYDRAULIC START SYSTEM

DWG NO. 7253049-969232

REV. A

SCALE NONE

SHEET 1 OF 3

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	HYDRAULIC PUMP SUCTION STRAINER	MARVEL 450M200	1	STRAINER, 2" FNPT, RATED 50 GPM, SS SCREEN, 200 MESH BYPASS SET @ 3 PSID [21 kPaD]
2	N/A	CHARGE PUMP FILTER ELEMENT	DONALDSON {398A4593P0001}	(1) REF	9 MICRON AT BETA = 1000 9.4" [240 MM] LENGTH, REPLACEMENT ELEMENT: P/N P165332
3	N/A	HYDRAULIC STARTER CLUTCH	HILLIARD {382A3861P0100}	1	OVERRUNNING HYDRAULIC START CLUTCH MAX CUT OUT SPEED 4500 RPM MAX OVER RUNNING SPEED 10200 RPM
4	N/A	LOW PRESSURE RETURN FILTER	DONALDSON {398A4324P0001}	1	FILTER, DUPLEX, 1 1/2" SAE 4 BOLT FLANGE,10 MICRON ELEMENT @ BETA=1000 W/25 PSID [172 kPaD] BYPASS VISUAL INTEGRAL CLOGGING INDICATOR, REPLACEMENT ELEMENT: P/N P176567
5	N/A	CASE DRAIN RETURN FILTER	DONALDSON {398A4485P0001}	1	FILTER, SIMPLEX, 1 1/4" SAE -20 STRAIGHT THREAD, 10 MICRON ELEMENT W/25 PSID [172 kPaD] BYPASS VISUAL INTEGRAL CLOGGING INDICATOR, REPLACEMENT ELEMENT: P/N P176567
6	N/A	HYDRAULIC PUMP SUPPLY SHUTOFF VALVE	WATTS {2INCH-S8000-LL}	1	BALL VALVE, 2" FNPT, SS BODY AND TRIM, REDUCED PORT, TFE SEATS, 1500 PSIG [10342 kPaG] WOG LOCKABLE HANDLE
7 & 8		INTENTIONALLY LEFT BLANK			
9	N/A	INSTRUMENT VALVE	DRAGON 1053V3	3	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
10	N/A	HYDRAULIC STARTER MOTOR ASSEMBLY	SUNDSTRAND {382A3860P0100}	1	HYDRAULIC MOTOR, VARIABLE DISPLACEMENT, 0-6.71 CID
11	SOV-6019	HYDRAULIC PUMP/SOV ACTUATED	SUNDSTRAND {382A9258P0001}	1	HYDRAULIC TRANSMISSION PUMP, 130 CC, VARIABLE DISPLACEMENT, RATED 58 GPM AT 5200 PSIG, SAE 2-BOLT THROUGH DRIVE WITH CHARGE PUMP
12	MOT-6015	HYDRAULIC STARTER MOTOR	MARATHON MOTORS {382A7311P0002}	1	ELECTRIC MOTOR, SEVERE DUTY, 200 HP 460 VAC, 3 PH, 60 HZ, TEFC-SD 449TC FRAME, 1800 RPM
13	N/A	FLEXIBLE COUPLING	LOVEJOY/CENTAFLEX {J05525}	1	COUPLING, RUBBER ELEMENT, MODEL 2, SIZE 140, BORED TO SIZE BY GEPPLP
14		INTENTIONALLY LEFT BLANK			
15	PDT-6025	CHARGE PUMP VACUUM PRESSURE DIFFERENTIAL TRANSMITTER	ROSEMOUNT {382A5655P0001}	1	PRESSURE DIFFERENTIAL TRANSMITTER, -623 TO 623 mBAR [-250 TO 250 IN H20], 316 SS ISOLATING DIAPHRAGM, 4-20 mA OUTPUT WITH HART PROTOCOL 1/4"-18 NPT PROCESS CONNECTION, 1/2"-14 NPT ELECTRICAL CONNECTION, COMBINATION OF ATEX AND CSA APPROVAL. SET AT: 4 mA = 0 PSID [0 kPaD] 20 mA = 9 PSID [62 kPaD]
16		INTENTIONALLY LEFT BLANK			
17		INTENTIONALLY LEFT BLANK			
18	TE-6003A1 TE-6003A2	RESERVOIR TEMPERATURE ELEMENT	ROSEMOUNT {J04182}	1	PLATINUM RTD, DUAL ELEMENT, 12" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/ CHAIN ATTACHED, FLAT COVER, CSA APPROVED, SUPPLIED WITH THERMOWELL
19	HE-6010 TC-6010 TC-6011	RESERVOIR HEATER AND THERMOSTAT	CHROMALOX {216A4982P0001}	1	THERMOSTATICALLY CONTROLLED HEATER, HI-LIMIT CUTOUT IN SPECIAL HOUSING 2 1/2" NPT, 24 1/2" LG, 3/2.6 KW, 15 WATTS/SQ IN, 480/400 VAC, 3 PH, T-4, 50/60 Hz RANGE 60 °F [16 °C] TO 250 °F [121 °C] SET AT 90 °F [32 °C] CSA/ATEX APPROVED, EXPLOSION PROOF
20	N/A	RESERVOIR	GEPPLP {747906}	1	TANK, 40 GALLON CAPACITY, SS CONSTRUCTION
21		INTENTIONALLY LEFT BLANK			
22	PI-6009	MAIN SYSTEM PRESSURE GAUGE	ASHCROFT {J00001}	1	PRESSURE GAUGE, 4 1/2" DIAL, 0-10000 PSIG [0-68948 KPaG] DUAL SCALE RANGE, LIQUID FILLED, PANEL MOUNTED, ALUMINUM CONSTRUCTION, 316 SS BOURDON TUBE, 1/4" NPT BACK CONNECTION
23	TE-6027A1 TE-6027A2	HYDRAULIC STARTER CLUTCH TEMPERATURE ELEMENT	BF GOODRICH AEROSPACE INC L35166P02	1	IMMERSION RTD, DUAL ELEMENT, 5/8" IMMERSION LENGTH, 100 OHM AT 0 °C, SUPPLIED WITH THERMOWELL
24	N/A	MOTOR MOUNT ISOLATOR	LORD MANUFACTURING CBA28-800	4	VIBRATION ISOLATORS, CENTER BONDED, RATED 800 LBS STATIC AXIAL LOAD
25	N/A	PRESSURE GAUGE SNUBBERS	ASHCROFT 1112SD	2	PRESSURE SNUBBER, 1/4" NPT, 303 SS HOUSING, AISI 316 SS FILTER DISC
26	N/A	INTENTIONALLY LEFT BLANK			
27	N/A	CLUTCH DRAIN RETURN STRAINER	STREAMFLO STRAINERS {377A7898P0001}	1	Y-STRAINER, 1/2" NPT, 40 MESH, SS BODY AND SCREEN WITH MAGNETS
28	PI-6012	CHARGE PUMP PRESSURE GAUGE	ASHCROFT {J00002}	1	PRESSURE GAUGE, 4 1/2" DIAL, 0-600 PSIG [0-4137 kPaG] DUAL SCALE RANGE, LIQUID FILLED, PANEL MOUNTED, ALUMINUM CONSTRUCTION, 316 SS BOURDON TUBE, 1/4" NPT BACK CONNECTION
29	N/A	PUMP CASE RELIEF VALVE	KEPNER {393A3458P0001}	1	IN-LINE RELIEF, 1" MNPT INLET AND 1" MJIC OUTLET CONNECTIONS, 316 SS, 50 PSID [345 kPaD] CRACKING PRESSURE
30	N/A	OIL TANK FILL CAP	MAGNALOY (OR EQUAL) FB-A008X	1	40 MICRON (OR BETTER) FOAM AIR BREATHER, SS CAP, 30 MESH BASKET
31	MOT-6016	COOLER	HAYDEN {398A4891P0001}	1	HEAT EXCHANGER, AIR TO OIL, TWO PASS, DUAL RATED AC MOTOR, 380V/460V, 3 HP, 50/60 HZ, 950/1140 RPM, ASME CERTIFIED
32	LG-6020	LEVEL GAUGE	GEPPLP {386A3537P0001}	1	BOROSILICATE SIGHT GLASS, 0-250 °F PREMIUM 5", THERMOMETER INCLUDED
33 THRU 60		INTENTIONALLY LEFT BLANK			

NOTE:
1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW AND INSTRUMENT DIAGRAM HYDRAULIC START SYSTEM

DWG NO. 7253049-969232

REV. A

SCALE NONE

SHEET 2 OF 3

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
61	TE-6002A1 TE-6002A2 TE-6026A1 TE-6026A2	TEMPERATURE SENSOR	ROSEMOUNT {J01068}	2	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/ CHAIN ATTACHED, FLAT COVER, CSA APPROVED, SUPPLIED WITH THERMOWELL
62	LT-6001	TANK LEVEL TRANSMITTER	ROSEMOUNT {393A3446P0001}	1	GUIDED WAVE RADAR LEVEL TRANSMITTER, 1 1/2" MNPT PROCESS CONNECTION AND 1/2"-14 NPT CONDUIT FOR ELECTRICAL CONNECTION, 316 SS COAXIAL PROBE, 2'-1" PROBE LENGTH, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVALS CE, ATEX, CSA FLAME-PROOF/EXPLOSION PROOF, METER TYPE INTEGRAL DISPLAY. SET AT: 4 mA = 0% VOLUME [0" FROM BOTTOM] 20 mA = 100% VOLUME [21" FROM BOTTOM OF TANK] END OF PROBE IS 1 1/2" FROM BOTTOM OF TANK
63	N/A	PUMP CASE RELIEF VALVE	KEPNER {382A5454P0001}	1	INLINE RELIEF/CHECK VALVE, 1" MJIC CONNECTIONS, 316 SS, 15 PSID CRACKING PRESSURE

NOTE:
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

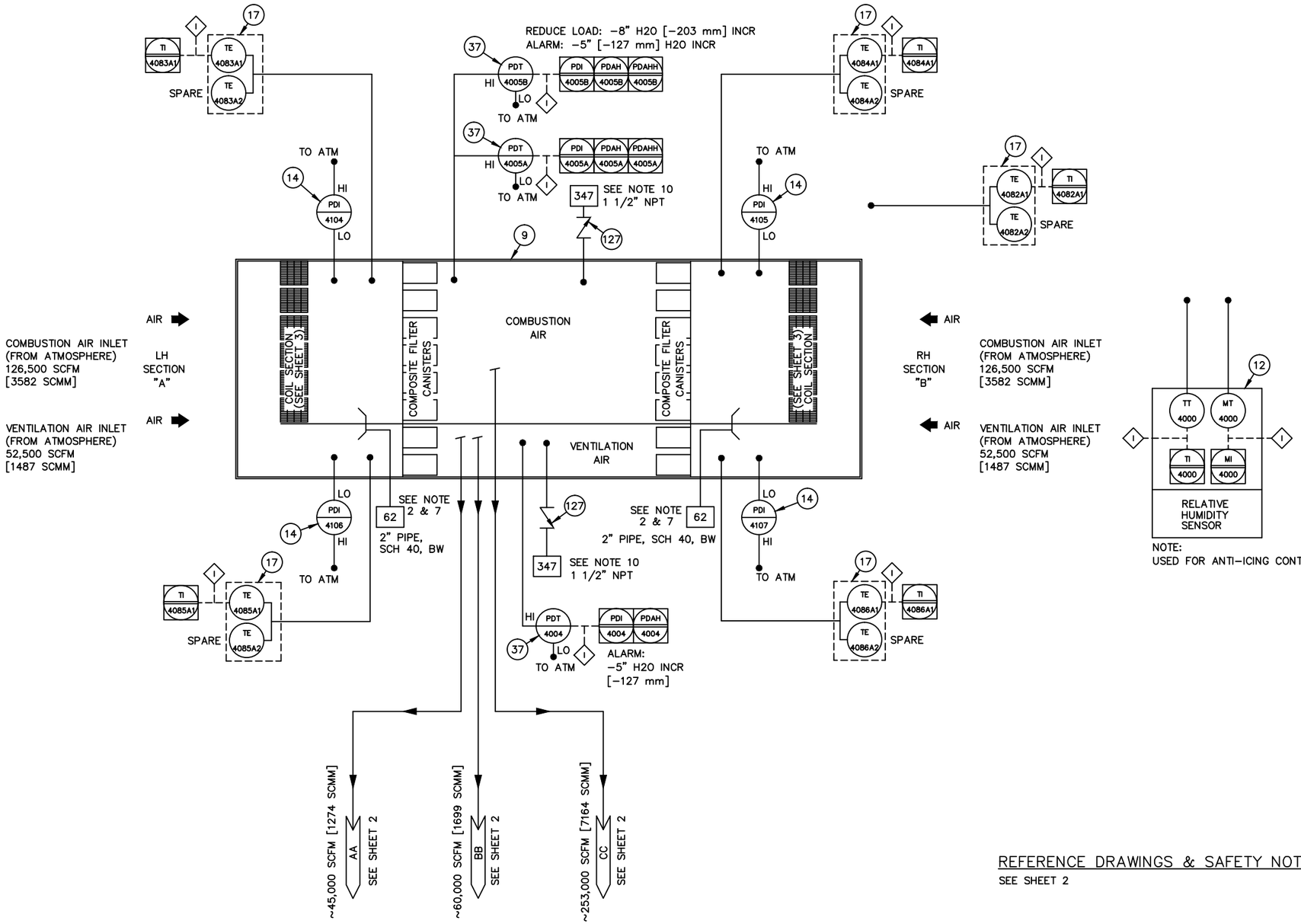
UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW AND INSTRUMENT DIAGRAM
HYDRAULIC START SYSTEM

DWG NO. 7253049-969232
REV. A
SCALE NONE
SHEET 3 OF 3



LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

DM = DECELERATION TO MINIMUM LOAD
ES = EMERGENCY SHUTDOWN MOTORING
ESN = EMERGENCY SHUTDOWN NO MOTORING
NSD = NORMAL SHUTDOWN

NOTES:

1. DAMPERS CLOSE AUTOMATICALLY WITH CO2 DISCHARGE. 85 PSI [586 kPa] PRESSURIZED AIR IS REQUIRED TO RESET THE DAMPERS.
2. ADDITIONAL CUSTOMER DRAIN CONNECTION [62] SHOWN IN GENERAL ARRANGEMENT 969204.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. GENERATOR VENT FANS ARE RATED AT 45,000 SCFM [1274 SCMM] EACH. NORMAL OPERATION REQUIRES 1 FAN RUNNING WITH 1 FAN ON STANDBY.
5. TURBINE ROOM VENT FANS ARE RATED AT 60,000 SCFM [1699 SCMM] EACH. NORMAL OPERATION REQUIRES 1 FAN RUNNING WITH 1 FAN ON STANDBY.
6. FILTER CONFIGURATION IS SHOWN SCHEMATICALLY. ACTUAL CONFIGURATION WILL DIFFER.
7. FOR AIR FILTER CUSTOMER CONNECTIONS SEE GENERAL ARRANGEMENT, AIR FILTER FOR FURTHER DETAILS.
8. TYPICAL OFF-LINE WATER WASH WILL HAVE APPROXIMATELY 100 GALLONS [378 L] OF SOLUTION DRAINING FROM CONNECTION [149] FOR TYPICAL SINGLE WASH-DOUBLE RINSE CYCLE, ACTUAL VOLUME WILL DEPEND ON CUSTOMER USAGE.
9. FIRE PROTECTION DAMPER TRIPPED BY RELEASE OF CO2. REFER TO F & ID FIRE PROTECTION SYSTEM.
10. CONNECTION [347] 1 1/2" NPT CONDENSATE DRAIN, AIR FILTER INLET PLENUM ITEM 127 TO BE INSTALLED TO PROVIDE AT LEAST 20" [508 mm] OF HEAD.
11. APPROXIMATE COMBUSTION AIR FLOW RATE AT HIGH SPEED CRANK IS 8010 SCFM.
12. THE COIL SOLUTION SHOULD HAVE AN INHIBITOR TO PREVENT CORROSION OF COPPER TUBED COILS. COILS MOP = TBD PSIG [TBD kPaG].
13. THE TOTAL QUANTITY OF WATER IN THE COILS, SUPPLY & RETURN HEADERS IS TBD GALLONS [TBD L]. THIS INCLUDES BOTH SIDES A & B.
14. IF FREEZING TEMPERATURES ARE ANTICIPATED (UNLESS PROPER GLYCOL SOLUTION IS USED) THE WATER COIL SYSTEM MUST BE FULLY DRAINED.
15. IF UNEVEN TEMPERATURE DISTRIBUTION ACROSS THE COIL FACE IS NOTED, VENT TRAPPED AIR FROM COILS. 1/2" NPT PETCOCKS ARE PROVIDED BY COIL MANUFACTURER.
16. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
17. MONITOR POINT ONLY WHEN OFFLINE AND FANS OFF.
18. INTENTIONALLY LEFT BLANK.

(CONTINUED ON SHEET 3)

REFERENCE DRAWINGS & SAFETY NOTES

SEE SHEET 2

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03, .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000PC

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & INSTRUMENT DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049-969239

REV. A

SCALE NONE

SHEET 1 OF 7

185

1/4" NPT (TBD)
COMPRESSED AIR
60–100 PSIG
[414–689 kPaG]
MANUAL RESET

ALARM: 270 °F [132 °C] INCR
14 °F [–10 °C] DECR
DM: 290 °F [143 °C] INCR

TAHH 4026A1 | TAH 4026A1 | TAL 4026A1 | TI 4026A1 | SPARE
TAHH 4025A1 | TAH 4025A1 | TAL 4025A1 | TI 4025A1 | SPARE
TAHH 4024A1 | TAH 4024A1 | TAL 4024A1 | TI 4024A1 | SPARE
TAHH 4023A1 | TAH 4023A1 | TAL 4023A1 | TI 4023A1 | SPARE
TAHH 4022A1 | TAH 4022A1 | TAL 4022A1 | TI 4022A1 | SPARE
TAHH 4021A1 | TAH 4021A1 | TAL 4021A1 | TI 4021A1 | SPARE

(27) 6X

TE 4026A1 | TE 4026A2 | TE 4025A1 | TE 4025A2 | TE 4024A1 | TE 4024A2 | TE 4023A1 | TE 4023A2 | TE 4022A1 | TE 4022A2 | TE 4021A1 | TE 4021A2

ALARM: 200 °F [93 °C] INCR
DM: 220 °F [104 °C] INCR

TAHH 4030A1 | TAH 4030A1 | TI 4030A1
TAHH 4030A2 | TAH 4030A2 | TI 4030A2

TE 4030A1 | TE 4030A2 (25)

ATM

GENERATOR EXHAUST
~45,000 SCFM [1274 SCMM]
(SEE NOTE 4)

(30) AIR

(35) (SEE NOTE 9)

PDI 4014 | PDAL 4014 | (37) LO PDT 4014 HI

ALARM:
0.1" H2O DECR

ALARM: 125 °F [52 °C] INCR
OR 35 °F [2 °C] DECR (SEE NOTE 17)
DM: 150 °F [66 °C] INCR

TAL 4102A1 | TAHH 4102A1 | TAH 4102A1 | TI 4102A1
TAL 4102A2 | TAHH 4102A2 | TAH 4102A2 | TI 4102A2

TE 4102A1 | TE 4102A2 (11)

GENERATOR ROOM

TAHH 4031A1 | TAH 4031A1 | TI 4031A1
TAHH 4031A2 | TAH 4031A2 | TI 4031A2

TE 4031A1 | TE 4031A2 (26)

ALARM: 200 °F [93 °C] INCR
DM: 220 °F [104 °C] INCR

STATOR TEMP SENSORS

(24) HE 4051

HE 4050 (23)

TE 4093A2 | TE 4093A1 (29) | TI 4093A1

TE 4091A2 | TE 4091A1 (33)

SPARE
TI 4091A1 | TAL 4091A1 | TAH 4091A1

ALARM: 0 °F [–18 °C] DECR
ALARM: 125 °F [52 °C] INCR

~45,000 SCFM [1274 SCMM]
AA FROM SHEET 1

(39) (39)

(86) (6) MOT 4103A | MOT 4103B (6) (86)

A (16) B

FOR WINTERIZATION OPTION ONLY

SET THERMOSTAT TO TURN OFF AT 75 °F [24 °C] INCR

HE 4058 (75) | TC 4058

FOR WINTERIZATION OPTION ONLY

HE 4059 (75) | TC 4059

MOT 4036 (91) | TC 4036 (28)

SET THERMOSTAT TO TURN ON AT 75 °F [24 °C] INCR

MGTB

SET THERMOSTAT TO TURN OFF AT 75 °F [24 °C] INCR

HE 4053 (32) | TC 4053 (28)

SPARE
TI 4091A1 | TAL 4091A1 | TAH 4091A1

ALARM: 0 °F [–18 °C] DECR
ALARM: 125 °F [52 °C] INCR

BB FROM SHEET 1

CC FROM SHEET 1

TI 4101A1 SPARE | TI 4101B1 SPARE | TI 4101C1 SPARE | TI 4101D1 SPARE (11) 4X

TE 4101A1 | TE 4101A2 | TE 4101B1 | TE 4101B2 | TE 4101C1 | TE 4101C2 | TE 4101D1 | TE 4101D2

(10)

(37) HI PDT 4011A LO | (37) HI PDT 4011B LO

PDI 4011A | PDAH 4011A | PDAHH 4011A
PDI 4011B | PDAH 4011B | PDAHH 4011B

ALARM:
3.5" H2O INCR
[89 mm]

ESN:
4.5" H2O INCR
[114 mm]

(8) (36)

~60000 SCFM [1699 SCMM]

(22)

TC 4052 (74) | TC 4057 (128) | MOT 4187
HE 4052 | HE 4057

HEATER OFF:
100 °F [38 °C]

(38)

(31)

INLET VOLUTE

(89) HE 4216 | TC 4216

HE 4058 | TC 4058

(59) (60) (57) (58)

TURBINE ROOM

(SEE NOTE 8) (1) (149)

CONNECTION DESCRIPTION: INLET VOLUTE DRAIN		
SIZE: 2"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [L/min]	TEMPERATURE °F [°C]
1 [7]	100 [379]	180 [82]
ATM	N/A	AMB
N/A	N/A	N/A

(187)

CONNECTION DESCRIPTION: VBV DRAIN		
SIZE: 1"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [L/min]	TEMPERATURE °F [°C]
15 [103]	100 [379]	180 [82]
ATM	N/A	AMB
N/A	N/A	N/A

ATM

ALARM:
–0.5" H2O INCR

PDAL 4007 | PDI 4007 | (37) LO PDT 4007 HI

TURBINE ROOM EXHAUST
~60,000 SCFM [1699 SCMM]
(SEE NOTE 5)

(5) (5) (4) (4)

(87) (3) MOT 4017A | A | B | MOT 4017B (3) (87)

(1) (1)

(SEE NOTE 9)

AIR

(11)

TE 4001A1 | TE 4001A2

TI 4001A1 | TAH 4001A1

SPARE

TE 4054A1 | TE 4054A2

TI 4054A1 | TAH 4054A1 | TAHH 4054A1 | TAL 4054A1
TI 4054A2 | TAH 4054A2 | TAHH 4054A2 | TAL 4054A2

ALARM: 140 °F [60 °C] INCR
DM: 150 °F [66 °C] INCR
HEATER SHUT–OFF:
60 °F [16 °C] INCR
HEATER ON:
55 °F [13 °C] DECR

MTTB

(33)

TE 4090A1 | TE 4090A2

TI 4090A1 | TAL 4090A1 | TAH 4090A1

SPARE

ALARM: 0 °F [–18 °C] DECR
ALARM: 125 °F [52 °C] INCR

(34) MOT 4019 | TC 4019

THERMOSTAT SETTING
A.C. TURN ON :
70 °F [21 °C] INCR
HEATER TURN ON:
10 °F [–12 °C] DECR

(34) MOT 4120 | TC 4120

THERMOSTAT SETTING
A.C. TURN ON :
90 °F [32 °C] INCR
HEATER TURN ON:
41 °F [5 °C] DECR

SAFETY NOTES:

1. FLOWS AND PRESSURES ARE MACHINE DESIGN PARAMETERS AND ARE NOT GUARANTEE POINTS.

REFERENCE DRAWINGS:

X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X–969200 GENERAL ARRANGEMENT, MAIN UNIT – RH
X–969204 GENERAL ARRANGEMENT, AIR FILTER
X–000231 FLOW AND EQUIPMENT SYMBOLS, MECHANICAL

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REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

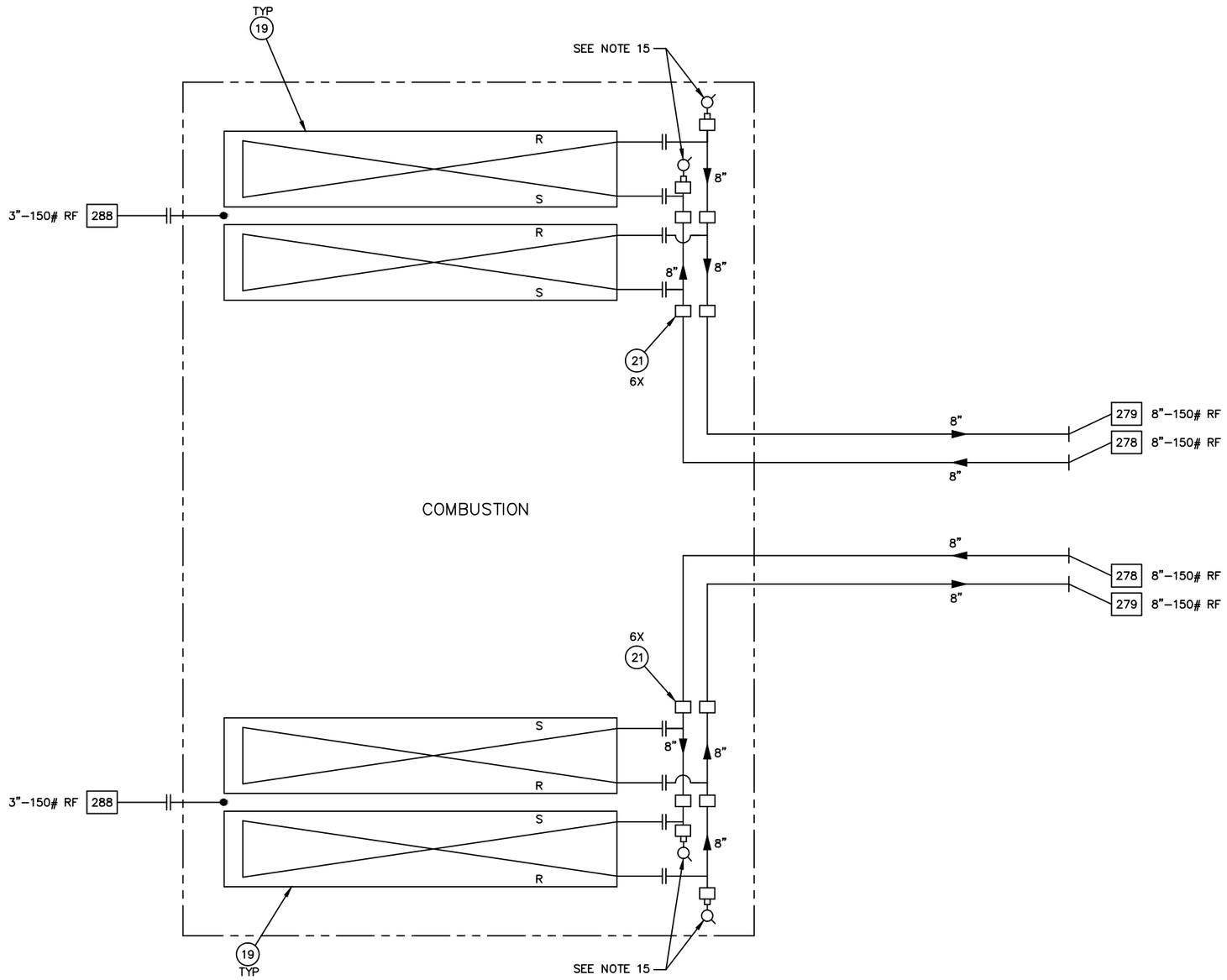
TITLE: FLOW & INSTRUMENT DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049–969239

REV. A

SCALE NONE

SHEET 2 OF 7



COIL SECTION
(SEE NOTE 17)

NOTES: (CONTINUED FROM SHEET 1)

19. COIL SYSTEM (EXPECTED PERFORMANCE, NOT GUARANTEED)

	HEAT	CHILL
– WATER SUPPLY FLOW RATE (GPM)	TBD	TBD
– ENTERING DRY BULB TEMPERATURE (°F)	TBD	TBD
– ENTERING WET BULB TEMPERATURE (°F)	–	TBD
– LEAVING DRY BULB TEMPERATURE (°F)	TBD	TBD
– LEAVING WET BULB TEMPERATURE (°F)	–	TBD
– ENTERING WATER TEMPERATURE (°F)	TBD	TBD
– LEAVING WATER TEMPERATURE (°F)	TBD	TBD
– CAPACITY	TBD MBTU	TBD TONS
– WATER/GLYCOL SOLUTION (%)	TBD/TBD	TBD/TBD
– COIL & HEADER PRESSURE DROP (FEET)	TBD	TBD

HEATING DATA IS FOR CONDITIONING OF BOTH COMBUSTION AND VENTILATION AIR. CHILLING DATA IS FOR CONDITIONING OF COMBUSTION AIR ONLY.

20. THE COIL SOLUTION SHOULD HAVE AN INHIBITOR TO PREVENT CORROSION OF COPPER TUBED COILS. COIL MOP = 689 kPaG [100 PSIG].
21. THE TOTAL QUANTITY OF WATER IN THE COILS, SUPPLY & RETURN HEADERS IS 720 GALLONS [2725 L]. THIS INCLUDES BOTH SIDES A & B.
22. IF FREEZING TEMPERATURES ARE ANTICIPATED (UNLESS PROPER GLYCOL SOLUTION IS USED) THE WATER COIL SYSTEM MUST BE FULLY DRAINED.
23. IF UNEVEN TEMPERATURE DISTRIBUTION ACROSS THE COIL FACE IS NOTED, VENT TRAPPED AIR FROM COILS. 1/2" NPT PETCOCKS ARE PROVIDED BY GEPPLP.
24. STANDARD CONDITION REF. AT 21 °C [70 °F] AND AT 101 kPaA [14.7 PSIA].
25. DO NOT OPERATE ANTI–ICING COILS WHEN UNIT IS NOT IN OPERATION.

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

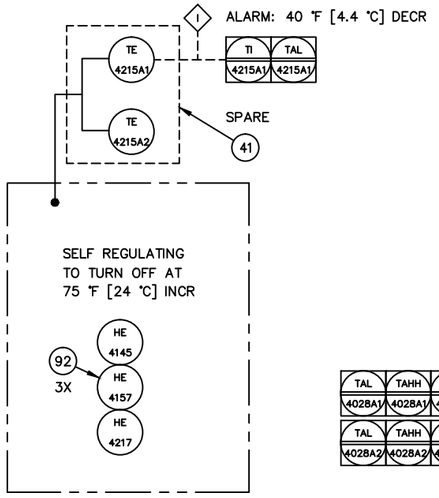
UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

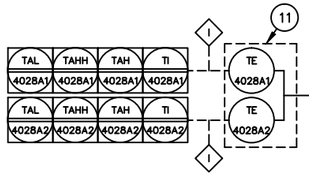
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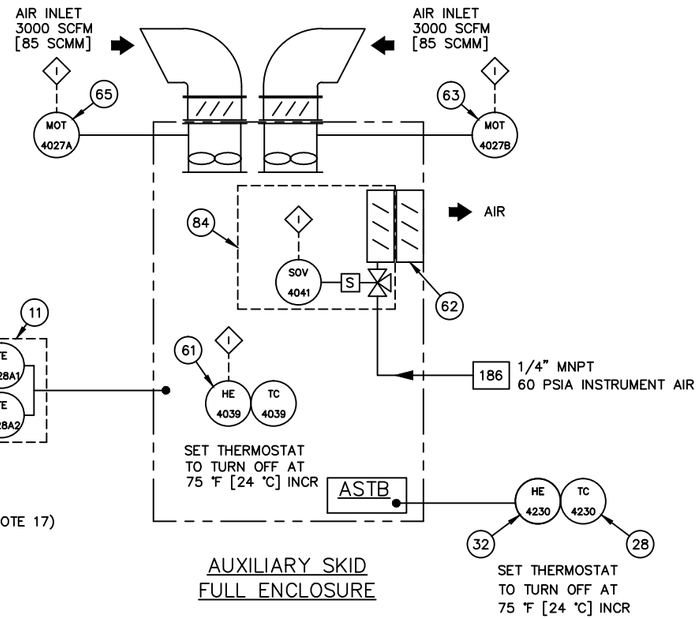
TITLE
FLOW & INSTRUMENT DIAGRAM
VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049–969239
REV. A
SCALE NONE
SHEET 3 OF 7

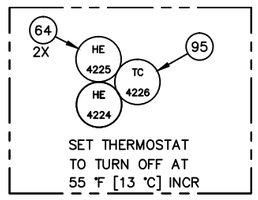


TURBINE INSTRUMENT PANEL ENCLOSURE

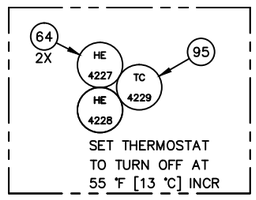




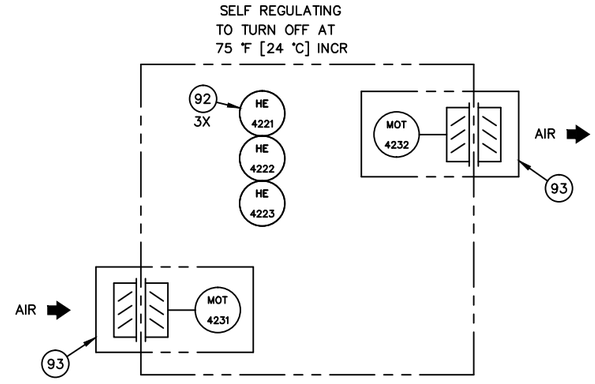
AUXILIARY SKID FULL ENCLOSURE



GENERATOR LINESIDE CUBICLE



GENERATOR NEUTRAL CUBICLE



SPRINT SKID ENCLOSURE

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049-969239

REV. A

SCALE NONE

SHEET 4 OF 7

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	TURBINE ENCLOSURE FIRE PROTECTION DAMPER	AWV {382A5531P0001}	2	FIRE PROTECTION DAMPER, 50 1/2" X 53", [1280 mm X 1346 mm] PARALLEL BLADES, 7 GA FRAME, 16 GA BLADES, GALVANIZED STEEL, VITON BLADE SEALS, 304 SS JAMB SEALS, HORIZ. MOUNTING W/VERTICAL UPWARD AIRFLOW, PNEUMATIC RESET, 60,000 SCFM [1699 SCMM]
2		INTENTIONALLY LEFT BLANK			
3	MOT-4017A MOT-4017B	TURBINE ENCLOSURE VENTILATION FAN	TCF AEROVENT {382A5647P0001}	2	CENTAXIAL BELT DRIVEN FAN, 66" [1676 mm] DIA. SOLID CAST ALUM. BLISK, 60000 ACFM [1699 SCMM] AT 7.5" WGSP, 140 °F [60 °C], MOTOR INCLUDED FAN/MOTOR ASSY UL/CSA COMPLIANT
4	N/A	SILENCER, TURBINE ROOM VENT FANS	TCF AEROVENT SS6625D2	2	SILENCER, 66" [1676 mm] DIA., SHALL LIMIT NOISE TRANSMITTED THRU FAN TO 85 dBA, 60,000 SCFM [1699 SCMM]
5	N/A	STACK CAP	TCF AEROVENT R-25766-00	2	STACK CAP, 66" DIA CAP, GALVANIZED STEEL, 60,000 SCFM [1699 SCMM]
6	MOT-4103A MOT-4103B	GENERATOR ENCLOSURE VENTILATION FAN	TCF AEROVENT {382A5648P0001}	2	CENTAXIAL FAN, 42" DIA., SOLID CAST ALUM. BLISK, 45,000 ACFM AT 6.5 WGSP 140 °F [60 °C], MOTOR INCLUDED
7		INTENTIONALLY LEFT BLANK			
8	N/A	INLET VOLUTE TRANSITION DUCT	(PART OF ITEM 10)	(1) REF	316 SS TRANSITION DUCT, PART OF COMBUSTION INLET SILENCER
9	N/A	AIR FILTER	GEPPLP {748200}	1	AIR FILTER, RATED FOR 250,000 SCFM [7164 SCMM] COMBUSTION AND 105,000 SCFM [2973 SCMM] VENTILATION AIR, PLENUM MODULE CS, WALKWAY, AND LADDER INCLUDED
10	N/A	GAS TURBINE AIR INLET SILENCER	GEPPLP {393A4075P0001}	1	AIR FILTER SILENCER, COMBUSTION AIR SILENCED, INTEGRAL UNSILENCED TURBINE VENTILATION AIR DUCT, COMBUSTION AIRFLOW 253,000 SCFM [7164 SCMM], SILENCER SHALL LIMIT NOISE TO 85 dBA
11	TE-4101A1,A2 TE-4101B1,B2 TE-4101C1,C2 TE-4101D1,D2 TE-4001A1,A2 TE-4102A1,A2 TE-4054A1,A2 TE-4028A1,A2	TEMPERATURE ELEMENT ASSEMBLY	ROSEMOUNT {J01310}	8	PLATINUM RTD, DUAL ELEMENT, 12" [305 mm] IMMERSION LENGTH, 100 OHM AT 0 °F, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, SUPPLIED WITHOUT THERMOWELL
12	MT-4000 TT-4000	RELATIVE HUMIDITY SENSOR (WEATHER STATION)	VAISALA {382A5673P0001}	1	HUMIDITY AND TEMPERATURE TRANSMITTER, MODEL HMT363, 2 X 4-20 mA ANALOG OUTPUT CHANNELS, CHANNEL 1 = 0-100% RELATIVE HUMIDITY, CHANNEL 2 = -40 °F to 176 °F, 1/2" NPT ELECTRIC CONDUIT CONNECTION, CE, ATEX - EEx ia IIC T4
13		INTENTIONALLY LEFT BLANK			
14	PDI-4104 PDI-4105 PDI-4106 PDI-4107	DIFFERENTIAL PRESSURE INDICATOR	DWYER {382A1426P0001}	4	DIFFERENTIAL PRESSURE GAUGE, CAPSUHELIC SERIES, 5" [127 mm] DIAL, 0-2" H2O [0-51 mm] DUAL SCALE RANGE ALUMINUM BODY, 1/4" NPT CONNECTIONS

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
15	N/A	HERESITE COIL COATING	GEPPLP {334A4900P0001}	1	HERESITE COIL PROTECTIVE COATING, P-413 BAKED PHENOLIC, MAX RATED FOR 204 °C [400 °F], DESIGN 149 °C [300 °F] COATING APPLIES TO ENTIRE COIL PACKAGE
16	N/A	GENERATOR VENTILATION BACK DRAFT DAMPER	AWV INC (PART OF ITEM 6)	(2) REF	FIRE PROTECTION DAMPER, 63 1/4" [1607 mm] X 63 1/4" [1607 mm], PARALLEL BLADES, 7 GA FRAME, 16 GA BLADES, GALV. STEEL, SILICONE BLADE SEALS, SS JAMB SEALS, HORIZ. MOUNTING WITH VERTICAL DOWNWARD FLOW, 45,000 SCFM [1274 SCMM]
17	TE-4082A1,A2 TE-4083A1,A2 TE-4084A1,A2 TE-4085A1,A2 TE-4086A1,A2	TEMPERATURE ELEMENT	ROSEMOUNT {393A4069P0001}	5	PLATINUM RTD, DUAL ELEMENT, 12" [305 mm] IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, ATEX & CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
18		INTENTIONALLY LEFT BLANK			
19	N/A	COMBUSTION COILS	{334A1133P0001}	1	HORIZONTAL COMBUSTION COILS, 12 ROWS, ASME
20		INTENTIONALLY LEFT BLANK			
21	N/A	PIPE COUPLING			
22	N/A	SILENCER, VBV	GEPPLP {393A4074P0001}	1	SILENCER, CS DUCT W/304 SS INTERNAL LINING, SHALL LIMIT NOISE TO 85 dBA, OFFSET DESIGN
23	HE-4050	GENERATOR SPACE HEATER ELEMENT	SUPPLIED BY GENERATOR MFR.	(1) REF	GENERATOR SPACE HEATER ELEMENT 480 VAC, 3 PH, 60 Hz, 5400 WATT
24	HE-4051	GENERATOR SPACE HEATER ELEMENT	SUPPLIED BY GENERATOR MFR.	(1) REF	EXCITER SPACE HEATER ELEMENT 480 VAC, 3 PH, 60 Hz, 76 WATT
25	TE-4030A1,A2	GENERATOR EXHAUST TEMPERATURE SENSOR	SUPPLIED BY GENERATOR MFR.	(1) REF	PLATINUM RTD, DUAL ELEMENT, 100 OHM AT 0 °C
26	TE-4031A1,A2	GENERATOR EXCITER TEMPERATURE SENSOR	SUPPLIED BY GENERATOR MFR.	(1) REF	PLATINUM RTD, DUAL ELEMENT, 100 OHM AT 0 °C
27	TE-4021A1,A2 THRU TE-4026A1,A2	GENERATOR STATOR TEMPERATURE ELEMENT	SUPPLIED BY GENERATOR MFR.	(6) REF	PLATINUM RTD, DUAL ELEMENT, 100 OHM AT 0 °C
28	TC-4036 TC-4053 TC-4230	THERMOSTAT	GEPPLP {J05501}	3	MAX RATED 5A/250 VAC or 3A/30 VDC
29	TE-4093A1,A2	GENERATOR AIR TEMPERATURE ELEMENT	SUPPLIED BY GENERATOR MFR.	(1) REF	PLATINUM RTD, 100 OHM AT 0 °C,
30	N/A	GENERATOR EXHAUST SILENCER	GEPPLP {382A5500P0001}	1	SILENCER, PARALLEL BAFFLE SPLITTER TYPE, ACOUSTICALLY LINED HOOD, GALVANIZED STEEL INTERNALS, SHALL LIMIT EXHAUST NOISE TO 85 dBA, 300 °F [149 °C] DESIGN TEMPERATURE, 45,000 SCFM [1274 SCMM]
31	N/A	EXPANSION JOINT VBV DUCT	GEPPLP {289174}	1	EXPANSION JOINT, 18.43" [468 mm] X 81.15" [2061 mm], SS FLANGES, 16" FLANGE TO FLANGE, FABRIC BOOT
32	HE-4053 HE-4230	SPACE HEATER	RITTAL {382A4164P0001}	(2) REF	HEATER, 24-48 VAC/DC
33	TE-4090A1,A2 TE-4091A1,A2	TEMPERATURE ELEMENT MGTB & MTTB CABINET AIR	ROSEMOUNT {377A7807P0001}	2	PLATINUM RTD, DUAL ELEMENT, 2.5" IMMERSION LENGTH, SUPPLIED WITHOUT THERMOWELL, CE

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & INSTRUMENT DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049-969239

REV. A

SCALE NONE

SHEET 5 OF 7

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
34	MOT–4019 MOT–4120	MTTB ENCLOSURE VENTILATION AIR CONDITIONER & HEATER	THERMAL EDGE INC {398A4665P0001}	2	6000 BTUH COOLING 60 HZ, 1000 WATTS CLASS 1 DIVISION 2 GRP C&D INT/EXT, UL LISTED
35	N/A	GENERATOR EXHAUST DAMPER	AWV {386A6937P0001}	1	BACKDRAFT DAMPER, 115" X 67" [2921mm X 1702mm], PARALLEL BLADES, 7 GA FRAME, 14 GA BLADES, GALV. STEEL, SILICONE BLADE SEALS, SS JAMB SEALS, HORIZONTAL MOUNTING W/VERTICAL UPWARD AIRFLOW, PNEUMATIC RESET
36	N/A	INLET VOLUTE EXPANSION JOINT	GEPPLP {289173}	1	136" X 54" [3454 mm X 1372 mm] SS FLANGES, 12" [305] O.A.L., FABRIC BOOT
37	PDT–4011A PDT–4011B PDT–4007 PDT–4014 PDT–4005A PDT–4005B PDT–4004	PRESSURE DIFFERENTIAL TRANSMITTER	ROSEMOUNT {382A5656P0001}	7	DIFFERENTIAL PRESSURE TRANSMITTER –25 TO 25 IN H2O [–62.2 TO 62.2 mBAR], 316 SS ISOLATING DIAPHRAGM, 4–20 mA OUTPUT WITH HART PROTOCOL 1/4"–18 NPT PROCESS CONNECTION, 1/2"–14 NPT ELECTRICAL CONNECTION, SET PT–4011A & B: 4mA = 0 IN H2O, 20mA = 10 IN H2O SET PT–4007 AND PT–4014: 4mA = –10 IN H2O, 20mA = +10 IN H2O CSA AND ATEX APPROVED
38	N/A	INLET SCREEN	WESTFLO {382A4154P0001} (QTY 1 EA SHIPLOOSE)	1	FLEXIBLE INLET SCREEN, NYLON SCREEN CONFORMS TO ASTM–3–800, 800 MICRON SCREEN FOR COMMISSIONING OF MAJOR INLET MAINTENANCE, 2" WHITE NYLON BINDING AND DOUBLE STITCHED SEAMS
39	N/A	GENERATOR INTAKE EXPANSION JOINT	GEPPLP {747714}	2	EXPANSION JOINT, GENERATOR FAN, 59" [1499 mm] ID X 7" [178 mm] LONG
40		INTENTIONALLY LEFT BLANK			
41	TE–4215A	TEMPERATURE ELEMENT	ROSEMOUNT {393A4066P0001}	1	PLATINUM RTD, DUAL ELEMENT, 2.5" [63.5 mm] IMMERSION LENGHTS, 100 OHM, CSA+ ATEX EXPLOSION PROOF, 3/4" – 14 NPT 316 SS THERMOWELL

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
42 THRU 56		INTENTIONALLY LEFT BLANK			
57	N/A	VBV DRAIN CHECK VALVE	DURABLA 8305	1	1" FNPT INLET AND OUTLET CONNECTIONS, SS BODY AND TRIM, LESS THAN 1/2 PSID [3.4 kPaD] CRACKING PRESSURE
58	N/A	VBV DRAIN STRAINER	GEPPLP {J05017}	1	1" FLANGE INSERT 304 SS, STRAINER FOR 1"–150# RF FLANGE, 40 MESH
59	N/A	INLET VOLUTE DRAIN STRAINER	GEPPLP {J05021}	1	FLANGE INSERT STRAINER, 304 SS, 40 MESH, 2"–150# RF
60	N/A	INLET VOLUTE DRAIN CHECK VALVE	MFR: WATSON MACDANIEL SPLY. BY: VERTZ & CO. {249A4667P0001}	1	2" FNPT, 750 PSI, 316 SS 0.2 PSID CRACKING PRESSURE
61	HE–4039 TC–4039	AUX SKID ENCLOSURE HEATER	CHROMALOX {382A9246P0001}	1	HEATER, FORCED AIR SPACE HEATER WITH BUILT–IN THERMOSTAT, 480/400 V, 3 PH, 10,000/6900 WATT, 60/50 Hz
62	N/A	AUXILIARY SKID ENCLOSURE ACOUSTICAL LOUVER	GEPPLP {382A7074P0001}	1	LOUVER, FIXED BLADE, 39 1/4" W X 39 1/4" H X 6" D [997 mm X 997 mm X 152 mm], 6" BLADE SPACE, 16 GA GALV. STL, WITH 1/2" ALUM. BIRD SCREEN
63	MOT–4027B	AUXILIARY SKID ENCLOSURE DAMPER/MOTOR/FAN ASSEMBLY – RH	GEPPLP {382A7120P0001}	1	FAN, HOOD & DAMPER ASSEMBLY, 3000 CFM [85 CMM], PRESSURIZATION, RH CONFIGURATIONS, COUNTERBALANCED BACKDRAFT DAMPER 480 V, 1 HP [0.75 kW], 3 PHASE, 60 Hz, 1745 RPM

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FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049–969239

REV. A

SCALE NONE

SHEET 6 OF 7

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
64	HE–4224 HE–4225 HE–4227 HE–4228	HEATER, GENERATOR LINE SIDE & NEUTRAL CUBICLE	GEPPLP {382A5669P0001}	4	240 V, 1 PH, 250 WATT
65	MOT–4027A	AUXILIARY SKID ENCLOSURE DAMPER/MOTOR/FAN ASSEMBLY – LH	GEPPLP {382A7120P0002}	1	FAN, HOOD & DAMPER ASSEMBLY, 3000 CFM [85 CMM], PRESSURIZATION, LH CONFIGURATIONS, COUNTERBALANCED BACKDRAFT DAMPER 480 V, 1 HP [0.75 kW], 3 PHASE, 60 Hz, 1745 RPM
66 THRU 73		INTENTIONALLY LEFT BLANK			
74	HE–4052 TC–4052 HE–4057 TC–4057	SPACE HEATER TURBINE ENCLOSURE	CHROMALOX {398A4910P0001}	2	HEATER, FORCED AIR, EXPLOSION PROOF, 480 V, 25 kW, 3 ph, 60 Hz, BUILT–IN THERMOSTAT
75		INTENTIONALLY LEFT BLANK			
76		INTENTIONALLY LEFT BLANK			
77		INTENTIONALLY LEFT BLANK			
78		INTENTIONALLY LEFT BLANK			
79		INTENTIONALLY LEFT BLANK			
80		INTENTIONALLY LEFT BLANK			
81		INTENTIONALLY LEFT BLANK			
82		INTENTIONALLY LEFT BLANK			
83		INTENTIONALLY LEFT BLANK			
84	SOV–4041	AUXILIARY SKID ENCLOSURE VOLUME CONTROL DAMPER	AWV {393A4123P0001}	1	PNEUMATIC ACTUATOR, FRAME: 39" W X 39" H X 6" D [991 mm X 991 mm X 152 mm], 12 GA GALVANIZED STEEL 5 BLADES @ 6 3/4" SPACING, 16 GAUGE GALVANIZED STEEL

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
85		INTENTIONALLY LEFT BLANK			
86	MOT–4103A MOT–4103B	GENERATOR ENCLOSURE VENTILATION MOTOR	ABB (SUPPLIED WITH ITEM 6)	(2) REF	MOTOR RATED, 100 HP [74.6 kW], 60 Hz, 460 VAC, 250SMB FRAME SIZE, 3 PH, 1800 RPM, EXPLOSION PROOF, NEMA, 240 V SPACE HEATER, 50 WATT
87	MOT–4017A MOT–4017B	TURBINE ENCLOSURE VENTILATION MOTOR	GE ULTRA (SUPPLIED WITH ITEM 3)	(2) REF	MOTOR RATED, 125 HP [93.2 kW], 60 Hz, 460 VAC, 445T FRAME SIZE, 3 PH, 1780 RPM, EXPLOSION PROOF, NEMA, 120 V SPACE HEATER, 50 WATT
88		INTENTIONALLY LEFT BLANK			
89		INTENTIONALLY LEFT BLANK			
90		INTENTIONALLY LEFT BLANK			
91	MOT–4036	MGTB FAN	RITTAL {377A6807P0001}	1	FAN, FILTER, 24 VDC, 14 WATT
92	HE–4221 HE–4222 HE–4223 HE–4145 HE–4157 HE–4217	SPACE HEATER SPRINT SKID ENCLOSURE TURBINE INSTRUMENT PANEL	NORSEMAN {382A1381P0001}	3 3	250 V, 1 PH, 500 WATT, WITH BUILT–IN THERMOSTAT
93	MOT–4231 (INLET) MOT–4232 (EXHAUST)	ACOUSTICAL LOUVER, DAMPER ASSEMBLY	AWV, INC. 32018	2	ASSEMBLY CONSISTING OF: LAA–6 STATIONARY ALUMINUM ACOUSTIC LOUVER. MOUNTED BEHIND THE LOUVER IN A SLEEVE WILL BE AN AWV, INC. VC–1 WITH BLADE AND JAMB SEALS AND A MA6–405–500, NEMA7, POWER OPEN/SPRING CLOSED120 VOLT ACTUATOR UL/CSA CERTIFIED
94		INTENTIONALLY LEFT BLANK			
95	TC–4226 TC–4229	THERMOSTAT	{WR–80EP}	2	THERMOSTAT, ROOM, EXPLOSION PROOF
96 TO 120		INTENTIONALLY LEFT BLANK			
127	N/A	CHECK VALVE	GEPPLP {398A4368P0001}	2	CHECK VALVE, DRAIN, 1–1/2 NPT, 0.500 PSI CRACKING PRESSURE, SS 316
128					

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049–969239

REV. A

SCALE NONE

SHEET 7 OF 7

GE ENGINE CONNECTIONS REF SHT 2 ZONE D-4

L1	LUBE OIL PUMP INLET
L2	SCAVENGE LUBE OIL DISCHARGE
L3	GAS TURBINE LUBE OIL SUPPLY OUTLET
L4	LUBE OIL SUPPLY PRESSURE
L5	LUBE OIL SCAVENGE DISCHARGE PRESSURE
L6	LUBE OIL SUPPLY TO FILTER
L8	VG PUMP OIL FILTER INLET PRESSURE
L9	VG PUMP OIL FILTER OUTLET PRESSURE
A9	A/B-C SUMP VENT
A10	D-E SUMP VENT
A13	STATER PAD
A23	D-E SUMP PURGE AIR SUPPLY
A24	D SUMP SCAVENGE PURGE AIR SUPPLY (SHUTDOWN)
A25	E SUMP SCAVENGE PURGE AIR SUPPLY (SHUTDOWN)
A28	LPRC VENT PURGE AIR SUPPLY (SHUTDOWN)
A51A	ACCESSORY GEARBOX "A" SUMP VENT
A51B	ACCESSORY GEARBOX "A" SUMP VENT
D1	TRF STRUT NO. 8 OIL DRAIN
D2	VSV-VBV OIL DRAIN
D3	TRF STRUT NO. 10 OIL DRAIN
D4	COMBINED ACCESSORY OIL DRAIN
D6	VIGV OIL DRAIN

LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

INDICATES G.E. ENGINE CONNECTION AS DESIGNATED BY G.E. DRAWINGS.

ESN = EMERGENCY STOP NO MOTORING
DM = DECEL TO MINIMUM LOAD

NOTES:

1. VALVE LOCKS TO BE SUPPLIED BY OTHERS UNLESS OTHERWISE NOTED.
2. PERCENTAGE (%) VOLUMES ARE REFERENCE FROM TANK CAPACITY 250 GALLONS [946 L].
   TANK LEVEL FOR NORMAL OPERATION IS IN THE RANGE OF 39-90% (95-219 GALLONS [360-829 L]).
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. CUSTOMER TO SUPPLY DRAIN VALVE AT CONNECTION 6, CLOSED WHEN RUNNING, OPEN DURING SHUTDOWN.
5. CONNECTION 229 IS SEAL/SUMP OIL DRAIN, WHICH IS TO BE OPEN AT ALL TIMES. NO TRAPS SHOULD BE INSTALLED. THERE SHOULD BE NO FLOW UNDER NORMAL CONDITIONS AND 0.5 USGPM [1.9 L/min] OF OIL PER SUMP AT SEAL FAILURE. ENGINE CONNECTION D1 AT FAILURE WILL FLOW .09 lb/sec [0.04 kg/s] AIR AND 1.6 USGPM [6 L/min] OF OIL PER SUMP.
6. FROM PURGE AIR/INSTRUMENT AIR SUPPLY:
   OPERATIONAL MODE
   PRESSURE RANGE = 85-120 PSIG [586-827 kPaG]
   CONSTANT PRESSURE REQUIRED FOR VALVE OPERATION.
   TEMPERATURE, MAX = 100 °F [38 °C]
   SHUTDOWN MODE - ZERO RPM
   PRESSURE RANGE = 85-120 PSIG [586-827 kPaG]
   FLOW RATE = 60 SCFM [1.7 SCMM]
   TEMPERATURE, MAX = 100 °F [38 °C]
   TIME DURATION = 1 1/2 HOURS
   AFTER GAS GENERATOR SHUTDOWN OR UNTIL GAS GENERATOR IS RESTARTED, WHICHEVER OCCURS FIRST.
7. COOLING WATER 120 GPM [454 L/min] AT 95 °F [35 °C] MAXIMUM INLET TEMPERATURE AND MAX WOP = 100 PSIG [689 kPaG].
   8 PSID [55 kPaD] MAXIMUM DROP WATER SIDE.
   HEAT LOAD = 12,565 BTU/MIN [13257 KJ/min]
8. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
9. CUSTOMER DRAWING NUMBERS CONSIST OF:
   (ORDER NUMBER)-(STANDARD DRAWING NUMBER),
   AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER),
   WHERE X = ORDER NUMBER.

REFERENCE DRAWINGS:

X-969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X-969201 GENERAL ARRANGEMENT, MAIN UNIT - LH
X-000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X-969247 F&ID, TURBINE HYDRAULIC SYSTEM
X-969248 F&ID, MINERAL LUBE OIL SYSTEM
X-969260 F&ID, FUEL SYSTEM
X-969262 F&ID, WATER WASH SYSTEM

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

SHELL & TUBE COOLER

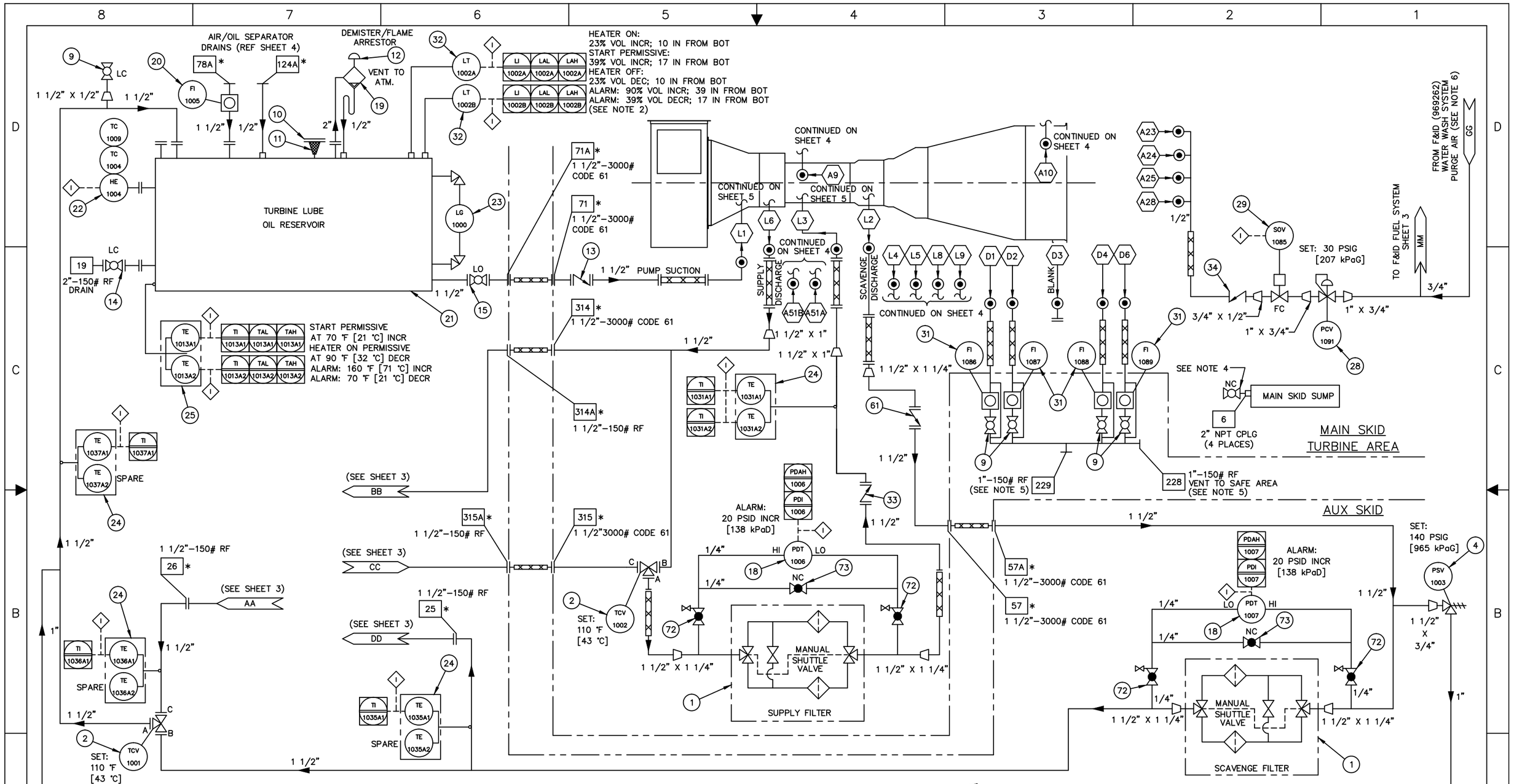
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049-969244
REV. A

SCALE NONE
SHEET 1 OF 8



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & INSTRUMENT DIAGRAM TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969244

REV. A

SCALE NONE

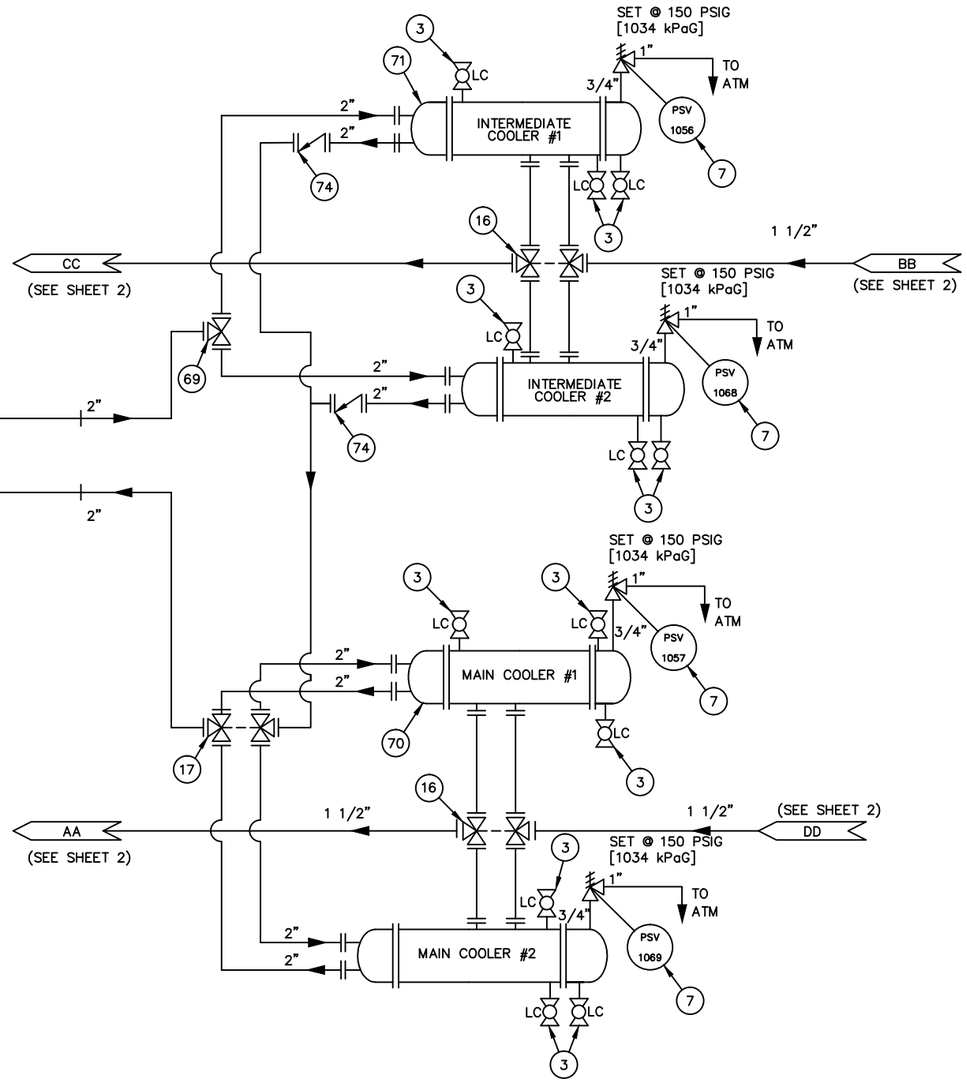
SHEET 2 OF 8

CONNECTION DESCRIPTION		
COOLING WATER SUPPLY		
SIZE		
2"–150#RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
100 [689]	120 [454]	95 [35]
–	–	–
–	–	–

SUPPLY (NOTE 7) 20

CONNECTION DESCRIPTION		
COOLING WATER RETURN		
SIZE		
2"–150#RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
82 [565]	120 [454]	109 [43]
–	–	–
–	–	–

21



HEAT EXCHANGER ASSEMBLY

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UNIT TYPE
LM6000PC

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

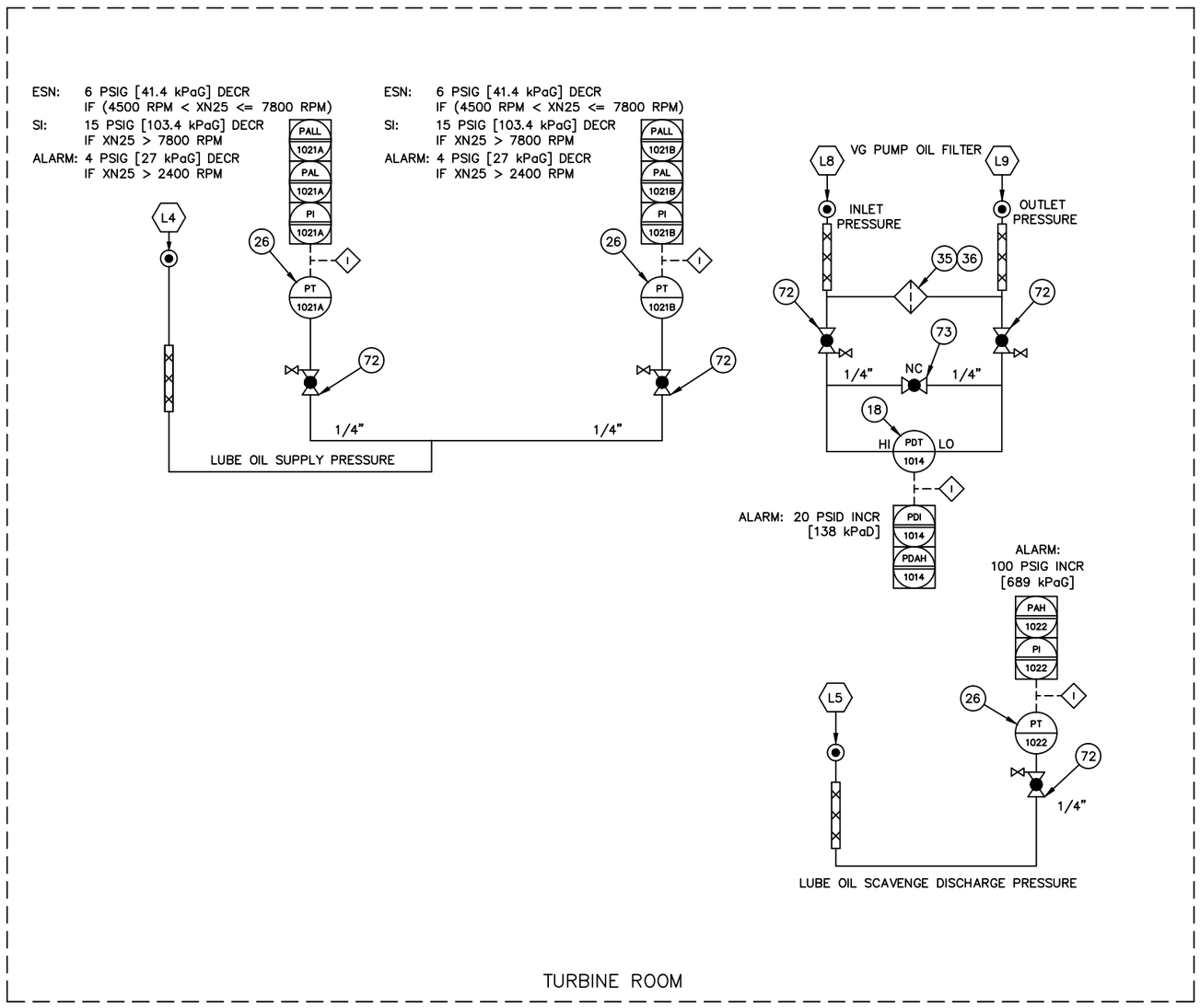
TITLE
FLOW & INSTRUMENT DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969244

REV. A

SCALE NONE

SHEET 3 OF 8



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GE PACKAGED POWER, L.P.

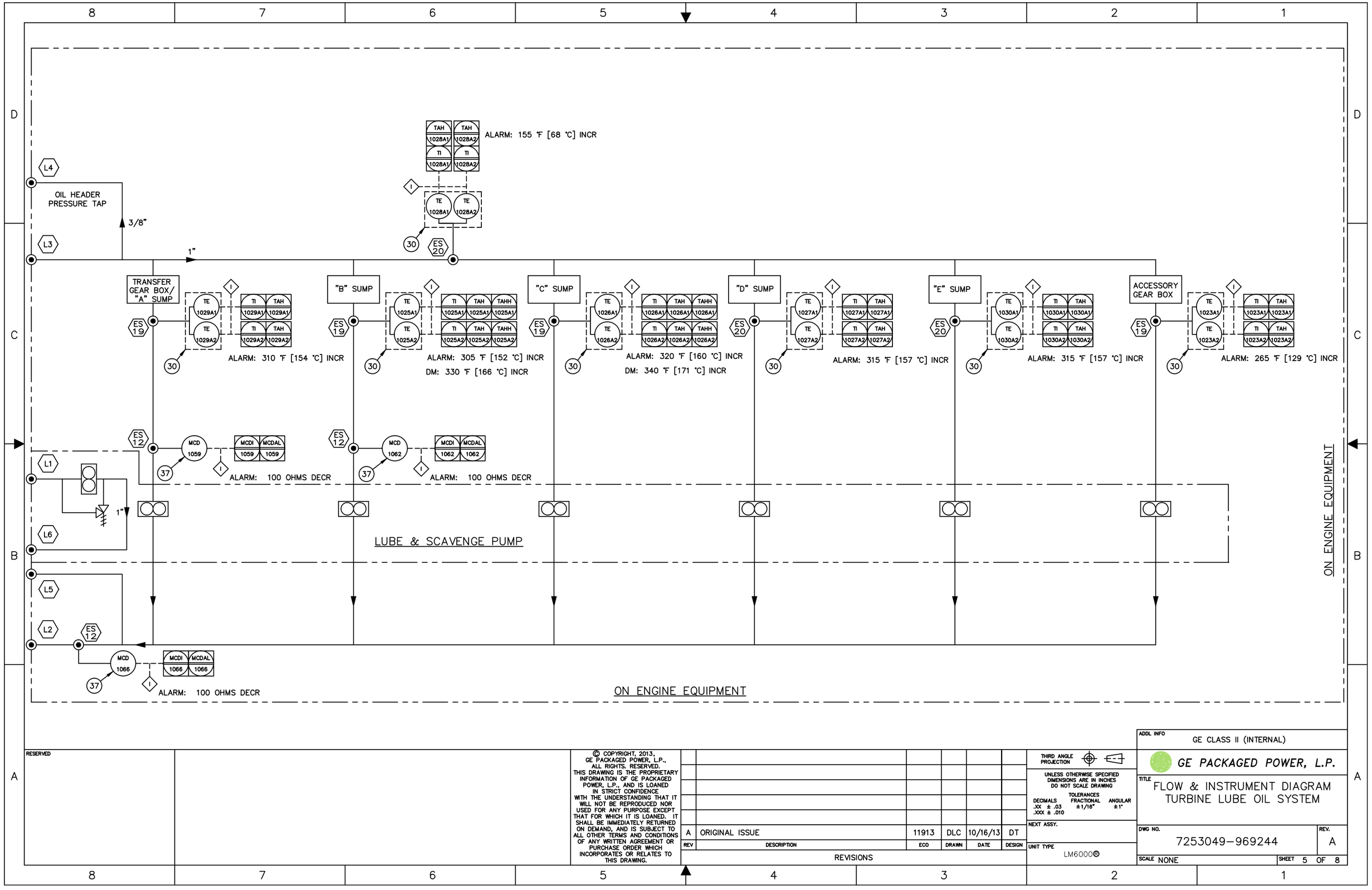
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REV. A

SCALE NONE

SHEET 4 OF 8



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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049-969244

REV. A

SCALE NONE

SHEET 5 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	TURBINE LUBE OIL FILTER	PALL {J00463}	2	PRESSURE BALANCED DUPLEX FILTER, 1 1/4" SAE STRAIGHT THREAD, 6 MICRON ABSOLUTE ELEMENTS, COLLAPSE RATED AT 150 PSID [1034 kPaD], BODY MWP 600 PSIG[4137 kPaG], INTEGRAL TRANSFER VALVE, NO BYPASS, VISUAL INDICATOR, REPLACEMENT ELEMENT: HC9600FKN13Z
2	TCV-1001 TCV-1002	TURBINE LUBE OIL THERMOSTATIC CONTROL VALVE	AMOT {J00464}	2	THERMOSTATIC 3-WAY VALVE, 1 1/2"-150# RF, CS BODY, VITON SEALS, NICKEL PLATED ELEMENT, 1/8" DIAMETER ORIFICE, 110 °F [44 °C] SETTING
3	N/A	DRAIN/VENT VALVE	KF CONTROMATICS S8000-02-LL SUPPLIED WITH ITEMS 70 AND 71	(12) REF	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, FULL PORT, TFE SEATS, 2000 WOG RATING, LOCKABLE HANDLE
4	PSV-1003	TURBINE SCAVENGE RELIEF VALVE	AGCO 81PS1F68-8(140)	1	PRESSURE RELIEF VALVE, 3/4" FNPT INLET X 1" FNPT OUTLET, CS BODY, SS TRIM, VITON SEALS, 1/2" DIAMETER ORIFICE
5&6		INTENTIONALLY LEFT BLANK			
7	PSV-1056 PSV-1057 PSV-1068 PSV-1069	TURBINE LUBE OIL COOLER WATER RELIEF VALVE	AGCO 81PS1M68-4(150)	4	PRESSURE RELIEF VALVE, 3/4" MNPT INLET X 1" FNPT OUTLET, CS BODY, SS TRIM, 1/4" DIAMETER ORIFICE
8		INTENTIONALLY LEFT BLANK			
9	N/A	DRAIN/VENT VALVE	KF CONTROMATICS 1/2"-S8000-LL	5	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, FULL PORT, TFE SEATS, 2000 WOG RATING, LOCKABLE HANDLE
10	N/A	TURBINE LUBE OIL TANK FILL CAP	TEDECO MF9639LKPSS	1	FILL CAP, 2" MNPT, HINGED, LOCKING TYPE, SS
11	N/A	TURBINE LUBE OIL TANK BASKET STRAINER	TEDECO {377A2452P0001}	1	BASKET STRAINER, 2"-150# RF, 304 SS, 40 MESH, 150% OPEN AREA
12	N/A	TURBINE LUBE OIL TANK FLAME ARRESTOR	PROTECTO SEAL FF6672	1	FLAME ARRESTOR, 2" FNPT, 316 SS
13	N/A	TURBINE LUBE OIL SUPPLY CHECK VALVE	KITZ 150UOAM	1	SWING CHECK VALVE, 1 1/2"-150# RF, SS BODY AND TRIM
14	N/A	TURBINE LUBE OIL TANK DRAIN VALVE	WATTS {J00465}	1	BALL VALVE, 2"-150# RF, CS BODY, SS TRIM, REDUCED PORT, DURAFILL REINFORCED TFE SEATS, LOCKABLE HANDLE
15	N/A	TURBINE LUBE OIL SUPPLY SHUT-OFF VALVE	WATTS {J04860}	1	BALL VALVE, 1 1/2"-150# RF, SS BODY, FULL PORT, DURAFILL REINFORCED PTFE SEATS, LOCKABLE HANDLE
16	N/A	TURBINE LUBE OIL COOLER OIL TRANSFER VALVE	SUPPLIED WITH ITEM 70 AND 71	(2) REF	6-WAY VALVE ASSEMBLY SET, 1 1/2"-150# RF
17	N/A	TURBINE LUBE OIL COOLER WATER RETURN VALVE	SUPPLIED WITH ITEM 70	(1) REF	6-WAY BALL VALVE, 2"-150# RF
18	PDT-1006 PDT-1007 PDT-1014	TURBINE LUBE OIL PRESSURE DIFFERENTIAL TRANSMITTER	ROSEMOUNT {382A5657P0001}	3	DIFFERENTIAL PRESSURE TRANSMITTER, -1000 to 1000 inH2O (-2.5 to 2.5 bar) RANGE, 316SS ISOLATING DIAPHRAGM, VITON O-RINGS, 1/4"-18 FNPT PROCESS & 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF CENELEC AND CSA, FLAMEPROOF, INTRINSIC SAFETY, NON-INCENDIVE. SET AT 4 mA = 0 PSID [0 kPaD] AND 20 mA = 35 PSID [242 kPaD]
19	N/A	TURBINE LUBE OIL TANK DEMISTER	DOLLINGER AE-229-110	1	DEMISTER, 2" FNPT, SS, REPLACEMENT ELEMENT: P/N 95-117 QUANTITY (2)

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
20	FI-1005	SIGHT FLOW INDICATOR	OPW {334A3746P0001}	1	FLOW INDICATOR, 1 1/2" SOCKET WELD, FLAPPER TYPE, 316 SS, VITON SEALS
21	N/A	TURBINE LUBE OIL RESERVOIR	GEPPLP {868340}	1	TANK, 304 SS, 250 GALLON CAPACITY, ATMOSPHERIC VENT
22	HE-1004 TC-1004 TC-1009	TURBINE LUBE OIL TANK HEATER AND THERMOSTAT	CHROMALOX {393A3645P0001}	1	THERMOSTATICALLY CONTROLLED HEATER, 3"-150# RF, 25 1/4" LONG, 3 KW, 15 WATTS/SQ-IN, 480 VAC, 3 PH, CSA APPROVED, EXPLOSION PROOF
23	LG-1000	TURBINE LUBE OIL TANK LEVEL GAUGE	ERNST 545-8	1	FLUID LEVEL SIGHT GLASS, 1 5/16" WIDE X 12 5/8" LONG
24	TE-1031A1 TE-1031A2 TE-1035A1 TE-1035A2 TE-1036A1 TE-1036A2 TE-1037A1 TE-1037A2	TURBINE LUBE OIL TEMPERATURE SENSOR	ROSEMOUNT {J01068}	4	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 32 °F [0 °C], DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
25	TE-1013A1 TE-1013A2	TURBINE LUBE OIL TANK TEMPERATURE SENSOR	ROSEMOUNT {J04182}	1	PLATINUM RTD, DUAL ELEMENT, 12" IMMERSION LG, 100 OHM AT 32 °F [0 °C], DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
26	PT-1021A PT-1021B PT-1022	TURBINE LUBE OIL PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	3	PRESSURE TRANSMITTER, 0-800 PSIG [0-5516 kPaG] 316 SS DIAPHRAGM, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, CSA, FM & ATEX EXPLOSION PROOF AND INTRINSIC SAFETY APPROVAL SET TRANSMITTERS AT 4 mA = 0 PSIG [0 kPaG] 20 mA = 200 PSIG [1379 kPaG]
27		INTENTIONALLY LEFT BLANK			
28	PCV-1091	AIR PRESSURE REGULATOR	FISHER 95L-124S	1	PRESSURE REGULATOR, 1" FNPT, 316 SS BODY AND TRIM, NEOPRENE DIAPHRAGM, 13-30 PSIG [90-207 kPaG] OUTLET PRESSURE RANGE, FIELD ADJUSTABLE SET AT 30 PSIG [207 kPaG]
29	SOV-1085	POWER TURBINE COOLING AIR PURGE SOLENOID	PARKER {393A1219P0001}	1	SOLENOID VALVE, 3/4" FNPT, FAILED CLOSED, 3/4" DIAMETER ORIFICE, BRASS BODY, 24 VDC, CLASS "H" COIL, EXPLOSION PROOF, UL/CSA APPROVED, WATER/AIR SERVICE, VALVE BODY RATED: OPERATING PRESSURE 0-150 PSIG [0-1034 kPaG], BACK PRESSURE 5 PSIG [35 kPaG], MAX FLUID TEMP 185 °F [85 °C]
30	TE-1023A1 TE-1023A2 TE-1025A1 TE-1025A2 TE-1026A1 TE-1026A2 TE-1027A1 TE-1027A2 TE-1028A1 TE-1028A2 TE-1029A1 TE-1029A2 TE-1030A1 TE-1030A2	TURBINE LUBE OIL TEMPERATURE SENSOR	GE SUPPLIED	(7) REF	PLATINUM RTD, SUPPLIED BY GENERAL ELECTRIC WITH ENGINE 100 OHM AT 32 °F [0 °C], DUAL ELEMENTS

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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE FLOW & INSTRUMENT DIAGRAM TURBINE LUBE OIL SYSTEM

DWG NO. 7253049-969244

REV. A

SCALE NONE

SHEET 6 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
31	FI–1086 FI–1087 FI–1088 FI–1089	TURBINE LUBE OIL SUMP DRAIN SIGHT GLASS	JOHN C ERNEST {382A5541P0001}	4	SIGHT FLOW INDICATOR, 1/2" FNPT, 3 3/4" OAL, DOUBLE WINDOW TYPE, 316 SS BODY, VITON GASKET, RATED FOR 150 PSIG @ 300 °F [1034 kPaG @ 149 °C]
32	LT–1002A LT–1002B	TURBINE LUBE OIL TANK LEVEL TRANSMITTER	ROSEMOUNT {398A4365P0001}	2	GUIDED WAVE RADAR LEVEL TRANSMITTER, 1 1/2" MNPT PROCESS CONNECTION AND 1/2"–14 NPT CONDUIT FOR ELECTRICAL CONNECTION, 316 SS COAXIAL PROBE, 3'–8 1/2" PROBE LENGTH, 4–20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, CSA, ATEX, FM FLAME/EXPLOSION PROOF APPROVAL, METER TYPE INTEGRAL DISPLAY. SET AT: 4mA = 0% VOL [0" FROM TANK BOTTOM] 20mA = 100% VOL [46" FROM TANK BOTTOM] END OF PROBE IS 1 1/2" FROM TANK BOTTOM
33	N/A	CHECK VALVE TURBINE LUBE OIL	DURABLA {398A4370P0001}	1	CHECK VALVE, 1 1/2"–300# RF, BODY A351 CF8M, TRIM 316 SS, SEAT VITON 4 PSID [27.6 kPaD] CRACKING PRESSURE
34	N/A	POWER TURBINE COOLING AIR PURGE CHECK VALVE	CHECK–ALL {J00838}	1	CHECK VALVE, 1/2" FNPT, 316 SS, METAL TO METAL SEAT, 1/2 PSID [3.4 kPaD] CRACKING PRESSURE
35	N/A	VGV PUMP FILTER ELEMENT	AIRCRAFT POROUS MEDIA AC–B244F–2440Y1	1	FILTER ELEMENT, 40 MICRON ABSOLUTE, GLASS FIBER MEDIA, OVERALL LENGTH = 5.048", COLLAPSE RATED AT 65 PSID [448 kPaD]
36	N/A	VGV PUMP FILTER BOWL	SUPPLIED BY GE IAD AA–B244–24D2Y1A	(1) REF	FILTER, BLACK ANODIZED, DESIGN INLET PRESSURE = 1300 PSIG, [8963 kPaG], 9 GPM [34 L/min], 70–200 °F [21–93 °C]
37	MCD–1059 MCD–1062 MCD–1066	MAGNETIC CHIP DETECTOR TURBINE LUBE SYSTEM	SUPPLIED BY GEAE ENGINE MANUFACTURER	(3) REF	MAGNETIC CHIP DETECTOR ELEMENT
38	PDT–1082	TURBINE AIR OIL SEPARATOR DIFFERENTIAL PRESSURE TRANSMITTER	ROSEMOUNT {382A5655P0001}	1	DIFFERENTIAL PRESSURE TRANSMITTER, –250 to 250 inH2O RANGE, 316 SS ISOLATING DIAPHRAGM, VITON O–RINGS, 1/4"–18 FNPT PROCESS, 1/2"–14 NPT ELECTRICAL CONNECTIONS, 4–20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF CENELEC AND CSA, FLAMEPROOF, INTRINSIC SAFETY, NON–INCENDIVE. SET AT 4 mA = 0 PSID [0 kPaD] AND 20 mA = 5 PSID [35 kPaD]

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
39	N/A	TURBINE LUBE OIL AIR/OIL SEPARATOR	GEPPLP {701209}	1	AIR/OIL SEPARATOR, 6"–150# INLET, 1/2" FNPT DRAIN, 6" VENT, CS, REPLACEMENT ELEMENT: MONSANTO, P/N: 20285.11 ELEMENT WEIGHT: 485 LB [220 kG] WET; 355 LB [161 kG] DRY
40	MOT–1083	TURBINE LUBE OIL AIR/OIL HEAT EXCHANGER	MARATHON ELECTRIC {386A6675P0002}	1	FIN/FAN COOLER, 6"–150# RF INLET AND OUTLET, CONSTRUCTION: PLENUM–CS, FAN–ALUMINUM, CORE–ALUMINUM WITH HERESITE COATING, DUAL RATED MOTOR: 1/1 HP 0.75/0.75 kW, 460/400 VAC, 3 PH, 1735/1450 RPM, 60/50 Hz
41	LG–1084	AIR/OIL PRE–SEPARATOR LEVEL GAUGE	GEPPLP {79908}	1	PART OF AIR/OIL PRE–SEPARATOR 701210
42	N/A	TURBINE LUBE OIL AIR/OIL PRE–SEPARATOR	GEPPLP {701210}	1	AIR/OIL PRE–SEPARATOR, 6"–150# INLET/OUTLET, 1 1/2" FNPT DRAIN, 304 SS REPLACEMENT ELEMENT: ACS IND INC, P/N: ACS–3BF–13.63 X 4
43 TO 60		INTENTIONALLY LEFT BLANK			
61	N/A	CHECK VALVE TURBINE LUBE OIL	GEPPLP {J00008}	1	CHECK VALVE, 1 1/2"–150# RF, SS BODY, TRIM AND SEAT, 2.2 PSID [15.2 kPaD] CRACKING PRESSURE

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
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NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969244

REV. A

SCALE NONE

SHEET 7 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
62		INTENTIONALLY LEFT BLANK			
63		INTENTIONALLY LEFT BLANK			
64		INTENTIONALLY LEFT BLANK			
65		INTENTIONALLY LEFT BLANK			
66		INTENTIONALLY LEFT BLANK			
67		INTENTIONALLY LEFT BLANK			
68		INTENTIONALLY LEFT BLANK			
69	N/A	LUBE OIL COOLER WATER SUPPLY VALVE	TRIAC CONTROLS, INC. {398A5274P0001}	1	3-WAY BALL VALVE, 2"-150 # RF, SS BODY, BALL, AND STEM, RTFE SEATS
70	N/A	TURBINE LUBE OIL HEAT EXCHANGER (MAIN)	API BASCO {398A5198P0001}	1	DUPLEX SHELL & TUBE HEAT EXCHANGER, SS TUBES, CS SHELL, ASME CODE STAMPED, TEMA "C"
71	N/A	TURBINE LUBE OIL HEAT EXCHANGER (INTERMEDIATE)	API BASCO {398A5199P0001}	1	DUPLEX SHELL & TUBE HEAT EXCHANGER, SS TUBES AND SHELL, CS BONNET ASME CODE STAMPED, TEMA "C"
72	N/A	TURBINE LUBE OIL SYSTEM INSTRUMENT VALVE	DRAGON 1053V3	11	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
73	N/A	DIFFERENTIAL PRESSURE BALANCE VALVE	DRAGON 10P053	4	GLOBE VALVE, 1/4" FNPT, 316 SS, GRAFOIL PACKING
74	N/A	DUAL WAFER CHECK VALVE BALANCE VALVE	GEPPLP {382A6360P0001}	2	CHECK VALVE DUAL WAFER, 2"-150#, 0-4 BAR SPRING, 316 SS

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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

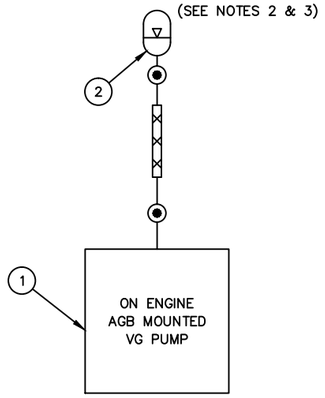
TITLE
FLOW & INSTRUMENT DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049-969244

REV. A

SCALE NONE

SHEET 8 OF 8



LEGEND:

INDICATES GE ENGINE CONNECTION AS DESIGNATED BY GE DRAWINGS

NOTES:

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2. ACCUMULATOR SUPPLIED WITH ENGINE.
3. PRE-CHARGE THE ACCUMULATOR TO 700-800 PSIG [4826-5516 KPaG] WITH NITROGEN AS FOLLOWS:
   A.) SLOWLY FILL ACCUMULATOR TO 700-750 PSIG [4826-5171 KPaG].
   B.) ALLOW PRE-CHARGE TO SIT FOR 10 TO 15 MINUTES.
   C.) IF PRE-CHARGE EXCEEDS 800 PSIG [5516 KPaG] SLOWLY OPEN BLEED VALVE TO REDUCE PRESSURE TO 700-800 PSIG [4826-5516 KPaG].
4. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.

REFERENCE DRAWING:

X-000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X-969244 F & ID, TURBINE LUBE OIL SYSTEM
X-969272 INSTRUMENTATION DIAGRAM, AUXILIARY SYSTEMS

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UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW AND INSTRUMENT DIAGRAM
TURBINE HYDRAULIC SYSTEM

DWG NO. 7253049-969247

REV. A

SCALE NONE

SHEET 1 OF 2

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	VG PUMP	SUPPLIED WITH ENGINE	(1) REF	POSITIVE DISPLACEMENT PUMP SUPPLIED WITH ENGINE
2	N/A	HYDRAULIC ACCUMULATOR	SUPPLIED WITH ENGINE	(1) REF	GE PART NUMBER L44991P01

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FLOW AND INSTRUMENT DIAGRAM
TURBINE HYDRAULIC SYSTEM

DWG NO. 7253049-969247

REV. A

SCALE NONE

SHEET 2 OF 2

LEGEND:

☐ INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

ESN = EMERGENCY STOP NO MOTORING

NOTES:

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2. LUBE OIL RESERVOIR SHALL BE 304 SS, PLATE ASTM A240/A240M.
3. CUSTOMER TO SUPPLY DRAIN VALVES AT CONNECTION 14, CLOSED WHEN RUNNING, OPEN WHEN SHUTDOWN OR DURING MAINTENANCE.
4. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
5. CUSTOMERS DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
6. COOLING WATER 325 GPM [1230 L/min] AT 95 °F [35 °C] MAXIMUM INLET MAXIMUM WOP = 100 PSIG [689 KPaG], 8 PSID [55 kPaD] MAXIMUM DROP WATER SIDE, HEAT LOAD = 47012 Btu/min [49600 kJ/min].
7. CUSTOMER SHALL BE RESPONSIBLE TO MAINTAIN COOLING WATER PRESSURE, NOT TO EXCEED 150 PSIG [1034 kPaG] MAXIMUM.
8. COOLING WATER 41 GPM [155 L/min] AT 95 °F [35 °C] MAXIMUM INLET, MAXIMUM WOP = 100 PSIG [689 kPaG], 5 PSID [34 kPaD] MAXIMUM DROP WATER SIDE, HEAT LOAD = 1377 Btu/min [1452 kJ/min].

REFERENCE DRAWINGS:

X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X–969200 GENERAL ARRANGEMENT, MAIN UNIT, RH
X–969221 GENERAL ARRANGEMENT, LUBE OIL RESERVOIR SKID
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969244 F&ID, TURBINE LUBE OIL SYSTEM

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

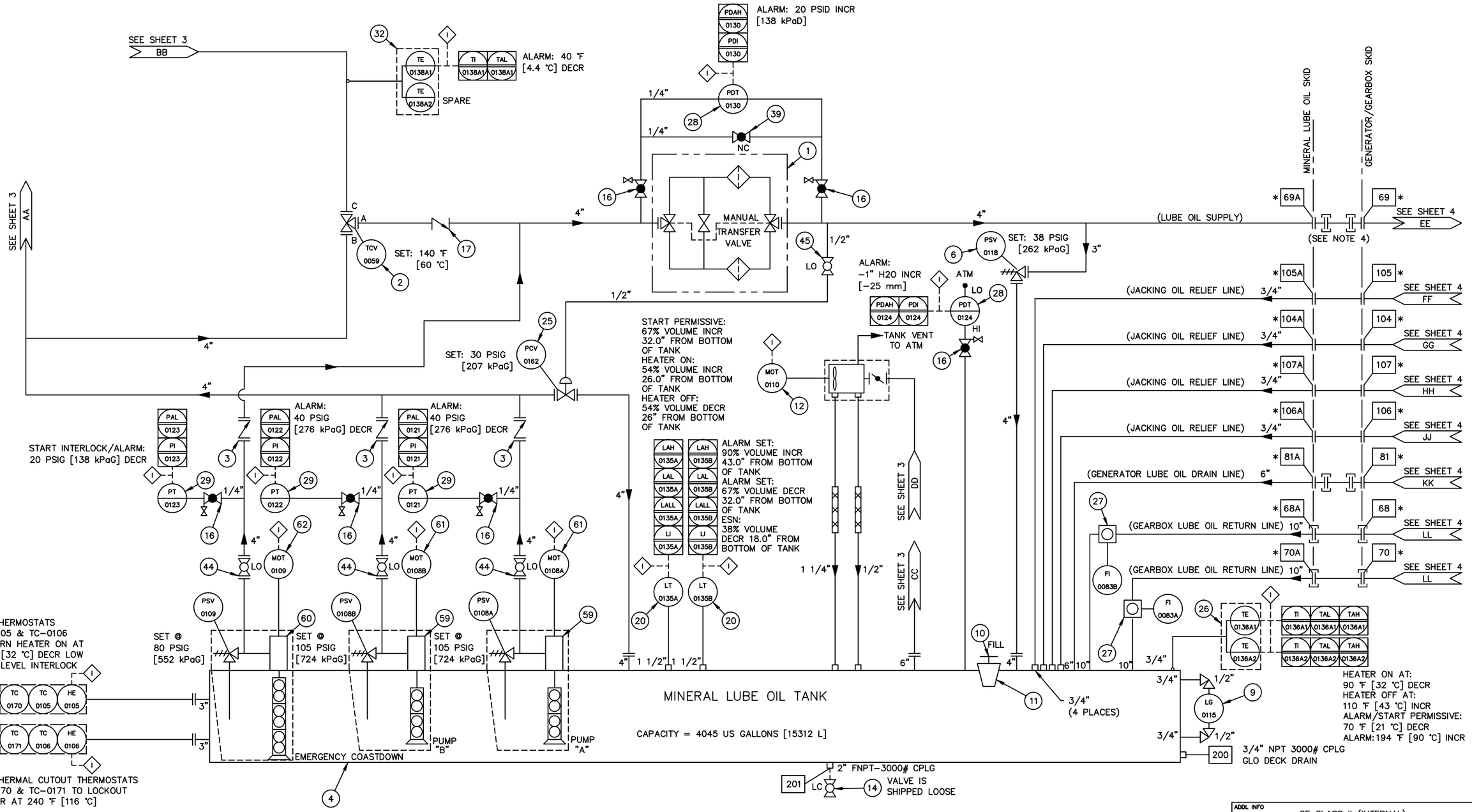
TITLE
FLOW & INSTRUMENT DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969248

REV. A

SCALE NONE

SHEET 1 OF 8



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UNIT TYPE LM6000PC

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049−969248
REV. A
SCALE NONE
SHEET 2 OF 8

CONNECTION DESCRIPTION: COOLING WATER RETURN		
SIZE: 4"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
52 [359]	325[1230]	114 [46]
–	–	–
–	–	–

102

CONNECTION DESCRIPTION: COOLING WATER SUPPLY		
SIZE: 4"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
60 [414]	325[1230]	95 [35]
–	–	–
–	–	–

(NOTE 6) 101

71 PSV 0098 SET: 1034 kPa [150 PSI] (TYP)

36 15 LC 15 LC 1" 3/4" TO ATM

46

LC LC 15

7 4" 4"

15 LC 15 LC 1" 3/4" TO ATM 71 PSV 0099

36 REF LC LC 15

MAIN MLO HEAT EXCHANGER

*153A 4"–150# RF

153 4"–150# RF

SEE SHEET 2 BB

*152A 4"–150# RF

152 4"–150# RF

MINERAL LUBE OIL TANK

SEE SHEET 2 AA

SEE SHEET 2 DD

CONNECTION DESCRIPTION: COOLING WATER SUPPLY		
SIZE: 2"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
–	–	–
–	41 [155]	95 [35]
–	–	–

108 (NOTE 8)

6" 69

CONNECTION DESCRIPTION: COOLING WATER RETURN		
SIZE: 2"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
–	–	–
–	41 [155]	100 [38]
–	–	–

109

6"

SEE SHEET 2 CC

MLO TANK DEMISTER HEAT EXCHANGER

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NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

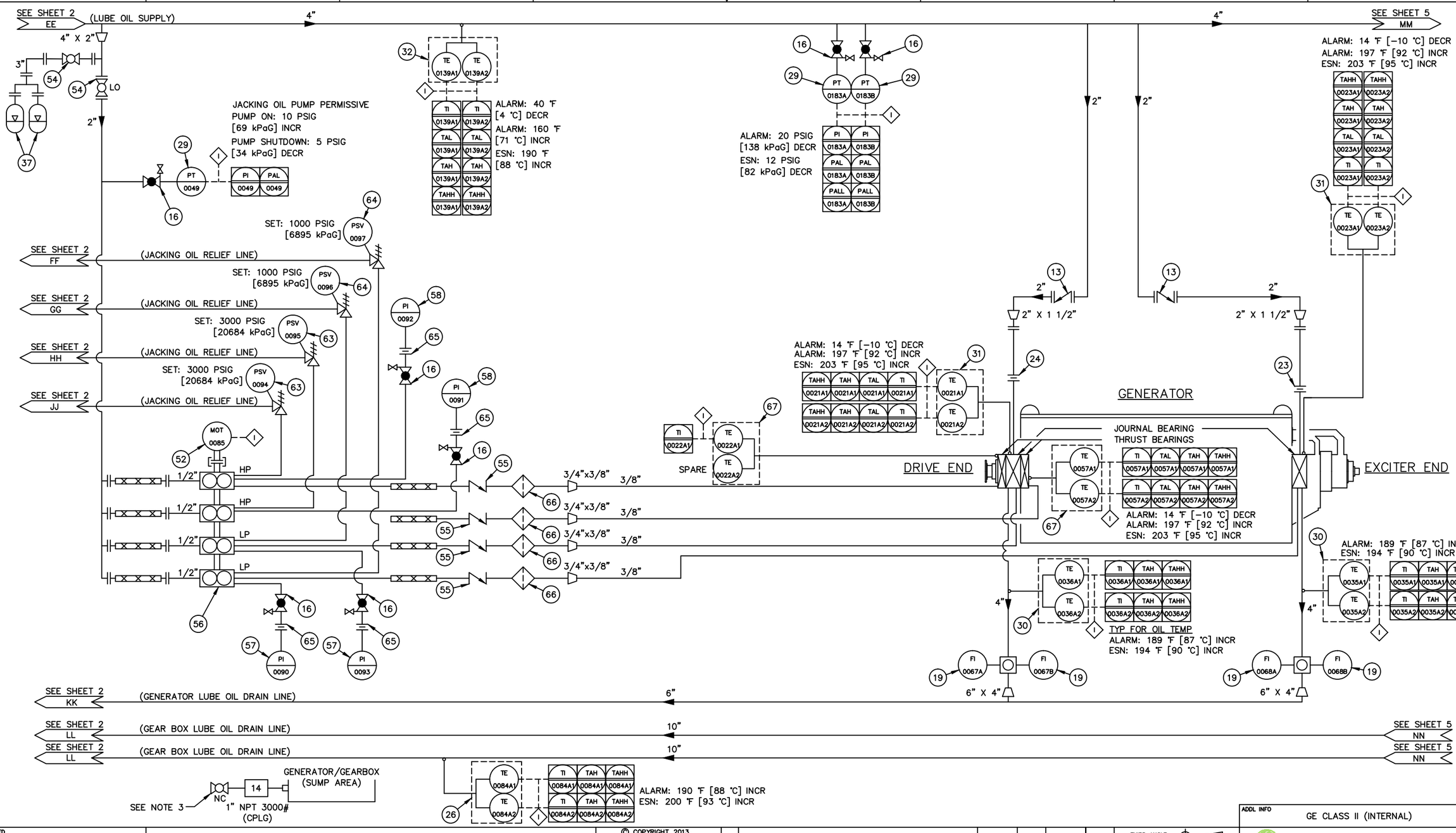
TITLE: FLOW & INSTRUMENT DIAGRAM MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969248

REV. A

SCALE NONE

SHEET 3 OF 8



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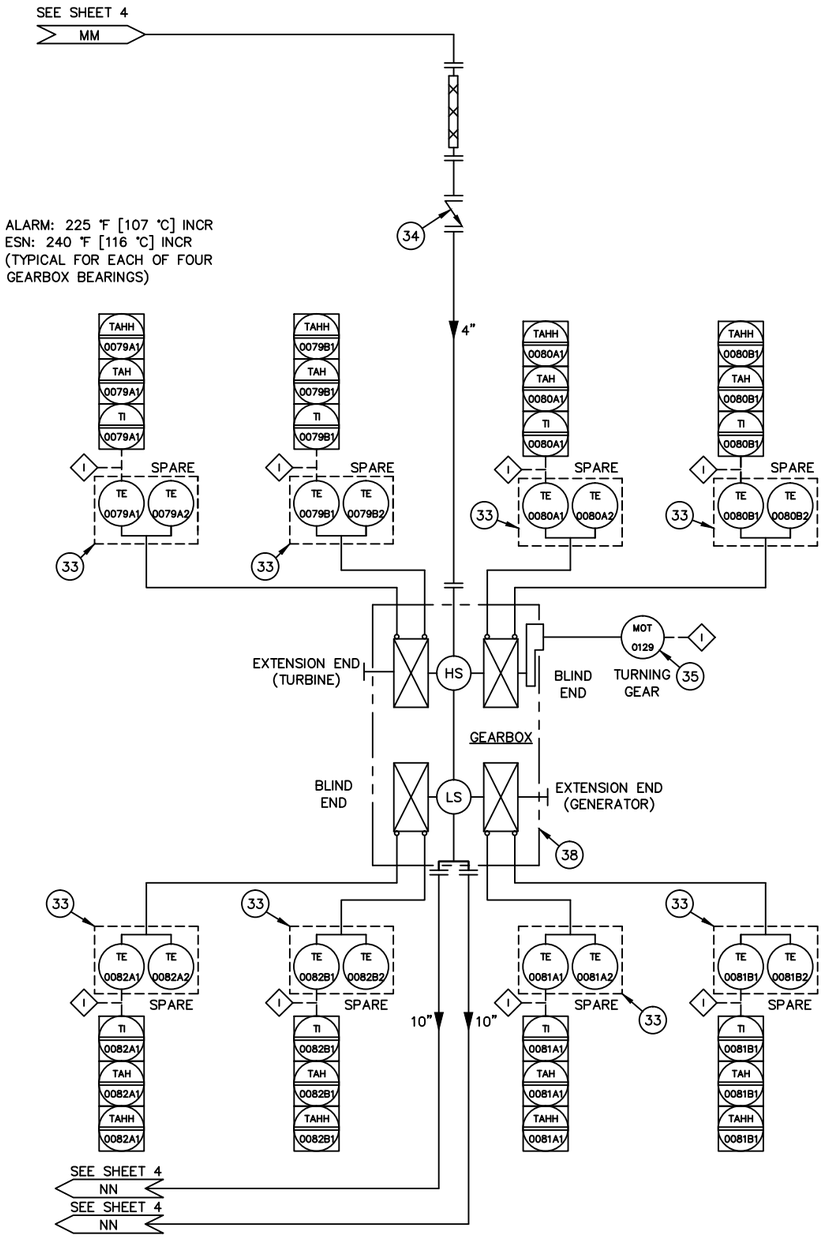
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NEXT ASSY.

UNIT TYPE LM6000PC

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & INSTRUMENT DIAGRAM MINERAL LUBE OIL SYSTEM

DWG NO. 7253049-969248

REV. A

SCALE NONE

SHEET 5 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	GENERATOR LUBE OIL FILTER	PALL {HZ3142J04KNXWPT}	1	PRESSURE BALANCED DPLX FILTER, 4"-150# RF, 6 MICRON ABSOLUTE ELEMENTS, 3 PER CANISTER, COLLAPSE RATED AT 150 PSID, BODY MWP 1793 kPaG [260 PSIG], INTEGRAL TRANSFER VALVE, VISUAL INDICATOR, NO BYPASS, REPL. ELEMENT: HC8900FKN39Z
2	TCV-0059	GENERATOR LUBE OIL THERMOSTATIC CONTROL VALVE	FLUID POWER ENERGY {399A1565P0001}	1	THERMOSTATIC 3-WAY VALVE, 4"-150# RF CS BODY, VITON SEALS, NICKEL PLATED THERMOSTAT, 1/8" DIAMETER LEAK HOLE, 140
3	N/A	GENERATOR LUBE OIL SUPPLY CHECK VALVE	CHECK-ALL {382A5210P0001}	3	CHECK VALVE, 4"-150# FLANGE INSERT, 316 SS, METAL TO METAL SEAT, 5 PSID [34 kPaD] CRACKING PRESSURE
4	N/A	GENERATOR LUBE OIL RESERVOIR	GEPPLP {868380}	1	TANK, 304 SS, 4045 GALLON [15312 LITERS] CAPACITY, ASTM A240, ATMOSPHERIC VENT
5		INTENTIONALLY LEFT BLANK			
6	PSV-0118	GENERATOR BEARING SUPPLY RELIEF VALVE	AGCO {J00824}	1	PRESSURE RELIEF VALVE, 3"-150# RF INLET X 4"-150# RF OUTLET, CS BODY, SS TRIM, BUNA-N SEALS, FOR 330 GPM [1249 L/MIN] SET AT 38 PSIG [262 kPaG]
7	N/A	GENERATOR LUBE OIL COOLER OIL TRANSFER VALVE	SUPPLIED WITH ITEM 36	(1) REF	6-WAY MANUAL VALVE, SS BODY AND TRIM, 4"-150# RF, VITON SEALS, 1 DRAIN AND 1 VENT VALVE
8	HE-0105 TC-0105/ 0170 HE-0106 TC-0106/ 0171	GENERATOR/GEARBOX LUBE OIL TANK HEATER	CHROMALOX {393A3444P0001}	2	THERMOSTATICALLY CONTROLLED HEATER, 3"-150# RF, 9'-6" IMMERSION LENGTH, 10.4/15 kW, 400/480 VAC, 3 PH, 50/60HZ, ATEX & CSA APPROVED
9	LG-0115	GENERATOR/GEARBOX LUBE OIL TANK LEVEL GAUGE	DANIEL {63-RL}	1	LEVEL GAUGE, 3/4" MNPT TANK CONNECTION, TYPE 1-S VALVE, 1/2" MNPT GAUGE CONNECTION
10	N/A	GENERATOR LUBE OIL TANK FILL CAP	TEDECO {MF9639LKPSS}	1	FILL CAP, 2" MNPT, HINGED, LOCKING TYPE, SS
11	N/A	GENERATOR LUBE OIL STRAINER	TEDECO {377A2452P0001}	1	BASKET STRAINER, 2"-150# RF, 304 SS, 40 MESH, 150% OPEN AREA
12	MOT-0110	GENERATOR/GEARBOX LUBE OIL TANK AIR/OIL SEPARATOR	DONALDSON {393A3530P0001}	1	AIR/OIL SEPARATOR, RAINHOOD INCLUDED, MOTOR: 3 HP [2.2 kW] 460 VAC, 3 PH, 60 HZ, 3450 RPM, CSA APPROVED REPLACEMENT ELEMENT: H.E.P.A. FILTER P/N 1411-13, WITH (2) 6" ID FLEX HOSE W/SS SPIRAL REINFORCEMENT AND DEMISTER DRAIN KIT P/N 942-02
13	N/A	GENERATOR LUBE OIL SUPPLY CHECK VALVE	CHECK-ALL {J00825}	2	CHECK VALVE, 2"-150# FLANGE INSERT 316 SS, METAL TO METAL SEAT, 1/2 PSID [3.4 kPaD] CRACKING PRESSURE
14	N/A	GENERATOR/GEARBOX LUBE OIL TANK DRAIN VALVE	WATTS {J00465}	1	BALL VALVE, 2" FNPT, CS BODY, SS TRIM, REDUCED PORT, DURAFILL REINFORCED TFE SEATS, LOCKABLE HANDLE
15	N/A	GENERATOR LUBE OIL HEAT EXCHANGER DRAIN/VENT VALVE	SUPPLIED WITH ITEM 36	(8) REF	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, FULL PORT, PTFE PACKING AND BUSHINGS, VITON SEALS
16	N/A	GENERATOR LUBE OIL INSTRUMENT VALVE	DRAGON {1053V3}	13	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
17	N/A	LUBE OIL SUPPLY CHECK VALVE	CHECK-ALL {J00120}	1	CHECK VALVE, 4"-150# FLANGE INSERT, 316 SS, METAL TO METAL SEAT, 1/2 PSID [34 kPaD] CRACKING PRESSURE
18		INTENTIONALLY LEFT BLANK			
19	FI-0067A FI-0067B FI-0068A FI-0068B	GENERATOR LUBE OIL FLOW INDICATOR	OPW {LSP51-09}	4	FLOW INDICATOR, 2" NPT, SS VITON SEALS

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
20	LT-0135A LT-0135B	GENERATOR LUBE OIL TANK LEVEL TRANSMITTER	ROSEMOUNT {393A1413P0001}	2	GUIDED WAVE RADAR LEVEL TRANSMITTER, 1 1/2" MNPT PROCESS CONNECTION AND 1/2"-14 NPT CONDUIT FOR ELECTRICAL CONNECTION, 316 SS COAXIAL PROBE, 3 FEET PROBE LENGTH, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, ATEX, FM AND CSA FLAME-PROOF/EXPLOSION PROOF APPROVAL, INTEGRAL DISPLAY. SET AT: 4 mA = 0% [10" FROM TANK BOTTOM] 20mA = 100% [22.5" FROM TANK BOTTOM] PROBE END IS 10" FROM TANK BOTTOM
21		INTENTIONALLY LEFT BLANK			
22		INTENTIONALLY LEFT BLANK			
23	N/A	GENERATOR OIL ORIFICE	SUPPLIED W/GENERATOR	(1) REF	ORIFICE, NON DRIVE END, 0.47" [12 mm] DIAMETER, SS
24	N/A	GENERATOR OIL ORIFICE	SUPPLIED W/GENERATOR	(1) REF	ORIFICE, DRIVE END, 0.67" [17 mm] DIAMETER, SS
25	PCV-0162	GENERATOR/GEARBOX LUBE OIL PRESSURE CONTROL VALVE	FISHER {655R-EDR-4"}	1	PRESSURE REGULATOR, 4"-150# RF, GLOBE STYLE, FULL PORT, CS BODY, SS TRIM, 19-53 PSIG [131-365 kPaG] SPRING, 7/16" TRAVEL, QUICK OPENING TRIM, SIZE 4B ACTUATOR
26	TE-0136A1 TE-0136A2 TE-0084A1 TE-0084A2	GENERATOR LUBE OIL TEMPERATURE ELEMENT	ROSEMOUNT {393A3482P0001}	2	PLATINUM RTD, DUAL ELEMENT, 10" IMMERSION CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
27	FI-0083A FI-0083B	GEARBOX LUBE OIL FLOW INDICATOR	CYCLOPS {393A3800P0001}	2	SAFETY SITE GLASS, SS CONSTRUCTION, TEFLON SEALS, PAD RADIUS TO MATCH 10" SCH 10 PIPE
28	PDT-0124 PDT-0130	GENERATOR LUBE OIL DIFFERENTIAL PRESSURE TRANSMITTER	ROSEMOUNT {382A5657P0001}	2	DIFFERENTIAL PRESSURE TRANSMITTER, -1000 to 1000 inH2O [-2.5 to 2.5 bar] RANGE, 316 SS ISOLATING DIAPHRAGM, VITON O-RINGS, 1/4"-18 FNPT PROCESS & 1/2"-14 NPT ELECTRICAL CONNECTION, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF ATEX AND CSA, FLAMEPROOF, INTRINSIC SAFETY, NON-INCENDIVE
29	PT-0049 PT-0121 PT-0122 PT-0123 PT-0183A PT-0183B	GENERATOR LUBE OIL PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	6	PRESSURE TRANSMITTER, -14.7 to 800 PSI, 316 SS DIAPHRAGM, VITON O-RINGS, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF CSA, FM, AND ATEX EXPLOSION PROOF, INTRINSIC SAFETY
30	TE-0035A1 TE-0035A2 TE-0036A1 TE-0036A2	GENERATOR LUBE OIL BEARING DRAIN TEMPERATURE ELEMENT	MINCO {D3130332-01}	(2) REF	DUAL ELEMENT RTD, PROVIDED BY BRUSH ELECTRIC, MOUNTED ON GENERATOR
31	TE-0021A1 TE-0021A2 TE-0023A1 TE-0023A2	GENERATOR LUBE OIL BEARING METAL TEMPERATURE ELEMENT	MINCO {D3132401-02}	(2) REF	DUAL ELEMENT RTD, PROVIDED BY BRUSH ELECTRIC, MOUNTED ON GENERATOR
32	TE-0138A1 TE-0138A2 TE-0139A1 TE-0139A2	LUBE OIL TEMPERATURE ELEMENT	ROSEMOUNT {J01068}	2	PLATINUM RTD, DUAL ELEMENT, 2 1/2" DIRECTLY CONNECTED TO TERMINAL BOX WITH CHAIN ATTACHED FLAT COVER, EXPLOSION PROOF ASSEMBLY, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL

NOTES:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.
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GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049-969248

REV. A

SCALE NONE

SHEET 6 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
33	TE-0079A1/A2 TE-0079B1/B2 TE-0080A1/A2 TE-0080B1/B2 TE-0081A1/A2 TE-0081B1/B2 TE-0082A1/A2 TE-0082B1/B2	GEARBOX LUBE OIL BEARING METAL TEMPERATURE ELEMENT	MINCO {S19350PD354880}	(8) REF	DUAL ELEMENT RTD, 100 OHM, PLATINUM, SUPPLIED WITH GEARBOX
34	N/A	GENERATOR/GEARBOX SUPPLY CHECK VALVE	CHECK-ALL {J00121}	1	CHECK VALVE, 4"-150# FLANGE INSERT, 316 SS, VITON SEAT, 1/2 PSID [3.4 kPaD] CRACKING PRESSURE
35	MOT-0129	TURNING GEAR MOTOR	PART OF ITEM 38	(1) REF	MOTOR, VERTICAL MOUNT, 30 HP [22 kW], 1800 RPM, 460 VAC, 3 PH, 60 Hz, FLAME PROOF
36	N/A	GENERATOR/GEARBOX LUBE OIL HEAT EXCHANGER	THERMAL & MECHANICAL EQUIPMENT CO. {398A5196P0001}	1	DUPLEX SHELL/TUBE HEAT EXCHANGER, COOLING WATER ON TUBE SIDE (4"-150# RF) & GENERATOR LUBE OIL ON SHELL SIDE (4"-150# RF), TEMA "C", ASME STAMPED, CS SHELL, ADMIRALTY TUBES
37	N/A	ACCUMULATOR ASSEMBLY	OLAER INDUSTRIES {393A3501P0001}	2	40 GAL [151.42 L] ACCUMULATOR ASSEMBLY, 3"-150# RF FOR FLUID PORT CONNECTION SET KIT: SEE SHIPLOOSE DRAWING
38	N/A	GEARBOX	LUFKIN {334A5064P0001}	(1) REF	GEARBOX, 60 HZ
39	N/A	GENERATOR LUBE OIL FILTER DIFFERENTIAL PRESSURE BALANCE VALVE	DRAGON {10P053}	1	GLOBE VALVE, 1/4" FNPT, 316 SS, GRAFOIL PACKING
40		INTENTIONALLY LEFT BLANK			
41		INTENTIONALLY LEFT BLANK			
42		INTENTIONALLY LEFT BLANK			
43		INTENTIONALLY LEFT BLANK			
44	N/A	GENERATOR/GEARBOX LUBE OIL ISOLATION VALVE	WATTS {4INCHSF-2800-150}	3	BALL VALVE, 4"-150# RF, SS BODY, SS TRIM, FULL PORT, DURAFILL REINFORCED TFE SEATS, LOCKABLE HANDLE
45	N/A	GENERATOR LUBE OIL PRESSURE SENSING VALVE	WATTS {1/2"-S8000-LL}	1	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, FULL PORT, TFE SEATS, 2000 WOG RATING, LOCKABLE HANDLE
46	N/A	GENERATOR LUBE OIL COOLER WATER SUPPLY VALVE	SUPPLIED WITH ITEM 36	(1) REF	6-WAY TRANSFER VALVE, 4"-150# RF, SS BODY, SS TRIM, SS BALL (PART OF ITEM 36)
47		INTENTIONALLY LEFT BLANK			
48		INTENTIONALLY LEFT BLANK			
49		INTENTIONALLY LEFT BLANK			
50		INTENTIONALLY LEFT BLANK			
51		INTENTIONALLY LEFT BLANK			
52	MOT-0085	JACKING OIL MOTOR	GEPPLP {393A3536P0001}	1	MOTOR, 11.2 kW/15 HP, 3 PH, 460 VAC, 60 HZ, 1800 RPM
53		INTENTIONALLY LEFT BLANK			
54	N/A	PUMP ISOLATION VALVE	WATTS {J00016}	2	BALL VALVE, 2"-150# RF, SS BODY, SS TRIM, FULL PORT, DURAFILL REINFORCED TFE SEATS, LOCKABLE HANDLE
55	N/A	PUMP DISCHARGE CHECK VALVE	KEPNER {2227}	4	CHECK VALVE, 3/4" FSAE INLET AND OUTLET CONNECTIONS, 316 SS, VITON O-RING, 30 PSID [207 kPaD] CRACKING PRESSURE
56	N/A	GENERATOR JACKING OIL PUMP	VOITH/ECKERLE {RCN1970A}	1	PUMP, 4 ELEMENT PUMP WITH EACH ELEMENT ISOLATED, 1/2" SAE CODE 61 INLET, 1/2" BSPP OUTLET, TWO (2) PUMP ELEMENTS EACH RATED AT 0.319 CUBIC INCHES PER REV AT 2850 PSIG DISCHARGE PRESSURE, TWO (2) PUMP ELEMENTS EACH RATED AT 0.219 CUBIC INCHES PER REV AT 800 PSIG DISCHARGE PRESSURE, COMPLETE WITH COUPLING AND BELL HOUSING
57	PI-0090 PI-0093	LP JACKING OIL PUMP DISCHARGE PRESSURE INDICATOR	ASHCROFT {377A1184P0000}	2	PRESSURE GAUGE, 4 1/2" DIAL, 0-1500 PSIG [0-100 BARG] DUAL SCALE RANGE, PANEL MOUNTED, ALUMINUM CONSTRUCTION, 316 SS BOURDON TUBE, 1/4" NPT BACK CONNECTION
58	PI-0091 PI-0092	HP JACKING OIL PUMP DISCHARGE PRESSURE INDICATOR	ASHCROFT {377A2327P0001}	2	PRESSURE GAUGE, 4 1/2" DIAL, 0-5500 PSIG [0-400 BARG] DUAL SCALE RANGE, PANEL MOUNTED, ALUMINUM CONSTRUCTION, 316 SS BOURDON TUBE, 1/4" NPT BACK CONNECTION
59	PSV-0108A PSV-0108B	GENERATOR/GEARBOX AC LUBE OIL PUMP	LEISTRITZ {393A3532P0001}	2	PUMP & AC MOTOR ASSEMBLY 457 GPM AT 1800 RPM AND 97 PSIG [669 kPaG], SUBMERGE, 4"-150# RF OUTLET, INCLUDES AC MOTOR ITEM 61
60	PSV-0109	GENERATOR/GEARBOX DC LUBE OIL EMERGENCY COASTDOWN PUMP	LEISTRITZ {398A4509P0001}	1	PUMP & DC MOTOR ASSEMBLY 165 GPM AT 1800 RPM AND 50 PSIG [345 kPaG], SUBMERGE, 4"-150# RF OUTLET, INCLUDES DC MOTOR ITEM 62

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049-969248

REV. A

SCALE NONE

SHEET 7 OF 8

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
61	MOT-0108A MOT-0108B	GENERATOR/GEARBOX AC LUBE OIL MOTOR	GEPPLP {393A3522P0001} PART OF ITEM 59	(2) REF	AC MOTOR 460 VAC, 3 PH, 60 HZ, 40 HP [30 kW], 1800 RPM
62	MOT-0109	GENERATOR/GEARBOX DC LUBE OIL MOTOR	GEPPLP {398A4500P0001} PART OF ITEM 60	(1) REF	DC MOTOR 20 HP [15 kW] 125 VDC, 1800 RPM, UL APPROVED, EXPLOSION PROOF CLASS 1, GROUP D
63	PSV-0094 PSV-0095	GENERATOR JACKING OIL HP PUMP RELIEF VALVE	VOITH/ECKERLE DBV-10 {J00021}	(2) REF	RELIEF VALVE, 3000 PSIG [20684 kPaG] SET PRESSURE, (PART OF ITEM 56)
64	PSV-0097 PSV-0096	GENERATOR JACKING OIL LP PUMP RELIEF VALVE	VOITH/ECKERLE DBV-10 {J00022}	(2) REF	RELIEF VALVE, 1000 PSIG [6895 kPaG] SET PRESSURE, (PART OF ITEM 56)
65	N/A	PRESSURE GAUGE SNUBBERS	ASHCROFT {1112SD}	4	PRESSURE SNUBBER, 1/4" NPT, 303 SS HOUSING, RAISIN 316 SS FILTER DISC
66	N/A	JACKING OIL PUMP DISCHARGE OIL FILTER	DONALDSON {HPK0300B0802NX}	4	HYDRAULIC OIL FILTERS, 3/4" SAE, 5 MICRON ABSOLUTE ELEMENT, COLLAPSE RATED AT 3000 PSID [20684 kPaG], NO BYPASS, VISUAL INDICATOR, REPLACEMENT ELEMENT: P16-7185
67	TE-0022A1 TE-0022A2 TE-0057A1 TE-0057A2	TEMPERATURE ELEMENT GENERATOR THRUST BEARING	SUPPLIED W/GENERATOR	(2) REF	(INBOARD AND OUTBOARD)
68		INTENTIONALLY LEFT BLANK			
69	N/A	GENERATOR TANK DEMISTER HEAT EXCHANGER	ANDERSON-SNOW {5096-W-18INCHX18INCH}	1	HEAT EXCHANGER, 9 FINS/INCH, 6 ROW, COOLANT: 2"-150# RF CONNECTIONS, AIR/OIL: 6" TUBE CONNECTIONS, ALUMINUM FINS, 304 SS HEADER, CASING AND TUBES
70		INTENTIONALLY LEFT BLANK			
71	PSV-0098 PSV-0099	GENERATOR LUBE OIL COOLER WATER RELIEF VALVE	AGCO {81PS1M68-4(150)}	2	PRESSURE RELIEF VALVE, CS BODY, SS TRIM, 1/4" DIAMETER ORIFICE, 3/4" MNPT INLET X 1" FNPT OUTLET

NOTES:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.
2. GEPPLP PARTS LISTED IN SIX DIGIT FORMAT ARE MANUFACTURING DRAWING NUMBERS. FOR THOSE ITEMS, CONTACT GEPPLP ENGINEERING FOR JOB SPECIFIC PART INFORMATION.

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

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LM6000®

ADDL INFO
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GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969248

REV. A

SCALE NONE

SHEET 8 OF 8

LEGEND:

ESN = FAST STOP LOCKOUT WITHOUT MOTOR
LEL = LOW EXPLOSION LEVEL

NOTES:

1. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
2. RUPTURE DISK MUST BE INSPECTED AFTER EACH CO2 DISCHARGE AND REPLACED AS NECESSARY.
3. THIS IS A SAMPLE DRAWING, DOES NOT DEPICT ACTUAL FIELD INSTALLATION. SHOWS TYPE OF INFORMATION TO BE SUPPLIED BY FIRE SYSTEM SUPPLIER OF FIRE SYSTEM DESIGN.
4. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
5. ROUTE ALL SWITCH AND DETECTOR WIRES TO CENTRAL FIRE AND GAS CONSOLE.
6. HAND SWITCHES TO BE LOCATED OUTSIDE MAIN SKID NEXT TO MOST FREQUENTLY USED DOORS.
7. WARNING NAMEPLATES ARE TO BE LOCATED AS INDICATED IN THE DESCRIPTION FOR ITEM 21.
8. WEIGH SCALE IS PROVIDED FOR CHECKING BOTTLES.
9. DAMPERS CLOSE AUTOMATICALLY WITH DISCHARGE OF CO2. 85 PSI PRESSURIZED AIR IS REQUIRED TO RESET THE DAMPERS.

REFERENCE DRAWINGS:

X–969201 GENERAL ARRANGEMENT, MAIN UNIT, LH
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969239 F&ID, VENTILATION AND COMBUSTION AIR SYSTEM

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FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

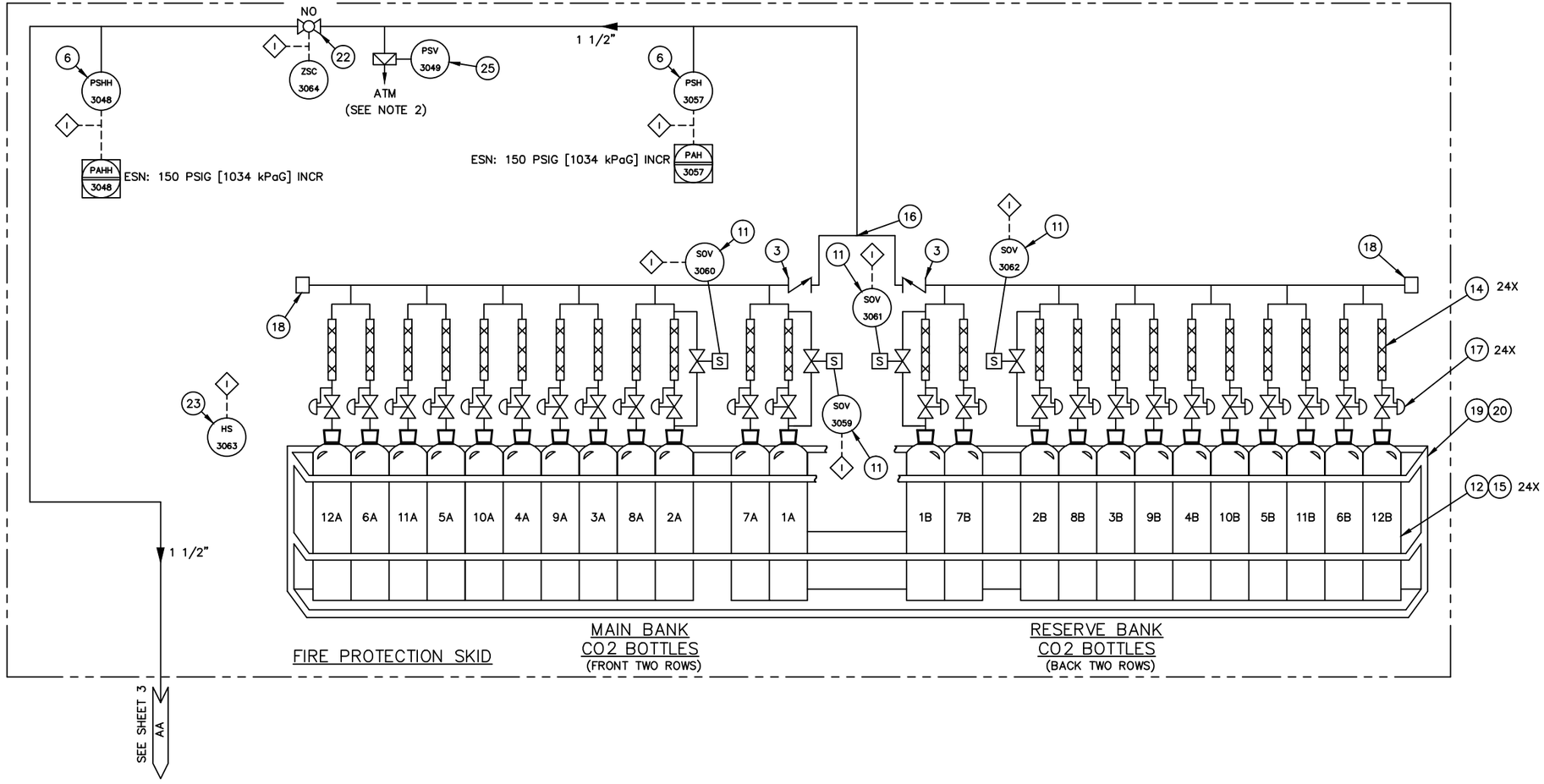
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW AND INSTRUMENT DIAGRAM
FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049–969254
REV. A

SCALE NONE
SHEET 1 OF 6



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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

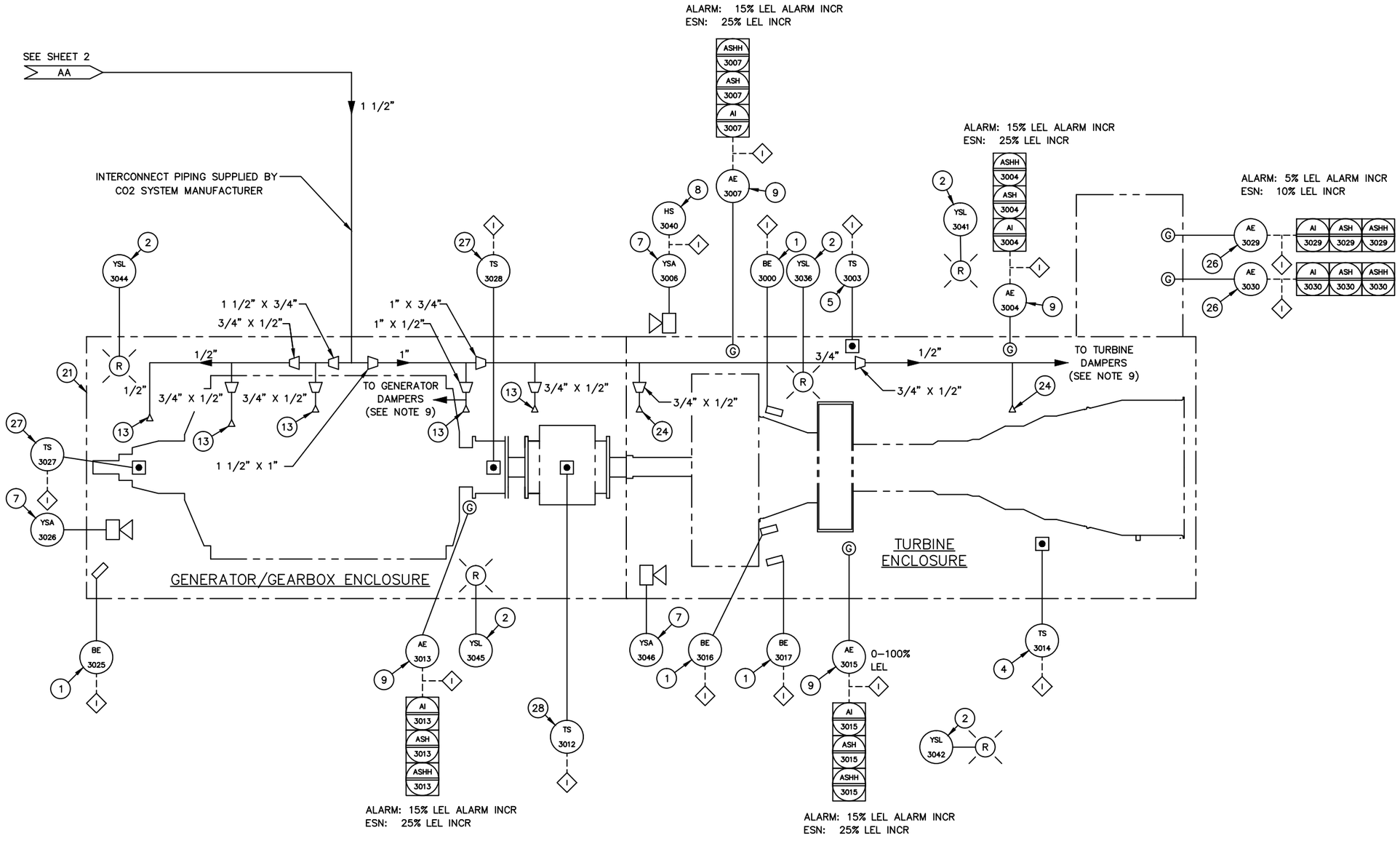
UNIT TYPE
LM6000®

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FLOW AND INSTRUMENT DIAGRAM
FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049-969254
REV. A
SCALE NONE
SHEET 2 OF 6



ALARM: 15% LEL ALARM INCR
ESN: 25% LEL INCR

ALARM: 15% LEL ALARM INCR
ESN: 25% LEL INCR

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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

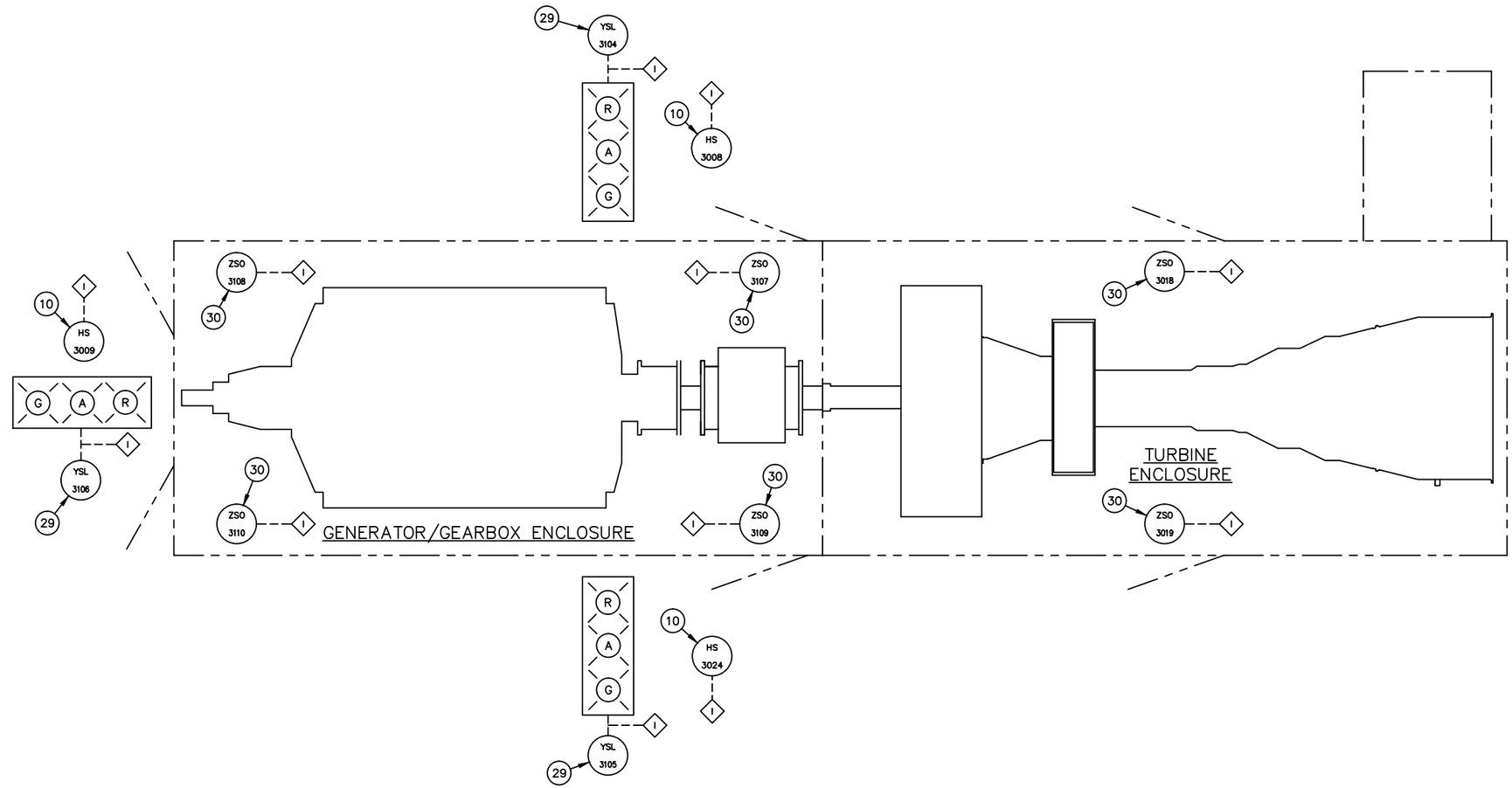
TITLE
FLOW AND INSTRUMENT DIAGRAM
FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049-969254

REV. A

SCALE NONE

SHEET 3 OF 6



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GE PACKAGED POWER, L.P.

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FLOW AND INSTRUMENT DIAGRAM
FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049-969254

REV. A

SCALE NONE

SHEET 4 OF 6

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	BE-3000 BE-3016 BE-3017 BE-3025	OPTICAL FLAME DETECTOR	DET-TRONICS {382A4669P0001}	4	IR FLAME DETECTOR, ATEX CERTIFIED, 90 DEGREE VIEW CONE, FORM C CONTACTS, 24 VDC (FAULT, FLAME)
2	YSL-3036 YSL-3041 YSL-3042 YSL-3044 YSL-3045	BEACON LIGHT	WILSON {TBD} {TBD}	5	LIGHT, RED, STROBE, 24 VDC, EXPLOSION PROOF
3	N/A	CHECK VALVE	WILSON {382A7487P0001}	2	CHECK VALVE, 1 1/2" NPT, MOUNTED IN MANIFOLD, BRASS BODY
4	TS-3014	THERMAL SPOT DETECTOR (TURBINE ROOM)	MEDC {386A4000P0001}	1	THERMAL SWITCH, FORM A, 24 VDC, 450 °F PLUS RATE OF RISE, 15 °F/MIN EXPLOSION PROOF
5	TS-3003	THERMAL SPOT DETECTOR (TURBINE ROOM)	MEDC {TBD}	1	THERMAL SWITCH, FORM A, 24 VDC, 450 °F PLUS RATE OF RISE, 15 °F/MIN WITH RESISTOR, EXPLOSION PROOF
6	PSHH-3048 PSH-3057	(DRY LINE) DISCHARGE PRESSURE SWITCH	WILSON {382A6241P0001}	2	PRESSURE SWITCH, TWO FORM A, 24 VDC, EXPLOSION PROOF DESIGNED FOR CO2 SERVICE
7	YSA-3006 YSA-3026 YSA-3046	FIRE/GAS ALARM HORN	WILSON {386A6240P0001} {TBD}	3	HORN, INDOOR/OUTDOOR, 24 VDC 100-110 dB AT 10 FEET, WHOOPING, EXPLOSION PROOF W/TONE CARD YELPING
8	HS-3040	HORN SILENCE SWITCH	WILSON {382A6424P0001}	1	KEYED STATION, FORM B MAINTAINED, 24 VDC
9	AE-3004 AE-3007 AE-3013 AE-3015	DETECTOR, COMBUSTIBLE GAS	WILSON {141A8869P0001}	4	DETECTOR, COMBUSTIBLE GAS (METHANE) ANALOG, EXPLOSION PROOF, ATEX CERTIFIED
10	HS-3008 HS-3009 HS-3024	MANUAL RELEASE STATION	WILSON {TBD} {TBD}	3	FIRE ALARM PULL STATION, MANUAL, 24 VDC, TWO FORM A, OUTDOOR, DESIGNED FOR CO2 SERVICE, EXPLOSION PROOF
11	SOV-3059 SOV-3060 SOV-3061 SOV-3062	AUTO/MANUAL RELEASE SOLENOID VALVE (MAIN)	KIDDE {382A6388P0001}	4	ELECTRIC CONTROL HEAD W/MANUAL RELEASE, 2 EACH MAIN AND RESERVE, EXPLOSION PROOF
12	N/A	FIRE SUPPRESSANT	CO2	2400 LBS	CO2, FOR FILLING ITEM 15, 100 LBS EACH CYLINDER, 1200 LBS MAIN BANK,1200 LBS RESERVE BANK, 2400 LBS TOTAL
13	N/A	NOZZLE (GENERATOR ROOM)	WILSON {382A6247P0001}	5	MULTIJET "S", 1/2" NPT, CS, CADMIUM PLATED
14	N/A	FLEXIBLE HOSE	KIDDE {377A2245P0002}	24	FLEX HOSE, 5/8" ID, FOR CO2, RUBBER WITH INTERNAL DOUBLE WIRE BRAID, BRONZE FITTINGS

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
15	N/A	CYLINDER	KIDDE {382A6387P0001}	24	CO2 CYLINDER, 100 LB CAPACITY, CS CONSTRUCTION, ALUMINUM SIPHON TUBE
16	N/A	MANIFOLD	WILSON {382A6313P0001}	1	MAIN/RESERVE MANIFOLD AND FITTINGS, 304 SS
17	N/A	DISCHARGE HEAD	KIDDE {377A2233P0001}	24	PLAIN NUT DISCHARGE HEAD
18	N/A	DISCHARGE INDICATOR	KIDDE {377A2244P0002}	2	POP-UP INDICATOR IN MANIFOLD, 3/4" NPT, BRASS BODY
19	N/A	CYLINDER RACK	WILSON {386A3351P0001}	1	CYLINDER FRAMING FOR TWENTY FOUR 100 LB CO2 BOTTLES, INCLUDES MOUNTS FOR ITEM 20
20	N/A	WEIGH SCALE	KIDDE {377A2251P0001}	1	CO2 CYLINDER WEIGH SCALE
21	N/A	CO2 WARNING NAMEPLATE SET GENERATOR & TURBINE COMPARTMENT DOORS	WILSON {216A4505P0001}	1	ONE (1) WARNING NAMEPLATE FOR THE OUTSIDE SURFACE OF EACH ENCLOSURE DOOR, AS FOLLOWS: SIGN 1 QUANTITY (6) (LAMINATED) (10" X 21") "WARNING, CARBON DIOXIDE GAS CAN CAUSE INJURY OR DEATH, WHEN ALARM OPERATES OR AFTER DISCHARGE, DO NOT ENTER, UNTIL VENTILATED". "DO NOT ENTER, WHILE UNIT IS OPERATING, INHIBIT FIRE PROTECTION SYSTEM BEFORE ENTRY". "NOTICE: RETAIN DOOR WITH HOLDER WHEN OPEN." ONE (1) WARNING NAMEPLATE FOR THE INSIDE SURFACE OF EACH ENCLOSURE DOOR, AS FOLLOWS: SIGN 2 QUANTITY (6) (ALU) (10" X 7") "WARNING, CARBON DIOXIDE GAS CAN CAUSE INJURY OR DEATH, WHEN ALARM OPERATES VACATE IMMEDIATELY". ONE (1) WARNING NAMEPLATE ADJACENT TO CO2 BOTTLES AND AT MANUAL RELEASE STATIONS, PER NFPA, AS FOLLOWS: SIGN 3 QUANTITY (4) (LAMINATED) (10" X 7") "WARNING, CARBON DIOXIDE GAS CAN CAUSE INJURY OR DEATH, ACTUATION OF THIS DEVICE WILL CAUSE CARBON DIOXIDE TO DISCHARGE, BEFORE ACTUATING BE SURE PERSONNEL ARE CLEAR OF THE AREA". ONE (1) WARNING NAMEPLATE FOR THE OUTSIDE SURFACE OF EACH ENCLOSURE DOOR AS FOLLOWS: SIGN 4 QUANTITY (6) (LAMINATED) (10" X 7") "WARNING, PRESSURIZED COMPARTMENT STAND CLEAR OF DOOR WHEN OPENING OR CLOSING" TOTAL 22 NAMEPLATES PER SET (THREE NAMEPLATES FOR EACH OF SIX ENCLOSURE DOORS, ONE NAMEPLATE ADJACENT TO CO2 BOTTLES AND ONE NAMEPLATE AT EACH OF THREE MANUAL RELEASE STATIONS).

NOTE:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
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NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW AND INSTRUMENT DIAGRAM
FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049-969254

REV. A

SCALE NONE

SHEET 5 OF 6

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
22	ZSC–3064	SERVICE BALL VALVE/ POSITION SWITCH	FLOWTEK {386A3104P0001}	1	BALL VALVE, 1 1/2" NPT, SS BODY & TRIM, GRAPHITE SEALS, FIRE SAFE, LOCKABLE HANDLES, ACCUTRAK NEMA–7 SWITCH, 24 VDC/1000 OHMS, UL/CSA LISTED
23	HS–3063	CO2 PURGE SWITCH	WILSON {382A6402P0001}	1	CO2 PURGE SWITCH WITH LATCHING RELAY ASSEMBLY
24	N/A	NOZZLE (TURBINE ROOM)	WILSON {382A6247P0001}	2	MULTIJET "S", 1/2" NPT, CS, CADMIUM PLATED
25	PSV–3049	SAFETY OUTLET VALVE ASSEMBLY	KIDDIE 803242	1	RUPTURE DISK ASSEMBLY RATED AT 2400–2800 PSIG RUPTURE DISK P/N: WK902514
26	AE–3029 AE–3030	IR GAS DETECTOR	WILSON {216A3298P0002}	2	IR GAS DETECTOR, 24 V, CLASS 1 DIV 2, EXPLOSION PROOF, ATEX CERTIFIED
27	TS–3027 TS–3028	THERMAL SPOT DETECTOR (GENERATOR ROOM)	MEDC {386A3999P0001}	2	THERMAL SWITCH, FORM A, 24 VDC, 225 °F PLUS RATE OF RISE, 15 °F/MIN EXPLOSION PROOF
28	TS–3012	THERMAL SPOT DETECTOR (GENERATOR ROOM)	MEDC {TBD}	1	THERMAL SWITCH, FORM A, 24 VDC, 225 °F PLUS RATE OF RISE, 15 °F/MIN WITH RESISTOR, EXPLOSION PROOF
29	YSL–3104 YSL–3105 YSL–3106	STATUS LAMPS	TBD	3	STATUS LAMPS, GREEN, RED, AMBER, 24 VDC, ATEX
30	ZSO–3108 ZSO–3107 ZSO–3018 ZSO–3019 ZSO–3109 ZSO–3110	SWITCH, DOOR LIMIT	TECHNOR {382A6250P0001}	6	LIMIT SWITCH, ROTARY HEAD, VARIABLE LENGTH DELRIN ROLLER LEVER, ACTUATION BY 30° CAM

NOTE:

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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW AND INSTRUMENT DIAGRAM FIRE AND GAS PROTECTION SYSTEM

DWG NO. 7253049–969254

REV. A

SCALE NONE

SHEET 6 OF 6

CUSTOMER INTERFACE INFORMATION

7

CONNECTION DESCRIPTION: EXHAUST DRAIN SIZE: 1"–150# RF FLANGED		
PRESSURE	FLOW	TEMPERATURE
**	**	**
0	0	0
**	**	**

** UP TO 20 GALLONS [76 L] OF WASH SOLUTION/WATER FOR TYPICAL SINGLE WASH – DOUBLE RINSE CYCLE. ACTUAL VOLUME WILL DEPEND ON CUSTOMER USAGE.
GAS OPERATION:
DURING SHUTDOWN–MAXIMUM AIR/NATURAL GAS MIXTURE: FLOW 0.93 PPS, PRESSURE 150 PSIG, TEMPERATURE 380 F DURATION 1 SEC.
UNDER AN UNDETECTED LEAK (FCV–2005) FLOW UP TO 0.26 PPS AT ATMOSPHERIC PRESSURE, TEMPERATURE 380 F.
(SEE NOTE 13)

3 11

CONNECTION DESCRIPTION: GAS FUEL VENT SIZE: 1" SCH 40 WELDED PIPE			
	PRESSURE PSIG [MPaG]	FLOW PPS[Kg/s]	TEMPERATURE °F [°C]
**	73[0.5]	0.79[0.36]	250[121]
***	0	0	70[21]
****	ATM	0.13[0.06]	NOTE 10

** MAX CONDITION WHEN ITEM 9 OPEN DURING SHUTDOWN, DURATION 35 SEC AT THIS PRESSURE & FLOW.
*** NORMAL OPERATION
**** IN CASE IF THERE WAS AN UNDETECTED LEAK (SEE NOTE 13)

3 391

CONNECTION DESCRIPTION: EXTERNAL GAS FUEL VENT SIZE: 2" SCH 40S BUTTWELDED			
	PRESSURE PSIG [MPaG]	FLOW PPS[Kg/s]	TEMPERATURE °F [°C]
**	390[2.69]	29.44[13.38]	250[121]
***	0	0	70[21]
****	ATM	0.26[0.12]	NOTE 10

** MAX CONDITION WHEN SOV–2061 OPEN DURING SHUTDOWN, DURATION 0.6 SEC AT THIS PRESSURE & FLOW.
*** NORMAL OPERATION
**** IN CASE IF THERE WAS AN UNDETECTED LEAK (SEE NOTE 13)

LEGEND:

- ☐ INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.
- ⬡ INDICATES G.E. ENGINE CONNECTION AS DESIGNATED BY G.E. DRAWINGS.

ES = EMERGENCY STOP
DM = DECELERATE TO MINIMUM LOAD
SI = STEP TO IDLE
NSD = NORMAL SHUTDOWN
LC = LOCK CLOSE
* = CONNECTION HARDWARE BY GEPPLP

NOTES:

1. INSTRUMENT AIR REQUIREMENTS ARE TO MEET ISA–S7.0.01 AND THE FOLLOWING GE RECOMMENDATIONS:
   – FILTERED TO MINIMUM 10 MICRONS
   – DEW POINT AT LEAST 18 °F [10.0 °C] BELOW THE MINIMUM LOCAL RECORDED AMBIENT TEMPERATURE AT THE PLANT SITE
   – TOTAL OIL OR HYDROCARBON CONTENT SHALL BE AS CLOSE TO ZERO AS POSSIBLE, BUT UNDER NO CIRCUMSTANCES SHALL IT EXCEED ONE (1) PPM UNDER NORMAL CONDITIONS (68 °F [20 °C] AND 14.7 PSIA [1 ATM])
   – FREE OF AIRBORNE SOLVENTS (E.G. AEROSOLS, PAINTS)
   – PRESSURED 80–120 PSIG [552–827 kPaG]
2. VALVE LOCKS TO BE SUPPLIED BY OTHERS UNLESS OTHERWISE NOTED.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. FUEL AND WATER MUST MEET G.E. QUALITY REQUIREMENTS PER G.E. AIRCRAFT DERIVATIVE TURBINES:
   NATURAL GAS: MID–TD–0000–1, SHORT TERM PRESSURE PULSATIONS NOT TO EXCEED 2% PEAK TO PEAK
   NOX WATER: MID–TD–0000–3
5. INTENTIONALLY LEFT BLANK
6. FOR EXTENDED NON–USE WITH ANTICIPATED FREEZE CONDITIONS, WATER INJECTION SYSTEM MUST BE DRAINED.
7. EXHAUST DRAIN FROM CONNECTION 7: SEE CONNECTION 7 TABLE.
8. VALVE IS OPENED FOR MAINTENANCE ONLY.
9. INTENTIONALLY LEFT BLANK
10. MINIMUM GAS SUPPLY TEMP SHALL BE 50 °F [27.8 °C] GREATER THAN THE SATURATED VAPOR TEMP AT THE SUPPLY PRESSURE.
11. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
12. ITEM 14 SHOULD BE LOCATED WITHIN 15 FEET FROM THE GAS TURBINE PACKAGE CONNECTION #10.
13. ALL CUSTOMER INTERFACE PIPING CONNECTIONS MATERIAL SHALL BE THE FOLLOWING AFTER THE MAIN FILTER.
   – 304 SS FOR GAS FUEL
   – 304 SS FOR LIQUID FUEL
   – 316 SS FOR WATER INJECTION
   – 304 SS FOR DRAIN & VENT SYSTEM
14. ITEM 1 IS SHIPPED LOOSE FOR INSTALLATION OUTSIDE OF MAIN UNIT AND SHOULD BE LOCATED WITHIN 20 FT [6.1 M] FROM CONNECTION 10.

SAFETY NOTES:

1 FLOWS AND PRESSURES ARE MACHINE DESIGN PARAMETERS AND ARE NOT GUARANTEE POINTS.

2 THIS VALVE MUST REMAIN OPEN EXCEPT FOR MAINTENANCE. SHALL BE WELDED LOCATED AT LEAST 3 METERS AWAY MAXIMUM BACK PRESSURE SHALL NOT EXCEED 1 PSIG [7 kPaG].

3 CUSTOMER SUPPLIED FLAME ARRESTOR MAY BE REQUIRED IF COMBUSTIBLE MIXTURE EXISTS IN CUSTOMER VENT. ALL GAS VENTS MUST BE ROUTED SEPERATELY– NO MANIFOLDING.

4 LINE NEEDS TO BE HEAT TRACED AND INSULATED TO PROTECT WATER FROM FREEZING.

REFERENCE DRAWINGS:

X–969149 CAUSE AND EFFECT MATRIX, CONTROL SYSTEM
X–969201 GENERAL ARRANGEMENT, MAIN UNIT – LH
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969244 F&ID, TURBINE LUBE OIL SYSTEM
X–969269 F&ID, WATER INJECTION PUMP
X–969690 AREA CLASSIFICATION DRAWING, MAIN UNIT

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

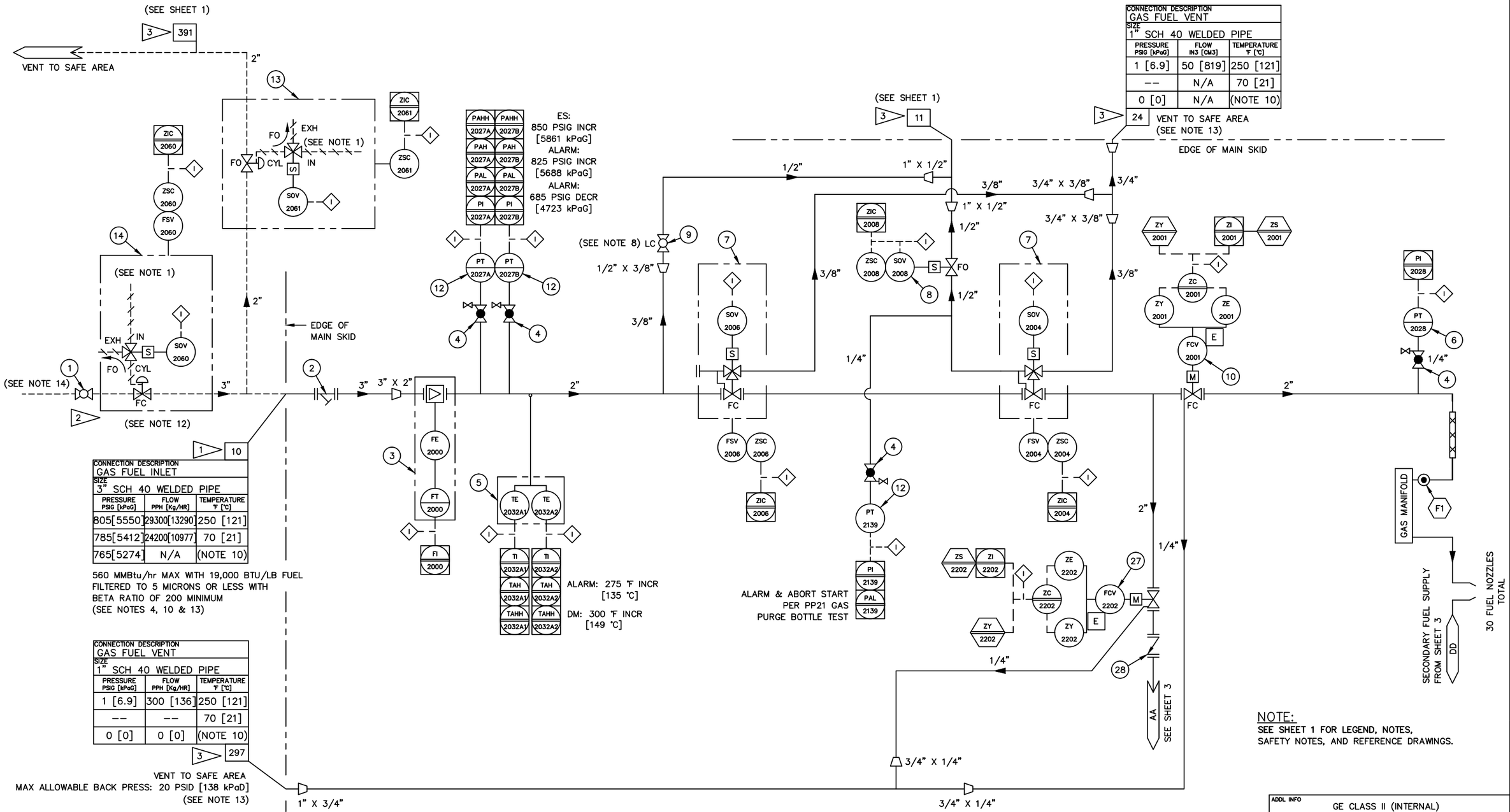
ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW & INSTRUMENT DIAGRAM FUEL SYSTEM

DWG NO. 7253049–969260 REV. A

SCALE NONE SHEET 1 OF 5



NOTE:
SEE SHEET 1 FOR LEGEND, NOTES, SAFETY NOTES, AND REFERENCE DRAWINGS.

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THIRD ANGLE PROJECTION

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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

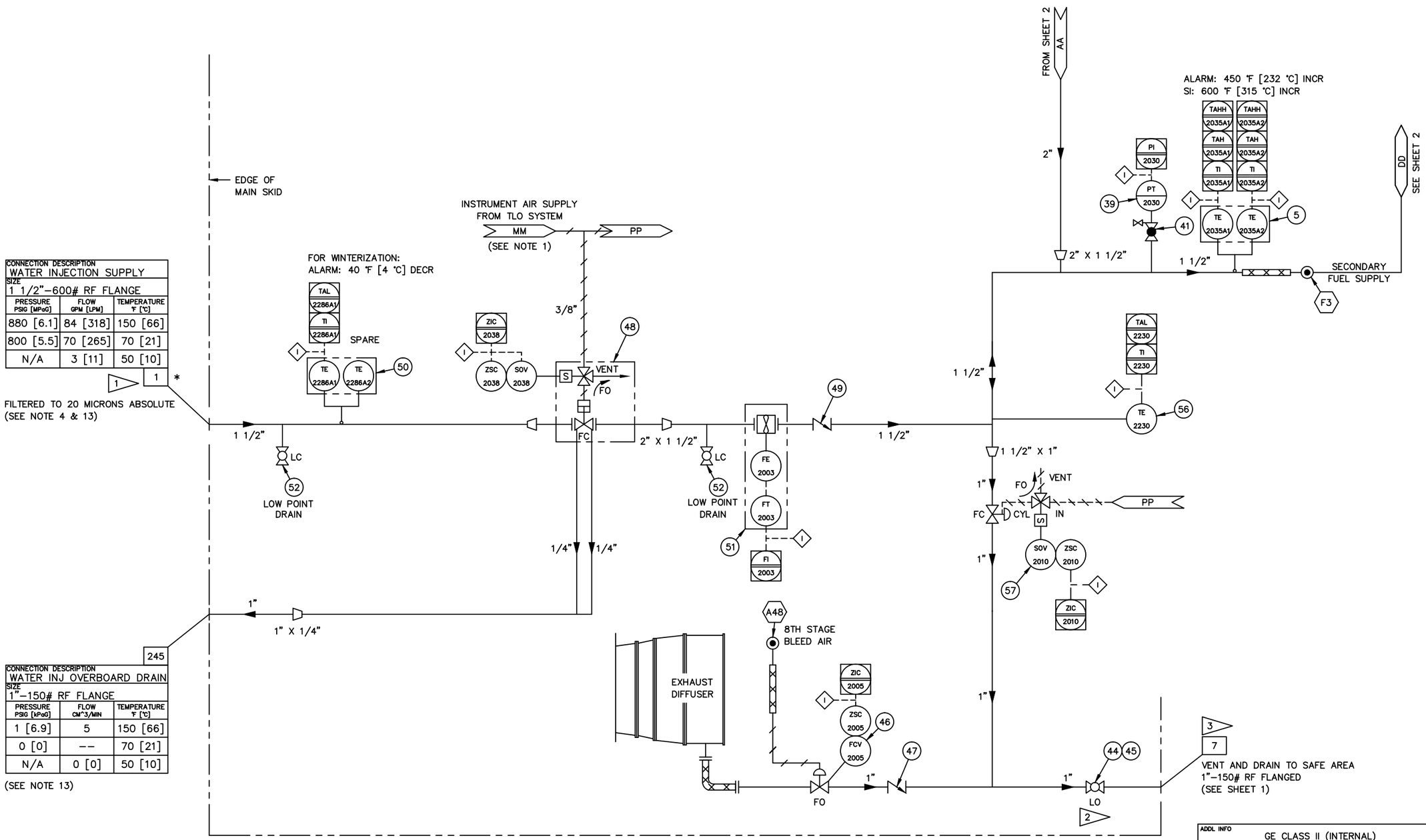
TITLE
FLOW & INSTRUMENT DIAGRAM
FUEL SYSTEM

DWG NO. 7253049-969260

REV. A

SCALE NONE

SHEET 2 OF 5



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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
FUEL SYSTEM

DWG NO. 7253049–969260
REV. A
SCALE NONE
SHEET 3 OF 5

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	TURBINE FUEL GAS BALL VALVE	TRUELINE VALVE CORP. {382A7191P0001} SHIP LOOSE	1	BALL VALVE, 3" SCH 40 BUTTWELD, 316 SS BODY, SS BALL & STEM, FULL PORT, FIRE SAFE PER API-607, BUBBLE TIGHT SHUTOFF, PED CAT II
2	N/A	TURBINE FUEL GAS STRAINER	MUELLER STEAM {377A7957P0001}	1	STRAINER, 3"-600# RF, "Y" TYPE SS BODY, SS SCREEN, 100 MESH, CE, PED
3	FT-2000 FE-2000	GAS FUEL FLOW TRANSMITTER	YOKOGAWA {382A4695P0001}	1	FLOW METER/CONVERTER ASSEMBLY, DY050-NBMBA4-2N/FF1/SCT- VORTEX SHEDDING METER, GAS, DYA-D2N/FF1/SCT/Z- REMOTE MOUNTED CONVERTER W/40FT CABLE, Z911-1-C01-YF/Z (/Z=CALIBRATION GRAPH), IM1F6A0-01E-A-DATA TABLE AND YEW FLOW MANUALS AND CERTIFICATE OF CALIBRATION. 2"-600# RF, 316 SS BODY, SS SHEDDER, SET FT-2000 AT: 4 mA = 0 ACFM, 20 mA = 345 ACFM
4	N/A	TURBINE GAS FUEL SYSTEM INSTRUMENT VALVE	DRAGON 1053V3	4	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
5	TE-2032A1 TE-2032A2 TE-2035A1 TE-2035A2	TEMPERATURE SENSOR	ROSEMOUNT **{J01068}**	2	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED **FLAT COVER, CSA APPROVED,** INCLUDES 3/4" MNPT 316 SS THERMOWELL
6	PT-2028	TURBINE GAS FUEL SUPPLY AND ENGINE MANIFOLD PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	1	PRESSURE TRANSMITTER, -14 TO 800 PSIG, 316 SS DIAPHRAGM, VITON O-RING 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT, WITH DIGITAL BASED ON HART PROTOCOL, APPROVAL: FM, CSA, CE ATEX, INTRINSIC SAFETY, NON-INCEDIVE. SET TRANSMITTER AT: 4 mA = 0 PSIG, 20 mA = 800 PSIG
7	FSV-2004 FSV-2006 ZSC-2004 ZSC-2006 SOV-2004 SOV-2006	TURBINE FUEL GAS SHUT-OFF VALVE	WOODWARD {393A3609P0001}	2	SOLENOID PILOTED VALVE, GSOV25HT, 2"-600# RF, SS BODY, SS TRIM, FAIL CLOSED/NORMALLY CLOSED, 24 VDC, LIMIT SWITCH, EXPLOSION PROOF, CE/ATEX ZONE 1 CAT 2 GROUP II G, Ex d IIB T3, CSA CERTIFIED FOR CL 1, DIV 1 GR C&D, T3
8	SOV-2008 ZSC-2008	TURBINE FUEL GAS VENT SOLENOID VALVE	WHITTAKER CONTROLS {393A3611P0001}	1	DIRECT ACTING SOLENOID VALVE, 1/2" NPT SS BODY AND TRIM, ANSI CL VI EXTERNAL LEAKAGE, FAIL OPEN/NORMALLY OPEN, 24 VDC
9	N/A	FUEL GAS PURGE & BLEED BALL VALVE	QUADRANT {398A4555P0001}	1	BALL VALVE, 1/2" FNPT, 316 SS BODY AND TRIM, GRAPHITE SEALS, PEEK SEATS, 3600 PSIG @ 100 °F RATING, FULL LOCKABLE SS HANDLE, FIRE SAFE
10	FCV-2001	FUEL METERING VALVE, NATURAL GAS	WOODWARD {382A5322P0001}	1	FUEL CONTROL VALVE, 2"-600# RF, NATURAL GAS SERVICE, ELECTRICALLY ACTUATED EM35MR (24 VDC POWER) ACTUATOR MODEL 3103 GAS VALVE WITH ROTARY METERING SLEEVE AND SHOE TYPE THROTTLING VALVE, CE/ATEX, PED, CSA
11	N/A	INTENTIONALLY LEFT BLANK			
12	PT-2027A PT-2027B PT-2139	TURBINE GAS FUEL SUPPLY PRESSURE TRANSMITTER AND BOTTLE TEST TRANSMITTERS	ROSEMOUNT {249A4699P0001}	3	PRESSURE TRANSMITTER, -14.7 TO 4000 PSIG, 316 SS DIAPHRAGM, VITON O-RINGS, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH SIGNAL BASED ON HART PROTOCOL, APPROVAL: CSA, FM, ATEX EXPLOSION PROOF, INTRINSIC SAFETY. SET TRANSMITTERS AT: 4 mA = 0 PSIG, 20 mA = 1200 PSIG

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
13	SOV-2061 ZSC-2061	GAS FUEL VENT VALVE (OFF SKID)	GEPPLP SPEC 393A3955P0001 SHIP LOOSE	1	2" SCH 40, STAINLESS STEEL GAS FUEL VENT VALVE, FAIL OPEN/ENERGIZE TO CLOSE, 24 VDC WITH EXPLOSION PROOF SOLENOID W/ CLASS "H" COIL, UL, CSA, CE, PED, AND ATEX APPROVED
14	FSV-2060 SOV-2060 ZSC-2060	GAS FUEL SHUT-OFF VALVE (OFF SKID)	GEPPLP SPEC 393A3954P0001 SHIP LOOSE	1	3" SCH 40, STAINLESS STEEL GAS FUEL SHUTOFF VALVE, FAIL CLOSED/ENERGIZE TO OPEN, 24 VDC WITH EXPLOSION PROOF SOLENOID W/ CLASS "H" COIL, UL, CSA, CE, PED, AND ATEX APPROVED
15		INTENTIONALLY LEFT BLANK			
16		INTENTIONALLY LEFT BLANK			
17		INTENTIONALLY LEFT BLANK			
18		INTENTIONALLY LEFT BLANK			
19		INTENTIONALLY LEFT BLANK			
20		INTENTIONALLY LEFT BLANK			
21		INTENTIONALLY LEFT BLANK			
22		INTENTIONALLY LEFT BLANK			
23		INTENTIONALLY LEFT BLANK			
24		INTENTIONALLY LEFT BLANK			
25		INTENTIONALLY LEFT BLANK			
26		INTENTIONALLY LEFT BLANK			
27	FCV-2202	FUEL METERING VALVE NATURAL GAS	WOODWARD {393A1945P0001}	1	ELECTRIC FUEL METERING VALVE, MODEL GS16DR, 2"-600# RF, DUAL COIL, OFF BOARD DRIVER, NATURAL GAS SERVICE CE/ATEX ZONE 2, CAT 3 G, Ex nA IIC T3 CSA CERTIFIED FOR CL 1, DIV 2 GR A-D, T3C
28	N/A	GAS FUEL BACK FLOW CHECK VALVE	FLOWSERVE {216A3838P0001}	1	CHECK VALVE, 2"-600# RF, 316 SS, 1 PSID CRACKING PRESSURE, INCONEL 600 RETAINER AND SLEEVE
29		INTENTIONALLY LEFT BLANK			

NOTE:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE FLOW & INSTRUMENT DIAGRAM FUEL SYSTEM

DWG NO. 7253049-969260

REV. A

SCALE NONE

SHEET 4 OF 5

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
30		INTENTIONALLY LEFT BLANK			
31		INTENTIONALLY LEFT BLANK			
32		INTENTIONALLY LEFT BLANK			
33		INTENTIONALLY LEFT BLANK			
34		INTENTIONALLY LEFT BLANK			
35		INTENTIONALLY LEFT BLANK			
36		INTENTIONALLY LEFT BLANK			
37		INTENTIONALLY LEFT BLANK			
38		INTENTIONALLY LEFT BLANK			
39	PT-2030	SUPPLY AND PRIMARY MANIFOLD PRESSURE TRANSMITTERS	ROSEMOUNT {249A4699P0001}	1	PRESSURE TRANSMITTER, -14.7 TO 4000 PSIG, 316 SS DIAPHRAGM, VITON O-RINGS, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20mA OUTPUT, WITH DIGITAL BASED ON HART PROTOCOL, APPROVAL: FM, CSA, ATEX, INTRINSIC SAFETY, NO-INCEDIVE. SET PT-2029 AND PT-2030 AT 4 mA = 0 PSIG & 20 mA = 1500 PSIG SET PT-2070A AND PT-2070B AT 4 mA = 0 PSIG & 20 mA = 2000 PSIG
40		INTENTIONALLY LEFT BLANK			
41	N/A	WATER INJECTION SYSTEM INSTRUMENT VALVE	DRAGON 1053V3	1	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
42		INTENTIONALLY LEFT BLANK			
43		INTENTIONALLY LEFT BLANK			
44	N/A	TURBINE FUEL DRAIN BALL VALVE	KF CONTROMATICS 1INCH-S8000-LL	1	BALL VALVE, 1" FNPT, SS BODY AND TRIM, FULL PORT, UNISEAL SEATS, 2000 WOG RATING, LOCKABLE HANDLE
45	N/A	PAD LOCK	MASTER LOCK {NBR_2}	1	PAD LOCK WITH (2) KEYS
46	FCV-2005 ZSC-2005	EXHAUST COLLECTOR DRAIN FLOW CONTROL VALVE	FISHER {382A6218P0001}	1	CONTROL VALVE, 1" NPT, GLOBE STYLE, CS BODY, 101 TRIM, GASKET SET #2, 1" DIAMETER QUICK OPENING PORT, 3/4" TRAVEL, 3/8" STEM, SIZE 3-B ACTUATOR WITH 0-50 PSIG SUPPLY, AIR TO CLOSE, SPRING TO OPEN WITH CLOSE POSITION FEEDBACK
47	N/A	TURBINE FUEL DRAIN CHECK VALVE	VOGT {97005}	1	CHECK VALVE, 1" FNPT, SWING TYPE, CS BODY, 13% CR TRIM, RATED FOR 2000 PSI AT 100 °F
48	SOV-2038 ZSC-2038	WATER INJECTION SHUTOFF VALVE	WOODWARD {382A5530P0001}	1	PNEUMATIC ACTUATED, SOLENOID PILOTED VALVE, 2"-900# RF, SS BODY AND TRIM, FAIL CLOSED, 24 VDC, EXPLOSION PROOF, CSA / ATEX APPROVED
49	N/A	WATER INJECTION SUPPLY CHECK VALVE	KEPNER {2352}	1	CHECK VALVE, 1 1/2" FSAE INLET AND OUTLET CONNECTIONS, 316 SS, VITON O-RING, 2 PSID CRACKING PRESSURE
50	TE-2286A1 TE-2286A2	WATER INJECTION SUPPLY TEMPERATURE SENSOR	ROSEMOUNT {J01068}	1	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
51	FT-2003 FE-2003	WATER INJECTION SYSTEM FLOW TRANSMITTER	FLOW TECHNOLOGY {393A3883P0002}	1	FLOW METER, FT-24C3XWRLEG-Y, 1 1/2"-600# RF, TURBINE TYPE, SS CONSTRUCTION, 0-160 GPM, REMOTE CONVERTER LA-5-C-MA-FCFP TRANSMITTER, CSA, EXPLOSION PROOF
52	N/A	LOW POINT DRAIN MANUAL BALL VALVE	KF CONTRAMATICS 1/2INCH-S8000-LL	2	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, REDUCED PORT, TFE SEATS, 2000 WOG RATING, LOCKABLE HANDLE
53		INTENTIONALLY LEFT BLANK			
54		INTENTIONALLY LEFT BLANK			
55		INTENTIONALLY LEFT BLANK			
56	TE-2230	WATER INJECTION HEAT TRACING DIAGNOSTICS TEMPERATURE SENSOR	CHROMALOX 399A1909P0001	1	ELEMENT, TEMP, RTD, SKIN PIPE SENSOR, ALL PIPE SIZES, -100 TO 900 °F, CSA/UL CERTIFIED
57	SOV-2010 ZSC-2010	FUEL MANIFOLD DRAIN SOLENOID VALVE	COAX {399A2321P0001}	1	VALVE, SOLENOID, W/POSITION SWITCH, EXTERNAL PNEUMATIC ACTUATION, LIQUID FUEL MANIFOLD DRAIN VALVE, 1" SAE CODE 61-3000 LB PORT, NORMALLY CLOSED/ FAIL CLOSED, 24 VDC, 1/2"-14 CONDUIT CONNECTION, ACTUATOR PORT: 1/4", ACTUATION OPENING AND CLOSING SPEED: LESS THAN 50 ms, UL/CSA, CE/ATEX AND PED, AMBIENT TEMP RANGE: -5 TO 200 °F, COMPATIBLE WITH DE-MINERALIZED WATER

NOTE:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

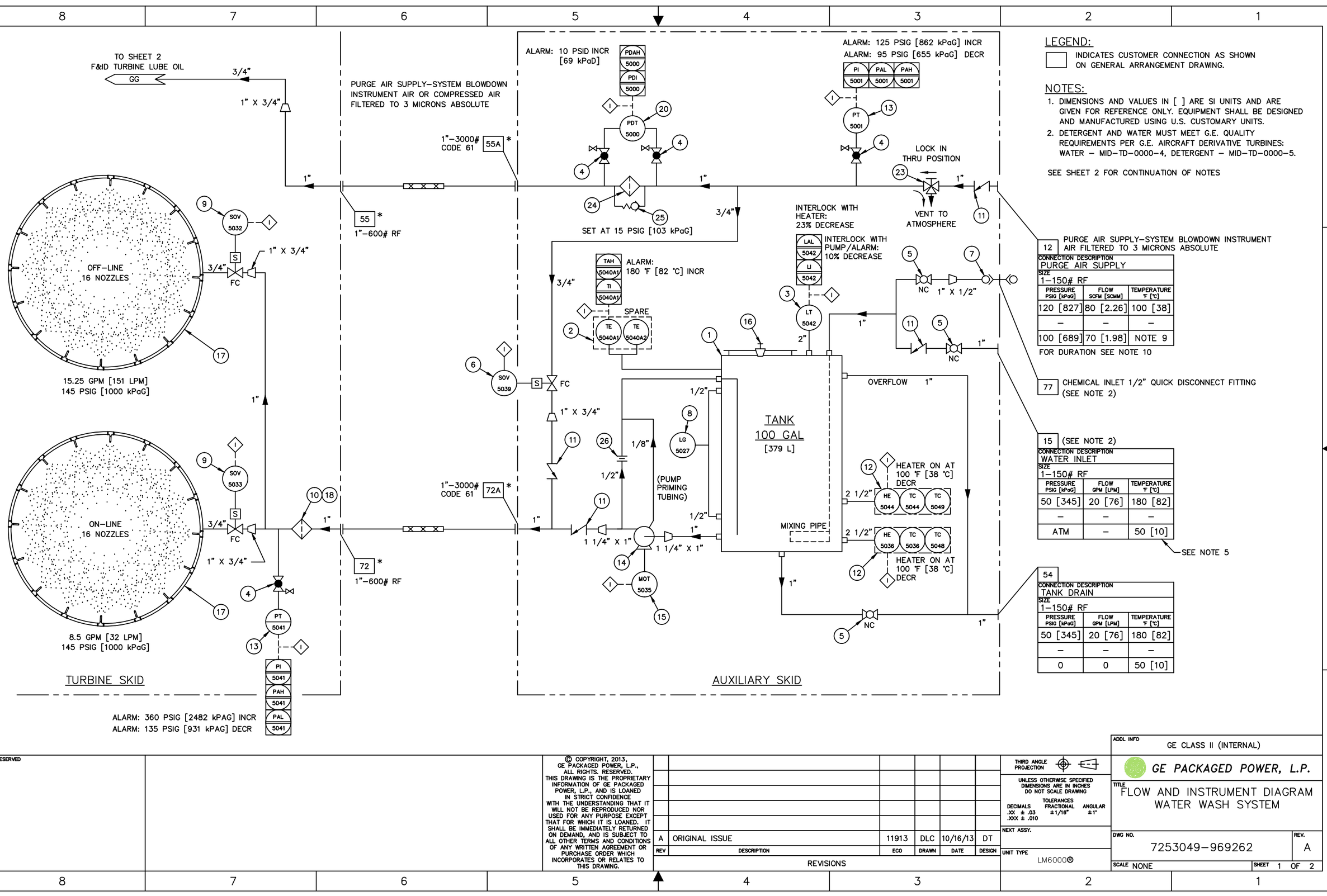
TITLE FLOW & INSTRUMENT DIAGRAM FUEL SYSTEM

DWG NO. 7253049-969260

REV. A

SCALE NONE

SHEET 5 OF 5



LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

NOTES:

1. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
2. DETERGENT AND WATER MUST MEET G.E. QUALITY REQUIREMENTS PER G.E. AIRCRAFT DERIVATIVE TURBINES: WATER – MID–TD–0000–4, DETERGENT – MID–TD–0000–5.

SEE SHEET 2 FOR CONTINUATION OF NOTES

12 PURGE AIR SUPPLY–SYSTEM BLOWDOWN INSTRUMENT AIR FILTERED TO 3 MICRONS ABSOLUTE

CONNECTION DESCRIPTION: PURGE AIR SUPPLY		
SIZE: 1–150# RF		
PRESSURE PSIG [kPaG]	FLOW SCFM [SCMM]	TEMPERATURE °F [°C]
120 [827]	80 [2.26]	100 [38]
–	–	–
100 [689]	70 [1.98]	NOTE 9

FOR DURATION SEE NOTE 10

77 CHEMICAL INLET 1/2" QUICK DISCONNECT FITTING (SEE NOTE 2)

15 (SEE NOTE 2)

CONNECTION DESCRIPTION: WATER INLET		
SIZE: 1–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
50 [345]	20 [76]	180 [82]
–	–	–
ATM	–	50 [10]

SEE NOTE 5

54

CONNECTION DESCRIPTION: TANK DRAIN		
SIZE: 1–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
50 [345]	20 [76]	180 [82]
–	–	–
0	0	50 [10]

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW AND INSTRUMENT DIAGRAM
WATER WASH SYSTEM

DWG NO. 7253049–969262

REV. A

SCALE NONE

SHEET 1 OF 2

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	N/A	WATER WASH TANK	GEPPLP {747907}	1	100 GAL, 304L SS, 3/16" PLATE
2	TE-5040A1,A2	WATER WASH TANK TEMPERATURE SENSOR	ROSEMOUNT {J04182}	1	PLATINUM RTD, DUAL ELEMENT, 12" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES THERMOWELL, 3/4" MNPT, 316 SS
3	LT-5042	WATER WASH TANK LEVEL TRANSMITTER	ROSEMOUNT {393A3347P0001}	1	GUIDED WAVE RADAR LEVEL TRANSMITTER, 1 1/2" MNPT PROCESS CONNECTION AND 1/2"-14 NPT CONDUIT FOR ELECTRICAL CONNECTION, 316 SS COAXIAL PROBE, 2'-7" PROBE LENGTH, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVALS CE, ATEX, CSA FLAME-PROOF/EXPLOSION PROOF, METER TYPE INTEGRAL DISPLAY. SET AT: 4 mA = 0" [0% TANK FULL] 20 mA = 23 1/2" [100% TANK FULL] PROBE END IS 1 3/4" FROM TANK BOTTOM
4	N/A	INSTRUMENT VALVE	DRAGON 1053V3	4	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
5	N/A	BALL VALVE	WATTS (OR EQUAL) 1"-S8000-LL	3	1" FNPT, SS BODY REDUCED PORT
6	SOV-5039	SOLENOID VALVE PURGE AIR SUPPLY	CO-AX {382A5646P0001}	1	SOLENOID VALVE, 3/4" FNPT, FAIL CLOSED, 3/4" DIAMETER ORIFICE, 316 SS BODY, 24 VDC CLASS "H" COIL, EXPLOSION PROOF, DEMINERALIZED WATER/AIR SERVICE VALVE BODY RATED 1500 PSIG 0-120 PSIG OPERATING PRESSURE 0 PSIG BACK PRESSURE 40-200 °F OPERATING TEMPERATURE
7	N/A	QUICK DISCONNECT	HANSEN LL4-S26,LL4-T26	1	COUPLING, 316 SS, POPPET SEALING STANDARD TYPE, 1/2" FNPT
8	LG-5027	WATER WASH TANK LEVEL GAUGE	KENCO 99M50-24-AVL	1	FLUID LEVEL SITE GLASS, 1/2" NPT, 24" BETWEEN CENTERS
9	SOV-5032 SOV-5033	SOLENOID VALVE	ATKOMATIC {J00092}	2	SOLENOID VALVE, "DYMO" SERIES, 3/4" FNPT, FAIL CLOSED, 3/4" DIAMETER ORIFICE, 316 SS BODY, 24 VDC CLASS "H" COIL, EXPLOSION PROOF, DEMINERALIZED WATER/AIR SERVICE VALVE BODY RATED 1500 PSIG 0-120 PSIG OPERATING PRESSURE 0 PSIG BACK PRESSURE 40-200 °F OPERATING TEMPERATURE
10	N/A	FILTER HOUSING	PALL CORPORATION {3985228P0001}	1	FILTER HOUSING, 1" FNPT, HEAD 316L SS, BOWL 316 SS, VITON SEAL
11	N/A	CHECK VALVE	CHECK-ALL {J00458}	4	1" FNPT, 316 SS BODY, VITON SEAL, 1/2 PSI CRACKING PRESSURE
12	HE-5036 TC-5036 TC-5048 HE-5044 TC-5044 TC-5049	HEATER	CHROMALOX {382A5510P0002}	2	THERMOSTATICALLY CONTROLLED HEATER 2 1/2" NPT, 480/400 VAC, 60/50 HZ, 9/7 KW, 3PH, STAINLESS STEEL, EXPLOSION RESISTANT/MOISTURE TIGHT, CE & ATEX APPROVED
13	PT-5001 PT-5041	WATER WASH PUMP DISCH. PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	2	SMART PRESSURE TRANSMITTER, 0-800 PSIG, 316 SS DIAPHRAGM, VITON O-RINGS, DRAIN/VENT VALVE, 1/2" FNPT PROCESS AND 1/2" NPT ELECTRICAL CONNECTIONS, 4-20 mADC OUTPUT, APPROVAL: CSA, FM, ATEX, EXPLOSION PROOF, INTRINSIC SAFETY SET PT-5001 AT 4mA = 0 and 20mA = 200 PSIG SET PT-5041 AT 4mA = 0 and 20mA = 500 PSIG
14	N/A	PUMP/MOTOR ASSEMBLY	GOULDS {399A1283P0001}	1	PUMP/MOTOR ASSEMBLY, 1 1/4"-300# RF SUCTION & DISCHARGE FLANGES, 20 STAGE, 18 GPM FLOW @ TDH 500 FT, MINIMUM FLOW 3 GPM
15	MOT-5035	MOTOR	(MOTOR PART OF ITEM 14)	(1) REF	5 HP [3.7 kW], 3 PHASE, 60 HZ, 460 VAC, 3600 RPM, UL/FM, CSA APPROVED
16	N/A	FILLER/VENT CAP	MAGNALOY (OR EQUAL) FB-A008X	1	40 MICRON (OR BETTER) FOAM FILTER, SS CAP, 30 MESH, SS BASKET
17	N/A	ON/OFF-LINE MANIFOLD AND NOZZLES	FP TURBOMANCHINARY {393A3776P0001}	2	1/2" MANIFOLD, 3/8" NOZZLES (16), 316 SS
18	N/A	FILTER CARTRIDGE	PALL CORPORATION {398A5229P0001}	1	FILTER CARTRIDGE, 50 MICRON, LENGTH 20"
19		INTENTIONALLY LEFT BLANK			
20	PDT-5000	INSTRUMENT AIR FILTER PRESSURE DIFFERENTIAL TRANSMITTER	ROSEMOUNT {382A5657P0001}	1	DIFFERENTIAL PRESSURE TRANSMITTER, -1000 to 1000 inH2O [-2.5 to 2.5 bar] RANGE, 316 SS ISOLATING DIAPHRAGM, VITON O-RINGS, 1/4"-18 FNPT PROCESS & 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF ATEX AND CSA, FLAMEPROOF, INTRINSIC SAFETY, NON-INCENDIVE. SET AT 4 mA = 0 PSID AND 20 mA = 35 PSID
21	N/A	INTENTIONALLY LEFT BLANK			
22	N/A	INTENTIONALLY LEFT BLANK			
23	N/A	BALL VALVE WITH AUTO DRAIN	APOLLO/CONBRACO 75-105-41-27	1	BALL VALVE, 1 FNPT, AUTO DRAIN REDUCED PORT BALL VALVE, BRONZE BODY W/316 SS BALL & STEM
24	N/A	INSTRUMENT AIR FILTER	HANKISON HF9-24-8-G	1	AIR SEPARATOR/FILTER, 1" FNPT CONNECTION, 3 MICRONS, RATED FOR 100 SCFM @ 100 PSIG, 150 °F MAX.
25	N/A	INSTRUMENT AIR BYPASS VALVE	HOKE {382A6621P0001}	1	CHECK VALVE, 316 SS, VITON SEAL, 1" FEMALE TUBE FITTING, 15 PSIG CRACKING PRESSURE
26	N/A	BLEED ORIFICE	SWAGELOK {698300P0318}	1	ADAPTER, 1/2" TUBE UNION, 0.095" ORIFICE, 316 SS

NOTES: (CONTINUED)

3. OFF-LINE WATER WASH MAY NOT BE INITIATED UNTIL SURFACE TEMPERATURES OF GAS TURBINE ARE LESS THAN 200 °F [93 °C].
4. DRAIN TANK AFTER OFF-LINE WASH, CLEAN TO AVOID FLUID FREEZING AS NECESSARY. VALVE POSITIONS SHOWN ARE FOR STORAGE/NON-WATER WASH OPERATION. CONSULT O & M MANUAL FOR WATER WASH VALVE POSITIONING.
5. CUSTOMER IS RESPONSIBLE FOR ADDITION OF ANTI-FREEZE FOR ENGINE PROTECTION DURING COLD WEATHER WASHING.
6. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
7. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
8. VALVE LOCKS TO BE SUPPLIED BY OTHERS UNLESS OTHERWISE NOTED.
9. INSTRUMENT AIR TO BE PER ISA S7.3.
10. INSTRUMENT AIR IS BROKEN DOWN INTO THE FOLLOWING:
    F&ID TURBINE LUBE OIL
    FROM PURGE AIR/INSTRUMENT AIR SUPPLY:
    OPERATIONAL MODE
    PRESSURE RANGE = 85-120 PSIG [586-827 kPaG]
    CONSTANT PRESSURE REQUIRED FOR VALVE OPERATION.
    TEMPERATURE, MAX = 100 °F [38 °C]
    SHUTDOWN MODE - ZERO RPM
    PRESSURE RANGE = 85-120 PSIG [586-827 kPaG]
    FLOW RATE = 60 SCFM [1.75 SCMM]
    TEMPERATURE, MAX = 100 °F [38 °C]
    TIME DURATION = 1 1/2 HOURS
    AFTER GAS GENERATOR SHUTDOWN OR UNTIL GAS GENERATOR IS RESTARTED, WHICHEVER OCCURS FIRST.
    F&ID WATER WASH SYSTEM
    FROM PURGE AIR/INSTRUMENT AIR SUPPLY:
    10 SCFM [0.28 SCMM]
    80-120 PSIG [552-827 kPaG]
    1 MINUTE
11. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

REFERENCE DRAWINGS:

X-969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X-969201 GENERAL ARRANGEMENT, MAIN UNIT - LH
X-969219 GENERAL ARRANGEMENT, AUXILIARY SKID, LH
X-000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X-969239 F & ID, VENTILATION & COMBUSTION AIR SYSTEM
X-969244 F & ID, TURBINE LUBE OIL SYSTEM

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

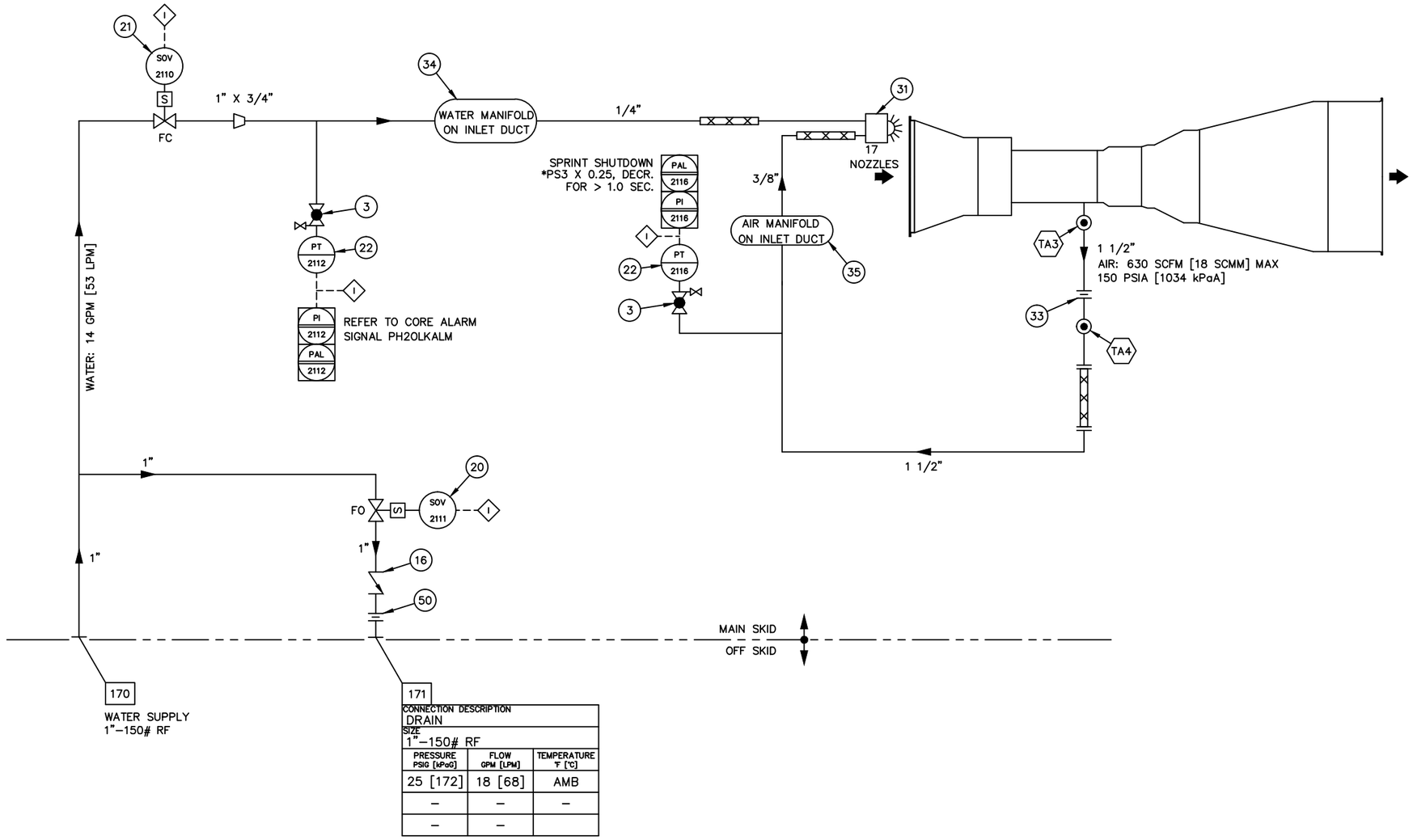
TITLE: FLOW AND INSTRUMENT DIAGRAM WATER WASH SYSTEM

DWG NO. 7253049-969262

REV. A

SCALE NONE

SHEET 2 OF 2



CONNECTION DESCRIPTION		
DRAIN		
SIZE		
1"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
25 [172]	18 [68]	AMB
–	–	–
–	–	

LEGEND:

- INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.
- INDICATES G.E. ENGINE CONNECTION AS DESIGNATED BY G.E. DRAWINGS.

* PS3 = COMPRESSOR DISCHARGE PRESSURE

NOTES:

1. WATER MUST MEET G.E. QUALITY REQUIREMENTS PER G.E. AIRCRAFT DERIVATIVE TURBINES: MID–TD–0000–3.
2. WATER AND AIR FLOW GIVEN IN SCHEMATIC ARE FOR REFERENCE ONLY.
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. SYSTEM DESIGN FLOW PARAMETER:
   MIN WATER FLOW = 5 GPM [19 L/min]
   MAX WATER FLOW = 18 GPM [69 L/min]
   MIN AIR FLOW = 404 SCFM [11 SCMM]
   MAX AIR FLOW = 630 SCFM [18 SCMM]
5. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.

REFERENCE DRAWINGS:

X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X–969201 GENERAL ARRANGEMENT MAIN UNIT – LH
X–969209 GENERAL ARRANGEMENT, SPRINT SKID
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969262 F&ID, WATER WASH SYSTEM
X–969270 F&ID, SPRINT SYSTEM, SPRINT SKID

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW AND INSTRUMENT DIAGRAM
SPRINT SYSTEM
MAIN UNIT

DWG NO. 7253049–969268

REV. A

SCALE NONE

SHEET 1 OF 2

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1 THRU 2		INTENTIONALLY LEFT BLANK			
3	N/A	INSTRUMENT VALVE	DRAGON 1053V3	2	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
4 THRU 15		INTENTIONALLY LEFT BLANK			
16	N/A	CHECK VALVE	CHECK ALL {382A7496P0001}	1	CHECK VALVE, 1" FNPT, 1/8" PSID CRACKING PRESSURE, 316 SS, VITON SEAL
17 THRU 19		INTENTIONALLY LEFT BLANK			
20	SOV-2111	SOLENOID VALVE	ATKOMATIC {377A8017P0001}	1	SOLENOID VALVE, 1" FNPT, 24 VDC, 3000# WP 316 SS, FAIL OPEN, DEMINERALIZED WATER
21	SOV-2110	SOLENOID VALVE	ATKOMATIC {J00095}	1	SOLENOID VALVE, 1" FSAE, 24 VDC, 3000# WP 316 SS, FAIL CLOSED, DEMINERALIZED WATER
22	PT-2112 PT-2116	PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	2	PRESSURE TRANSMITTER, 0-800 PSIG, 316 SS DIAPHRAGM, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, CSA, FM & ATEX EXPLOSION PROOF AND INTRINSIC SAFETY APPROVAL SET TRANSMITTERS AT 4 mA = 0 PSIG [0 kPaG] 20 mA = 300 PSIG [2068 kPaG]
23 THRU 30		INTENTIONALLY LEFT BLANK			
31	N/A	NOZZLES	SUPPLIED WITH ENGINE	(17) REF	INLET DUCT NOZZLES AIR/WATER ATOMIZED
32		INTENTIONALLY LEFT BLANK			
33	N/A	ORIFICE PLATE	SUPPLIED WITH ENGINE	(1) REF	1 1/4" DIAMETER
34	N/A	WATER MANIFOLD (INLET)	GEPPLP {868543}	1	3/4" WATER MANIFOLD (INLET)
35	N/A	AIR MANIFOLD (INLET)	GEPPLP {868544}	1	1 1/2" AIR MANIFOLD (INLET)
36 THRU 49		INTENTIONALLY LEFT BLANK			
50	N/A	ORIFICE	SWAGELOK {698300P0274}	1	ADAPTER, 1" TUBE UNION, 3/16" ORIFICE, 316 SS

NOTE:

1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE FLOW AND INSTRUMENT DIAGRAM SPRINT SYSTEM MAIN UNIT

DWG NO. 7253049-969268

REV. A

SCALE NONE

SHEET 2 OF 2

LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

NOTES:

1. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
2. WATER MUST MEET G.E. QUALITY REQUIREMENTS PER G.E. AIRCRAFT DERIVATIVE TURBINES, MID–TD–0000–3.
3. MAINTAIN 3" MINIMUM LINE SIZE FROM DEMIN. WATER SUPPLY. (DO NOT DOWNSIZE PIPING SYSTEM).
4. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER) – (STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
5. VALVE TO BE USED FOR COMMISSIONING ONLY. VALVE MUST BE MAINTAINED IN LOCKED CLOSE POSITION AFTER PUMP IS PRIMED.

SAFETY NOTES:

1. FLOWS AND PRESSURES ARE MACHINE DESIGN PARAMETERS AND ARE NOT GUARANTEE POINTS.
2. PUMP ISOLATION VALVES ARE FOR MAINTENANCE ONLY AND MUST BE LOCKED OPEN.
3. LINE NEEDS TO BE HEAT TRACED AND INSULATED TO PROTECT WATER FROM FREEZING.

REFERENCE DRAWINGS:

X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X–969201 GENERAL ARRANGEMENT, MAIN UNIT – LH
X–969219 GENERAL ARRANGEMENT, AUXILIARY SKID
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969260 FLOW & INSTRUMENT DIAGRAM, FUEL SYSTEM

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

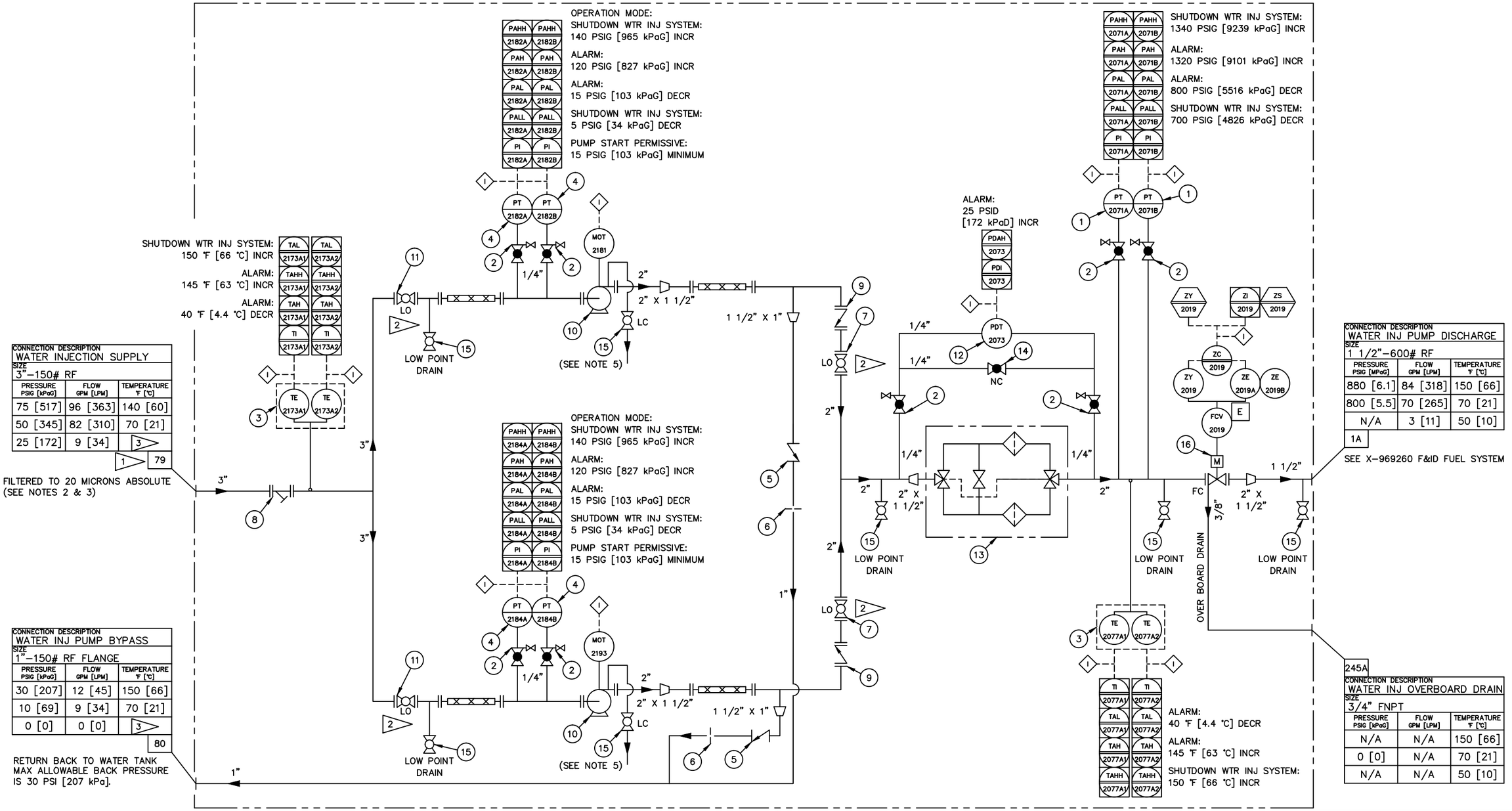
TITLE
FLOW & INSTRUMENT DIAGRAM
WATER INJECTION PUMP

DWG NO. 7253049–969269

REV. A

SCALE NONE

SHEET 1 OF 3



DEMINERALIZED WATER INJECTION PUMP (MOUNT ON AUXILIARY SKID)

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
FLOW & INSTRUMENT DIAGRAM
WATER INJECTION PUMP

DWG NO. 7253049–969269

REV. A

SCALE NONE

SHEET 2 OF 3

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	PT-2071A PT-2071B	PUMP DISCHARGE PRESSURE TRANSMITTER	ROSEMOUNT {249A4699P0001}	2	PRESSURE TRANSMITTER, 0-4000 PSIG, 316 SS DIAPHRAGM, VITON O-RINGS, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, APPROVAL FM, CSA, ATEX EXPLOSION PROOF, INTRINSIC SAFETY, SET TRANSMITTERS AT 4 mA = 0 PSIG, 20 mA = 2000 PSIG
2	N/A	INSTRUMENT VALVE	DRAGON 1053V3	8	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING
3	TE-2173A1 TE-2173A2 TE-2077A1 TE-2077A2	WATER INJECTION TEMPERATURE SENSOR	ROSEMOUNT {J01068}	2	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 0 °C, DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, CSA APPROVED, INCLUDES 3/4" MNPT 316 SS THERMOWELL
4	PT-2184A PT-2184B PT-2182A PT-2182B	PUMP SUCTION PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	4	PRESS. TRANSMITTER, -14.7 to 800 PSIG, 316 SS DIAPHRAGM, VITON O-RINGS, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, APPROVAL: FM, CSA, ATEX EXPLOSION PROOF, INTRINSIC SAFETY. SET TRANSMITTERS AT 4 mA = 0 PSIG, 20 mA = 200 PSIG
5	N/A	WATER INJECTION BYPASS CHECK VALVE	CHECK-ALL {J00458}	2	1" FNPT, 316 SS BODY, VITON SEAL, 1/2 PSI CRACKING PRESSURE
6	N/A	WATER INJECTION BYPASS ORIFICE	SWAGELOK {698300P0316}	2	ADAPTER, 1" TUBE UNION, 0.125" ORIFICE, 316 SS
7	N/A	BALL VALVE	KF CONTROMATICS {393A5124P0001}	2	BALL VALVE, 1 1/2"-600# RF, SS BODY AND TRIM, FULL PORT, REINFORCED PTFE SEATS, LOCKABLE HANDLE, FIRESAFE
8	N/A	WATER INJECTION STRAINER	MUELLER 185-SS(3INCH)	1	STRAINER, 3"-150# RF, BASKET TYPE, SS BODY AND SCREEN, 100 MESH
9	N/A	WATER PUMP CHECK VALVE	DURABLA {382A6518P0001}	2	CHECK VALVE, 1 1/2"-600# RF, WAFER TYPE, 316 SS, VITON SEALS, BUBBLE TIGHT, 1/2 PSID CRACKING PRESSURE
10	MOT-2181 MOT-2193	WATER INJECTION PUMP	ROTOJET {334A4910P0001}	2	PUMP MODEL: ROTO-JET VSR-2100 S484 3"-600# RF FLANGE INLET, 2"-900# RF FLANGE OUTLET, FLOW RATE AT 105 GPM, @ NORMAL OPERATING PRESS: 1175 PSIG, PUMP SPEED: 4706 RPM, EFFICIENCY 64%, MINIMUM FLOW: 9 GPM, 175 HP MOTOR, 460/400 VAC, 60/50 HZ, NEMA CLASS 1, GROUP 2, DIV 2 AND ATEX CATEGORY 3, ZONE 2, GROUP 2A, SR DRIVER BOX (P/N 334A4912P0001) SUPPLIED SEPARATELY
11	N/A	BALL VALVE	KF CONTRAMATICS {J00135}	2	BALL VALVE, 3"-150# RF, SS BODY, SS TRIM, FULL PORT, DURAFILL REINFORCED TFE SEATS, LOCKABLE HANDLE
12	PDT-2073	WATER INJECTION FILTER PRESSURE DIFFERENTIAL TRANSMITTER	ROSEMOUNT {382A5657P0001}	1	DIFFERENTIAL PRESSURE TRANSMITTER, -1000 to 1000 inH2O (-36 to 36 PSI) RANGE, 316 SS ISOLATING DIAPHRAGM, TEFLON O-RINGS, 1/4"-18 FNPT PROCESS & 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF CENELEC AND CSA, FLAMEPROOF, INTRINSIC SAFETY, SET AT 4 mA = 0 PSID AND 20 mA = 35 PSID
13	N/A	WATER INJECTION LAST CHANCE FILTER	INDUFIL {382A5653P0001}	1	DUPLEX 316SS FILTER ASSEMBLY COUPLED WITH AN INTEGRAL TRANSFER VALVE, 2" CODE 61 INLET AND OUTLET CONN., FILTER TO 25 MICRON BETA=200, COLLAPSE RATE AT 150 PSID, COMPLIANCE WITH ASME SEC VIII DIV. 1, WITH ASME STAMP AND PED REQUIREMENT. FILTER ELEMENT PART NUMBER: TMR-S-320-A-GF025-V
14	N/A	DIFFERENTIAL PRESSURE BALANCE VALVE	DRAGON 10P053	1	GLOBE VALVE, 1/4" FNPT, 316 SS, GRAFOIL PACKING
15	N/A	MANUAL VALVE	KF CONTRAMATICS 1/2INCH-S8000-LL	7	BALL VALVE, 1/2" FNPT, SS BODY AND TRIM, FULL PORT, TFE SEATS, 2000 WOG RATING, LOCKABLE HANDLE
16	FCV-2019 ZE-2019A ZE-2019B	WATER INJECTION METERING VALVE	WOODWARD {382A5529P0001}	1	WATER FLOW CONTROL VALVE, 2"-900# RF DEMIN. WATER SERVICE, ELECTRICALLY ACTUATED, 125 VDC POWER, WITH EGD DRIVER, DUAL RESOLVER (FEEDBACK), CSA/UL, CE ATEX ZONE 2 AND PED CATEGORY II

NOTE:
1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

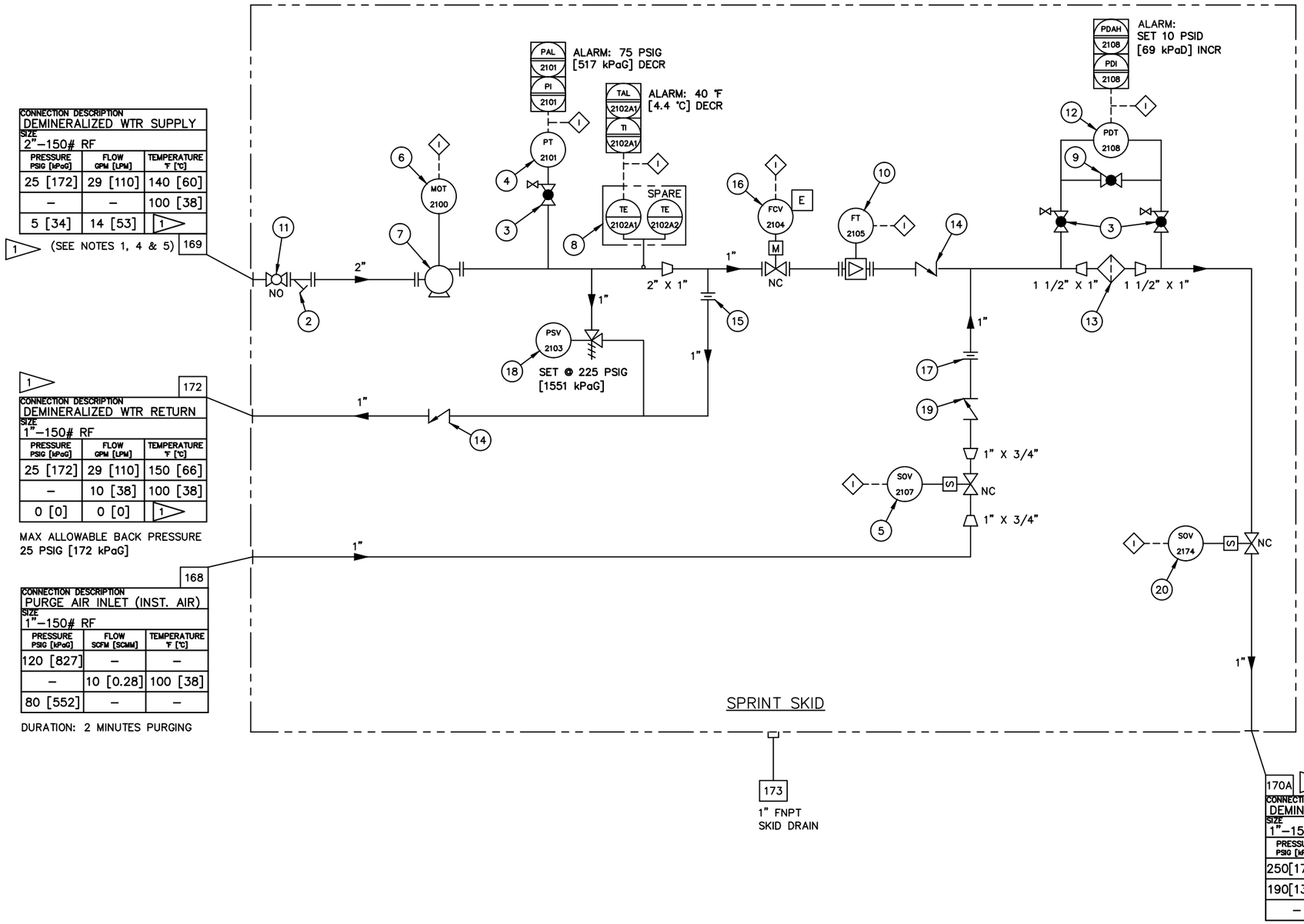
TITLE
FLOW & INSTRUMENT DIAGRAM
WATER INJECTION PUMP

DWG NO.
7253049-969269

REV.
A

SCALE NONE

SHEET 3 OF 3



CONNECTION DESCRIPTION: DEMINERALIZED WTR SUPPLY		
SIZE: 2"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
25 [172]	29 [110]	140 [60]
–	–	100 [38]
5 [34]	14 [53]	1

1 (SEE NOTES 1, 4 & 5) 169

CONNECTION DESCRIPTION: DEMINERALIZED WTR RETURN		
SIZE: 1"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
25 [172]	29 [110]	150 [66]
–	10 [38]	100 [38]
0 [0]	0 [0]	1

1 172

MAX ALLOWABLE BACK PRESSURE
25 PSIG [172 kPaG]

CONNECTION DESCRIPTION: PURGE AIR INLET (INST. AIR)		
SIZE: 1"–150# RF		
PRESSURE PSIG [kPaG]	FLOW SCFM [SCMM]	TEMPERATURE °F [°C]
120 [827]	–	–
–	10 [0.28]	100 [38]
80 [552]	–	–

168

DURATION: 2 MINUTES PURGING

173
1" FNPT
SKID DRAIN

170A 1 (SEE NOTE 6)

CONNECTION DESCRIPTION: DEMINERALIZED WTR OUTLET		
SIZE: 1"–150# RF		
PRESSURE PSIG [kPaG]	FLOW GPM [LPM]	TEMPERATURE °F [°C]
250[1724]	18 [68]	150 [66]
190[1310]	14 [53]	100 [38]
–	–	1

LEGEND:

INDICATES CUSTOMER CONNECTION AS SHOWN ON GENERAL ARRANGEMENT DRAWING.

NOTES:

1. SPRINT SKID SHALL BE LOCATED AT A DISTANCE FROM THE WATER SOURCE SUCH THAT A SUPPLY PRESSURE OF 5 PSIG [34 kPaG] MINIMUM IS MAINTAINED AT PUMP SUCTION FLANGE FOR ALL TANK LEVELS AND FLOW RATES.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. WATER MUST MEET G.E. QUALITY REQUIREMENTS PER G.E. AIRCRAFT DERIVATIVE TURBINES: MID–TD–0000–3.
5. THE LINE SHALL BE PIPED DIRECTLY FROM SUPPLY TANK.
6. RECOMMENDED SKID LOCATION TO BE WITHIN 30 EQUIVALENT PIPE FEET [9 EQUIVALENT PIPE METERS] OF MAIN UNIT CONNECTION POINT TO MINIMIZE PRESSURE LOSS.

SAFETY NOTE:

1 LINE NEEDS TO BE HEAT TRACED AND INSULATED TO PROTECT WATER FROM FREEZING.

REFERENCE DRAWINGS:

X–969149	CAUSE & EFFECT MATRIX, CONTROL SYSTEM
X–969209	GENERAL ARRANGEMENT, SPRINT SKID
X–000231	FLOW & EQUIPMENT SYMBOLS, MECHANICAL
X–969262	F&ID, WATER WASH SYSTEM
X–969268	F&ID, SPRINT SYSTEM MAIN UNIT

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000PC

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: FLOW AND INSTRUMENT DIAGRAM SPRINT SYSTEM SPRINT SKID

DWG NO. 7253049–969270

REV. A

SCALE NONE

SHEET 1 OF 2

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1		INTENTIONALLY LEFT BLANK			
2	N/A	Y-STRAINER	SURE FLOW EQUIPMENT {393A1746P0001}	1	2"-150# RF WITH SS BODY AND 0.045" PERFORATED SCREEN OPENING
3	N/A	INSTRUMENT VALVE	DRAGON 1053V3	3	316SS BODY, STEM, AND SEAT; 1/4" FNPT PROCESS CONNECTION, 1/4"JIC MALE TEST CONNECTION SS CAP & CHAIN ATTACHED, OPERATING PRESSURE RATING 6000 PSIG
4	PT-2101	PUMP DISCHARGE PRESSURE TRANSMITTER	ROSEMOUNT {249A4696P0001}	1	PRESSURE TRANSMITTER, 0-800 PSIG, 316 SS DIAPHRAGM, 1/2"-14 NPT PROCESS AND 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL BASED ON HART PROTOCOL, CSA, FM & ATEX EXPLOSION PROOF AND INTRINSIC SAFETY APPROVAL SET TRANSMITTERS AT 4 mA = 0 PSIG [0 kPaG] 20 mA = 300 PSIG [2068 kPaG]
5	SOV-2107	PUMP DISCHARGE	CO-AX {382A5646P0001}	1	SOLENOID VALVE, 3/4" FNPT, 240 PSI MAX, 24 VDC, 316 SS, 2-WAY NORMALLY CLOSED, INSTRUMENT AIR
6	MOT-2100	ELECTRIC MOTOR	(MOTOR SUPPLIED WITH ITEM 7)	1	10 HP [7.5 kW], 3500 RPM, 60 HZ, UL/FM, CSA APPROVED
7	N/A	PUMP	GOULDS {399A2814P0001}	1	PUMP/MOTOR ASSEMBLY, 2"-300# RF SUCTION & DISCHARGE FLANGES, 12 STAGE, 30 GPM @ TDH 620 FEET, MINIMUM FLOW 10 GPM
8	TE-2102A1 TE-2102A2	TEMPERATURE SENSOR	ROSEMOUNT {J01068}	1	PLATINUM RTD, DUAL ELEMENT, 2 1/2" IMMERSION LENGTH, 100 OHM AT 0 °C DIRECTLY CONNECTED TO EXPLOSION PROOF TERMINAL BOX W/CHAIN ATTACHED FLAT COVER, INCLUDES 3/4" MNPT 316 SS THERMOWELL, CSA EXPLOSION PROOF APPROVAL
9	N/A	GLOBE VALVE	DRAGON 10P053	1	GLOBE VALVE 1/4" FNPT GRAFOIL PACKING, 316 SS BODY AND SS TRIM, TEE HANDLE, 0.19" ORIFICE
10	FT-2105	FLOW METER	YOKOGAWA {386A7270P0001}	1	4-20 MA OUTPUT, 1"-150# RF, 0-30 GPM [0-1.9L/sec] SS BODY AND SHEDDER BAR, WITH INTEGRAL CONVERTER
11	N/A	BALL VALVE	WATTS {J00016}	1	2"-150# RF, SS, FULL PORT, 275 PSI PRESSURE RATING, LOCKING LEVER HANDLE
12	PDT-2108	DIFFERENTIAL PRESSURE TRANSMITTER	ROSEMOUNT {382A5657P0001}	1	DIFFERENTIAL PRESSURE TRANSMITTER, -1000 to 1000 inH2O (-2.5 to 2.5 bar) RANGE, 316 SS ISOLATING DIAPHRAGM, VITON O-RINGS, 1/4"-18 FNPT PROCESS & 1/2"-14 NPT ELECTRICAL CONNECTIONS, 4-20 mA OUTPUT WITH DIGITAL SIGNAL BASED ON HART PROTOCOL, SAFETY APPROVAL COMBINATION OF ATEX AND CSA FLAMEPROOF, INTRINSIC SAFETY, NON-INCENDIARY, SET AT 4 mA = 0 AND 20 mA = 35 PSID [242 kPaD]
13	N/A	FILTER	INDUFIL {382A1201P0001}	1	CONSTRUCTION INCLUDES ALL 316 SS FILTER HOUSING WITH VITON A O-RING SEALED COVERS, WITH 1/2" NPT VENTS, DRAINS FITTED WITH 1/2"-316 SS PLUGS, FILTER ELEMENT: TMR-S-200-CC10V
14	N/A	CHECK VALVE	CHECK ALL {J00458}	2	CHECK VALVE, 1" FNPT, 1/2" PSID CRACKING PRESSURE, 316 SS, VITON SEAL
15	N/A	BYPASS ORIFICE	SWAGELOK {698300P0274}	1	ADAPTER, 1" TUBE UNION, 3/16" ORIFICE, 316 SS
16	FCV-2104	FLOW CONTROL VALVE	AWC {382A5526P0001}	1	1" FLOW CONTROL VALVE, WITH 1/8" SLOT SEAT, 316 SS THREE PIECE VALVE WITH 1" NPT CONNECTIONS, EQUIPPED WITH 75 SERIES ELECTRIC ACTUATOR, 24 VDC, NEMA 4, 4X, 7, 9, CSA APPROVED 4-20 mA INPUT SIGNAL, NORMALLY CLOSED
17	N/A	PURGE AIR ORIFICE	SWAGELOK {698300P0316}	1	ADAPTER, 1" TUBE UNION, 0.125" ORIFICE, 316 SS
18	PSV-2103	PRESSURE UNLOADING VALVE	FISHER FS98HH-20/B2	1	VALVE, PRESSURE REGULATOR, 1" FNPT, 150-375 PSIG, 316 SS SPRING CASE AND SPRING
19	N/A	CHECK VALVE	CHECK ALL {382A7496P0001}	1	CHECK VALVE, 1" FNPT, 1/8" PSID CRACKING PRESSURE, 316 SS, VITON SEAL
20	SOV-2174	SOLENOID VALVE	ATKOMATIC {J00095}	1	SOLENOID VALVE, 1" FSAE, 24 VDC, 3000# WP 316 SS, NORMALLY CLOSED, DEMINERALIZED WATER

NOTE:

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE FLOW AND INSTRUMENT DIAGRAM SPRINT SYSTEM SPRINT SKID

DWG NO. 7253049-969270

REV. A

SCALE NONE

SHEET 2 OF 2

LEGEND

⬡ INDICATES G.E. ENGINE CONNECTION AS DESIGNATED BY G.E. DRAWINGS.

ES = FAST STOP WITH MOTOR
ESN = FAST STOP LOCKOUT WITHOUT MOTOR
SI = STEP TO CORE IDLE
DM = SLOW DECEL TO MINIMUM LOAD
NS = NO START

NOTES:

1. XE–8007X, XE–8007Y, XE–8009X, AND XE–8009Y ARE PROXIMITERS, MOUNTED ON 90° SEPARATION.
2. XE–8076 AND XE–8077 ARE ACCELEROMETERS, MOUNTED ON THE LM6000 WITH SETTINGS FOR THE LP & HP COMPRESSORS.
3. REFERENCE X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM – LM6000PG/PH FOR ALARM/SHUTDOWN SETPOINTS.
4. ESX INDICATES TURBINE ELECTRICAL SERVICE CONNECTION, WHERE INDICATED.

REFERENCE DRAWINGS

X–969149 CAUSE & EFFECT MATRIX, CONTROL SYSTEM – LM6000 PG/PH
X–000231 FLOW & EQUIPMENT SYMBOLS, MECHANICAL

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DECIMALS .XX ± .03 .XXX ± .010
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ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

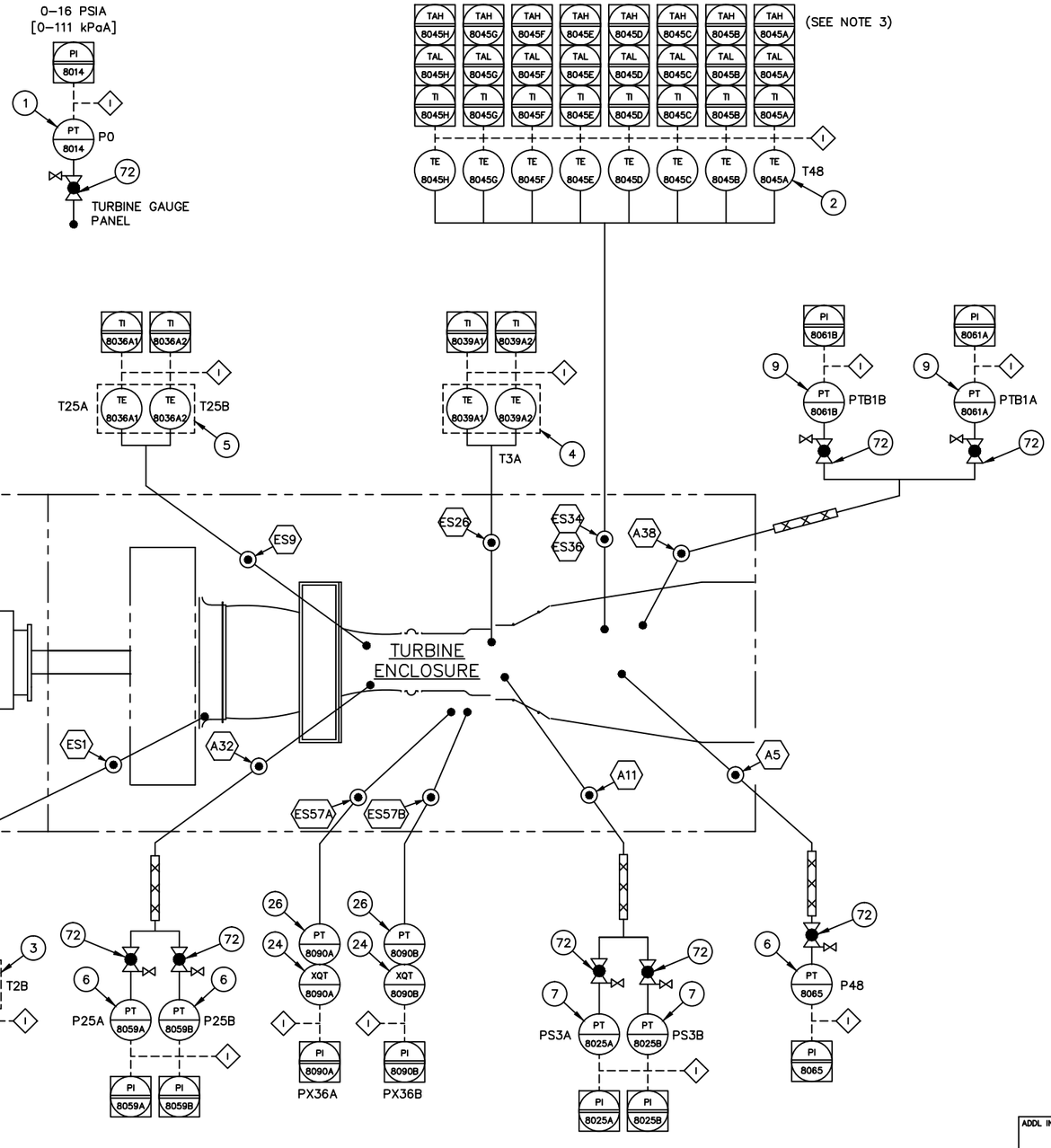
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENTATION DIAGRAM
AUXILIARY SYSTEMS

DWG NO. 7253049–969272
REV. A
SCALE NONE
SHEET 1 OF 4

PRESSURE & TEMPERATURE INSTRUMENTATION

(SEE SHEET 3 FOR MISCELLANEOUS INSTRUMENTATION)



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TOLERANCES
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FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

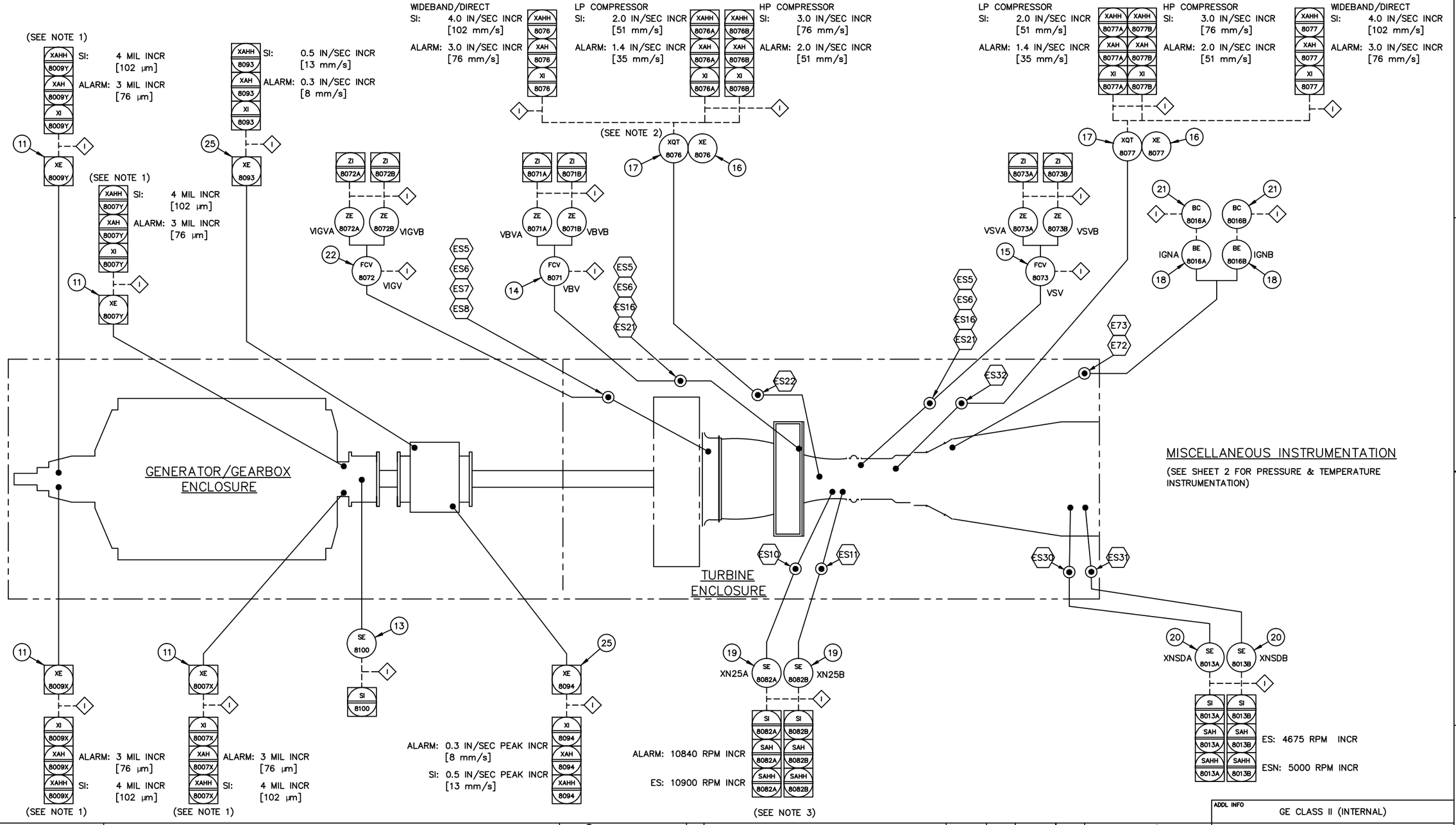
TITLE
INSTRUMENTATION DIAGRAM
AUXILIARY SYSTEMS

DWG NO. 7253049–969272

REV. A

SCALE NONE

SHEET 2 OF 4



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UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENTATION DIAGRAM
AUXILIARY SYSTEMS

DWG NO. 7253049-969272

REV. A

SCALE NONE

SHEET 3 OF 4

ITEM NO.	TAG NO.	DEVICE	MFR/PART NO.	QTY	DESCRIPTION
1	PT-8014	PRESSURE TRANSMITTER, INLET STATIC PRESSURE (PO)	YOKAWAGA {J03490}	1	PRESSURE TRANSMITTER, 0-430 PSIA, HASTELLOY C276 DIAPHRAGM, VITON O-RINGS, DRAIN/VENT VALVE, 1/4" FNPT PROCESS AND 1/2" NPT ELECTRICAL CONNECTIONS, 4-20 mADC OUTPUT, FM APPROVED, EXPLOSION PROOF, SET PT-8014 AT 4 mA = 0 PSIA, 20 mA = 16 PSIA
2	TE-8045A THRU TE-8045H	TEMPERATURE ELEMENT, LPT INLET GAS (T48)	SUPPLIED WITH ENGINE 1962M86	(8) REF	THERMOCOUPLE, CHROMEL-ALUMEL TYPE
3	TE-8021A1 TE-8021A2	TEMPERATURE ELEMENT, LP COMPRESSOR INLET (T2)	SUPPLIED WITH ENGINE L44745	(1) REF	PLATINUM RTD, DUAL ELEMENT, 100 OHMS AT 0 °C
4	TE-8039A1 TE-8039A2	TEMPERATURE ELEMENT, HP COMPRESSOR DISCHARGE (T3)	SUPPLIED WITH ENGINE L43416	(1) REF	THERMOCOUPLE, CHROME-ALUMEL TYPE, DUAL ELEMENT, ±1% ACCURACY
5	TE-8036A1 TE-8036A2	TEMPERATURE ELEMENT, HP COMPRESSOR INLET (T25)	SUPPLIED WITH ENGINE L44745	(1) REF	PLATINUM RTD, DUAL ELEMENT, 100 OHMS AT 0 °C
6	PT-8059A PT-8059B PT-8065	PRESSURE TRANSMITTER, HP COMPRESSOR INLET (P25) (TOTAL) LP TURBINE INLET (P48) (TOTAL)	ROSEMOUNT {382A5661P0001}	3	PRESSURE TRANSMITTER, 0-150 PSIA, 316 SS DIAPHRAGM, VITON O-RINGS, DRAIN/VENT VALVE, 1/2" FNPT PROCESS AND 1/2" NPT ELECTRICAL CONNECTIONS, 4-20 mADC OUTPUT, CSA & ATEX APPROVED, EXPLOSION PROOF, SET PT-8059 A & B AT 4 mA = 0 PSIA, 20 mA = 100 PSIA SET PT-8065 AT 4 mA = 0 PSIA, 20 mA = 150 PSIA
7	PT-8025A PT-8025B	PRESSURE TRANSMITTER, TURBINE HP COMPRESSOR DISCHARGE (PS3)	DRUCK {382A5355P0001}	2	PRESSURE TRANSMITTER, 0-600 PSIA, HASTELLOY C276 DIAPHRAGM, 1/2" NPT PROCESS AND 3/4" NPT ELECTRICAL CONNECTIONS, 4-20 mADC OUTPUT, FULL SCALE RESPONSE NOT TO EXCEED 2ms, FM/CSA APPROVED, EXPLOSION PROOF, SET PT-8025A & PT-8025B AT 4 mA = 0 PSIA, 20 mA = 600 PSIA
8		INTENTIONALLY LEFT BLANK			
9	PT-8061A PT-8061B	PRESSURE TRANSMITTER, BALANCE PISTON PRESSURE (PTB1)	ROSEMOUNT {382A5662P0001}	2	PRESSURE TRANSMITTER, 0-800 PSIA, 316 SS DIAPHRAGM, VITON O-RINGS, DRAIN/VENT VALVE, 1/2" FNPT PROCESS AND 1/2" NPT ELECTRICAL CONNECTIONS, 4-20 mADC OUTPUT, CSA & ATEX APPROVED, EXPLOSION PROOF, SET PT-8061 A & B AT 4 mA = 0 PSIA, 20 mA = 300 PSIA
10		INTENTIONALLY LEFT BLANK			
11	XE-8007X XE-8007Y XE-8009X XE-8009Y	PROXIMITY TRANSDUCER ASSEMBLY GENERATOR BEARING (DRIVE END & NON-DRIVE END)	BENTLY NEVADA {382A5599P0001}	4	PROXIMITY TRANSDUCER WITH NO STANDOFF ADAPTER, 8.5" PROBE LENGTH, 1/2"-14 NPT ELECTRICAL CONNECTION, 3/4"-14 NPT MOUNTING THREAD
12		INTENTIONALLY LEFT BLANK			
13	SE-8100	PROXIMITY TRANSDUCER ASSEMBLY, GENERATOR KEY PHASOR	BENTLY NEVADA {382A5599P0001}	1	PROXIMITY TRANSDUCER WITH NO STANDOFF ADAPTER, 8.5" PROBE LENGTH, 1/2"-14 NPT ELECTRICAL CONNECTION, 3/4"-14 NPT MOUNTING THREAD
14	FCV-8071 ZE-8071A ZE-8071B	FLOW CONTROL VALVE, VARIABLE BYPASS VALVE (VBV)	SUPPLIED WITH ENGINE L44571/L43419	(1) REF	CONTROL VALVE, LVDT POSITION SENSOR 0-2.27 INCHES, ASSEMBLY INCLUDES 2 LVDT'S AND ONE ACTUATOR
15	FCV-8073 ZE-8073A ZE-8073B	FLOW CONTROL VALVE, VARIABLE STATOR VANE (VSV)	SUPPLIED WITH ENGINE L44571/L43418	(1) REF	CONTROL VALVE, LVDT POSITION SENSOR 0-3.095 INCHES, ASSEMBLY INCLUDES 2 LVDT'S AND ONE ACTUATOR
16	XE-8076 XE-8077	VIBRATION ELEMENT, COMPRESSOR REAR FRAME, TURBINE REAR FRAME	SUPPLIED WITH ENGINE L31967	(2) REF	TURBINE VIBRATION, SELF-GENERATING ACCELEROMETER, 50 pC/g OUTPUT, PIEZOELECTRIC OUTPUT
17	XQT-8076 XQT-8077	ACCELEROMETER INTERFACE MODULE	BENTLY NEVADA {382A1213P0001}	2	24 VDC, TEMPERATURE 32 °F TO 158 °F
18	BE-8016A BE-8016B	TURBINE IGNITER	SUPPLIED WITH ENGINE 9392M95	(2) REF	IGNITION EXCITER MODULE
19	SE-8082A SE-8082B	SPEED ELEMENT, HPC MAGNETIC PICKUP (XN25)	SUPPLIED WITH ENGINE L21131	(2) REF	SPEED ELEMENT, MAGNETIC RELUCTANCE TYPE, PULSE GENERATOR
20	SE-8013A SE-8013B	SPEED ELEMENT, LPT MAGNETIC PICKUP (XNSD)	SUPPLIED WITH ENGINE L59095	(2) REF	SPEED ELEMENT, MAGNETIC RELUCTANCE TYPE, PULSE GENERATOR
21	BC-8016A BC-8016B	IGNITION EXCITER	SUPPLIED WITH ENGINE L21454	(2) REF	EXCITER
22	FCV-8072 ZE-8072A ZE-8072B	FLOW CONTROL VALVE, TURBINE VARIABLE INLET GUIDE VALVE (VIGV)	SUPPLIED WITH ENGINE L44571/L43418	(1) REF	CONTROL VALVE, LVDT POSITION SENSOR 0-3.095 INCHES, ASSEMBLY INCLUDES TWO LVDT'S AND ONE ACTUATOR
23		INTENTIONALLY LEFT BLANK			
24	XQT-8090A XQT-8090B	DYNAMIC PRESS CHARGE AMPLIFIER	BENTLY NEVADA {377A6927P0001}	2	WITH MOD. #161472-01. THE MODIFICATION IS TO BE INCORPORATED WITH THE CONNECTOR MS3112-8-3P, CE MARKED, ATEX
25	XE-8093 XE-8094	VIBRATION ELEMENT, GEARBOX	BENTLY-NEVADA 330400-01-05 SUPPLIED WITH GEARBOX	(2) REF	GEARBOX ACCELEROMETER
26	PT-8090A PT-8090B	PRESSURE TRANSMITTER, COMBUSTION DYNAMIC SENSOR	SUPPLIED WITH ENGINE L44723	(2) REF	COMBUSTOR DYNAMIC PRESSURE
27		INTENTIONALLY LEFT BLANK			
28		INTENTIONALLY LEFT BLANK			
29 THRU 71		INTENTIONALLY LEFT BLANK			
72	N/A	INSTRUMENT VALVE	DRAGON 1053V3	8	INSTRUMENT VALVE, 1/4" FNPT PROCESS CONNECTION, 1/4" JIC TEST PORT WITH CAP, 316 SS, VITON PACKING

NOTE:
1. NUMBERS IN { } BRACES ARE GEPPLP ASSIGNED PART NUMBERS.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11913	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENTATION DIAGRAM AUXILIARY SYSTEMS

DWG NO. 7253049-969272

REV. A

SCALE NONE

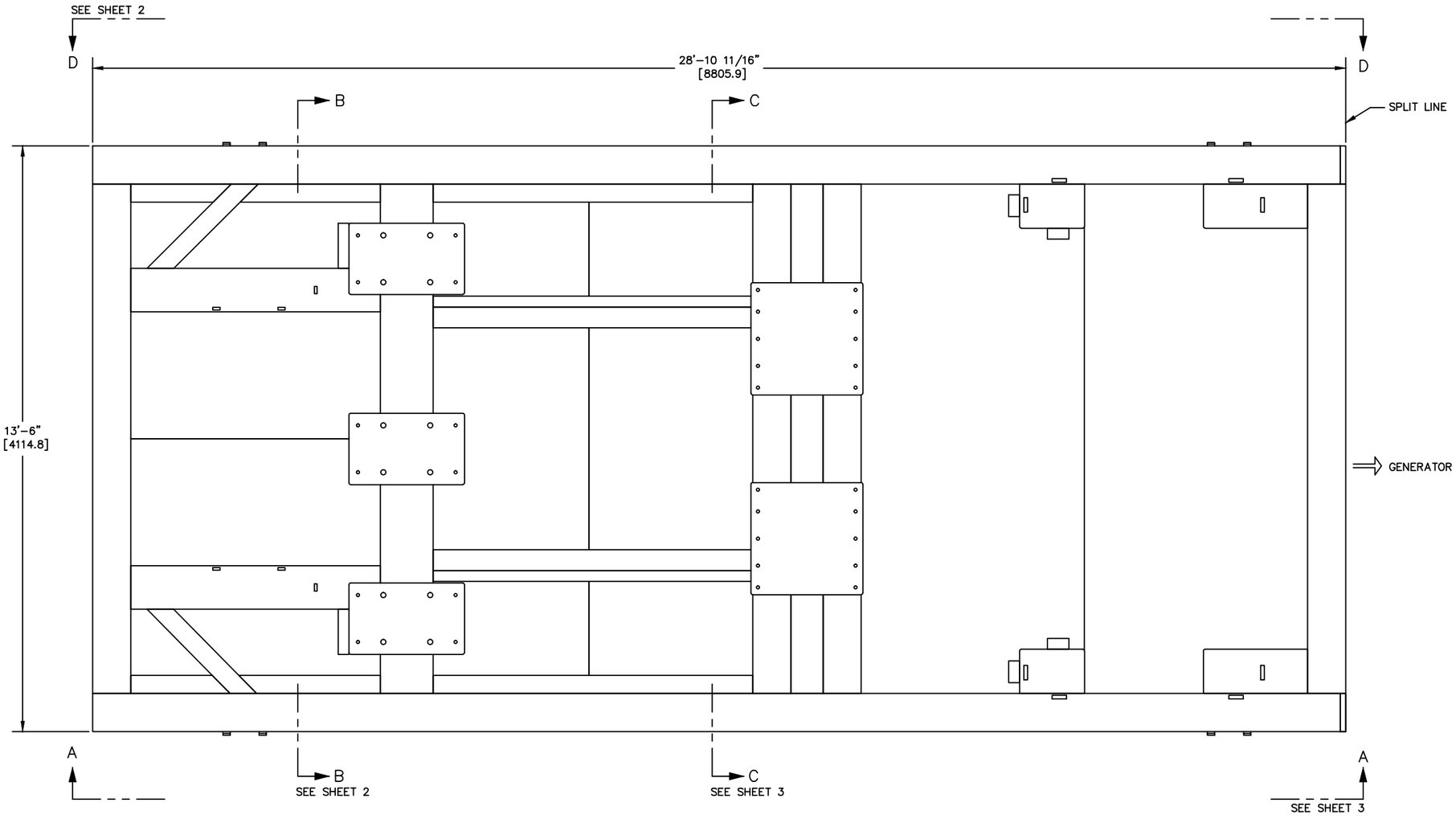
SHEET 4 OF 4

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: ASME Y14.5M–1994, DIMENSIONING AND TOLERANCING.
2. REMOVE ALL BURRS AND SHARP EDGES.
3. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. ITEM NUMBERING DESIGNATION:

ITEM NUMBERS:	DESCRIPTION:
1–100	RAW MATERIALS
101–200	COMPONENT PARTS
201–300	F&ID COMPONENTS

5. SURFACE PREPARATION/FINISHING SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF GE SPECIFICATION 95953.
6. DRILLING, CUTTING AND/OR WELDING SHALL BE DONE PRIOR TO SURFACE PREPARATION/FINISHING.



TURBINE SKID – PLAN VIEW

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A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
PIPING PENETRATIONS OPTION LH

DWG NO. 7253049–969293

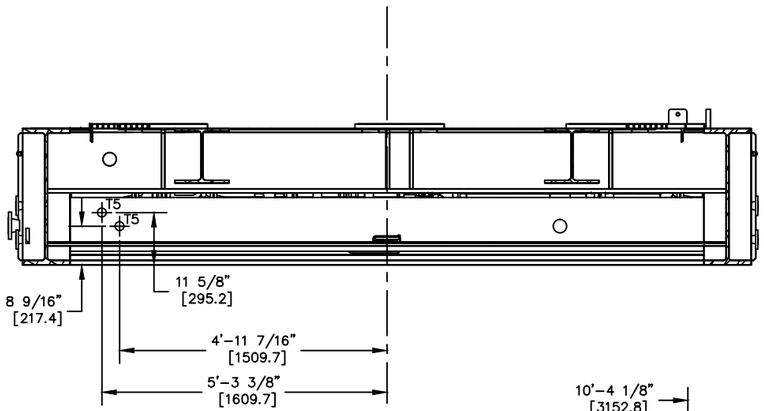
REV. A

SCALE 3/4" = 1'–0"

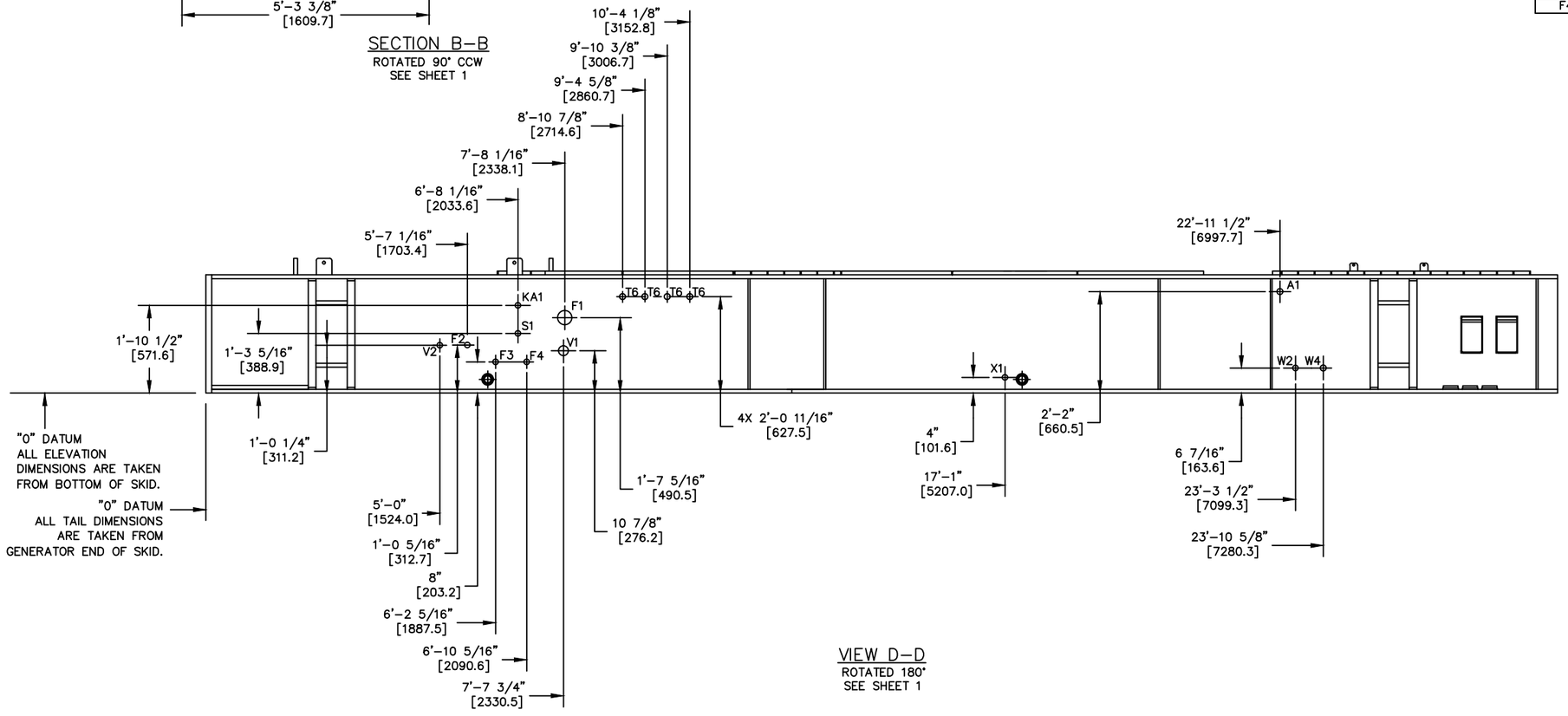
SHEET 1 OF 3

HOLE LEGEND			CUSTOMER CONNECTION
HOLE	UNIVERSAL	DIA.	
V1	INLET VOLUTE	2 1/2"	149
V2	VBV DRAIN	1 7/16"	187
X1	EXHAUST DRAIN	1 7/16"	7
KA1	CLUTCH TELL DRAIN	1 7/16"	291
T5	TURBINE LUBE OIL	2"	
T6	TURBINE LUBE OIL	1 1/2"	
HOLE	OPTION	DIA.	
W2	WATER INJECTION	1 7/16"	190
W4	WATER INJECTION	1 1/2"	245
HOLE	OPTION	DIA.	
S1	SPRINT SYSTEM	1 7/16"	171
A1	INSTRUMENT AIR	3/4"	185

HOLE	OPTION	DIA.	
F1	GAS FUEL	3 5/8"	10
F2	GAS FUEL	1 7/16"	11
F3	GAS FUEL	1 7/16"	24
F4	GAS FUEL	1 7/16"	297



SECTION B–B
ROTATED 90° CCW
SEE SHEET 1



VIEW D–D
ROTATED 180°
SEE SHEET 1

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

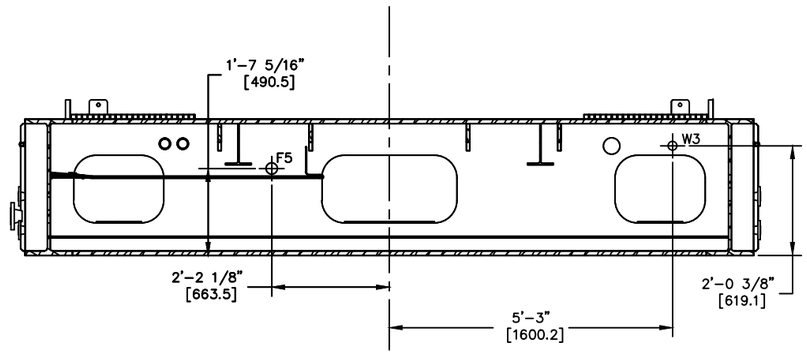
GE PACKAGED POWER, L.P.

TITLE
PIPING PENETRATIONS OPTION LH

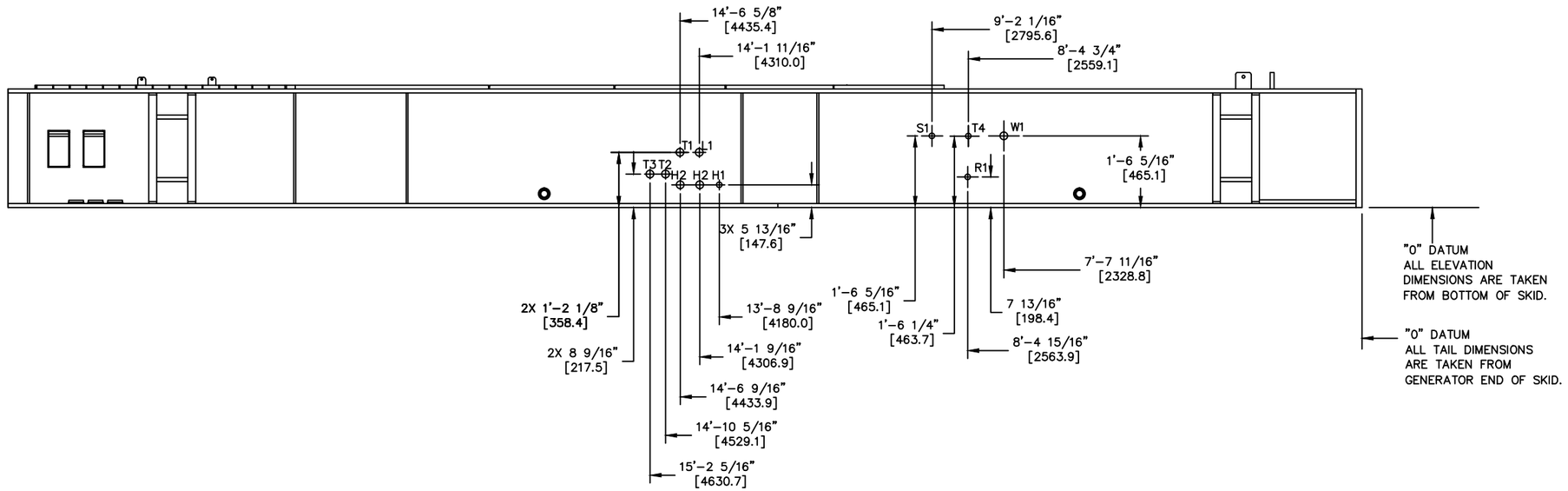
DWG NO. 7253049–969293
REV. A

SCALE 3/4" = 1'–0"
SHEET 2 OF 3

HOLE LEGEND			CUSTOMER CONNECTION
HOLE	UNIVERSAL	DIA.	
H1	HYDRAULIC START	1 7/16"	5
H2	HYDRAULIC START	2"	2,3
L1	SCAVENGE LUBE OIL	2"	57
R1	WATER WASH	1 7/16"	72
T1	TURBINE LUBE OIL	2"	71
T2	TURBINE LUBE OIL	2"	314
T3	TURBINE LUBE OIL	2"	315
T4	TURBINE LUBE OIL	1 7/16"	55
HOLE	OPTION	DIA.	
W1	WATER INJECTION	2"	1
W3	WATER INJECTION	2"	
HOLE	OPTION	DIA.	
S1	SPRINT SYSTEM	1 7/16"	170
HOLE	OPTION	DIA.	
F5	GAS FUEL	2 1/2"	



SECTION C-C
ROTATED 90° CCW
SEE SHEET 1



VIEW A-A
SEE SHEET 1

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A	ORIGINAL ISSUE	11914	DLC	10/16/13	DT

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
PIPING PENETRATIONS OPTION LH

DWG NO. 7253049-969293

REV. A

SCALE 3/4" = 1'-0"

SHEET 3 OF 3

NOTES:

1. INSIDE THE TURBINE ROOM IS CONSIDERED CLASS 1, DIVISION 2. PER API RP500 AND NEC 500
2. AREA OUTSIDE OF TURBINE ENCLOSURE CAN BECOME UNCLASSIFIED WHEN GAS FUEL SUPPLY PIPE INTERFACE IS SEAL WELDED. EXCLUSIVE OF THE TURBINE FAN AND VBV EXHAUST PATHS
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. REFERENCE GENERAL ARRANGEMENT FOR EQUIPMENT LAYOUT.
5. IT IS THE CUSTOMERS SCOPE OF RESPONSIBILITY TO ROUTE GAS VENT LINES TO A SAFE AREA.

REFERENCE DRAWINGS:

X–969200 GENERAL ARRANGEMENT MAIN UNIT–RH
X–969201 GENERAL ARRANGEMENT MAIN UNIT–LH
X–969245 FLOW & INSTRUMENT DIAGRAM, DLE FUEL SYSTEM
X–969260 FLOW & INSTRUMENT DIAGRAM, FUEL SYSTEM
X–969691 AREA CLASSIFICATION REPORT

LEGEND:

CLASS 1, DIVISION 1 (60 Hz)

CLASS 1, DIVISION 2 (60 Hz)

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

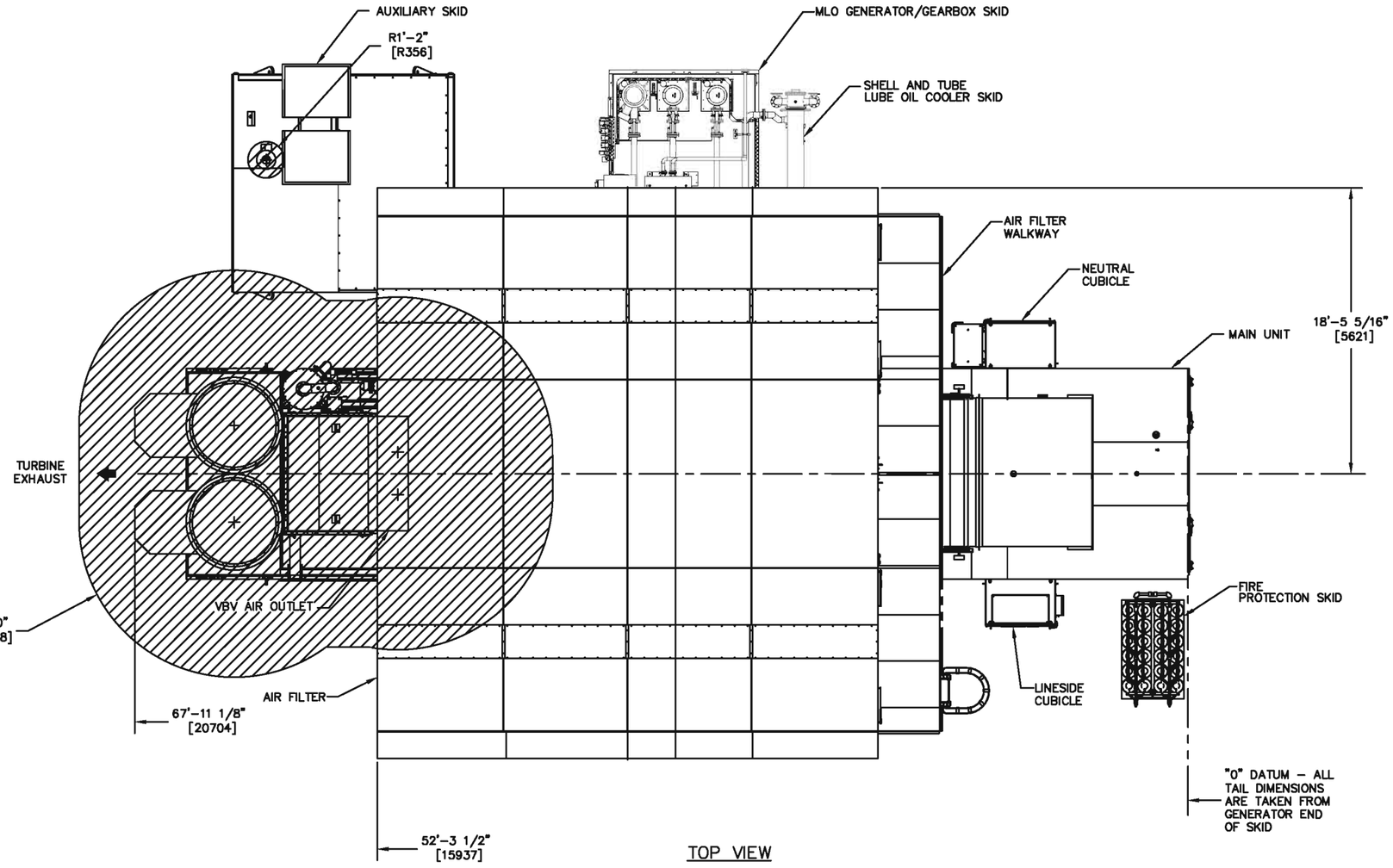
TITLE
AREA CLASSIFICATION DRAWING
MAIN UNIT

DWG NO. 7253049–969690

REV. A

SCALE 1/4" = 1'–0"

SHEET 1 OF 7



TOP VIEW

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

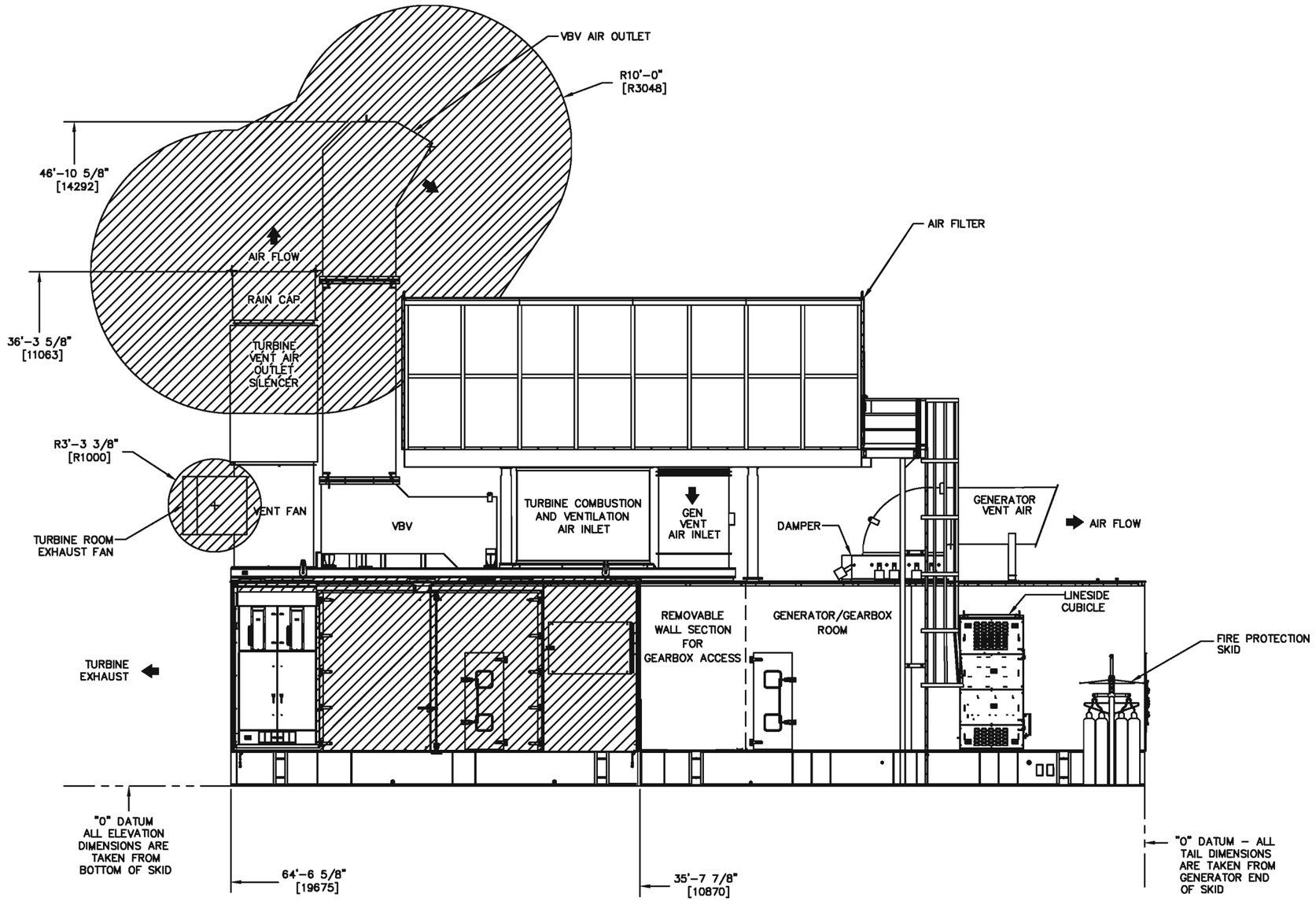
TITLE
AREA CLASSIFICATION DRAWING
MAIN UNIT

DWG NO. 7253049-969690

REV. A

SCALE 1/4" = 1'-0"

SHEET 2 OF 7



LEFT SIDE VIEW

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

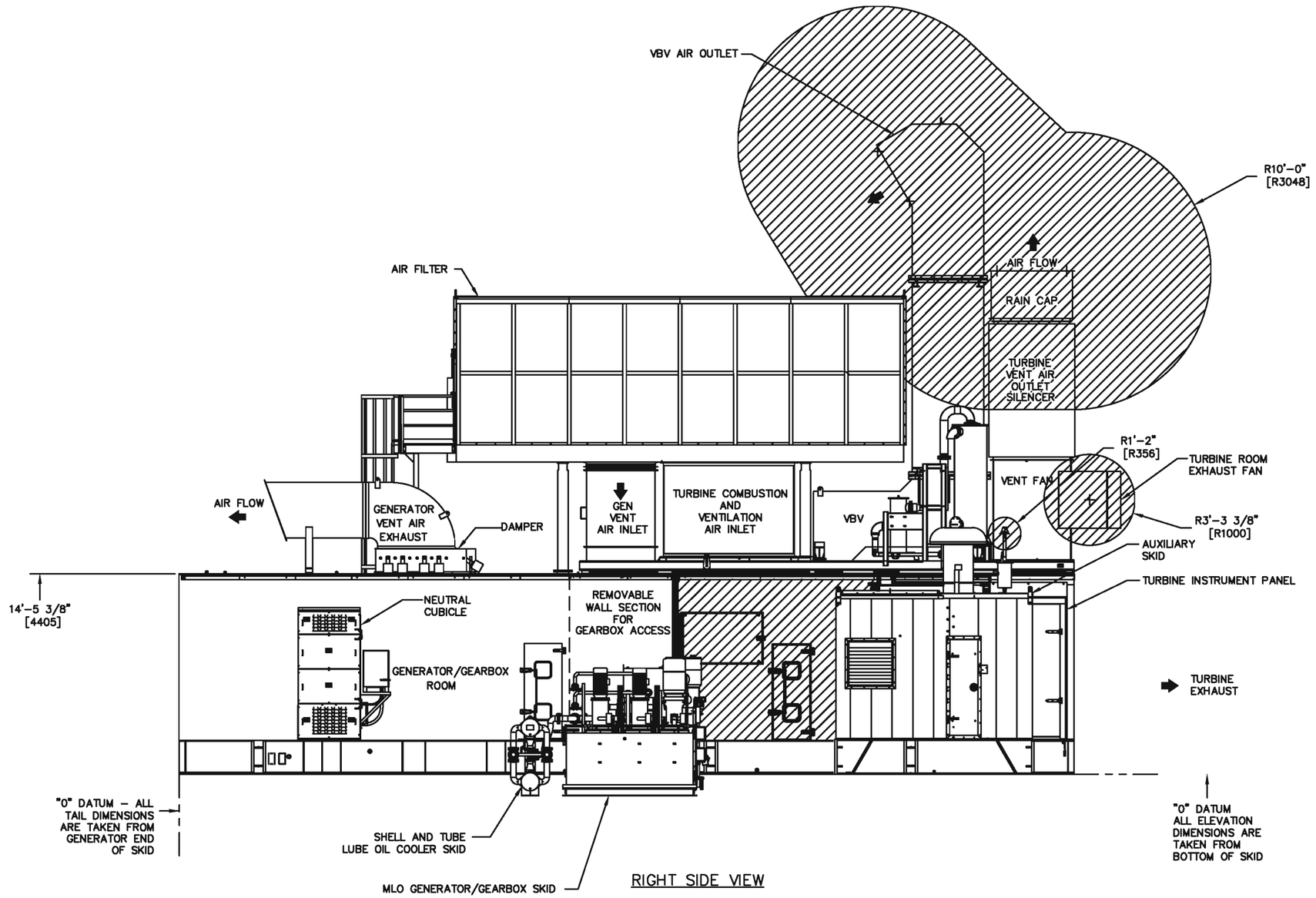
TITLE
AREA CLASSIFICATION DRAWING
MAIN UNIT

DWG NO. 7253049-969690

REV. A

SCALE 1/4" = 1'-0"

SHEET 3 OF 7



RIGHT SIDE VIEW

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

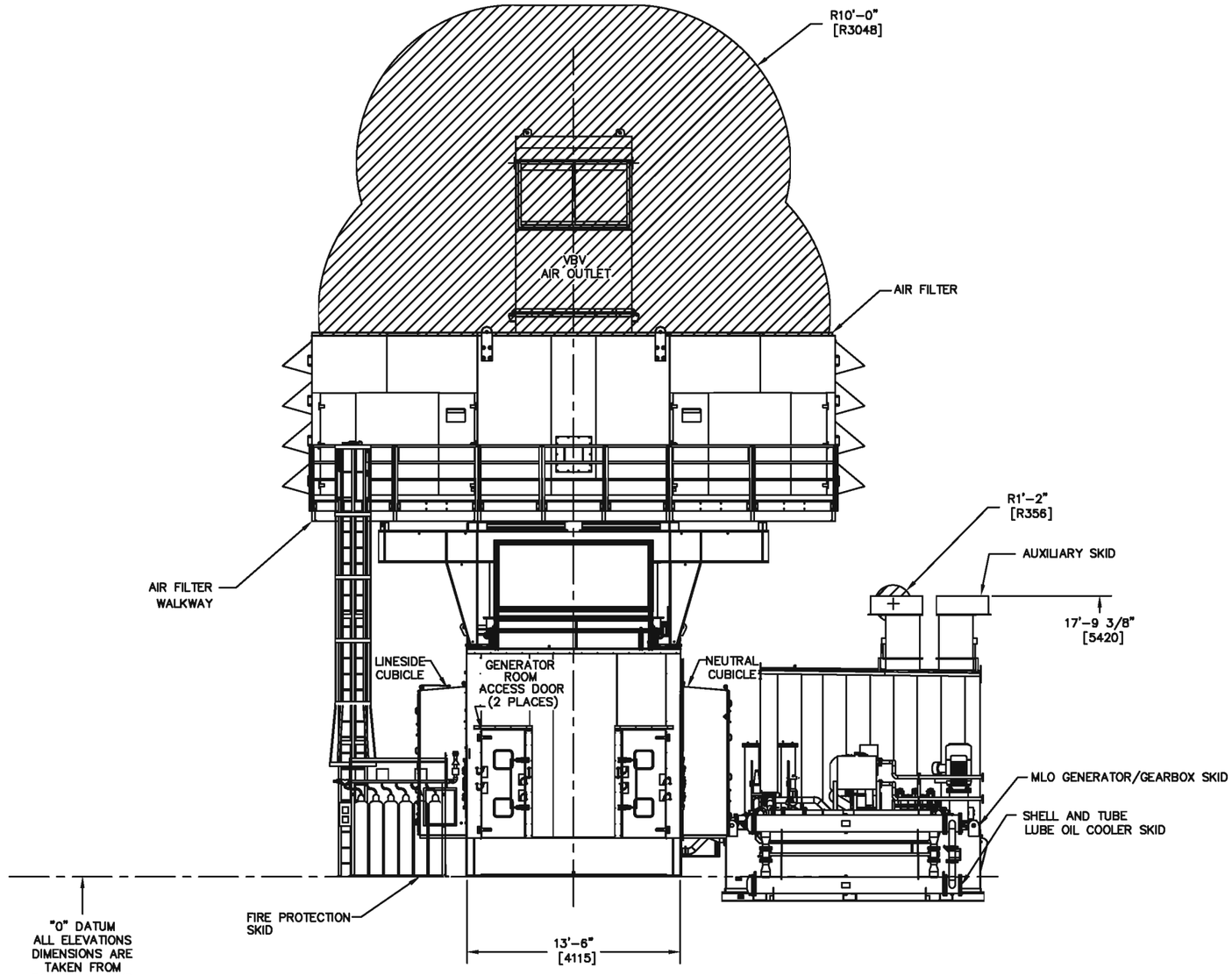
TITLE
AREA CLASSIFICATION DRAWING
MAIN UNIT

DWG NO. 7253049-969690

REV. A

SCALE 1/4" = 1'-0"

SHEET 4 OF 7



GENERATOR END VIEW

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

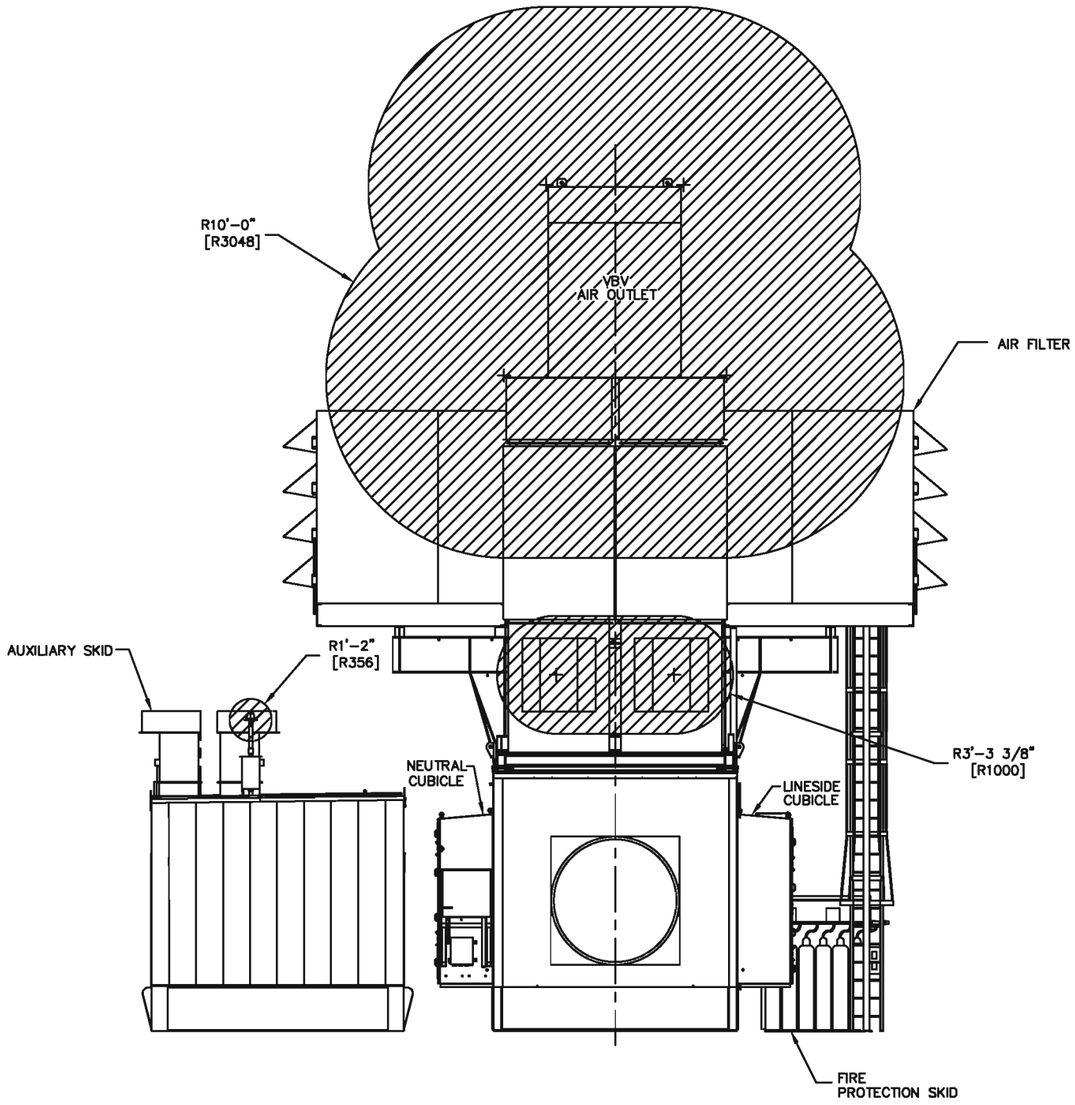
TITLE: AREA CLASSIFICATION DRAWING
MAIN UNIT

DWG NO. 7253049-969690

REV. A

SCALE 1/4" = 1'-0"

SHEET 5 OF 7



EXHAUST END VIEW

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DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000©

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

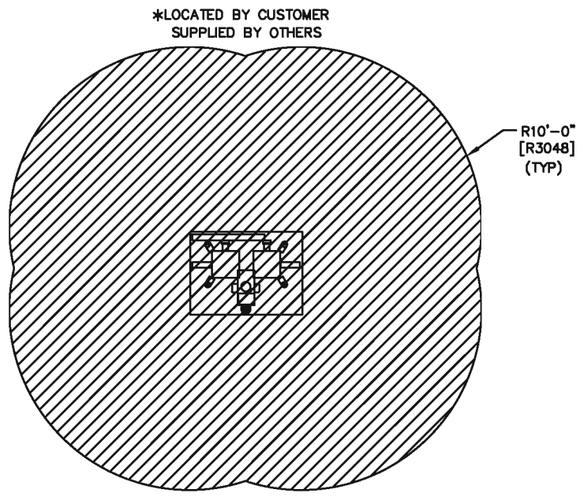
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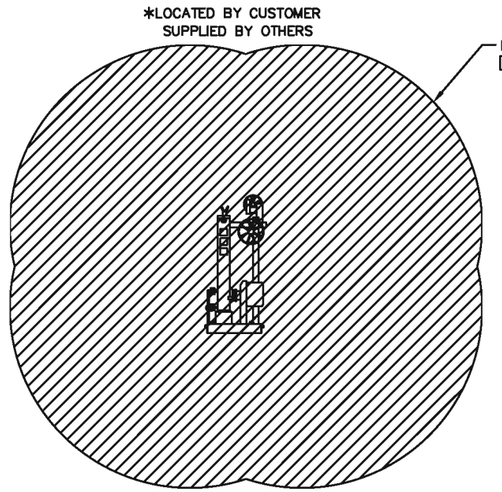
DWG NO. 7253049-969690

REV. A

SCALE 1/4" = 1'-0"

SHEET 6 OF 7





GAS FUEL FILTER SKID
60 Hz

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

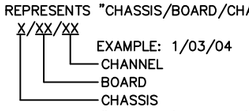
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MAIN UNIT

DWG NO. 7253049-969690
REV. A

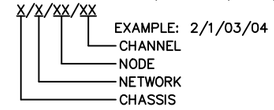
SCALE 1/4" = 1'-0"
SHEET 7 OF 7

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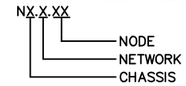
1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975
   GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–
   (CONFIG. OR SITE)–(STANDARD DRAWING NUMBER).
   WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS



6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK



LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969232 FLOW & INSTRUMENT DIAGRAM, HYDRAULIC START SYSTEM

WIRE COLOR CONVERSION TABLE (IEC–ANSI/NEC)*

Color	IEC* Letter Code	IEC–NEC GE Design Colors
Black	BK	BLK
Brown	BN	BRN
Red	RD	RED
Orange	OG	ORN
Yellow	YE	YEL
Green	GN	GRN
Blue	BU	BLU
Violet	VT	VLT
Gray	GY	GRY
White	WH	WHT
Pink	PK	PNK
Gold	GD	GD
Turquoise	TQ	TQ
Silver	SR	SR
Green–and–yellow	GN/YE	GRN/YEL

* IEC COLORS CHART PER IEC PUBLICATION 757, TABLE 1.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	MR	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

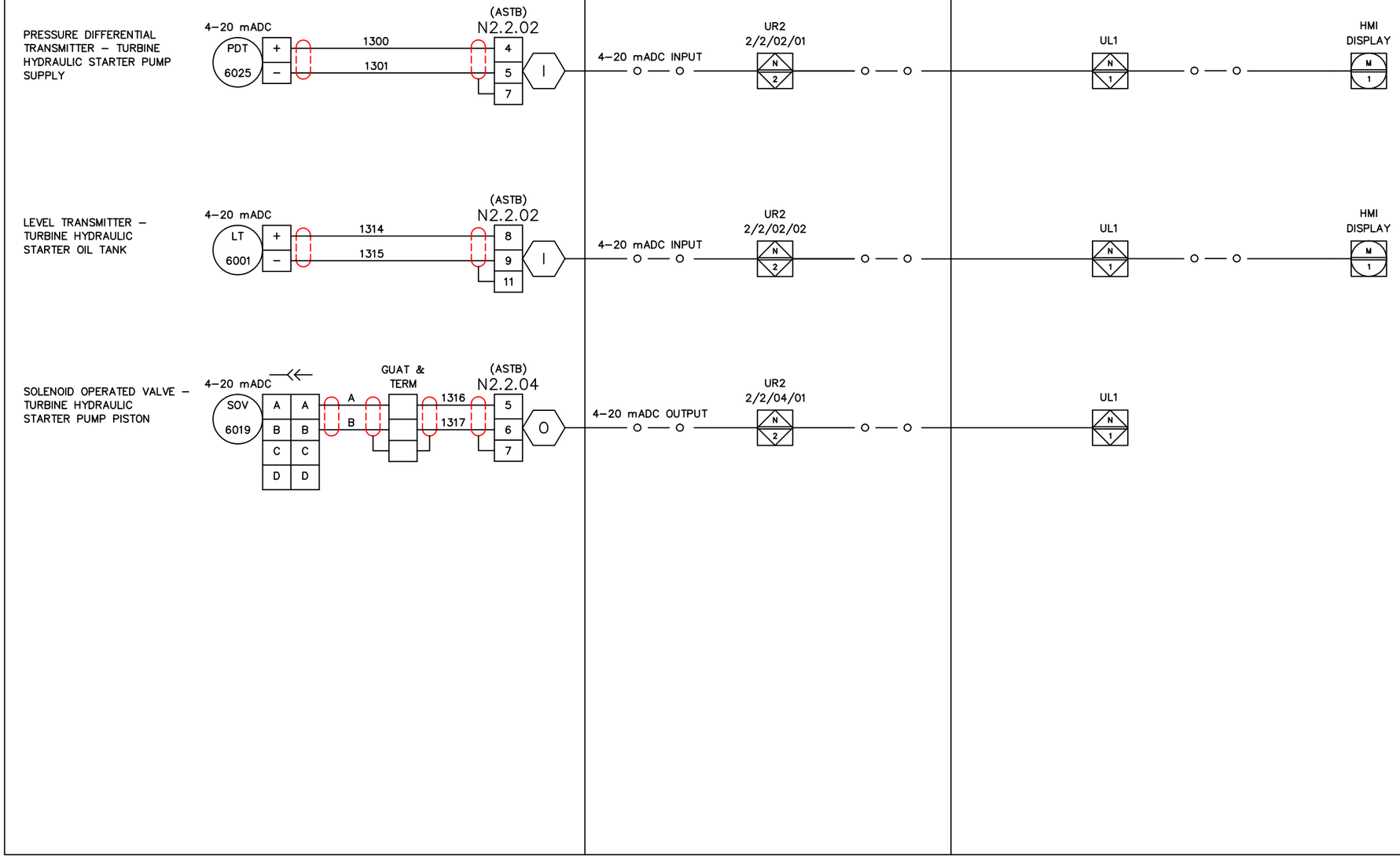
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
HYDRAULIC START SYSTEM

DWG NO. 7248201–571270
REV. A
SCALE NONE
SHEET 1 OF 4

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM HYDRAULIC START SYSTEM

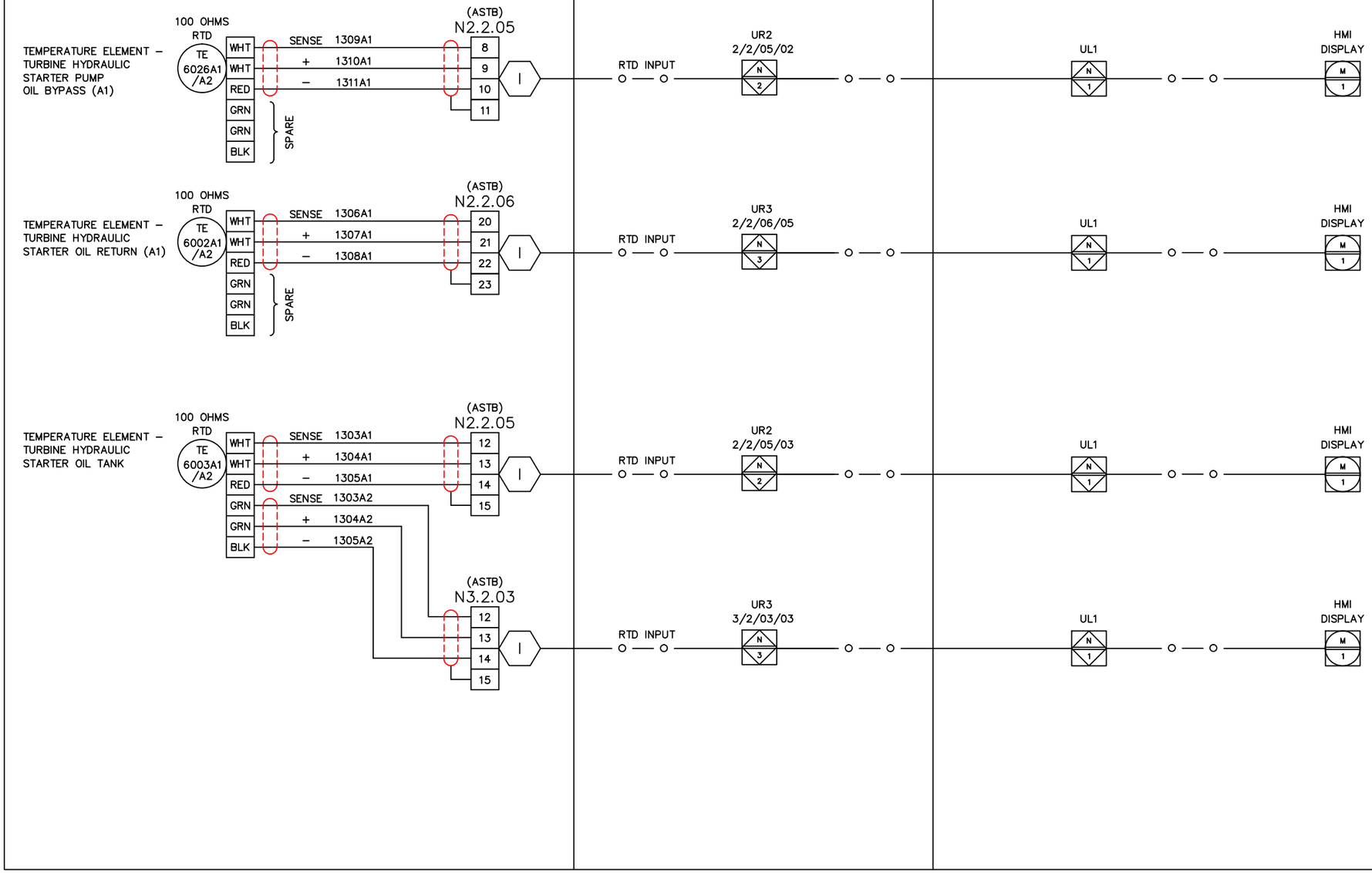
DWG NO. 7248201–571270

REV. A

SCALE NONE

SHEET 2 OF 4

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM HYDRAULIC START SYSTEM

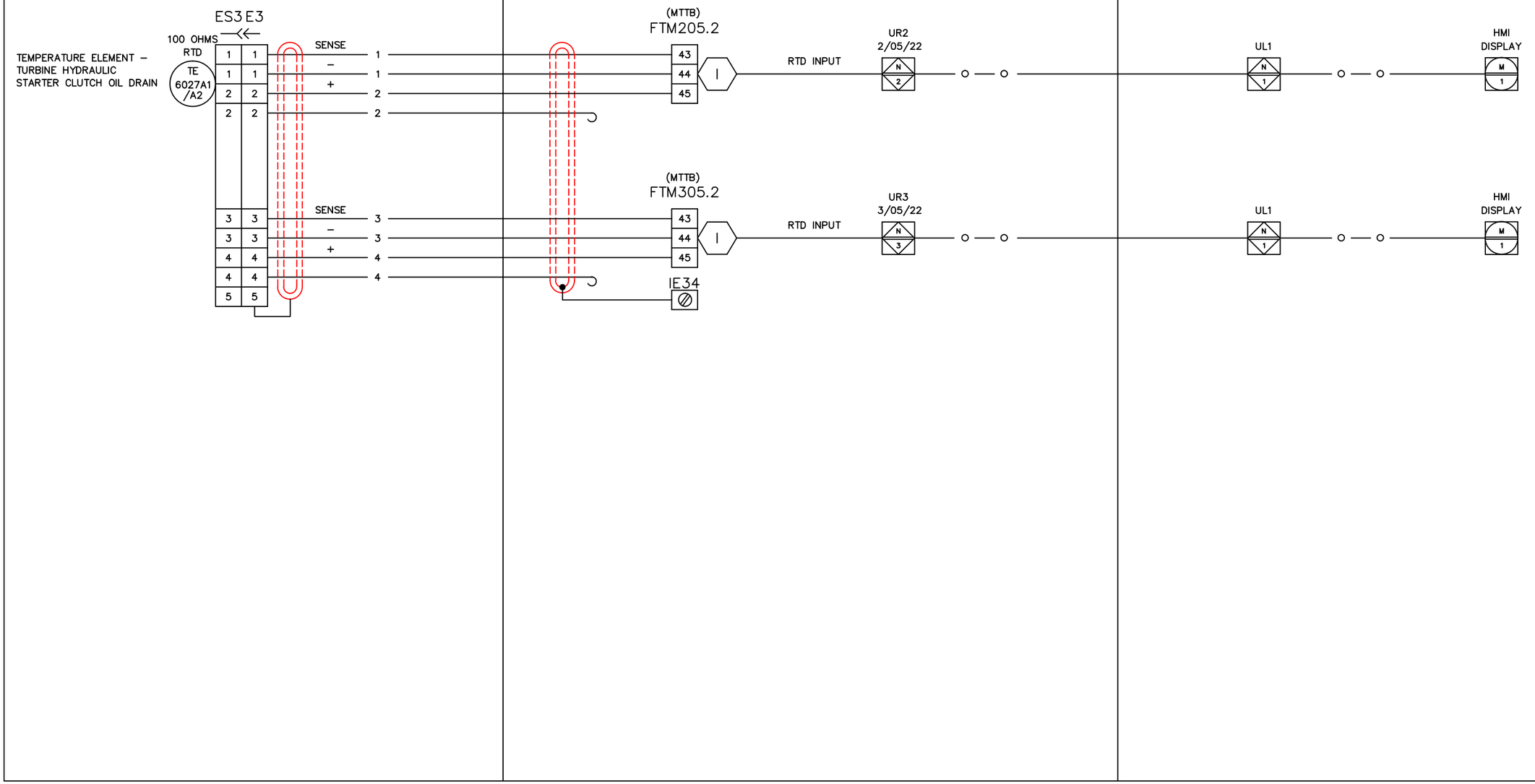
DWG NO. 7248201–571270

REV. A

SCALE NONE

SHEET 3 OF 4

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM HYDRAULIC START SYSTEM

DWG NO. 7248201–571270

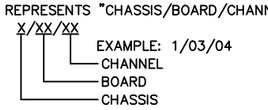
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SCALE NONE

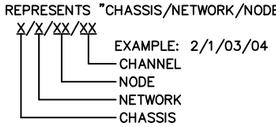
SHEET 4 OF 4

NOTES:

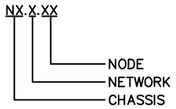
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4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS



6. REPRESENTS NODE NUMBER IN DISTRIBUTION I/O NETWORK



7. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS–THRU BAR AT THAT TERMINAL FOR SHIELD CONNECTION, UNLESS OTHERWISE INDICATED.
8. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
9. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA

X–969239 FLOW & INSTRUMENT DIAGRAM, VENTILATION & COMBUSTION AIR SYSTEM
X–969767 SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

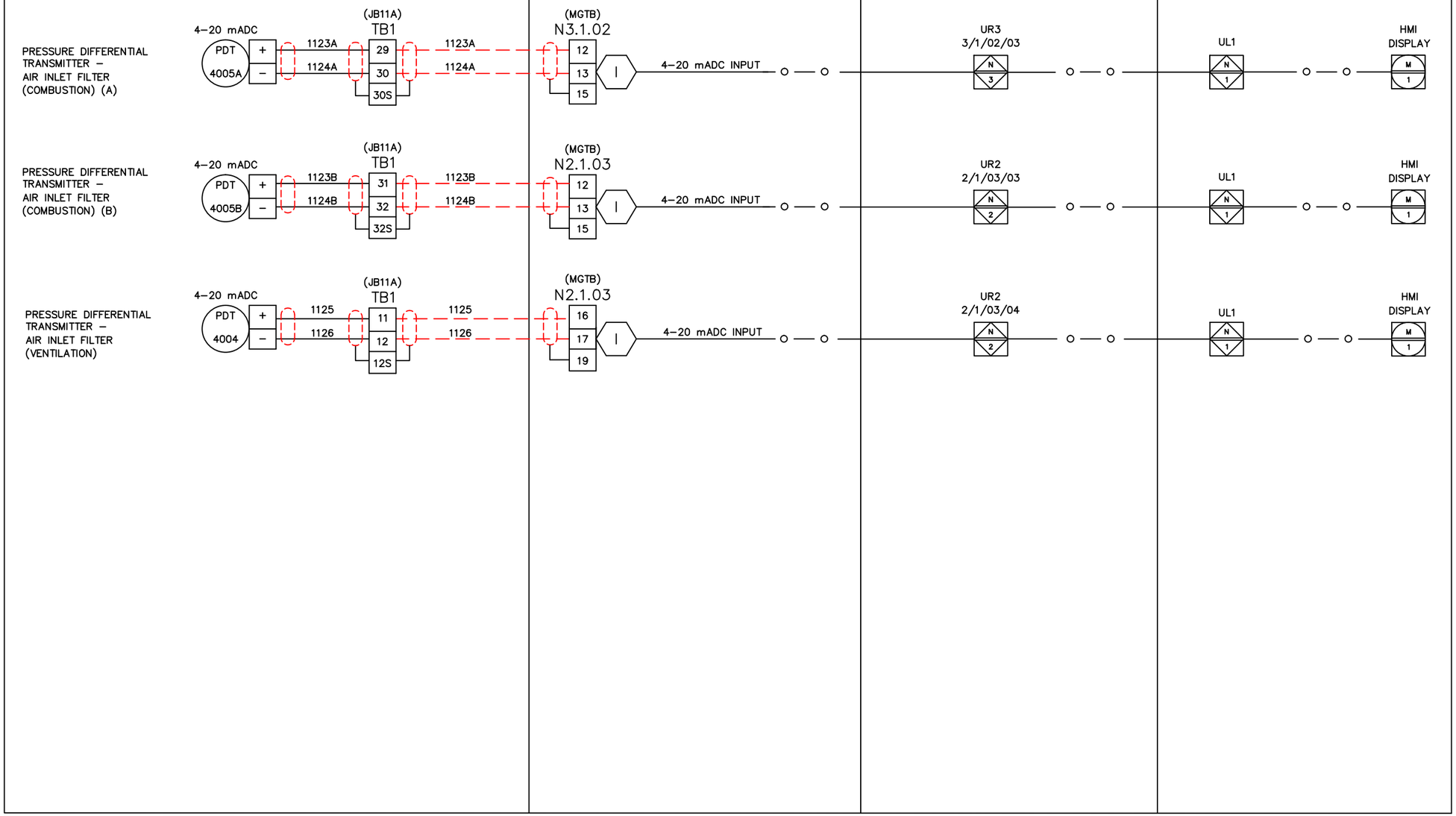
DWG NO. 7253049–969742

REV. A

SCALE NONE

SHEET 1 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE AIR INLET FILTER	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

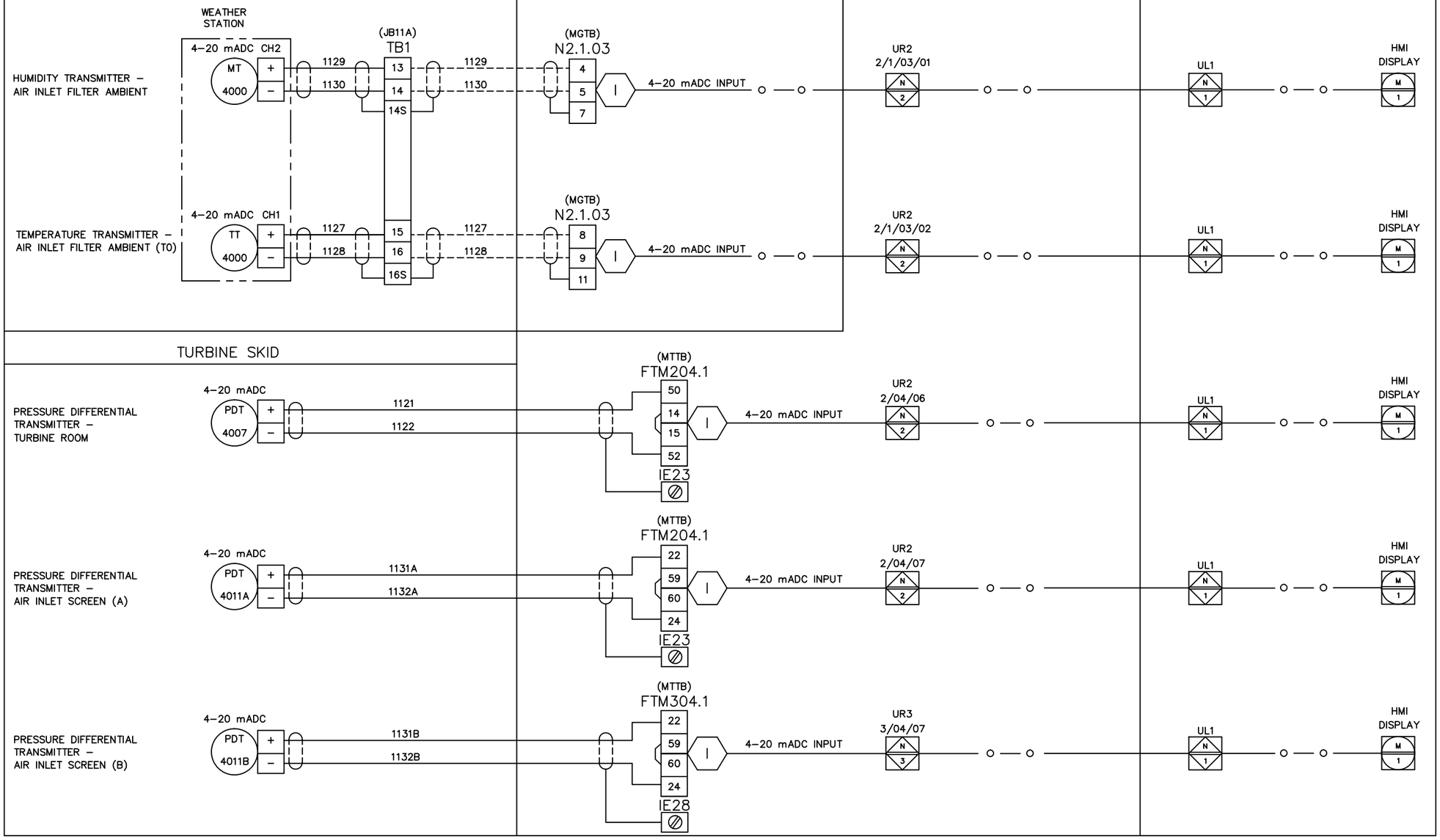
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INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO.	REV.
7253049–969742	A

SCALE NONE SHEET 2 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE AIR INLET FILTER	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

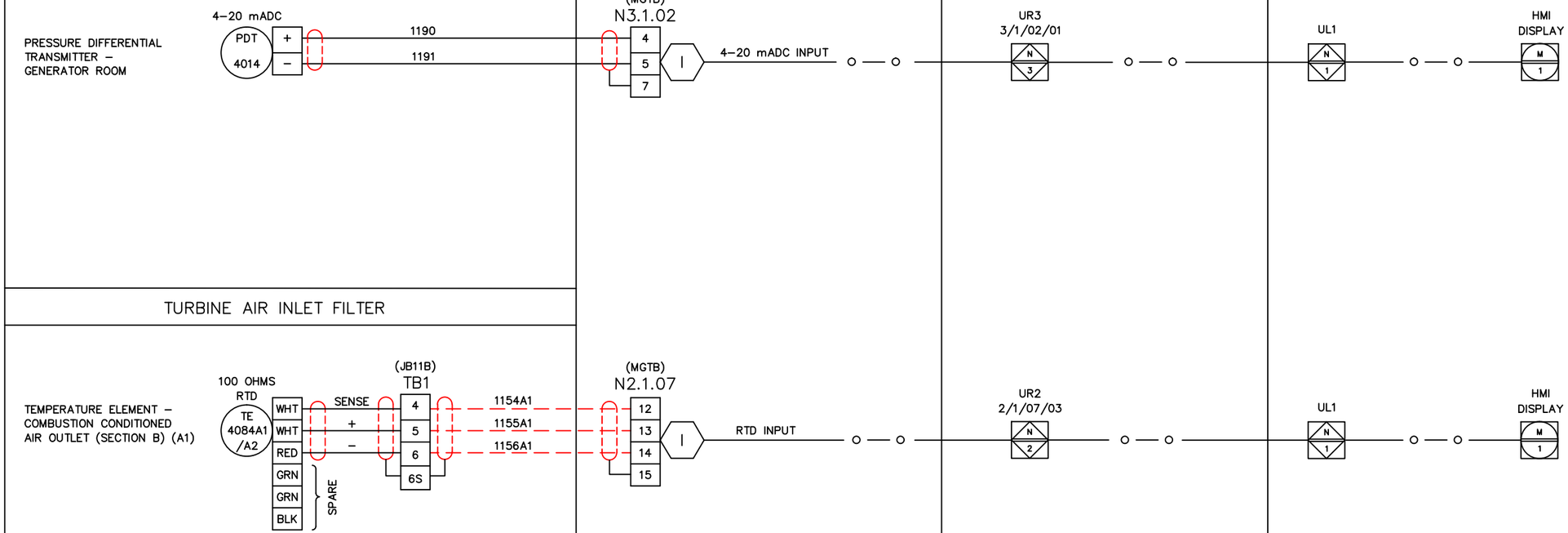
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO.	REV.
7253049–969742	A

SCALE NONE SHEET 3 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000™

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
VENTILATION & COMBUSTION
AIR SYSTEM

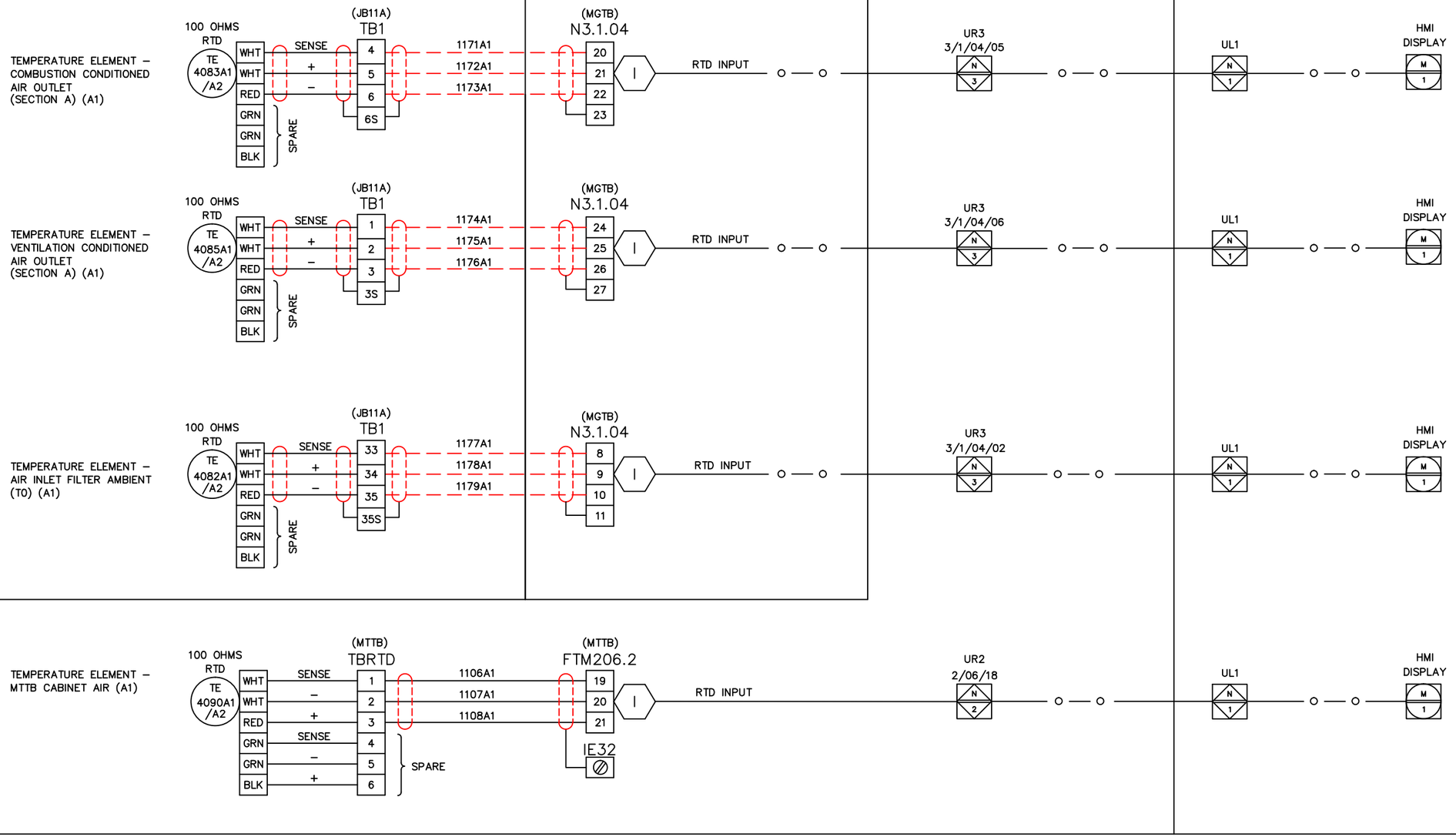
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REV. A

SCALE NONE

SHEET 4 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE AIR INLET FILTER	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

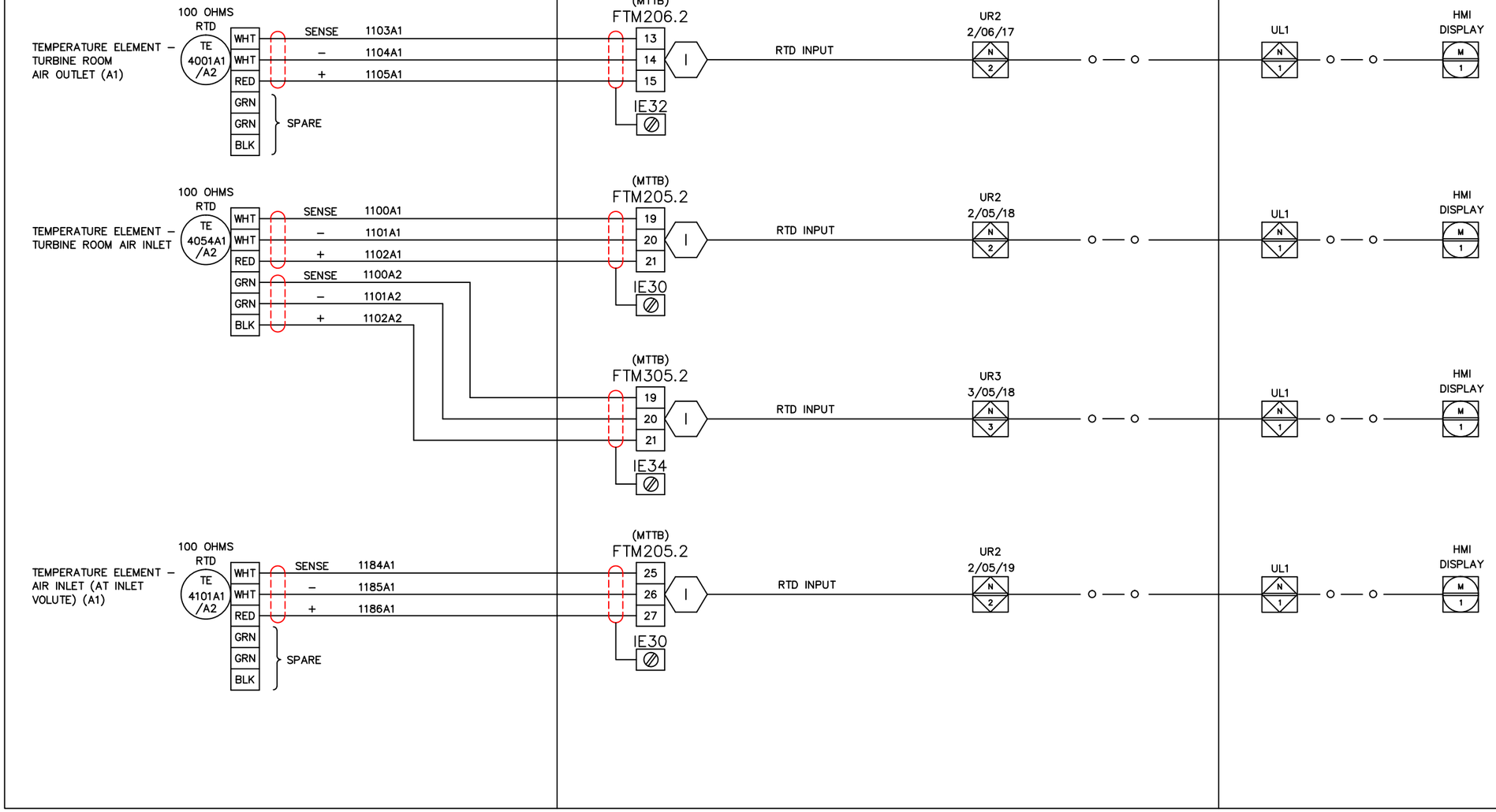
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REV. A

SCALE NONE

SHEET 5 OF 12

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

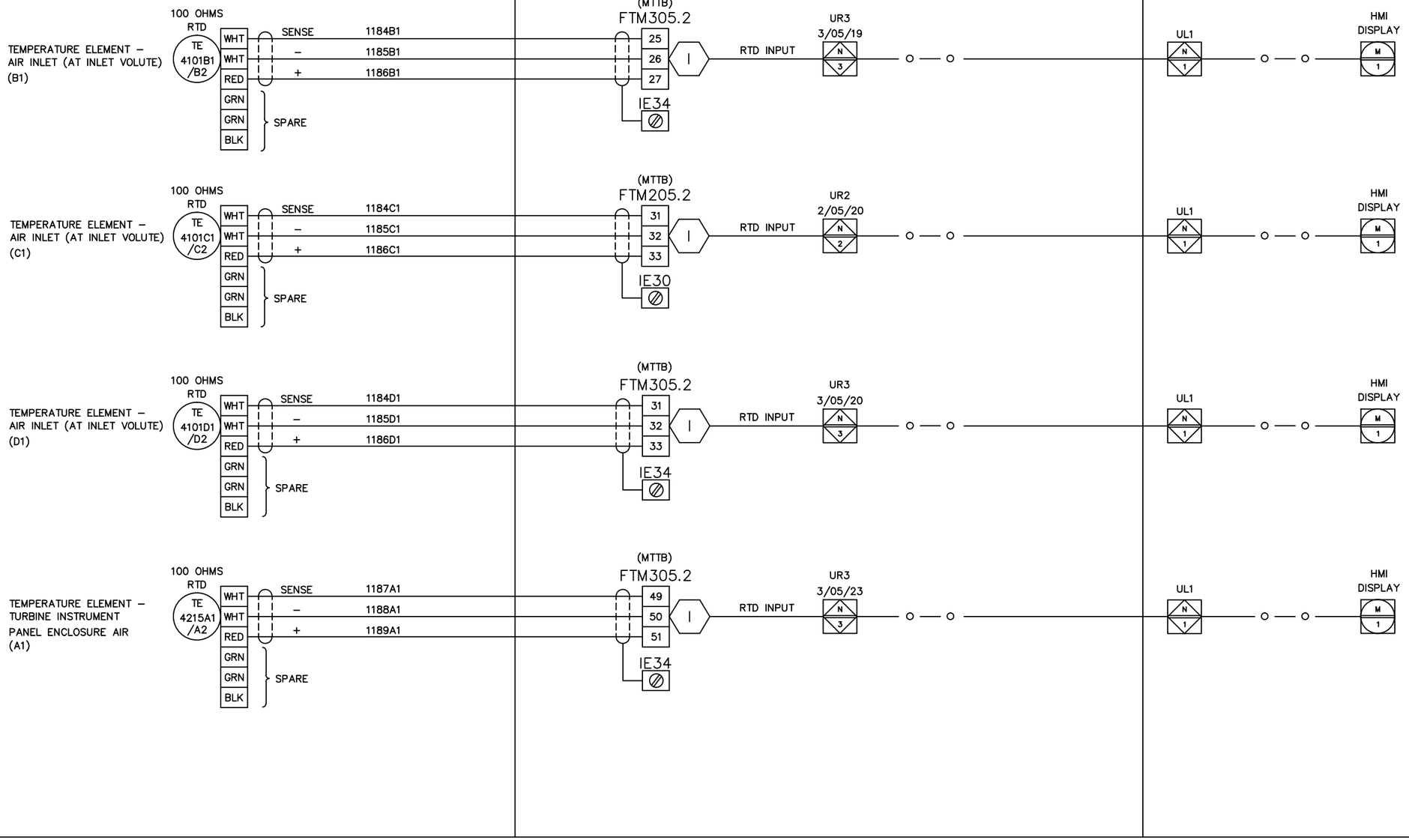
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO.	REV.
7253049-969742	A

SCALE NONE SHEET 6 OF 12

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

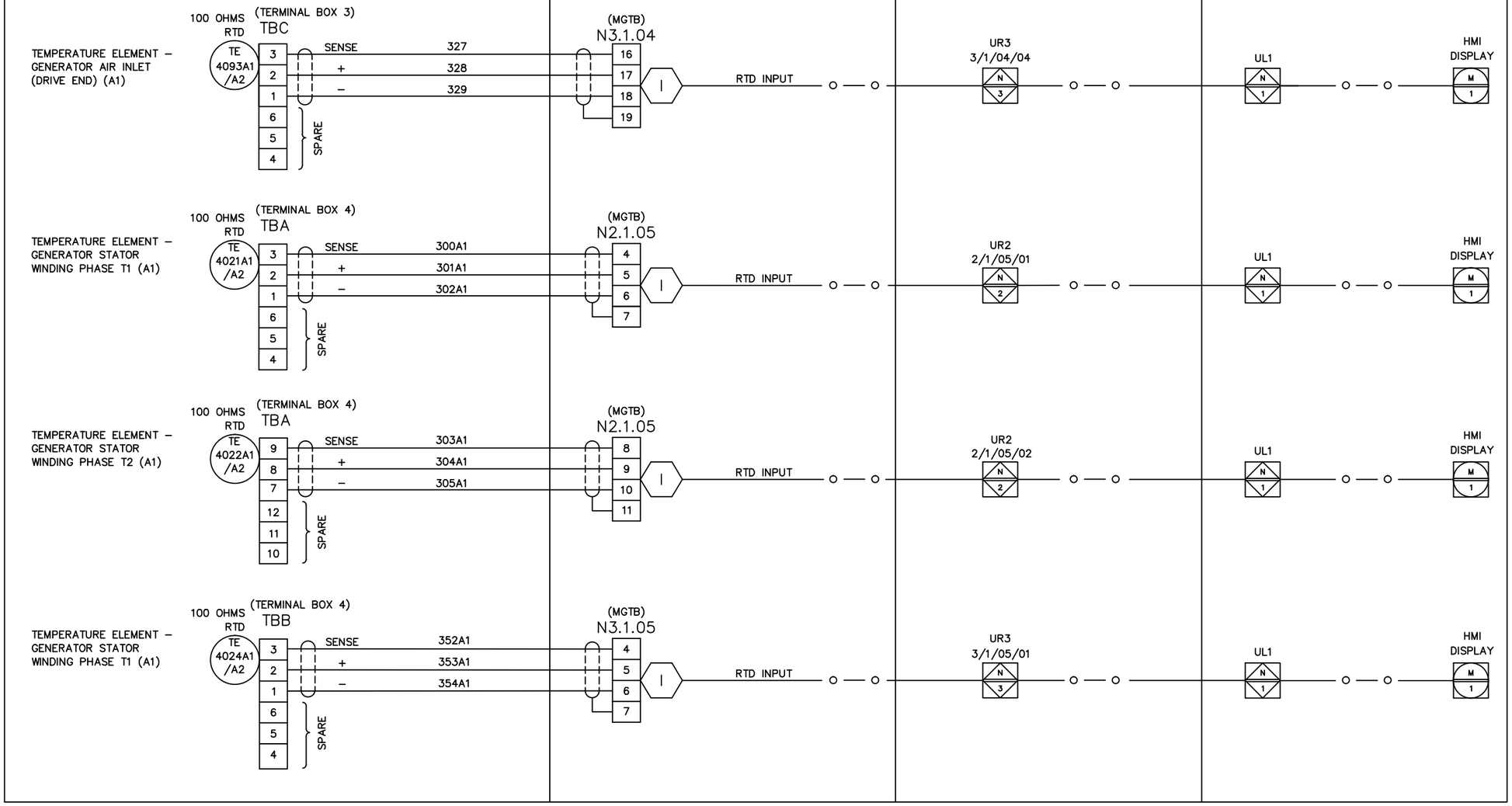
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REV. A

SCALE NONE

SHEET 7 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
VENTILATION & COMBUSTION
AIR SYSTEM

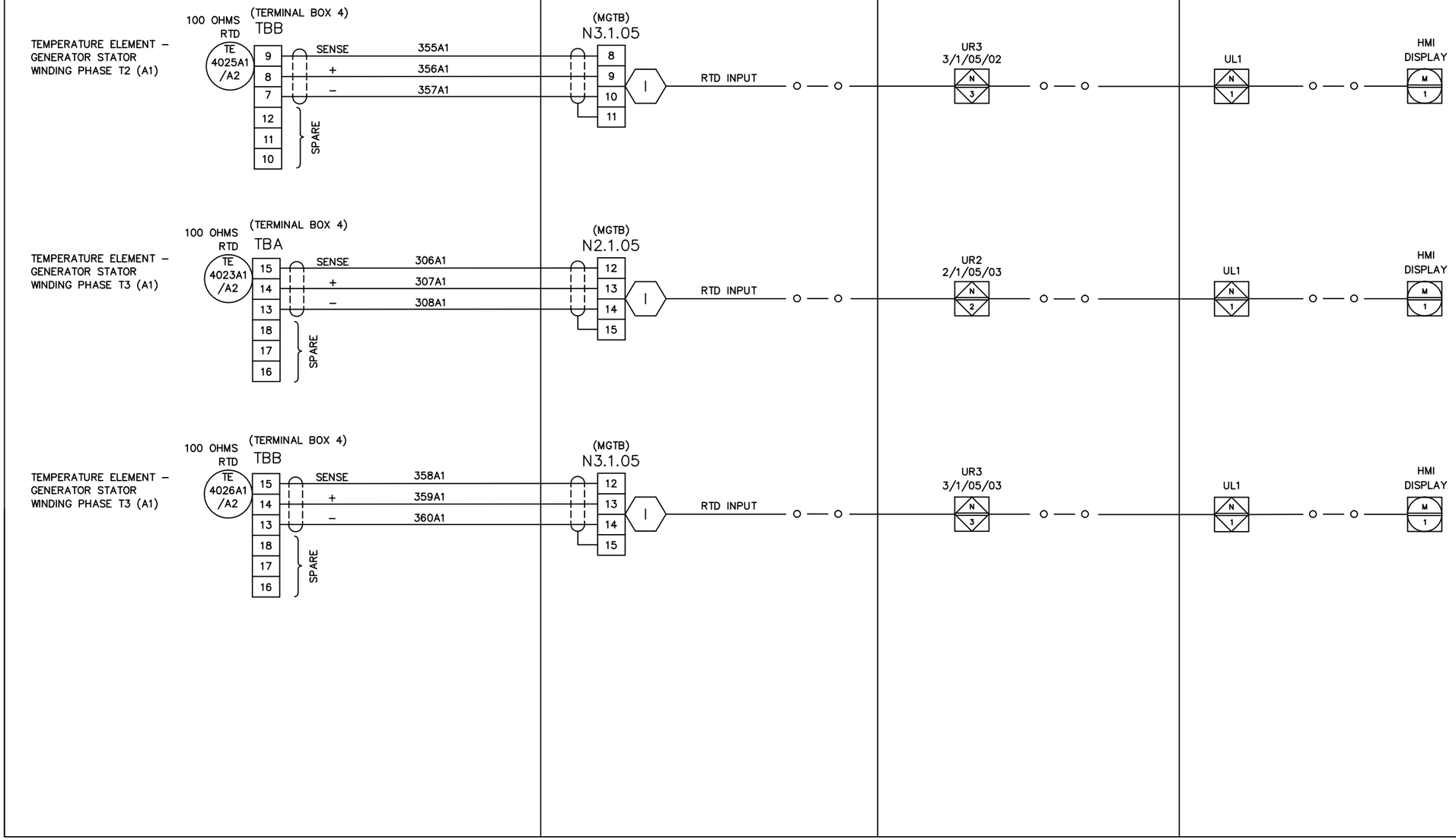
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REV. A

SCALE NONE

SHEET 8 of 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



BRUSH GENERATOR OPTION

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	DR	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE

LM6000®

ADDL INFO

GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

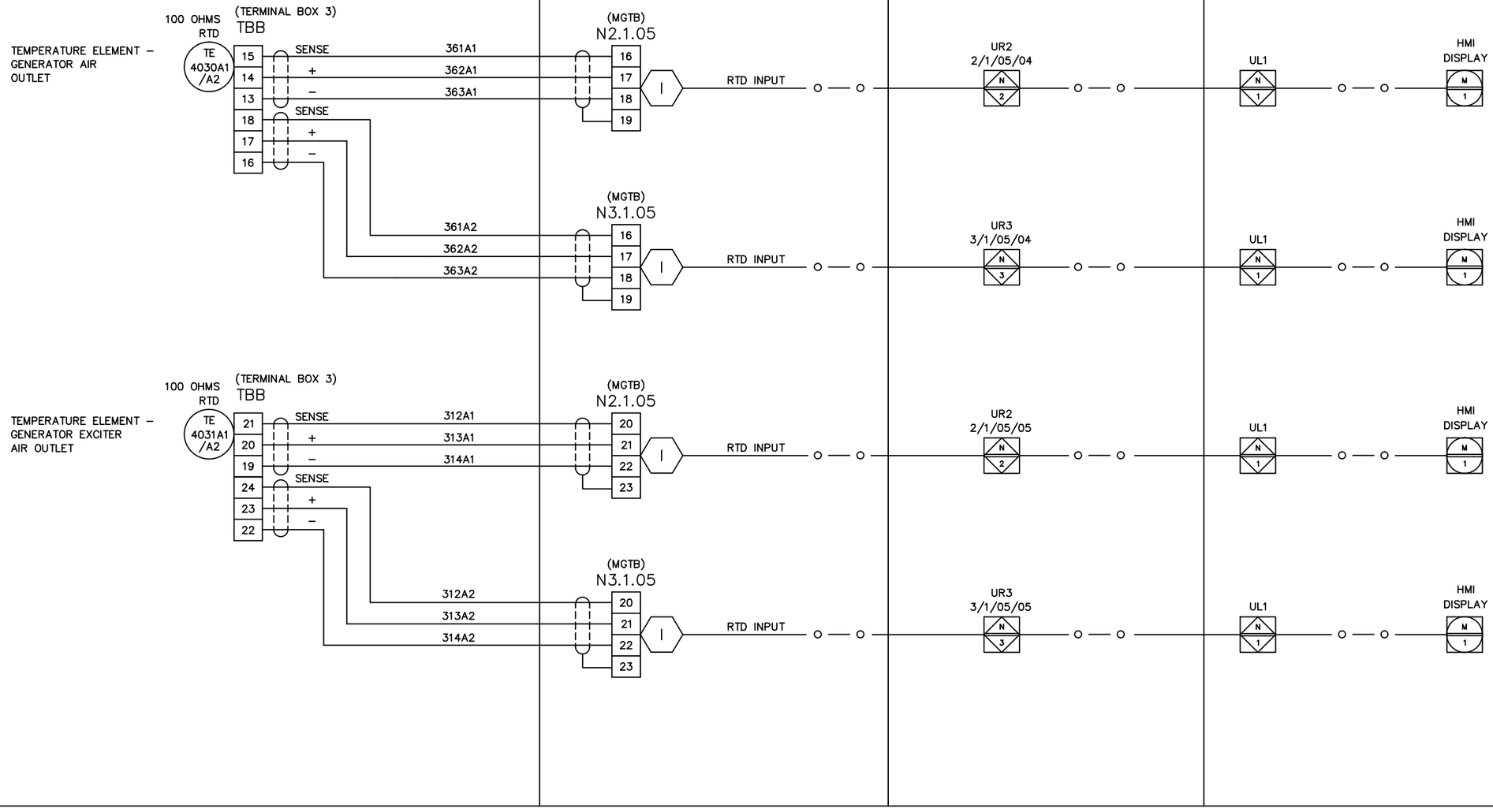
INSTRUMENT LOOP DIAGRAM
VENTILATION & COMBUSTION
AIR SYSTEM

DWG NO.	REV.
7253049–969742	A

SCALE NONE

SHEET 9 of 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 FRACTIONAL ±1/16" ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

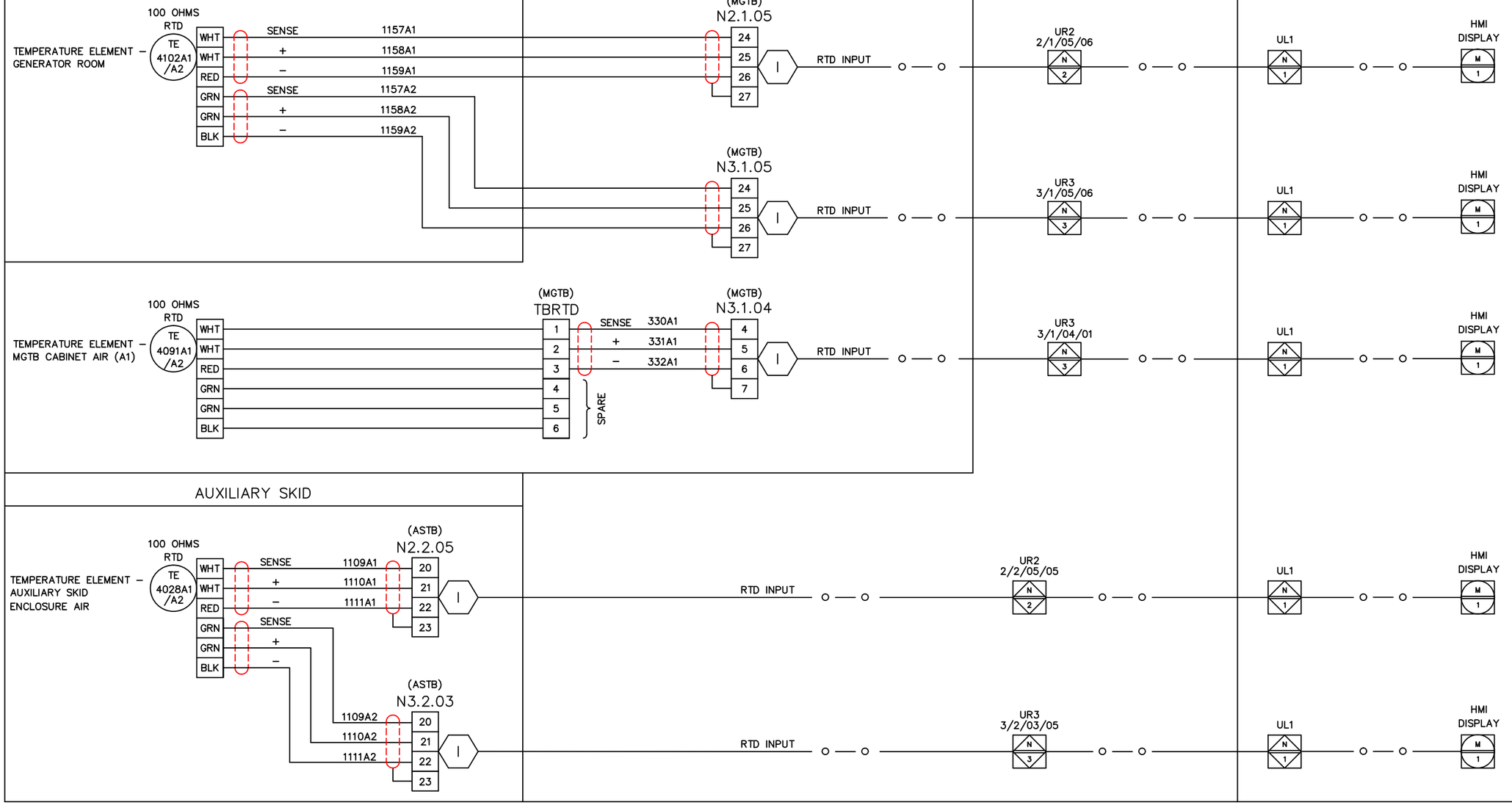
DWG NO. 7253049-969742

REV. A

SCALE NONE

SHEET 10 of 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO. 7253049-969742

REV. A

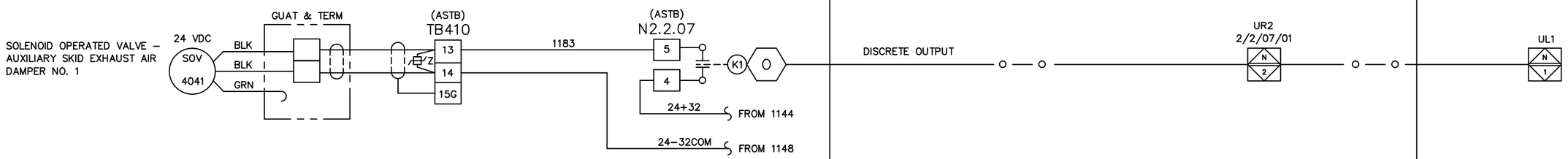
SCALE NONE

SHEET 11 of 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE AIR INLET FILTER	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

FIELD PROCESS AREA

AUXILIARY SKID



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

INSTRUMENT LOOP DIAGRAM VENTILATION & COMBUSTION AIR SYSTEM

DWG NO.	REV.
7253049–969742	A

SCALE NONE SHEET 12 of 12

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS

   X/XX/XX — EXAMPLE: 1/03/04
   - CHANNEL
   - BOARD
   - CHASSIS

5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS

   X/X/XX/XX — EXAMPLE: 2/1/03/04
   - CHANNEL
   - NODE
   - NETWORK
   - CHASSIS

6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK

   NX.X.XX
   - NODE
   - NETWORK
   - CHASSIS

7. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS–THRU BAR AT THAT TERMINAL FOR SHIELD CONNECTION, UNLESS OTHERWISE INDICATED.
8. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
9. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969767 SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969248 FLOW & INSTRUMENT DIAGRAM, MINERAL LUBE OIL SYSTEM

WIRE COLOR CONVERSION TABLE (IEC–ANSI/NEC)*

Color	IEC* Letter Code	IEC–NEC GE Design Colors
Black	BK	BLK
Brown	BN	BRN
Red	RD	RED
Orange	OG	ORN
Yellow	YE	YEL
Green	GN	GRN
Blue	BU	BLU
Violet	VT	VLT
Gray	GY	GRY
White	WH	WHT
Pink	PK	PNK
Gold	GD	GD
Turquoise	TQ	TQ
Silver	SR	SR
Green–and–yellow	GN/YE	GRN/YEL

* IEC COLORS CHART PER IEC PUBLICATION 757, TABLE 1.

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

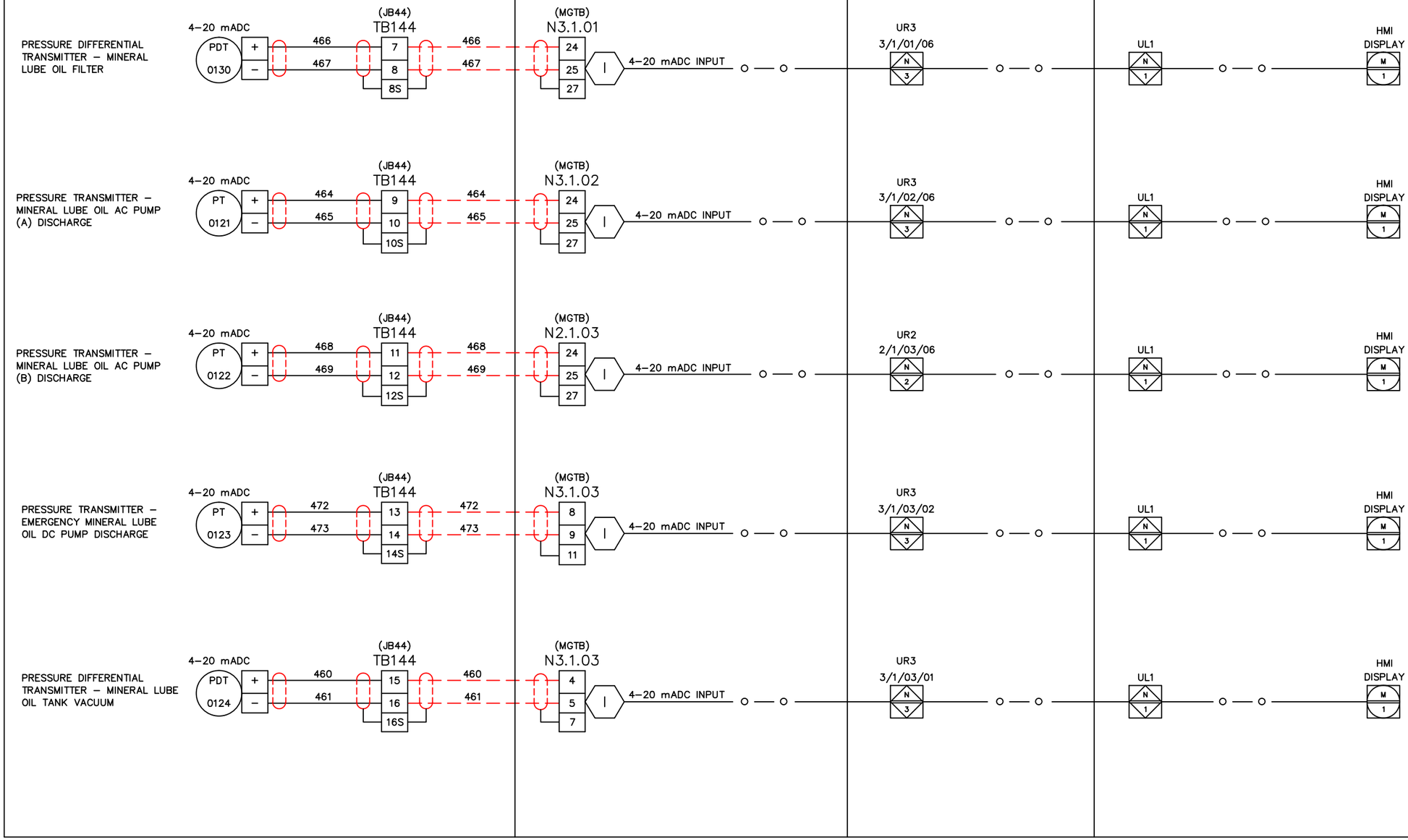
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969743
REV. A

SCALE NONE
SHEET 1 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
MINERAL LUBE OIL SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
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NEXT ASSY.

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ADDL INFO
GE CLASS II (INTERNAL)

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MINERAL LUBE OIL SYSTEM

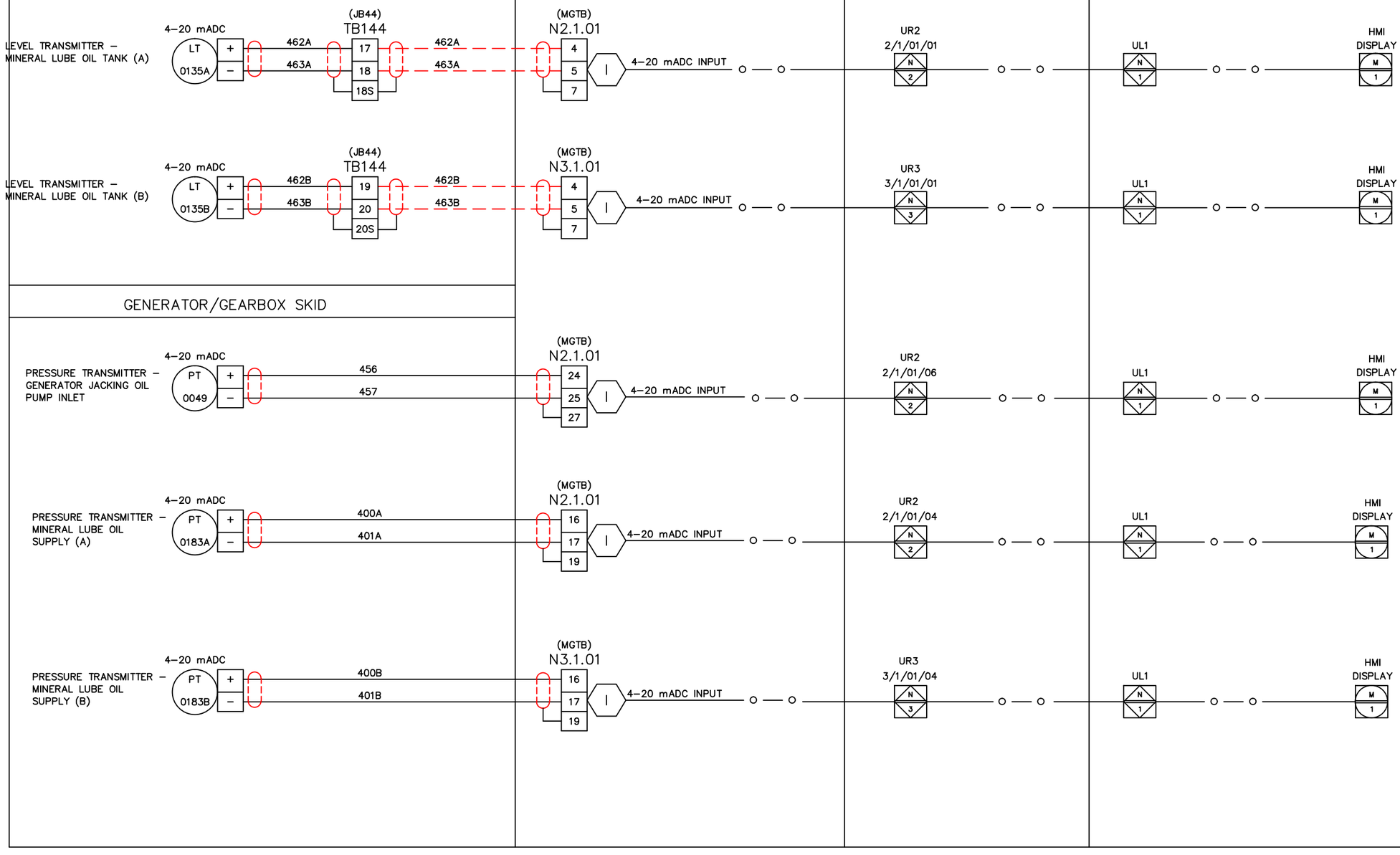
DWG NO. 7253049–969743

REV. A

SCALE NONE

SHEET 2 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
MINERAL LUBE OIL SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
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TITLE
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MINERAL LUBE OIL SYSTEM

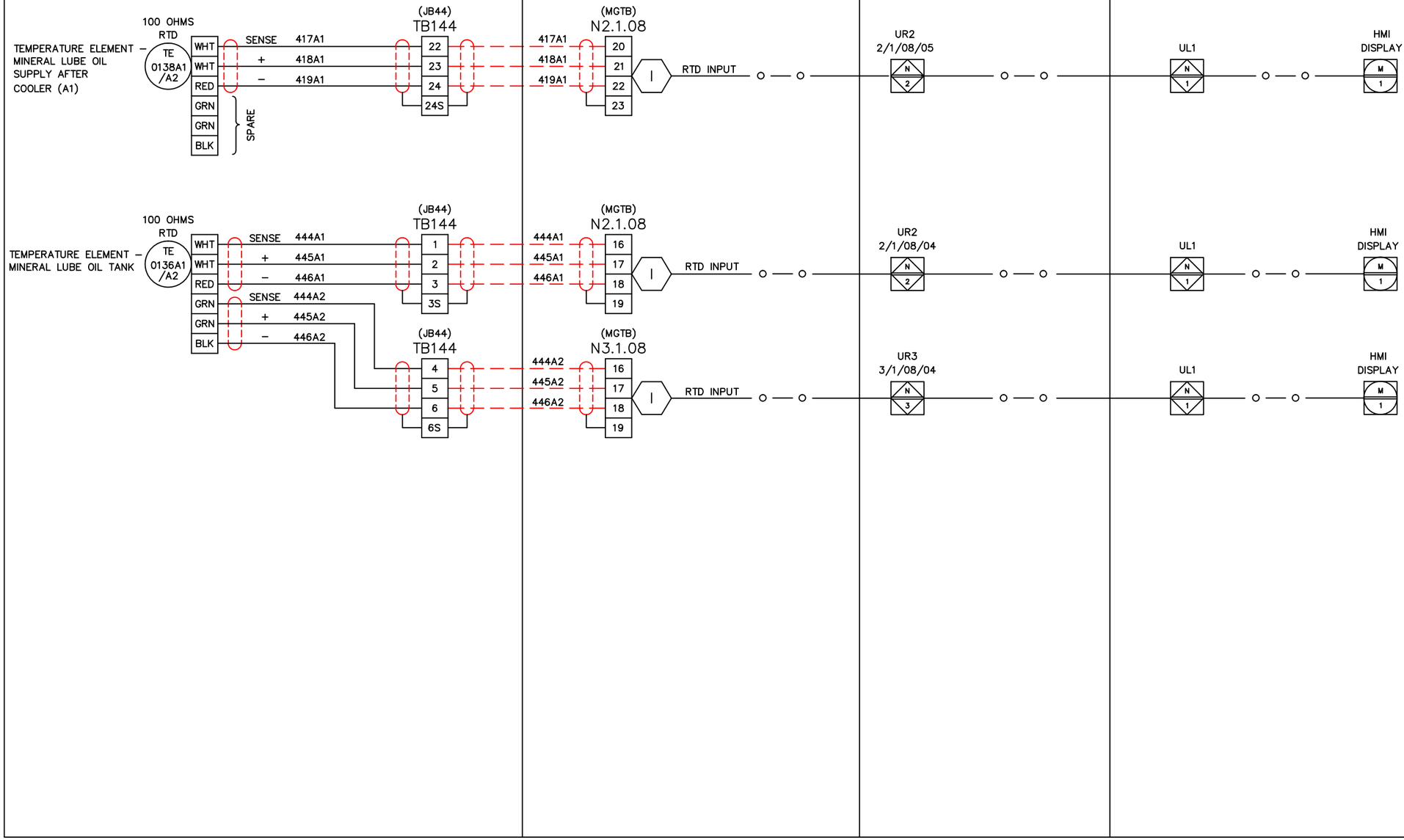
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REV. A

SCALE NONE

SHEET 3 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
MINERAL LUBE OIL SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM MINERAL LUBE OIL SYSTEM

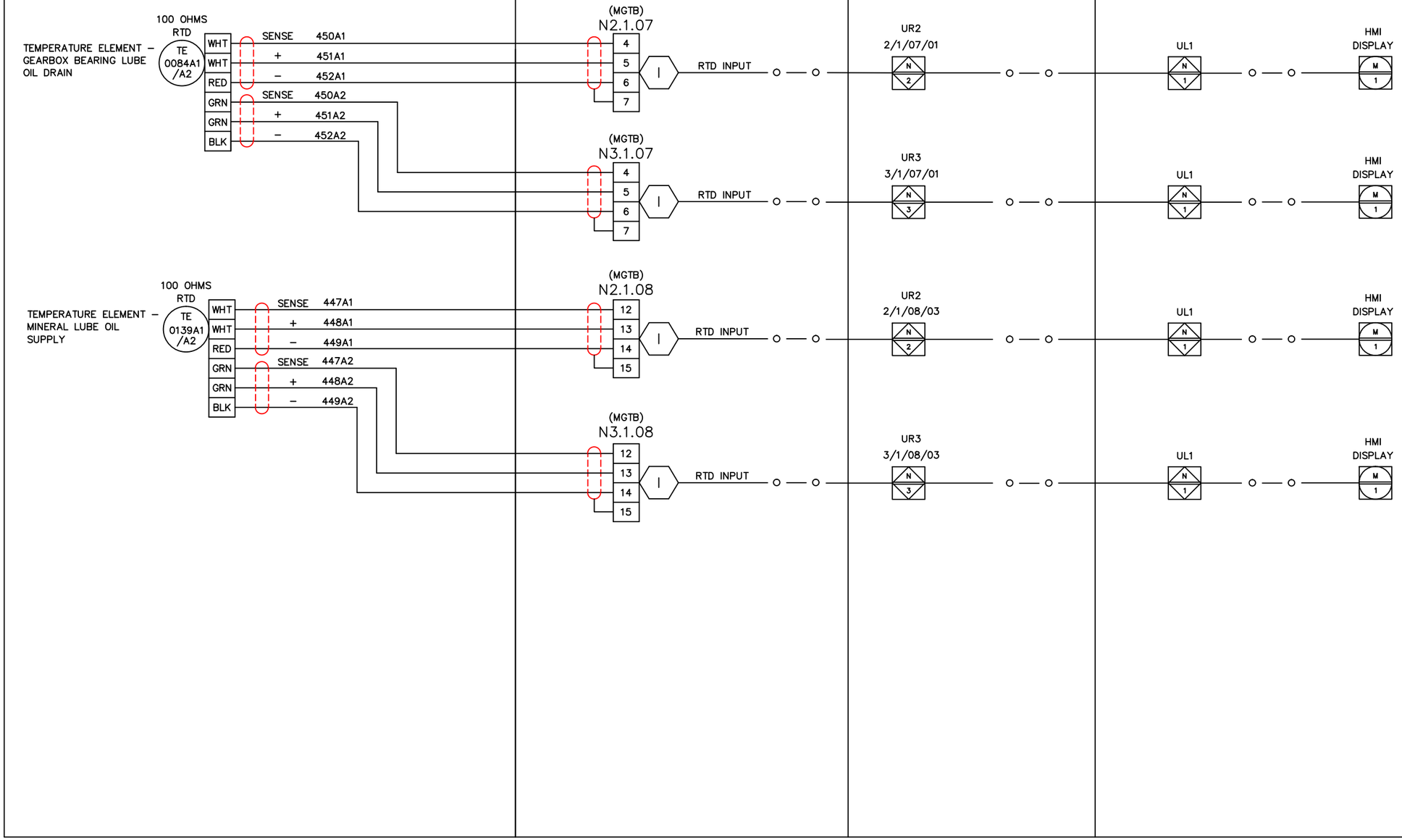
DWG NO. 7253049–969743

REV. A

SCALE NONE

SHEET 4 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM MINERAL LUBE OIL SYSTEM

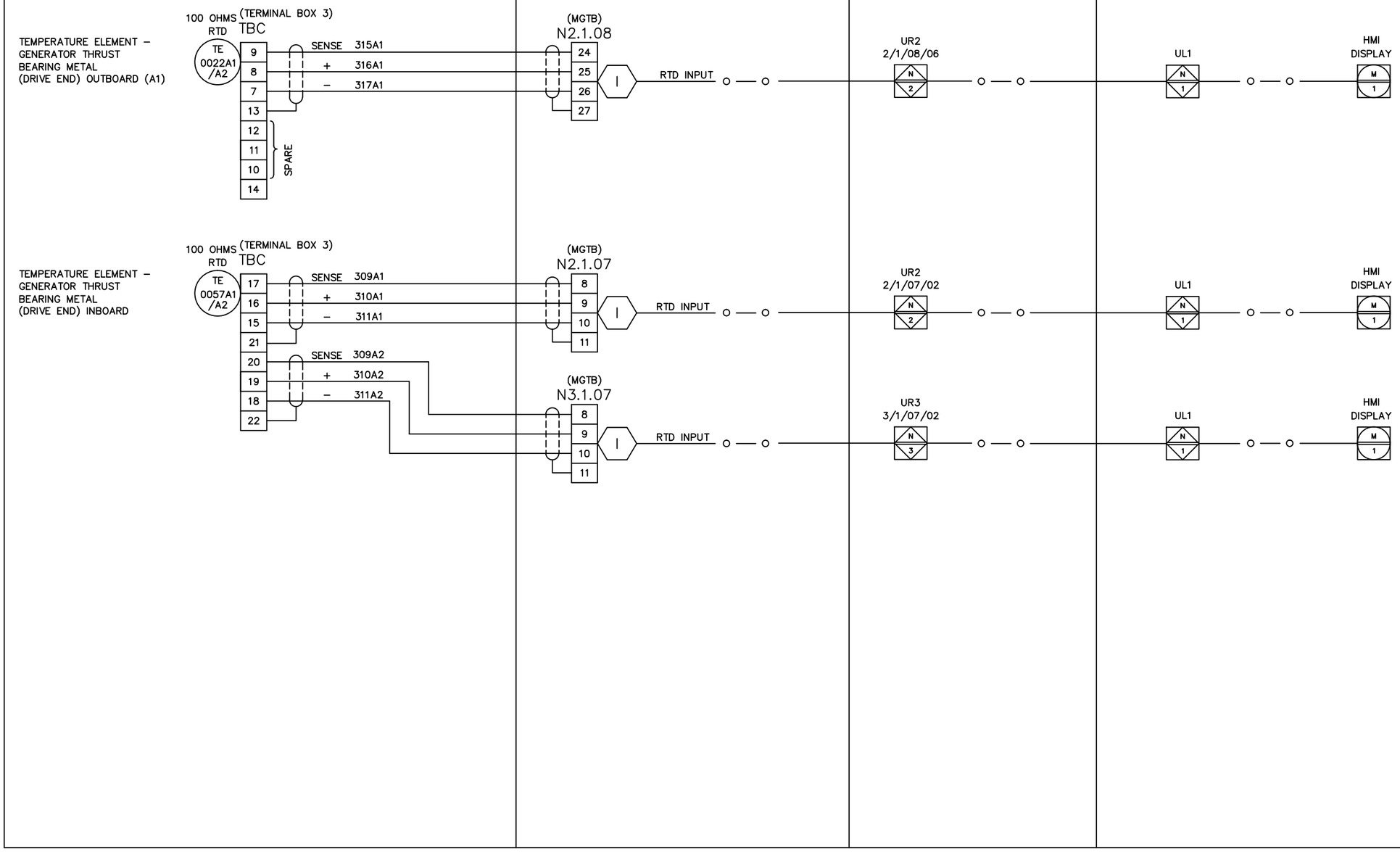
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REV. A

SCALE NONE

SHEET 5 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



BRUSH GENERATOR OPTION

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TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
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NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
MINERAL LUBE OIL SYSTEM

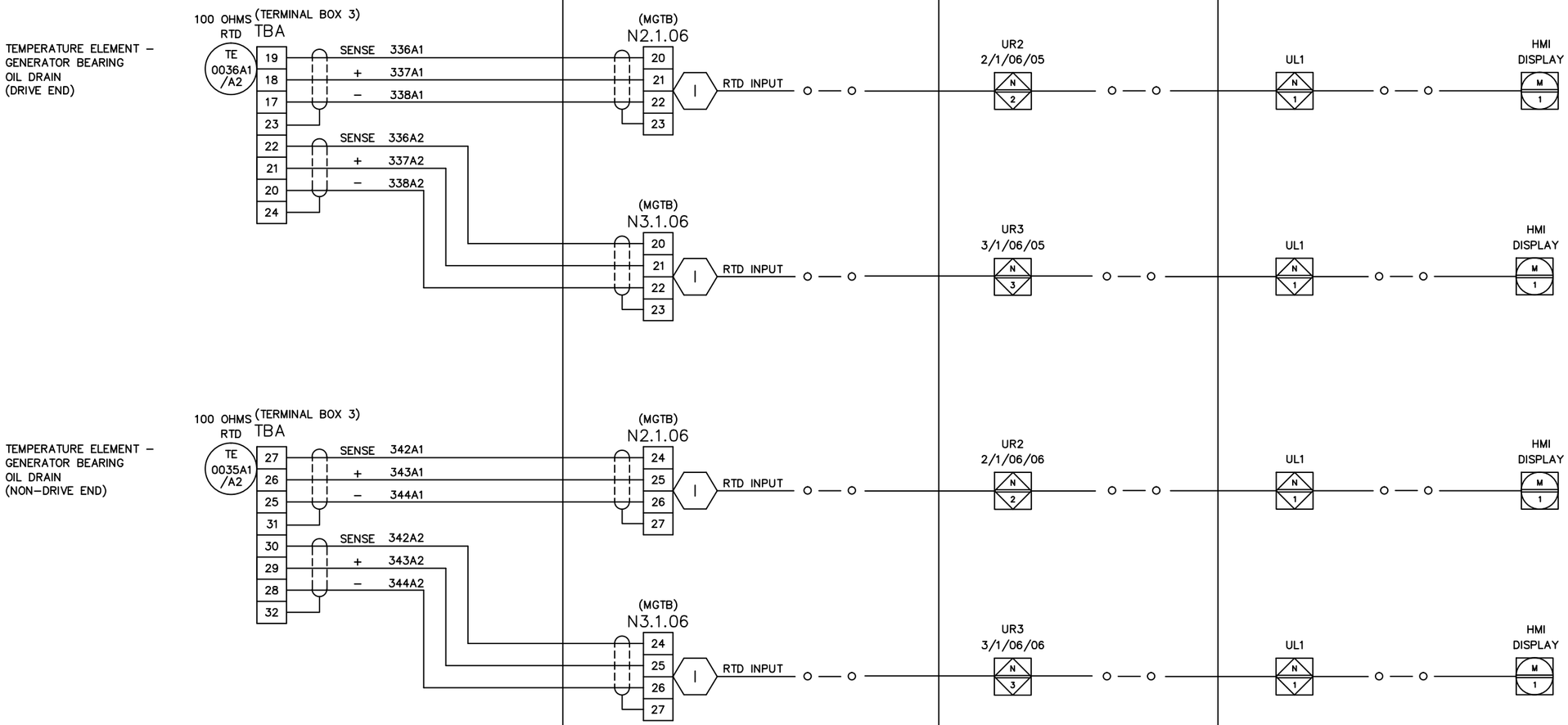
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REV. A

SCALE NONE

SHEET 6 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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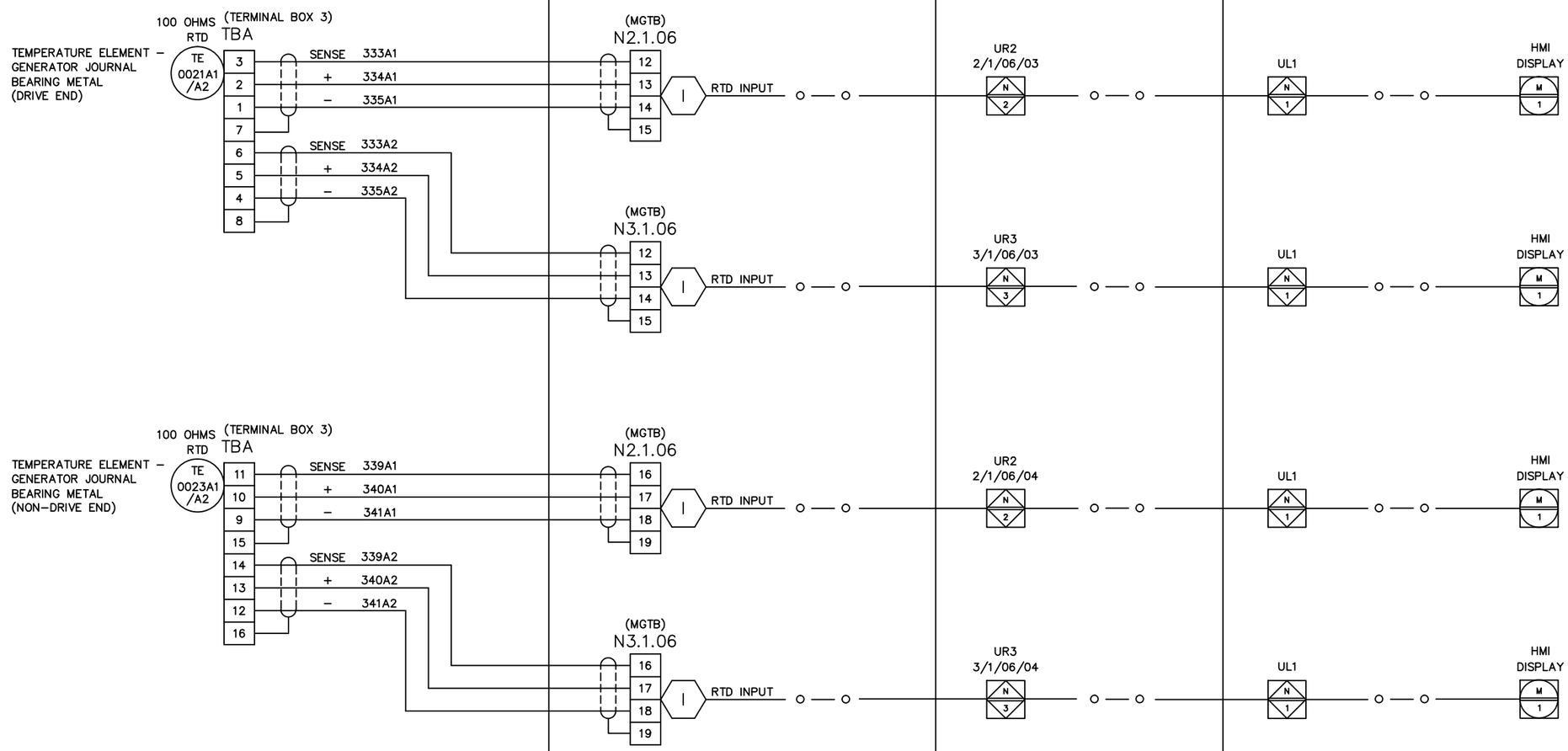
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REV. A

SCALE NONE

SHEET 7 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GENERATOR)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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ADDL INFO
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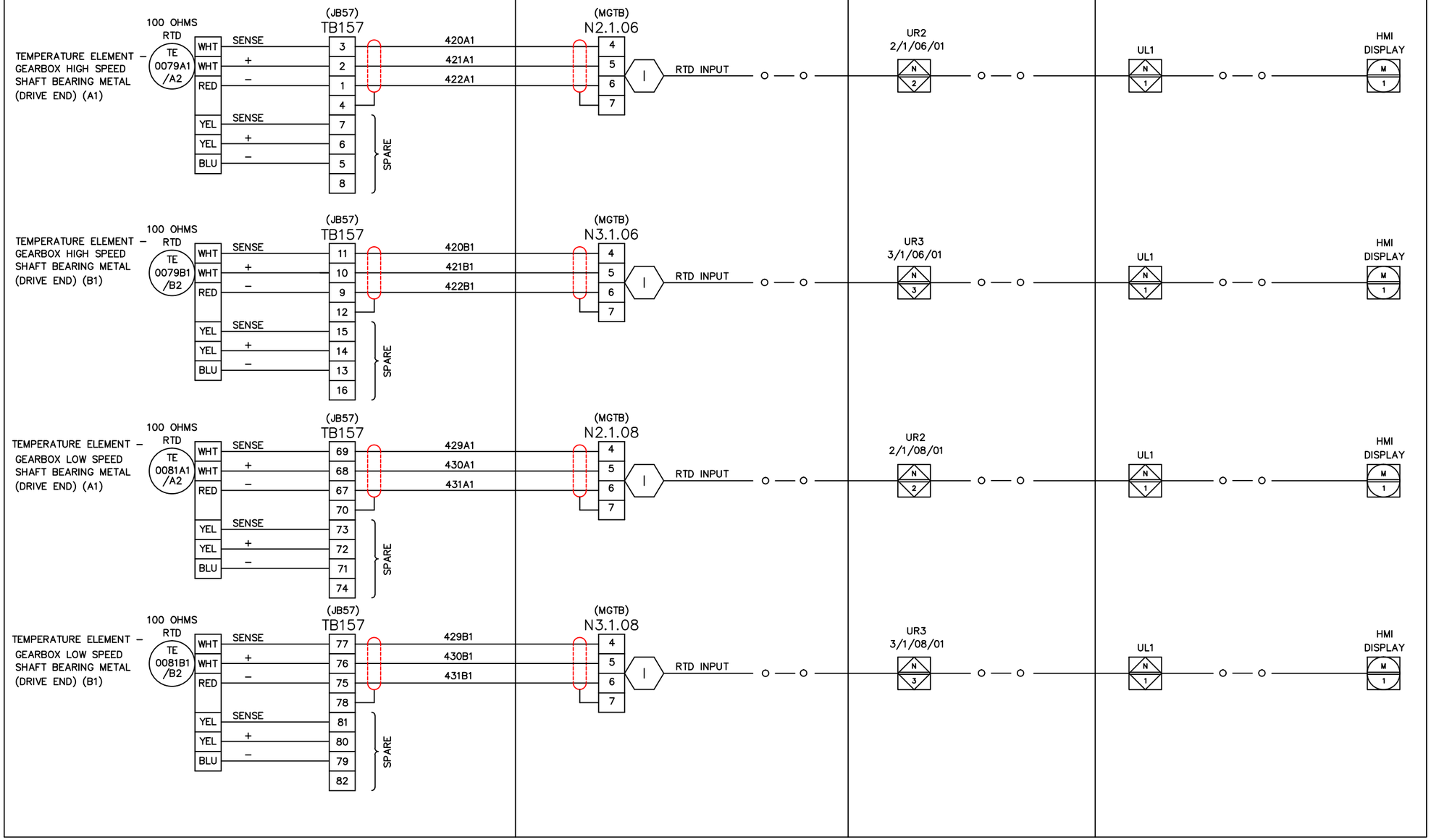
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO.	REV.
7253049–969743	A

SCALE NONE SHEET 8 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GEARBOX)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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UNIT TYPE LM6000®

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GE PACKAGED POWER, L.P.

TITLE
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MINERAL LUBE OIL SYSTEM

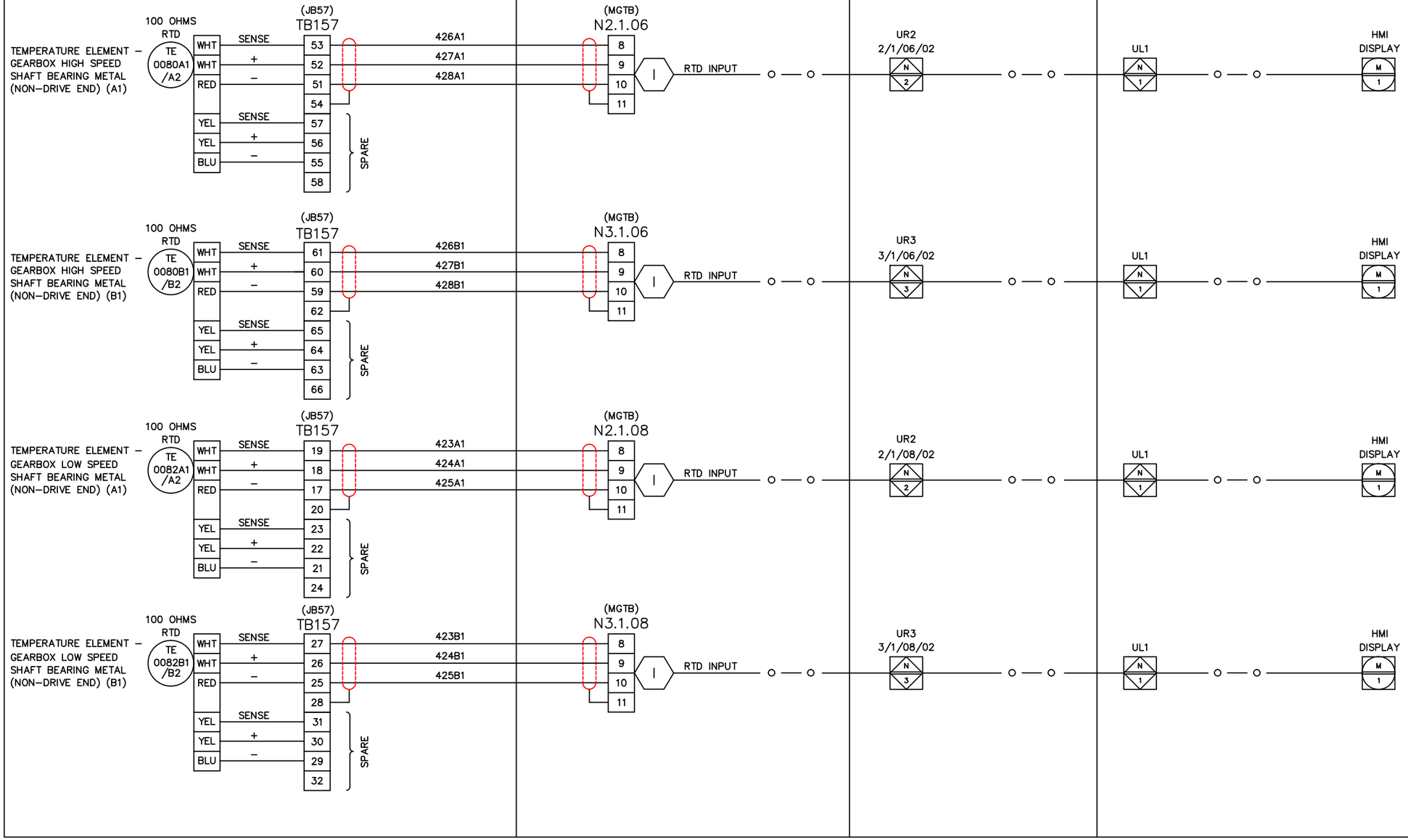
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REV. A

SCALE NONE

SHEET 9 OF 12

FIELD PROCESS AREA	GENERATOR/GEARBOX SKID	TURBINE SKID	TURBINE CONTROL PANEL
GENERATOR/GEARBOX SKID (GEARBOX)	MAIN GENERATOR TERMINAL BOX	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	DR	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000PC

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969743

REV. A

SCALE NONE

SHEET 10 OF 12

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.XX ± .03	±1/16"	±1°
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NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969743

REV. A

SCALE NONE

SHEET 11 OF 12

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MINERAL LUBE OIL SYSTEM

DWG NO. 7253049–969743

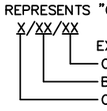
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SCALE NONE

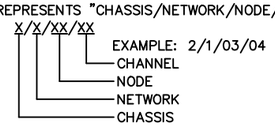
SHEET 12 OF 12

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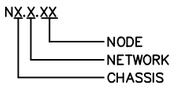
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3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS



6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK



7. TERMINATION SUFFIXED WITH A "G" INDICATES
   HALF GREEN/HALF YELLOW GROUND TERMINAL.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969767 SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969244 FLOW & INSTRUMENT DIAGRAM, TURBINE LUBE OIL SYSTEM

WIRE COLOR CONVERSION TABLE (IEC–ANSI/NEC)*

Color	IEC* Letter Code	IEC–NEC GE Design Colors
Black	BK	BLK
Brown	BN	BRN
Red	RD	RED
Orange	OG	ORN
Yellow	YE	YEL
Green	GN	GRN
Blue	BU	BLU
Violet	VT	VLT
Gray	GY	GRY
White	WH	WHT
Pink	PK	PNK
Gold	GD	GD
Turquoise	TQ	TQ
Silver	SR	SR
Green–and–yellow	GN/YE	GRN/YEL

* IEC COLORS CHART PER IEC PUBLICATION 757, TABLE 1.

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

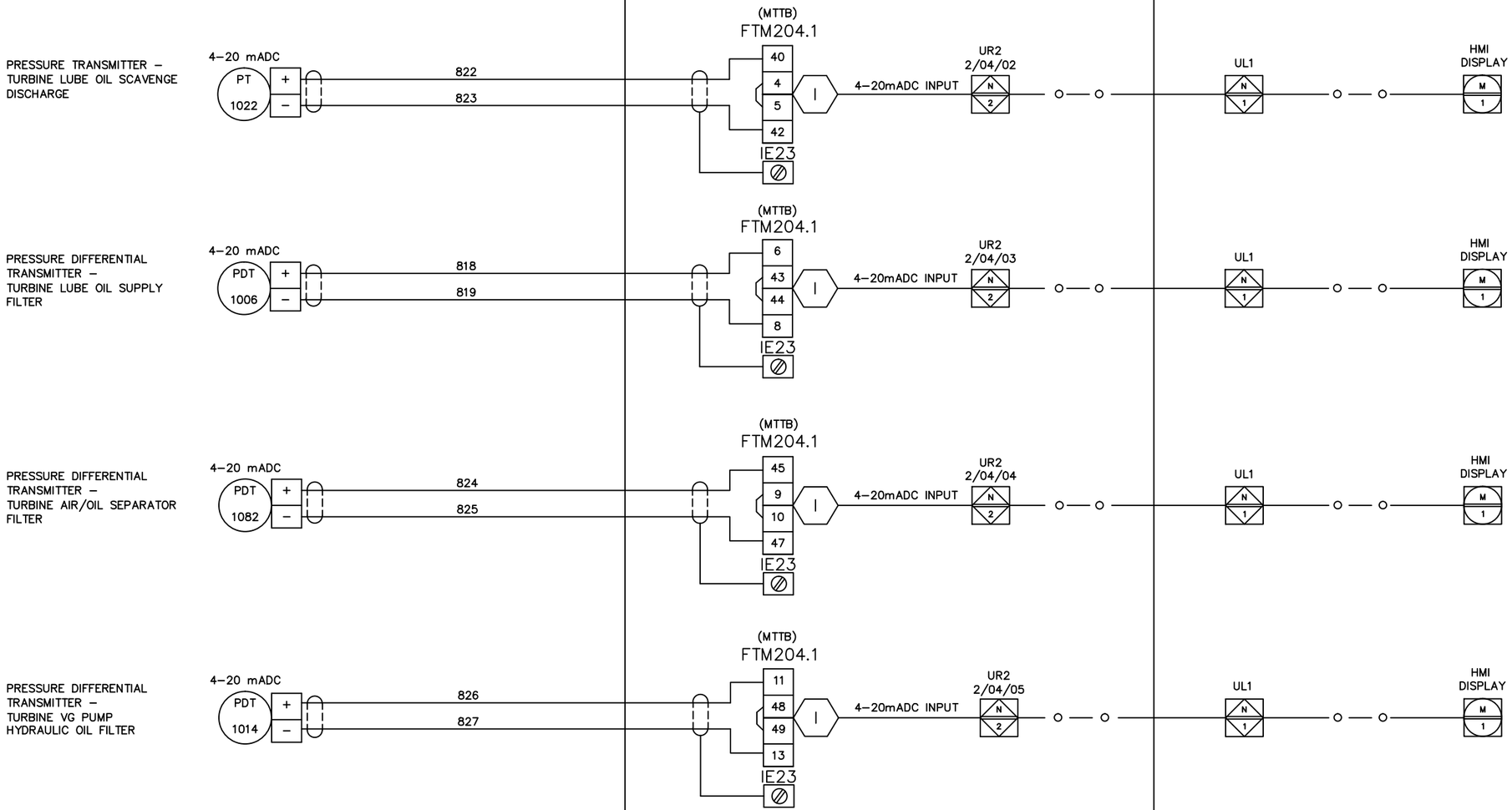
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969744
REV. A
SCALE NONE
SHEET 1 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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.XXX ± .010		

NEXT ASSY.

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GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM TURBINE LUBE OIL SYSTEM

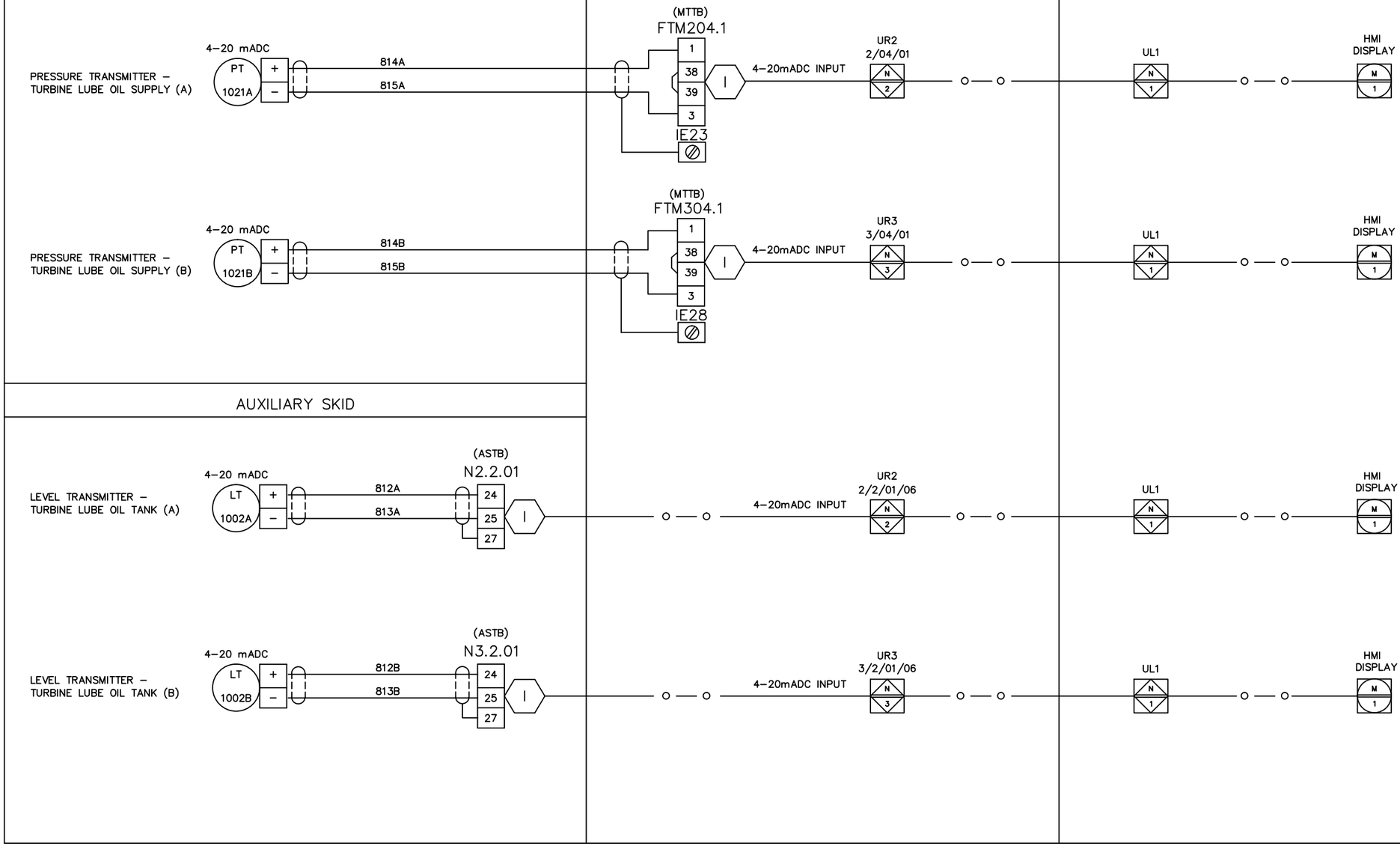
DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 2 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

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.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 3 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

PRESSURE DIFFERENTIAL TRANSMITTER – TURBINE LUBE OIL SCAVENGE FILTER

4–20 mADC — PDT 1007 (+ 820, – 821) → (ASTB) N2.2.02 (20, 21, 23) → 4–20mADC INPUT → UR2 2/2/02/05 (N/2) → UL1 (N/1) → HMI DISPLAY (M/1)

TURBINE SKID

TEMPERATURE ELEMENT – TURBINE LUBE OIL SUPPLY (TLUBA/TLUBB)

100 OHMS RTD — TE 1028A1 /A2 → PART OF ES20 E20 (1, 2, 3, 4, 5) → (MTTB) FTM205.2 (57, 56, 55) → RTD INPUT → UR2 2/05/24 (N/2) → UL1 (N/1) → HMI DISPLAY (M/1)

+	1
–	2
SENSE	2
+	3
–	4
SENSE	4

(MTTB) FTM305.2 (57, 56, 55) → RTD INPUT → UR3 3/05/24 (N/3) → UL1 (N/1) → HMI DISPLAY (M/1)

TEMPERATURE ELEMENT – TURBINE LUBE OIL "E" SUMP SCAVENGE (TGBEA/TGBEB)

100 OHMS RTD — TE 1030A1 /A2 → PART OF ES20 E20 (1, 2, 3, 4, 5, 6, 7, 8) → (MTTB) FTM205.2 (69, 68, 67) → RTD INPUT → UR2 2/05/26 (N/2) → UL1 (N/1) → HMI DISPLAY (M/1)

+	5
–	6
SENSE	6
+	7
–	8
SENSE	8

(MTTB) FTM305.2 (69, 68, 67) → RTD INPUT → UR3 3/05/26 (N/3) → UL1 (N/1) → HMI DISPLAY (M/1)

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM
TURBINE LUBE OIL SYSTEM

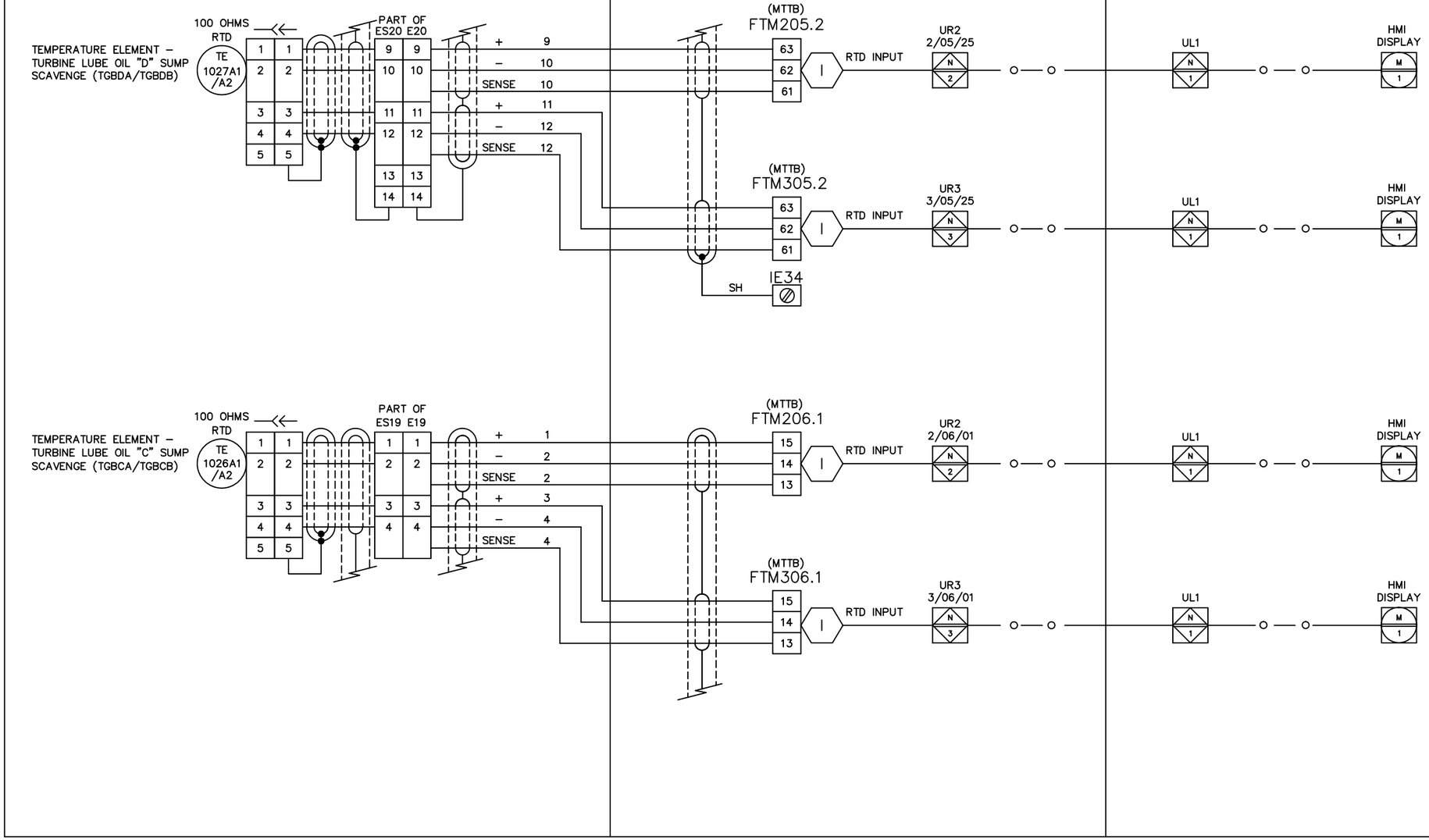
DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 4 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

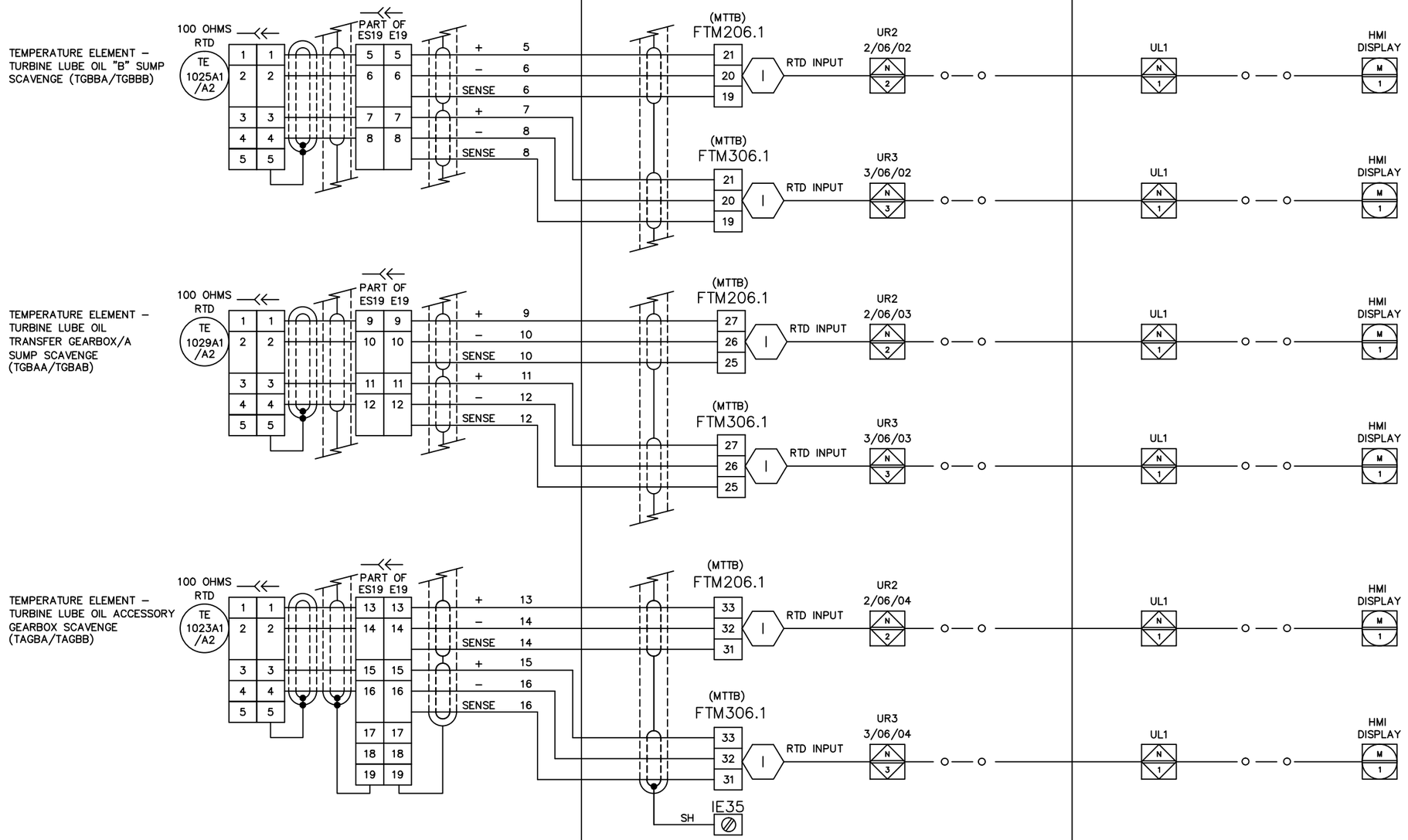
GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM TURBINE LUBE OIL SYSTEM

DWG NO.	REV.
7253049-969744	A

SCALE NONE SHEET 5 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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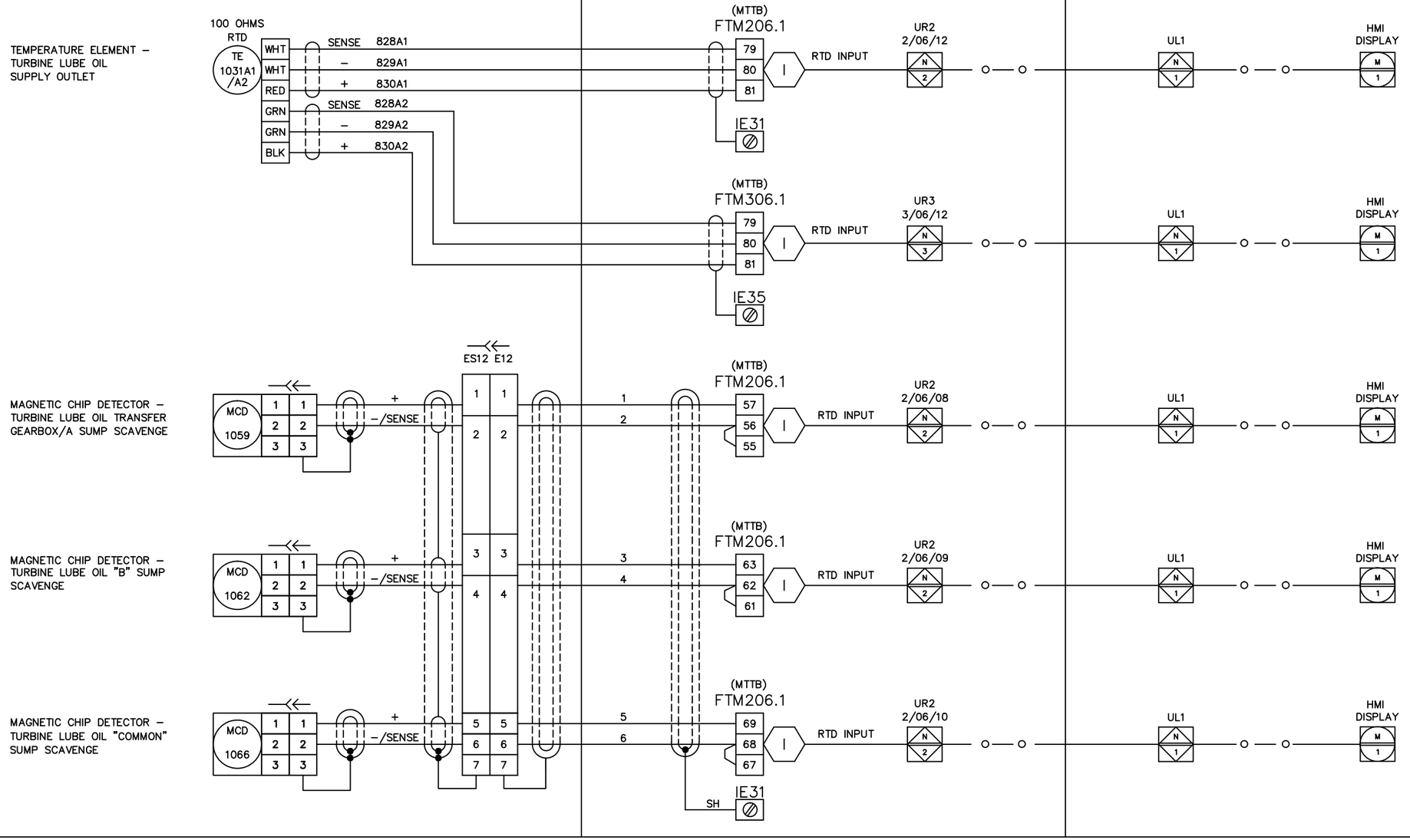
GE PACKAGED POWER, L.P.

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DWG NO. 7253049–969744 REV. A

SCALE NONE SHEET 6 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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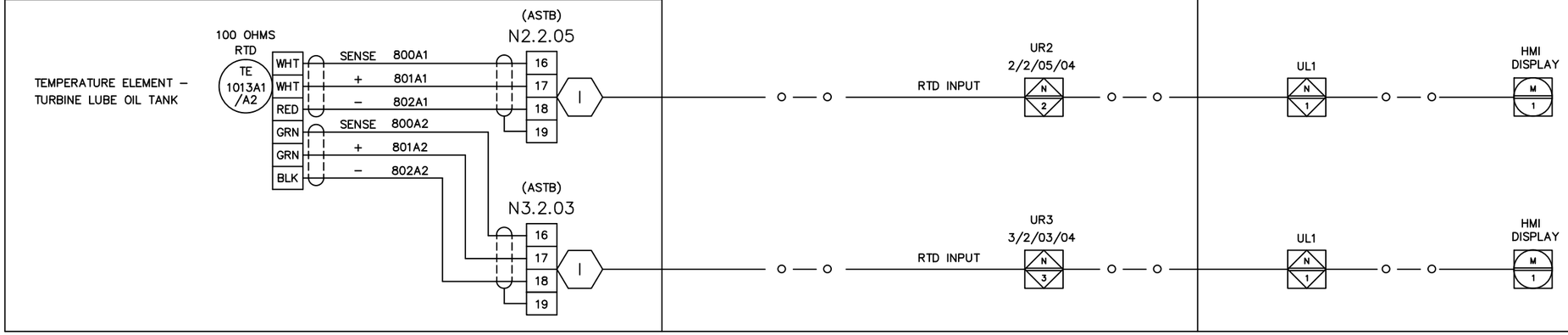
REV. A

SCALE NONE

SHEET 7 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

AUXILIARY SKID



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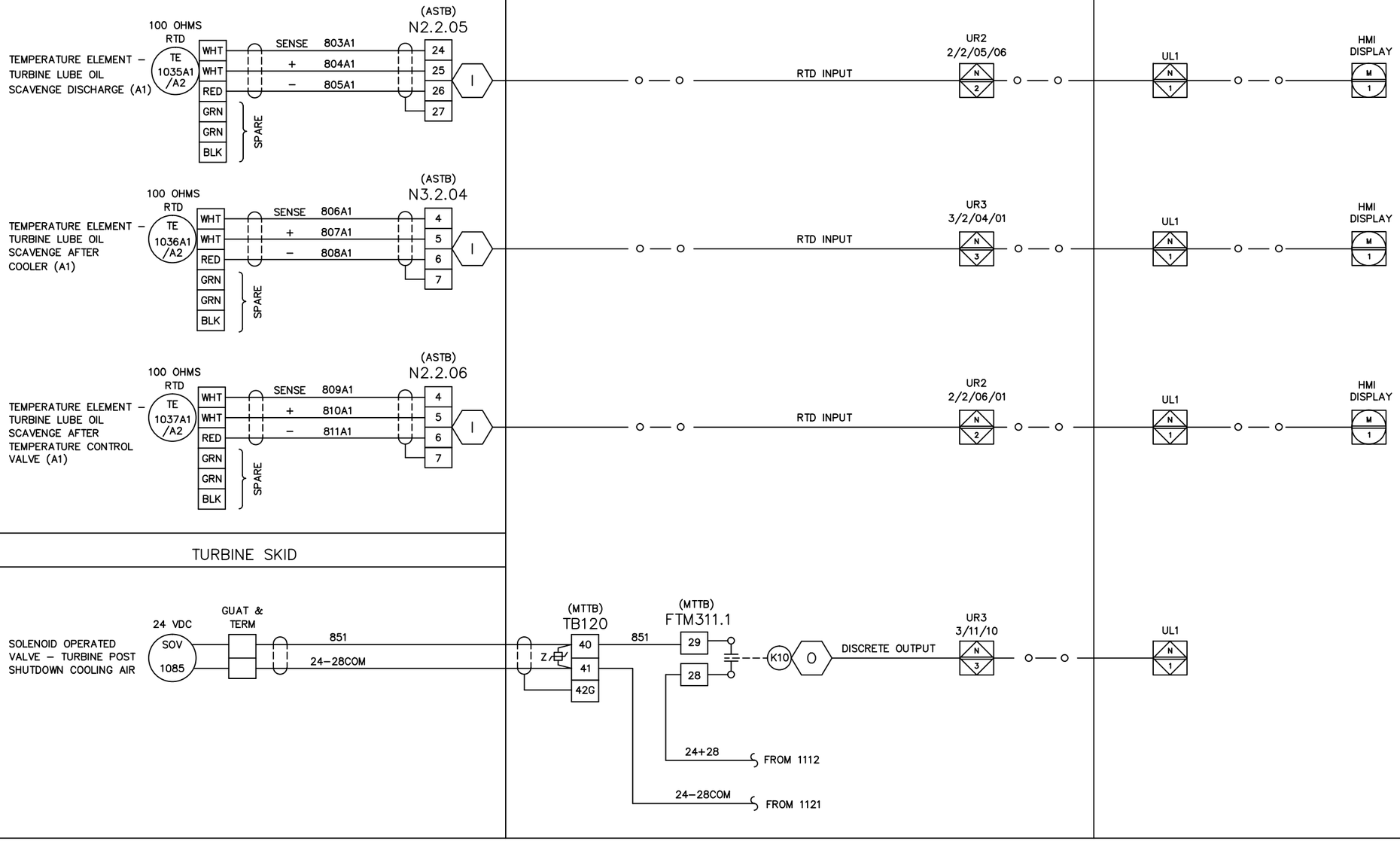
DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 8 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TITLE
INSTRUMENT LOOP DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 9 OF 10

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
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NEXT ASSY.

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GE CLASS II (INTERNAL)

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TITLE
INSTRUMENT LOOP DIAGRAM
TURBINE LUBE OIL SYSTEM

DWG NO. 7253049–969744

REV. A

SCALE NONE

SHEET 10 OF 10

NOTES:

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   (CONFIG. OR SITE)–(STANDARD DRAWING NUMBER).
   WHERE X = ORDER NUMBER.
3. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS

   X/XX/XX
   - EXAMPLE: 1/03/04
   - CHANNEL
   - BOARD
   - CHASSIS
4. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
5. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.
6. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS–THRU
   BAR AT THAT TERMINAL FOR SHIELD CONNECTION,
   UNLESS OTHERWISE INDICATED.
7. ALL FPP WIRING MUST BE SEPARATED FROM OTHER UNIT WIRING.
   WIRING FOR FPP MUST NOT BE TIED OR BUNDLED WITH OTHER WIRING.
8. (XXXX) INDICATES CABLE WITH IDENTIFICATION NO.

LEGEND:

A_____	FAULT MODULE
B_____	MANUAL PULL MODULE
C_____	RELEASE MODULE
CBFPP__	CIRCUIT BREAKER, 24 VDC FIRE & GAS POWER
CHG#3__	CHARGER, FIRE & GAS BATTERY
CR_____	DIODE, SUPPRESSION
D,E_____	3–CHANNEL INPUT MODULE
DSW24F_	FUSED DISCONNECT SWITCH, 24 VDC FIRE & GAS POWER
F_____	ALARM OUTPUT MODULE
FBAT___	BATTERY, FIRE & GAS PROTECTION POWER
FPP_____	PANEL, FIRE & GAS PROTECTION
G TO N_	COMBUSTIBLE GAS MODULE
IE#_____	GROUND BAR, INSTRUMENT EARTH
JB#_____	BOX, JUNCTION
LDP_____	PANEL, LIGHTING & DISTRIBUTION
MCC_____	MOTOR CONTROL CENTER
O_____	STATUS COLOR MODULE
P_____	RELAY MODULE
TB#_____	TERMINAL BLOCK
U_____	TERMINAL MODULE

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969254	FLOW & INSTRUMENT DIAGRAM, FIRE & GAS PROTECTION SYSTEM

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

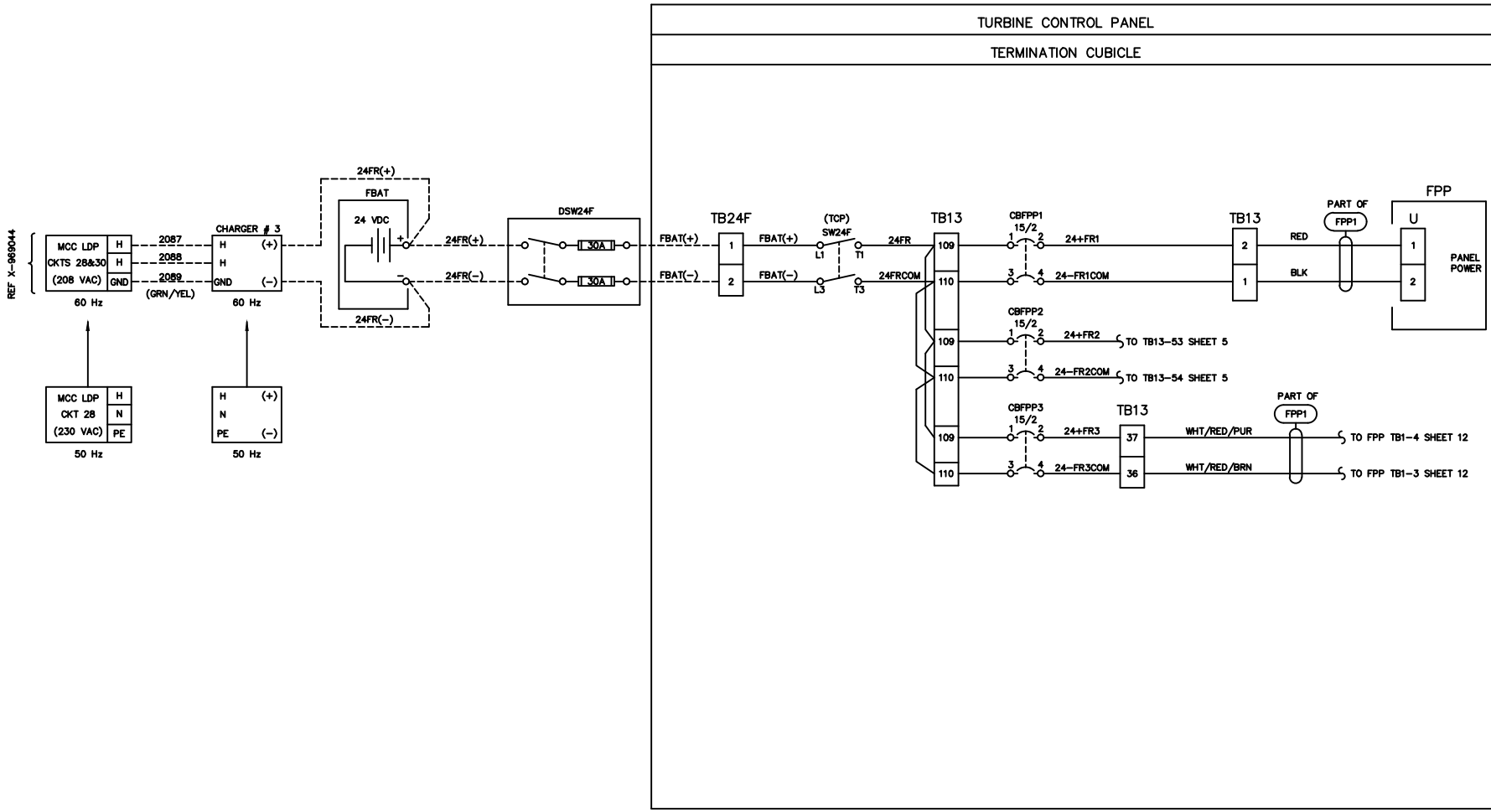
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INSTRUMENT LOOP DIAGRAM
FIRE & GAS PROTECTION SYSTEM

DWG NO. 7253049–969746

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SHEET 1 OF 13



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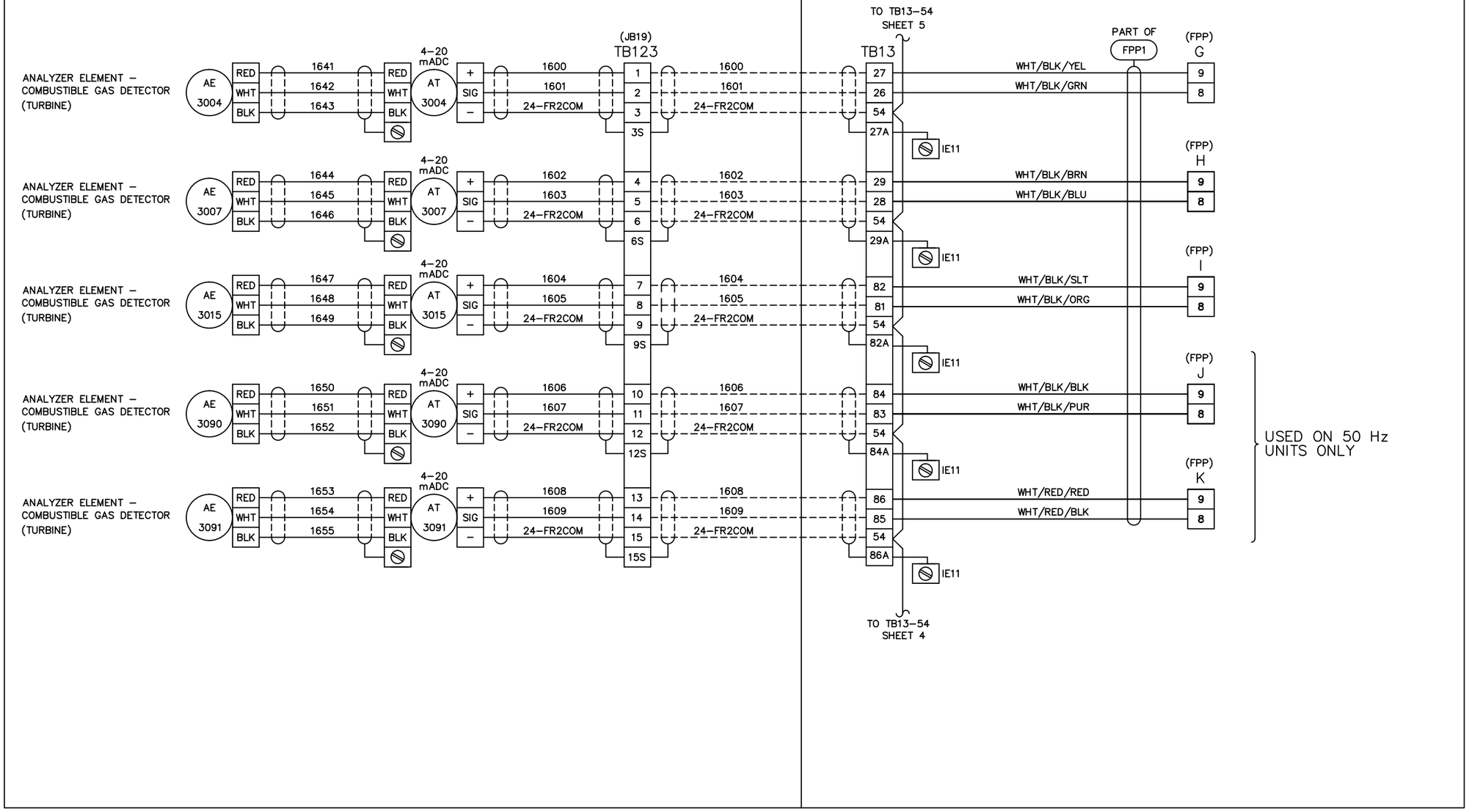
SHEET 2 OF 13

FIELD PROCESS AREA

TURBINE SKID

TURBINE CONTROL PANEL

TERMINATION CUBICLE



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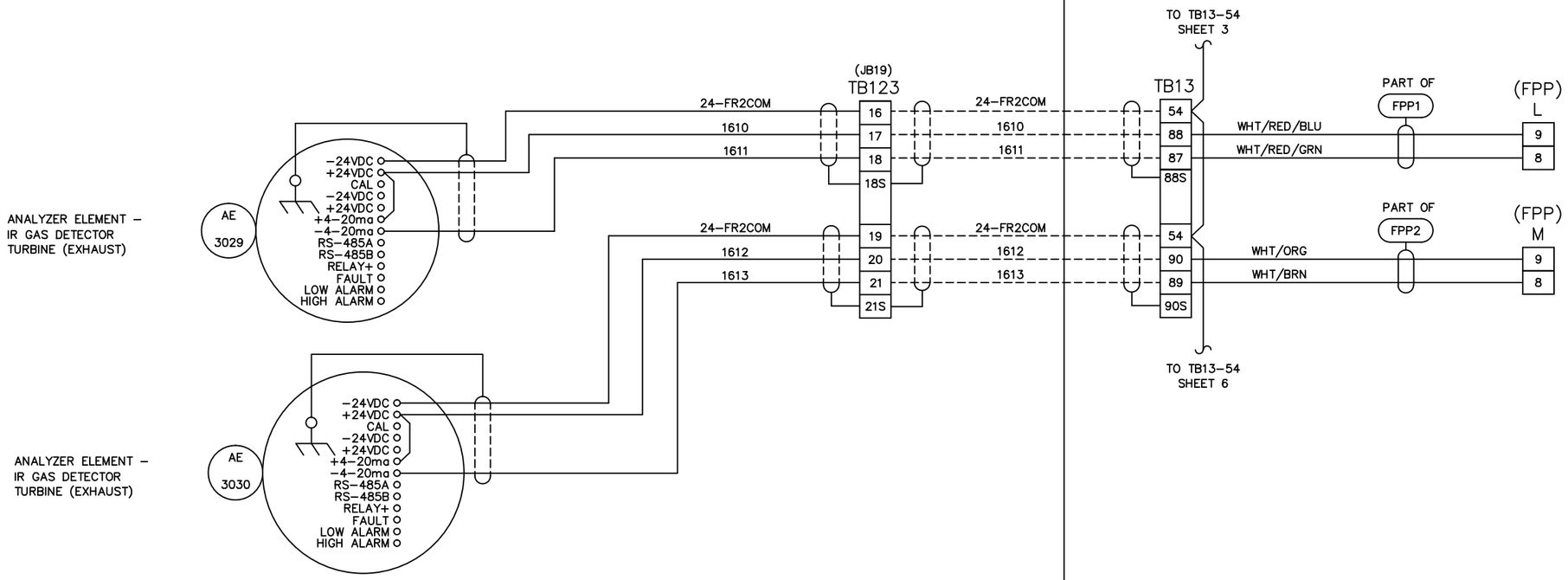
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FIELD PROCESS AREA	TURBINE CONTROL PANEL
TURBINE SKID	TERMINATION CUBICLE



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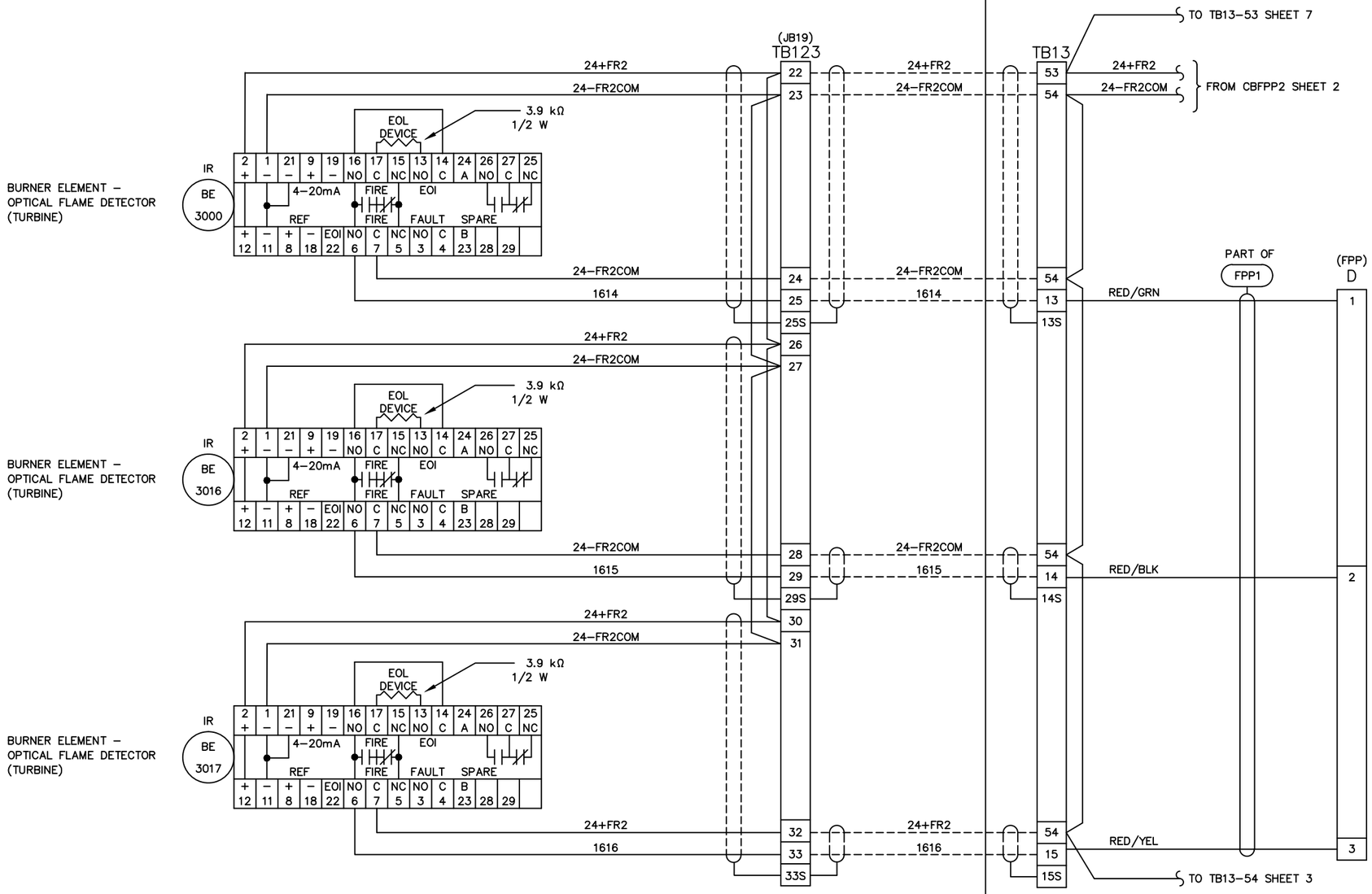
INSTRUMENT LOOP DIAGRAM FIRE & GAS PROTECTION SYSTEM

DWG NO.	REV.
7253049–969746	A

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FIELD PROCESS AREA | TURBINE CONTROL PANEL

TURBINE SKID | TERMINATION CUBICLE



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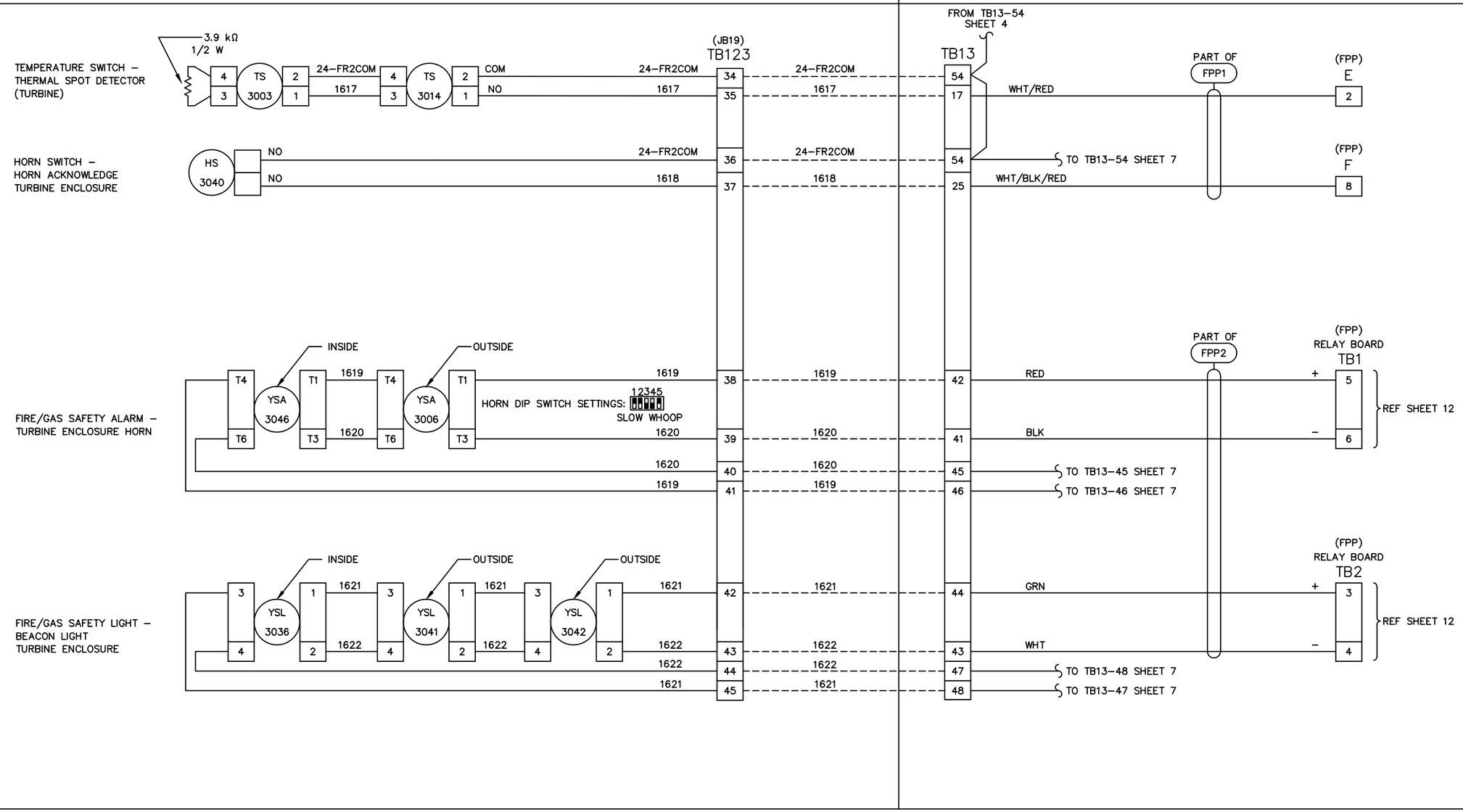
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FIELD PROCESS AREA

TURBINE SKID

TURBINE CONTROL PANEL

TERMINATION CUBICLE



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SHEET 6 OF 13

FIELD PROCESS AREA

GENERATOR/GEARBOX SKID

TURBINE CONTROL PANEL

TERMINATION CUBICLE

ANALYZER ELEMENT – COMBUSTIBLE GAS DETECTOR (GENERATOR/GEARBOX)

AE 3013 — RED, WHT, BLK — 1665, 1666, 1667 — RED, WHT, BLK — 4–20 mADC — AT 3013 — +, SIG, –

1668, 1669, 24–FR2COM → (JB18) TB113 1, 2, 3, 3S → 1668, 1669, 24–FR2COM → TB13 31, 30, 54, 31A

FROM TB13–53 SHEET 5

PART OF FPP2 (FPP) N: 9, 8

WHT/VLT, WHT/GRY

IE11

BURNER ELEMENT – OPTICAL FLAME DETECTOR (GENERATOR/GEARBOX)

IR BE 3025

EOL DEVICE — 3.9 K OHMS 1/2 W

2 + | 1 – | 21 – | 9 + | 19 – | 16 NO | 17 C | 15 NC | 13 NO | 14 C | 24 A | 26 NO | 27 C | 25 NC

4–20mA | FIRE | EOI

REF | FIRE | FAULT | SPARE

+ 12 | – 11 | + 8 | – 18 | EOI 22 | NO 6 | C 7 | NC 5 | NO 3 | C 4 | B 23 | 28 | 29

24+FR2, 24–FR2COM → (JB18) TB113 4, 5 → 24+FR2, 24–FR2COM → TB13 53, 54

TO TB13–53 SHEET 9

FROM TB13–54 SHEET 6

24–FR2COM, 1670 → TB113 6, 7, 7S → 24–FR2COM, 1670 → TB13 54, 16, 16S

PART OF FPP1 (FPP) E: 1

WHT/BLK

TEMPERATURE SWITCH – THERMAL SPOT DETECTOR (GENERATOR/GEARBOX)

3.9 kΩ 1/2 W

TS 3027 (4, 3 / 2, 1) — 24–FR2COM — TS 3028 (4, 3 / 2, 1) — 1671 — TS 3012 (4, 3 / 2, 1) — COM / NO — 24–FR2COM, 1671 → TB113 8, 9 → 24–FR2COM, 1671 → TB13 54, 18

(FPP) E: 3

WHT/GRN

HAND SWITCH – MANUAL FIRE SUPPRESANT AGENT RELEASE STATION

3.9 kΩ 1/2 W

HS 3008 (3,4 / 2,1) — 24–FR2COM — HS 3009 (1 / 2) — 1672 — HS 3024 (1 / 2) — 24–FR2COM, 1672 → TB113 10, 11 → 24–FR2COM, 1672 → TB13 54, 5

TO TB13–54 SHEET 9

(FPP) B: 1

ORG

FIRE/GAS SAFETY ALARM – GENERATOR/GEARBOX ENCLOSURE HORN

3.9 kΩ 1/2 W

YSA 3026 (T4, T6 / T1, T3) — INSIDE

HORN DIP SWITCH SETTINGS: 12345 — SLOW WHOOP

1619, 1620 → TB113 12, 13 → 1619, 1620 → TB13 46, 45

TO TB13–46 SHEET 6

TO TB13–45 SHEET 6

FIRE/GAS SAFETY LIGHT – BEACON LIGHT GENERATOR/GEARBOX ENCLOSURE

3.9 kΩ 1/2 W

YSL 3044 (3 / 4, 1 / 2) — INSIDE — 1621, 1622 — YSL 3045 (3 / 4, 1 / 2) — INSIDE

1621, 1622 → TB113 14, 15 → 1621, 1622 → TB13 48, 47

TO TB13–48 SHEET 6

TO TB13–47 SHEET 6

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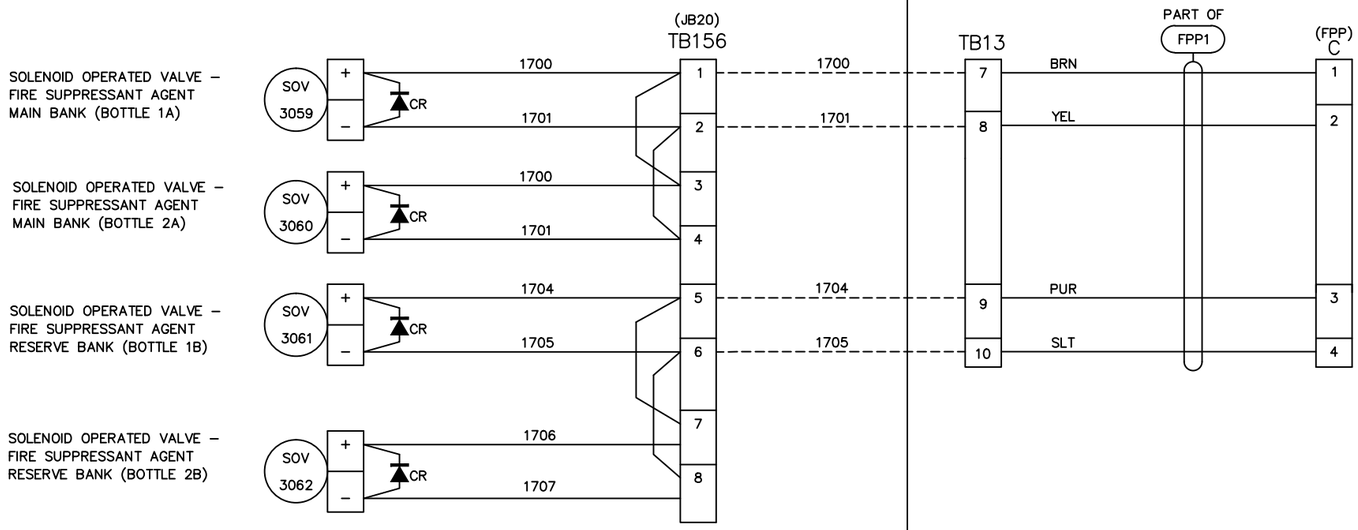
DWG NO. 7253049–969746

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SHEET 7 OF 13

FIELD PROCESS AREA	TURBINE CONTROL PANEL
CO2 SKID	TERMINATION CUBICLE



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SHEET 8 OF 13

FIELD PROCESS AREA

CO2 SKID

TURBINE CONTROL PANEL

TERMINATION CUBICLE

CONTROL CUBICLE

PRESSURE SWITCH HIGH HIGH – FIRE SUPPRESSANT AGENT DISCHARGE (DOWNSTREAM)

PSHH 3048

1 COM 1708 → (JB20) TB156 9
2 NO 24+FR2 → 10 — 24+FR2 → TB13 53 — TO TB13–53 SHEET 13
3 NC
4 COM 24+9 → 11 — 24+9 → 52 — FROM TB13–34 SHEET 11
5 NO
6 NC 1709 → 12 — 1709 → 51 — 1709 → FTM109.1 11 — DISCRETE INPUT → UL1 1/09/11 N 1 — HMI DISPLAY M 1

HAND SWITCH – FIRE SUPPRESSANT AGENT PURGE ACKNOWLEDGE (& LATCHING RELAY)

HS 3063

1 24+FR2 → 13
2 1708 → 14
3 24–FR2COM → 15 — 24–FR2COM → 54 — FROM TB13–54 SHEET 7 — PART OF FPP1
4
5 1710 → 16 — 1710 → 11 — PNK → (FPP) C 5
6 1711 → 17 — 1711 → 24 — WHT/VLT → (FPP) F 7
7
8

POSITION SWITCH CLOSED – FIRE SUPPRESSANT AGENT BLOCK VALVE (CLOSED SWITCH = OPEN VALVE)

ZSC 3064

1 1712 → 18 — 1712 → 12 — TAN → (FPP) C 6
3 24–FR2COM → 19 — 24–FR2COM → 54

3.9 kΩ 1/2 W

PRESSURE SWITCH HIGH – FIRE SUPPRESSANT AGENT DISCHARGE (UPSTREAM)

PSH 3057

1 COM 24–FR2COM → 20 — 24–FR2COM → 54
2 NO 1713 → 21 — 1713 → 103 — WHT/GRN/BLK → (FPP) F 1
3 NC
4 COM 1714 → 22
5 NO
6 NC 1715 → 23

TO TB13–54 SHEET 13

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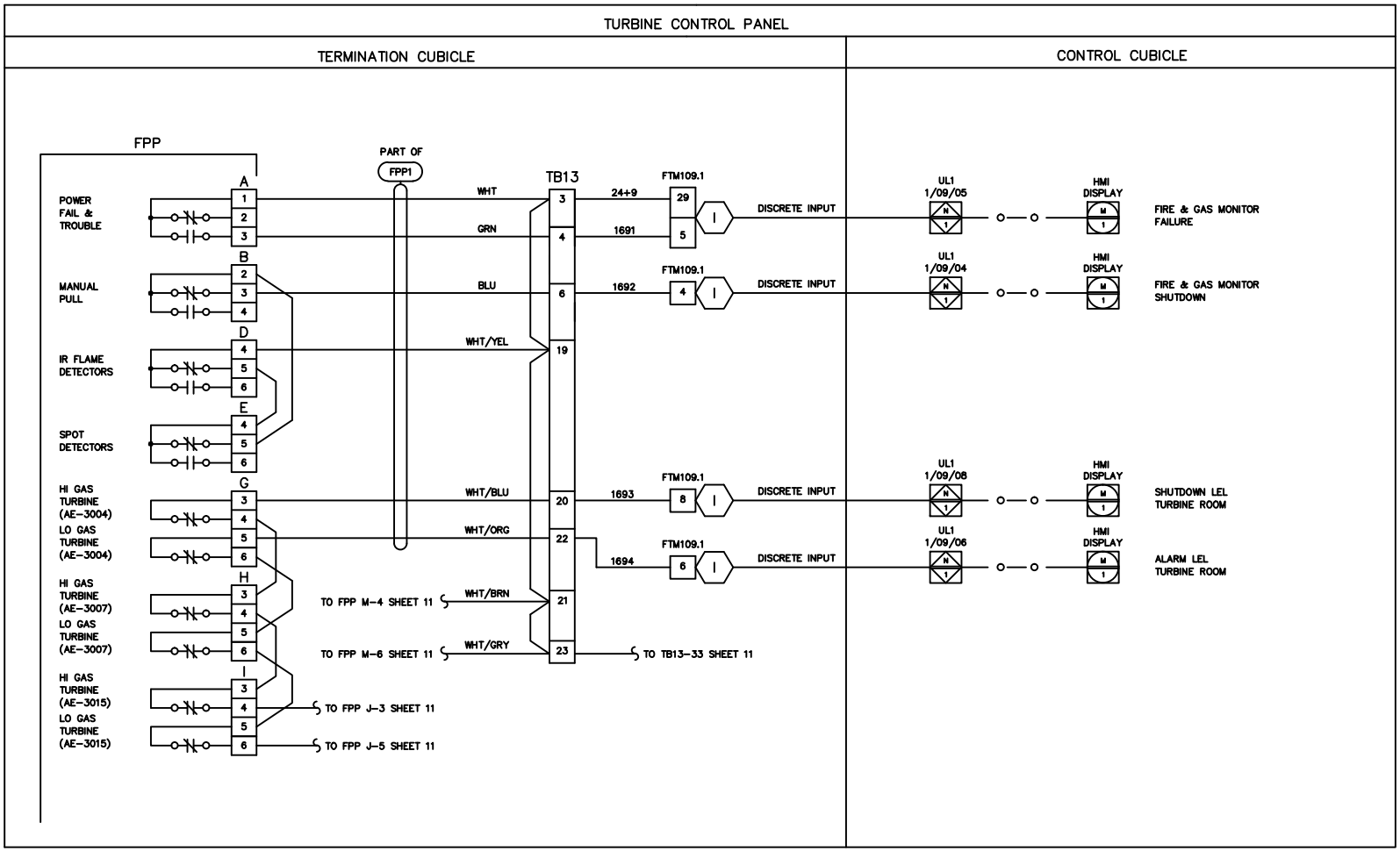
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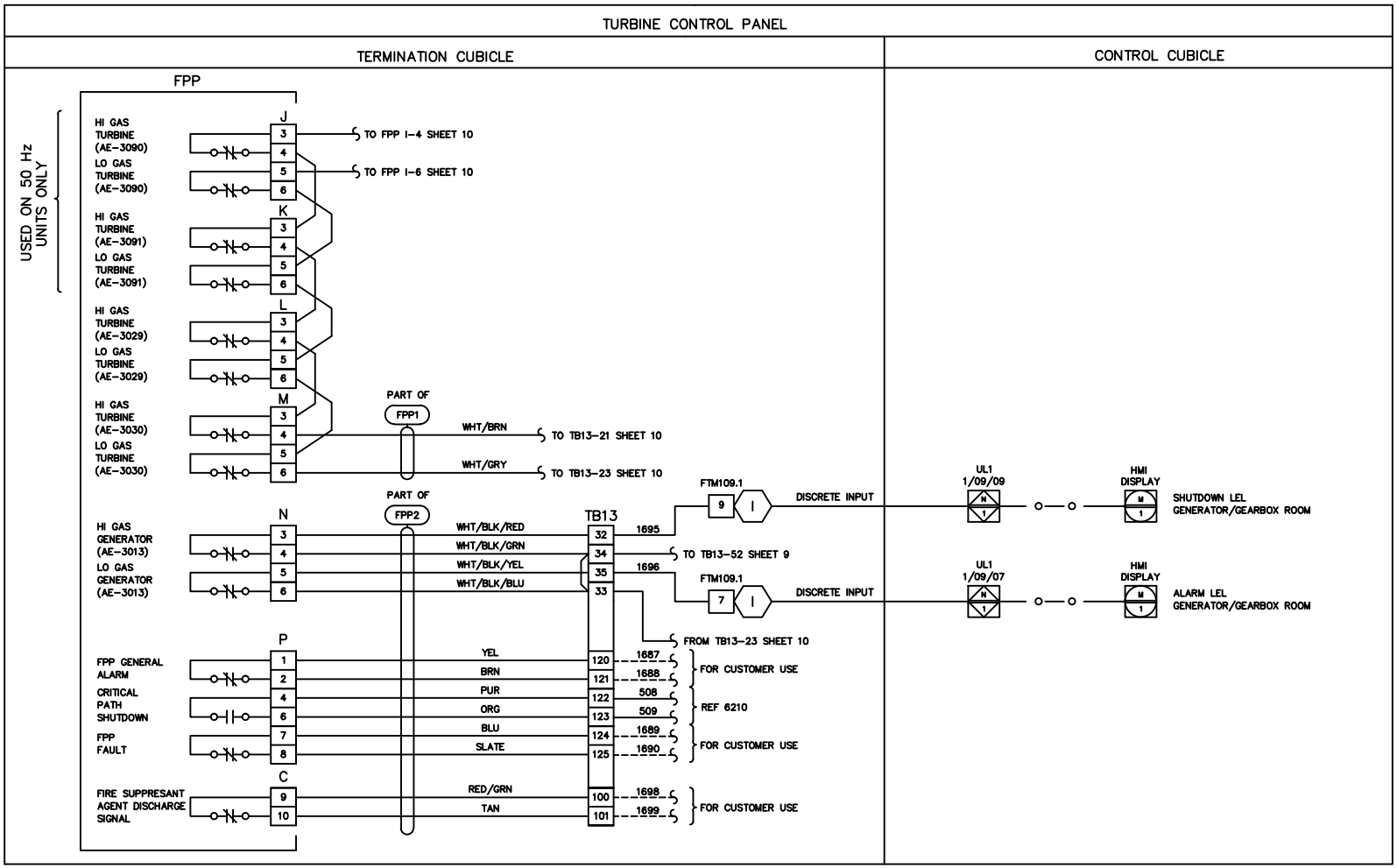
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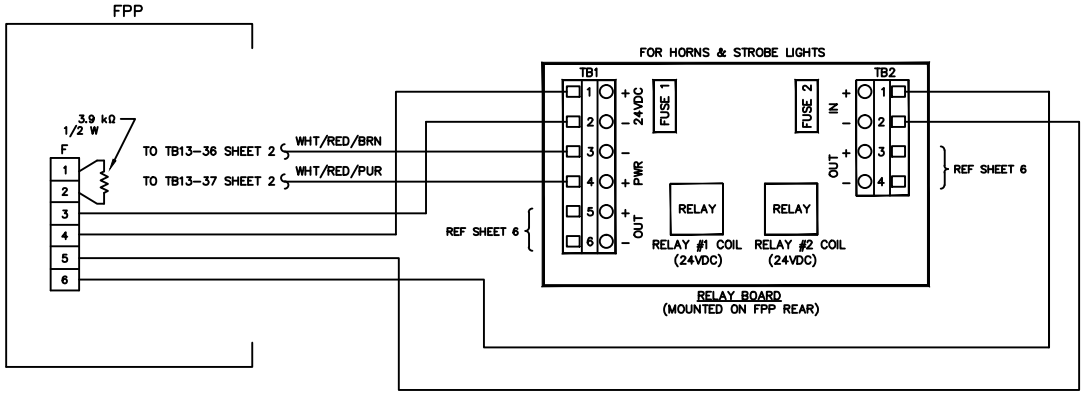
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SHEET 11 OF 13

TURBINE CONTROL PANEL

TERMINATION CUBICLE



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SHEET 12 OF 13

FIELD PROCESS AREA

GENERATOR/GEARBOX SKID

TURBINE CONTROL PANEL

TERMINATION CUBICLE

(JB18) TB113

TB13

PART OF FPP2

(FPP)

NORMAL — GREEN — YSL–3104 / YSL–3106 / YSL–3105 STATUS LIGHTS

INHIBIT — 3.9 kΩ 1/2 W — AMBER

DISCHARGE — 3.9 kΩ 1/2 W — RED

		TB113		TB13		(FPP)
NORMAL GREEN	1673	16	1673	70	PNK	1
NORMAL GREEN	24+FR2	19	24+FR2	53	FROM TB13–53 SHEET 9	
INHIBIT AMBER	1675	18	1675	71	RED/YEL	2
INHIBIT AMBER	1677	21	1677	72	RED/BLK	3
DISCHARGE RED	1674	17	1674	73	WHT/BLK	4
DISCHARGE RED	1676	20	1676	74	WHT/RED	5
POSITION SWITCH OPEN – GENERATOR/GEARBOX ENCLOSURE DOOR — ZSO 3107	1	22	1678	76	WHT/YEL	7
	2	23	1679			
POSITION SWITCH OPEN – GENERATOR/GEARBOX ENCLOSURE DOOR — ZSO 3108	1	24	1679			
	2	25	1680			
POSITION SWITCH OPEN – GENERATOR/GEARBOX ENCLOSURE DOOR — ZSO 3109	1	26	1680			
	2	27	1681			
POSITION SWITCH OPEN – GENERATOR/GEARBOX ENCLOSURE DOOR — ZSO 3110	1	28	1681			
	2	29	24–FR2COM	54	FROM TB13–54 SHEET 9	

TURBINE SKID

(JB19) TB123

		TB123		TB13		(FPP) C
POSITION SWITCH OPEN – TURBINE ENCLOSURE DOOR — ZSO 3018	1	46	1623	75	WHT/GRN	6
	2	47	1624			8
POSITION SWITCH OPEN – TURBINE ENCLOSURE DOOR — ZSO 3019	1	48	1624			
	2	49	24–FR2COM	54		

OPTIONAL

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	DR	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM FIRE & GAS PROTECTION SYSTEM

DWG NO. 7253049–969746

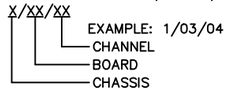
REV. A

SCALE NONE

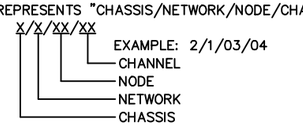
SHEET 13 OF 13

NOTES:

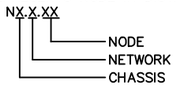
1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975
   GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–
   (STANDARD DRAWING NUMBER), AND ARE REFERENCED AS
   X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS



6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK



7. TERMINATION SUFFIXED WITH A "G" INDICATES
   HALF GREEN/HALF YELLOW GROUND TERMINAL.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969260	FLOW & INSTRUMENT DIAGRAM, FUEL SYSTEM
X–969269	FLOW & INSTRUMENT DIAGRAM WATER INJECTION PUMP
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969934	SYSTEM SCHEMATIC, COMMUNICATION

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
NOX WATER INJECTION SYSTEM

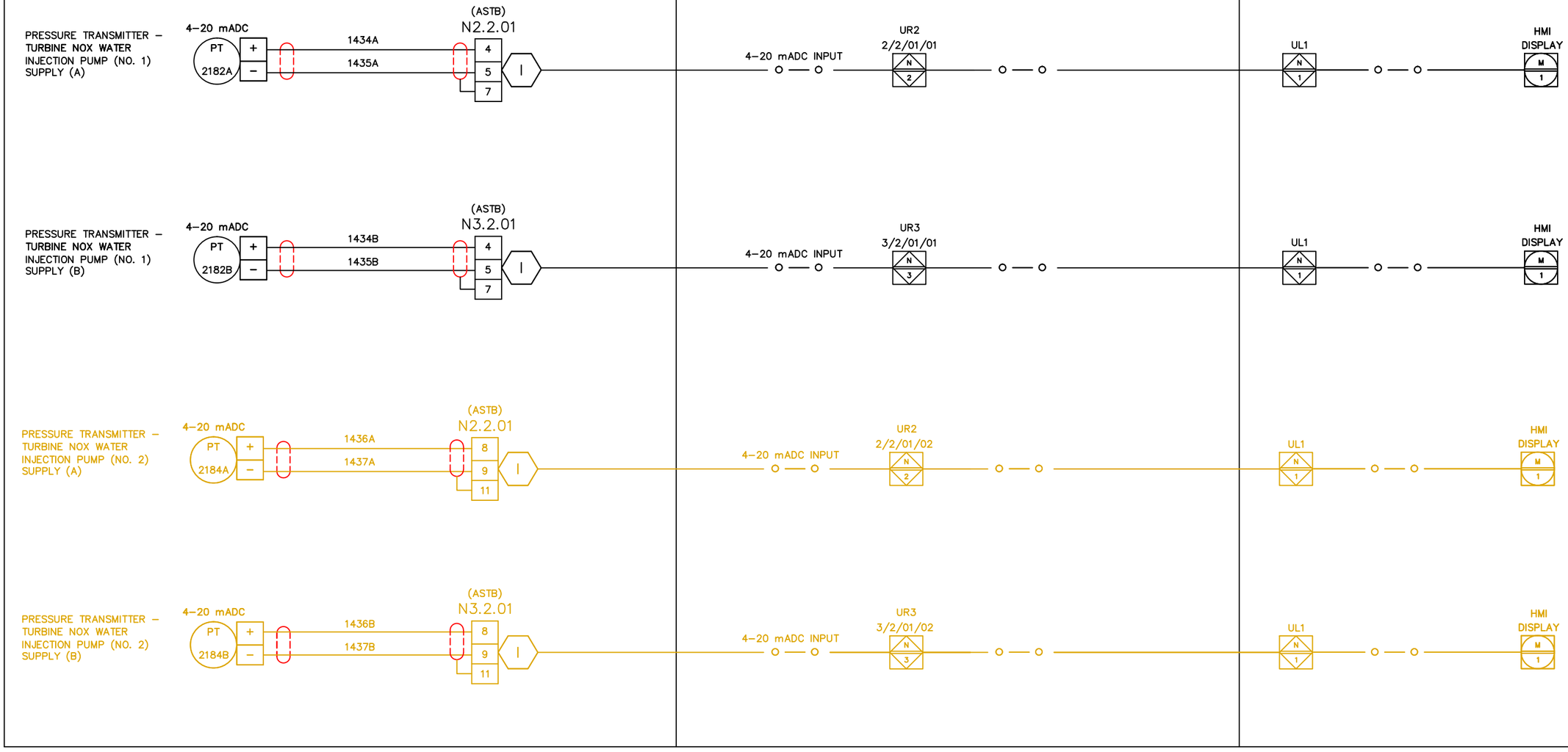
DWG NO. 7253049–969750

REV. A

SCALE NONE

SHEET 1 OF 7

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



DUPLEX NOX WATER INJECTION PUMP OPTION

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
NOX WATER INJECTION SYSTEM

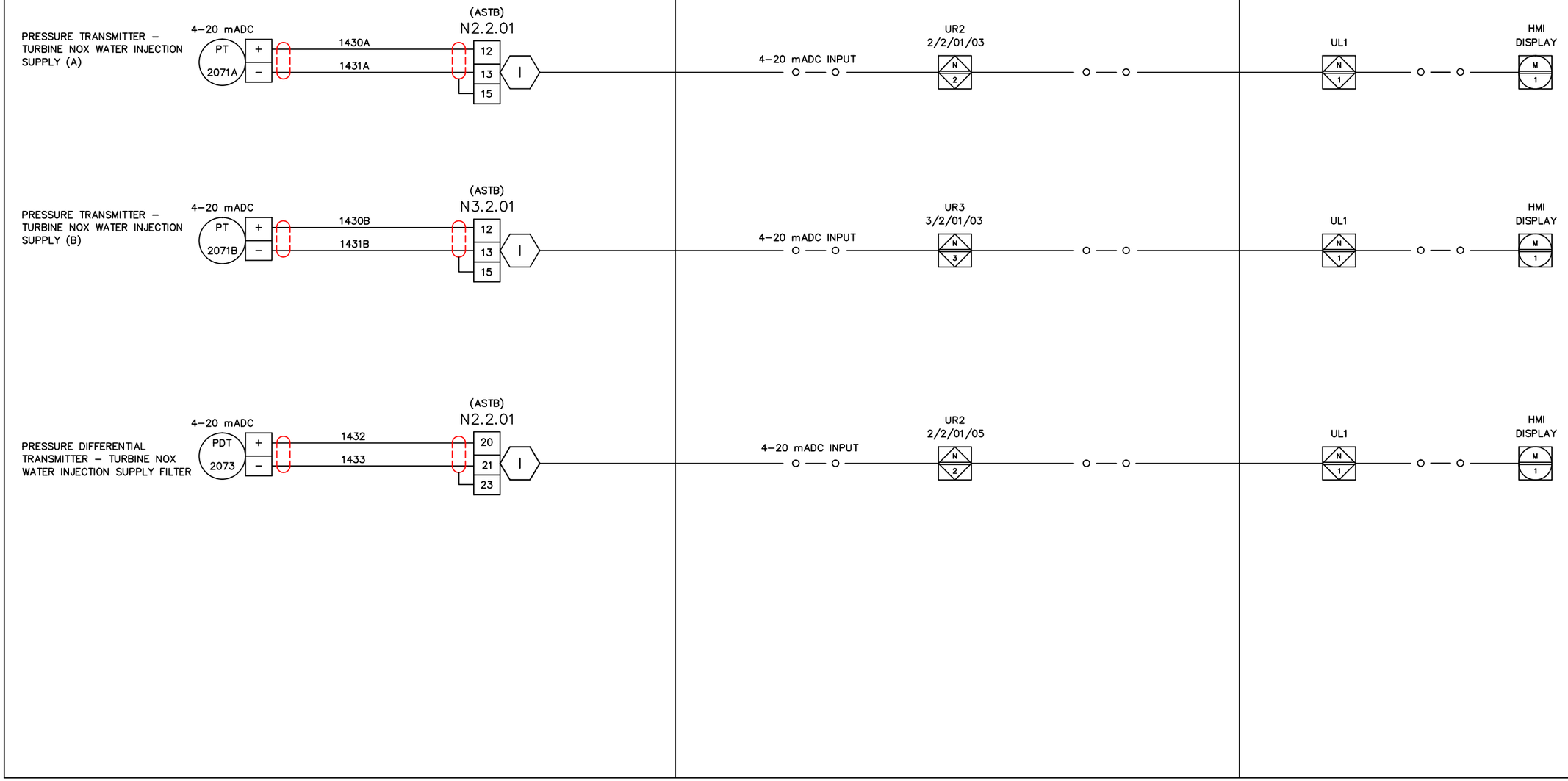
DWG NO. 7253049–969750

REV. A

SCALE NONE

SHEET 2 OF 7

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
NOX WATER INJECTION SYSTEM

DWG NO.
7253049–969750

REV.
A

SCALE NONE

SHEET 3 OF 7

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

FLOW TRANSMITTER – TURBINE NOX WATER INJECTION SUPPLY

RF FE 2003 — WHT, WHT — 1452, 1453

(MTTB) FT–2003: 8, 9, 10, 3, 4, 11, 1, 2

1450, 1451

ISO3: 41, 13, 42, 11

3514, 3515

(MTTB) FTM304.1: 8, 44; I; IE28

4–20 mADC INPUT

UR3 3/04/03 N 3

UL1 N 1

HMI DISPLAY M 1

24+22A — FROM 1032

24–22ACOM — FROM 1033

SOLENOID OPERATED VALVE – TURBINE NOX WATER INJECTION BLOCK

24 VDC

SOV 2038: 4, 5

1460, 24–28COM

(MTTB) TB120: 22, 23, 24G

Z

(MTTB) FTM311.1: 8, 7

1460

K3; O

DISCRETE OUTPUT

UR3 3/11/03 N 3

UL1 N 1

2308 — FROM 1118

24–28COM — FROM 1124

TO TB120–26

POSITION SWITCH CLOSED – TURBINE NOX WATER INJECTION BLOCK VALVE

4–20 mADC

ZSC 2038: 1, 2

NO, COM

GUAT & TERM: 1, 2, 3

1.8K, 2K

1470, 1471

(MTTB) FTM303.2: 45, 9, 10, 47

I

4–20 mADC INPUT

IE27

UR3 3/03/20 N 3

UL1 N 1

HMI DISPLAY M 1

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM NOX WATER INJECTION SYSTEM

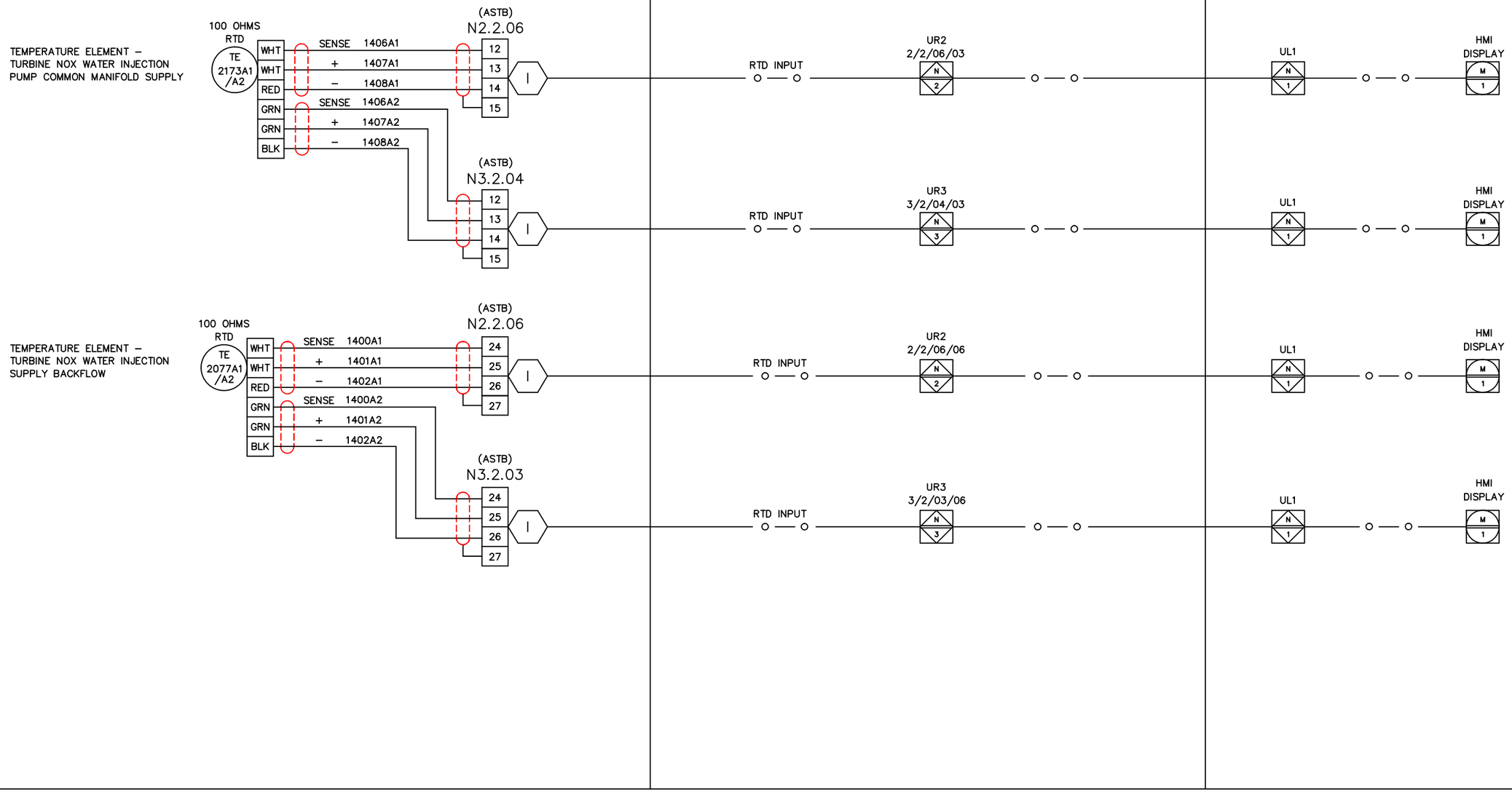
DWG NO. 7253049–969750

REV. A

SCALE NONE

SHEET 4 OF 7

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
NOX WATER INJECTION SYSTEM

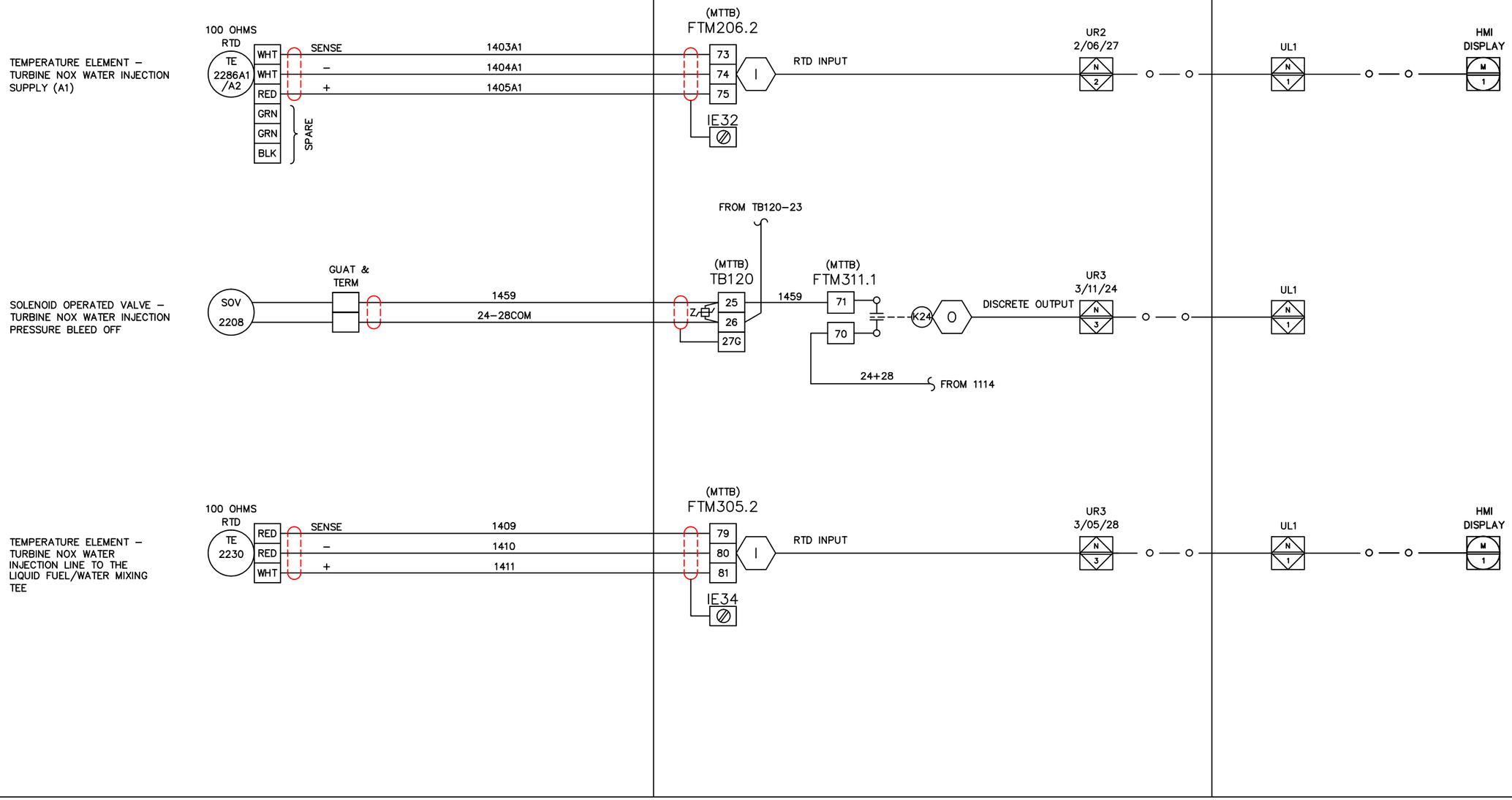
DWG NO. 7253049–969750

REV. A

SCALE NONE

SHEET 5 OF 7

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM NOX WATER INJECTION SYSTEM

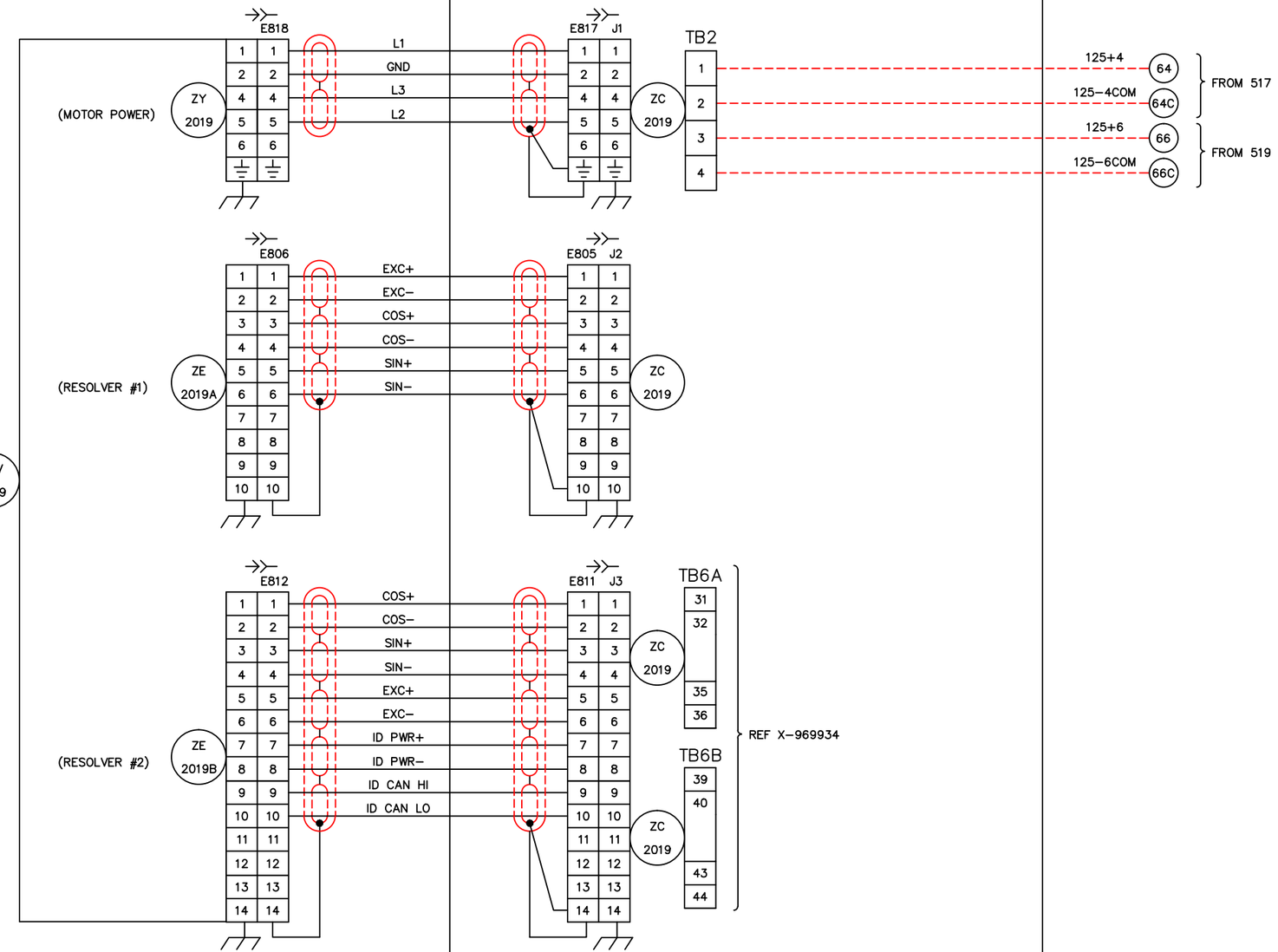
DWG NO. 7253049–969750

REV. A

SCALE NONE

SHEET 6 OF 7

FIELD PROCESS AREA	AUXILIARY SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	NOX WATER INJECTION METERING VALVE DRIVER (BELOW ASTB)	TERMINATION CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM NOX WATER INJECTION SYSTEM

DWG NO. 7253049–969750

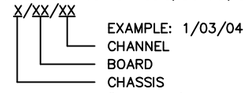
REV. A

SCALE NONE

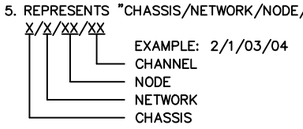
SHEET 7 OF 7

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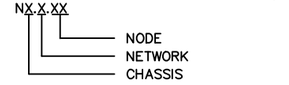
1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315-1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE-ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS



6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK



7. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS-THRU BAR AT THAT TERMINAL FOR SHIELD CONNECTION, UNLESS OTHERWISE INDICATED.
8. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
9. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X-969767.
10. SOLENOID IS FITTED WITH A FUSE, WHERE INDICATED

LEGEND:

SEE X-969005

REFERENCE DRAWINGS:

X-969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X-969245	FLOW & INSTRUMENT DIAGRAM, DLE FUEL SYSTEM
X-969260	FLOW & INSTRUMENT DIAGRAM, FUEL SYSTEM
X-969263	FLOW & INSTRUMENT DIAGRAM, LIQUID FUEL PUMP (BOOST)
X-969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X-969934	SYSTEM SCHEMATIC, COMMUNICATION

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

INSTRUMENT LOOP DIAGRAM FUEL SYSTEM

DWG NO.	REV.
7253049-969751	A

SCALE NONE SHEET 1 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

PRESSURE TRANSMITTER – TURBINE GAS FUEL MANIFOLD
4–20 mADC
PT 2028 (+, –)
1034
1035
(MTTB) FTM303.1
40
4
5
42
IE26
4–20 mADC INPUT
UR3 3/03/02
UL1
HMI DISPLAY

FLOW TRANSMITTER – TURBINE GAS FUEL SUPPLY
PULSE
FE 2000
A
B
C
RED
WHT
BLK
BLU
(MTTB) FT–2000
+
–
A
B
C
1038
1039
(MTTB) FTM303.1
22
59
60
24
IE26
4–20 mADC INPUT
UR3 3/03/07
UL1
HMI DISPLAY

PRESSURE TRANSMITTER – TURBINE GAS FUEL SUPPLY (A)
4–20 mADC
PT 2027A (+, –)
1030A
1031A
(MTTB) FTM203.1
1
38
39
3
IE21
4–20 mADC INPUT
UR2 2/03/01
UL1
HMI DISPLAY

PRESSURE TRANSMITTER – TURBINE GAS FUEL SUPPLY (B)
4–20 mADC
PT 2027B (+, –)
1030B
1031B
(MTTB) FTM303.1
1
38
39
3
IE26
4–20 mADC INPUT
UR3 3/03/01
UL1
HMI DISPLAY

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 2 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

PRESSURE TRANSMITTER – TURBINE GAS FUEL BETWEEN UPSTREAM AND DOWNSTREAM BLOCK VALVES

4–20 mADC
PT 2139 (+, –)
1032
1033
(MTTB) FTM204.1
66
30
31
68
IE23
4–20 mADC INPUT
UR2 2/04/10 N 2
UL1 N 1
HMI DISPLAY M 1

POSITION SWITCH CLOSED – TURBINE GAS FUEL VENT VALVE (UPSTREAM OF FSV–2004)

GUAT & TERM
ZSC 2008
4
3
NO
COM
1.8K
2K
1
2
3
1076
1077
(MTTB) FTM204.1
32
69
70
34
IE23
4–20 mADC INPUT
UR2 2/04/11 N 2
UL1 N 1
HMI DISPLAY M 1

SOLENOID OPERATED VALVE – TURBINE GAS FUEL VENT VALVE (UPSTREAM OF FSV–2004)

24 VDC
SOV 2008
1
2
1056
24–27COM
(MTTB) TB120
7
8
9G
ZA
(MTTB) FTM311.1
5
4
K2
0
1056
2305
FROM 1101
DISCRETE OUTPUT
UR3 3/11/02 N 3
UL1 N 1

SOLENOID OPERATED VALVE – TURBINE GAS FUEL UPSTREAM BLOCK

24 VDC
SOV 2006
BLK
BLK
GRN
GUAT & TERM
1052
24–27COM
(MTTB) TB120
4
5
6G
ZA
(MTTB) FTM311.1
2
1
K1
0
1052
2305
FROM 1102
24–27COM
FROM 1109
DISCRETE OUTPUT
UR3 3/11/01 N 3
UL1 N 1

FLOW SAFETY VALVE – TURBINE GAS FUEL UPSTREAM BLOCK

FSV 2006

POSITION SWITCH CLOSED – TURBINE GAS FUEL UPSTREAM BLOCK VALVE

GUAT & TERM
ZSC 2006
NC
NO
COM
RED
BLU
BLK
GRN
1.8K
2K
1
2
3
1084
1085
(MTTB) FTM303.2
1
38
39
3
IE27
4–20 mADC INPUT
UR3 3/03/17 N 3
UL1 N 1
HMI DISPLAY M 1

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	JDD	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000(R)

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

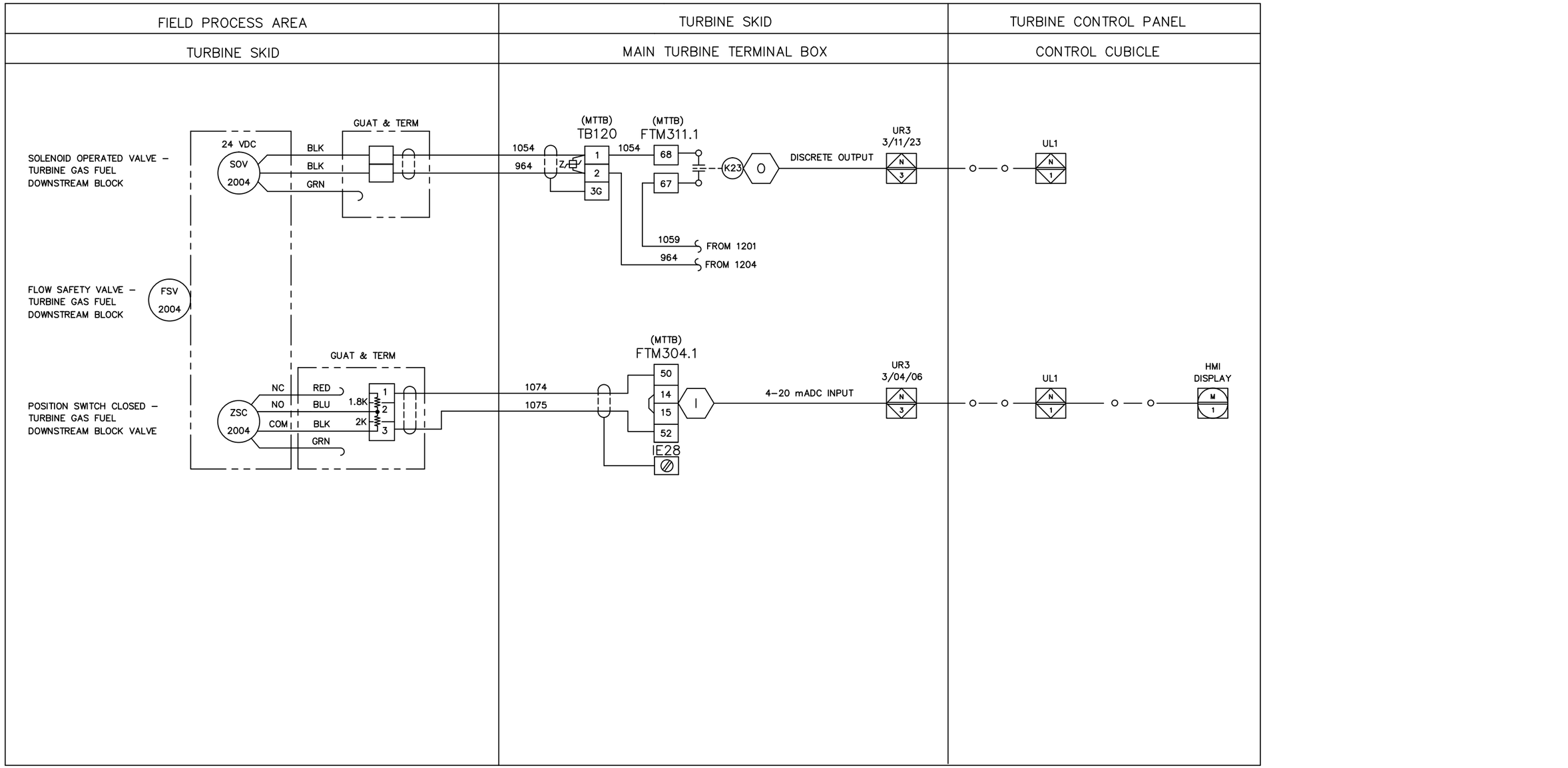
TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 3 OF 10



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 4 OF 10

FIELD PROCESS AREA			TURBINE CONTROL PANEL			
GAS FUEL FILTER SKID			TERMINATION CUBICLE		CONTROL CUBICLE	
PRESSURE DIFFERENTIAL TRANSMITTER – TURBINE GAS FUEL FILTER/SEPARATOR	4–20 mADC PDT 2063 + –	(JB82) TB82 1 2 2S	1012 1013	(TCP) FTM104.1 6 43 44 8	4–20 mADC INPUT	UL1 1/04/03 N 1 — HMI DISPLAY M 1
				IE12		
LEVEL TRANSMITTER – TURBINE GAS FUEL FILTER/SEPARATOR NO. 1 (TOP)	4–20 mADC LT 2118 + –	(JB82) TB82 3 4 4S	1014 1015	(TCP) FTM103.1 40 4 5 42	4–20 mADC INPUT	UL1 1/03/02 N 1 — HMI DISPLAY M 1
				IE11		
LEVEL TRANSMITTER – TURBINE GAS FUEL FILTER/SEPARATOR NO. 2 (TOP)	4–20 mADC LT 2123 + –	(JB82) TB82 5 6 6S	1016 1017	(TCP) FTM104.1 40 4 5 42	4–20 mADC INPUT	UL1 1/04/02 N 1 — HMI DISPLAY M 1
				IE12		
LEVEL TRANSMITTER – TURBINE GAS FUEL FILTER/SEPARATOR NO. 1 (BOTTOM)	4–20 mADC LT 2119 + –	(JB82) TB82 7 8 8S	1018 1019	(TCP) FTM103.1 1 38 39 3	4–20 mADC INPUT	UL1 1/03/01 N 1 — HMI DISPLAY M 1
				IE11		
LEVEL TRANSMITTER – TURBINE GAS FUEL FILTER/SEPARATOR NO. 2 (BOTTOM)	4–20 mADC LT 2124 + –	(JB82) TB82 9 10 10S	1020 1021	(TCP) FTM104.1 1 38 39 3	4–20 mADC INPUT	UL1 1/04/01 N 1 — HMI DISPLAY M 1
				IE12		

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

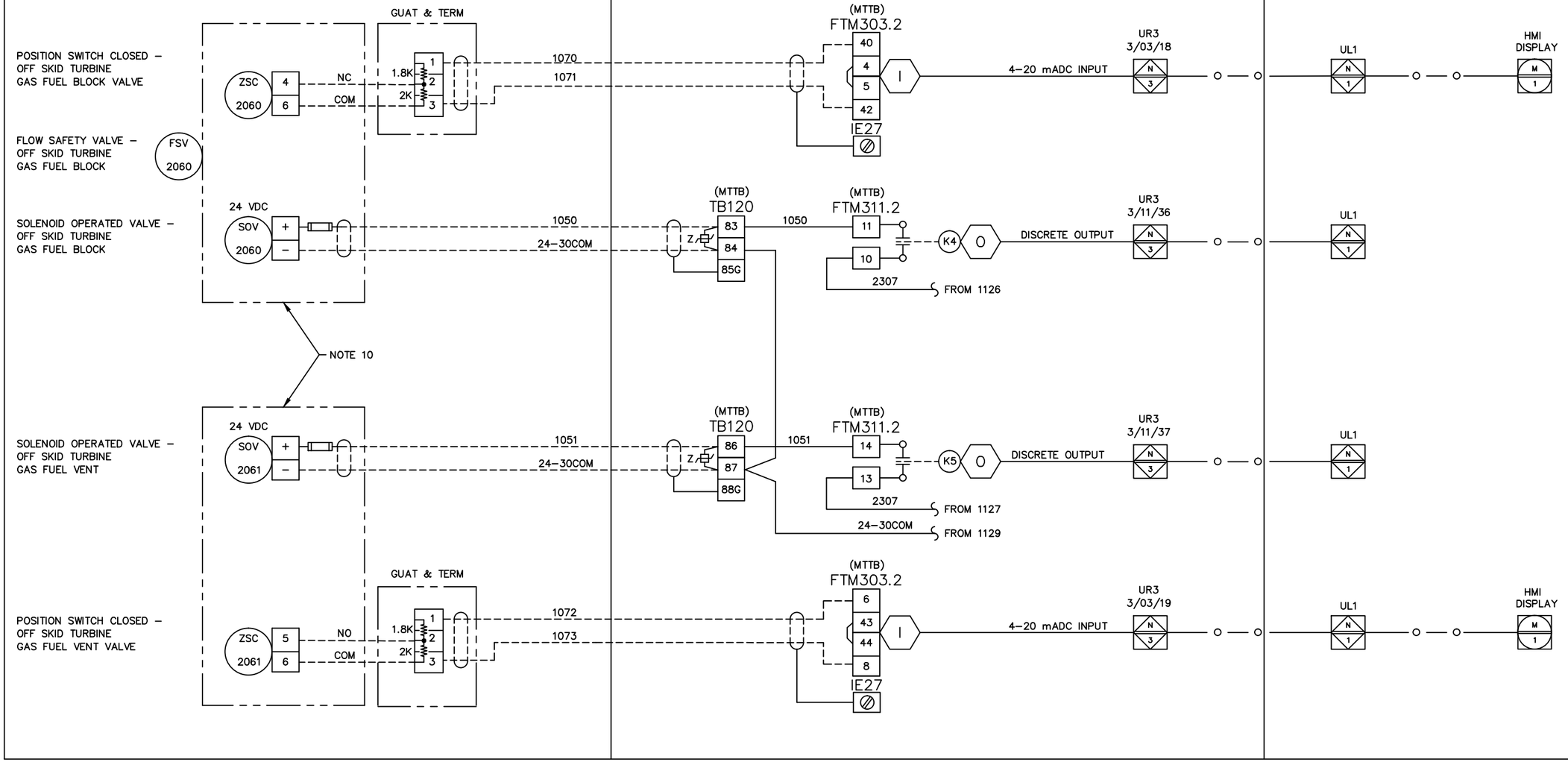
TITLE

INSTRUMENT LOOP DIAGRAM FUEL SYSTEM

DWG NO.	REV.
7253049–969751	A

SCALE NONE SHEET 5 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
OFF–TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

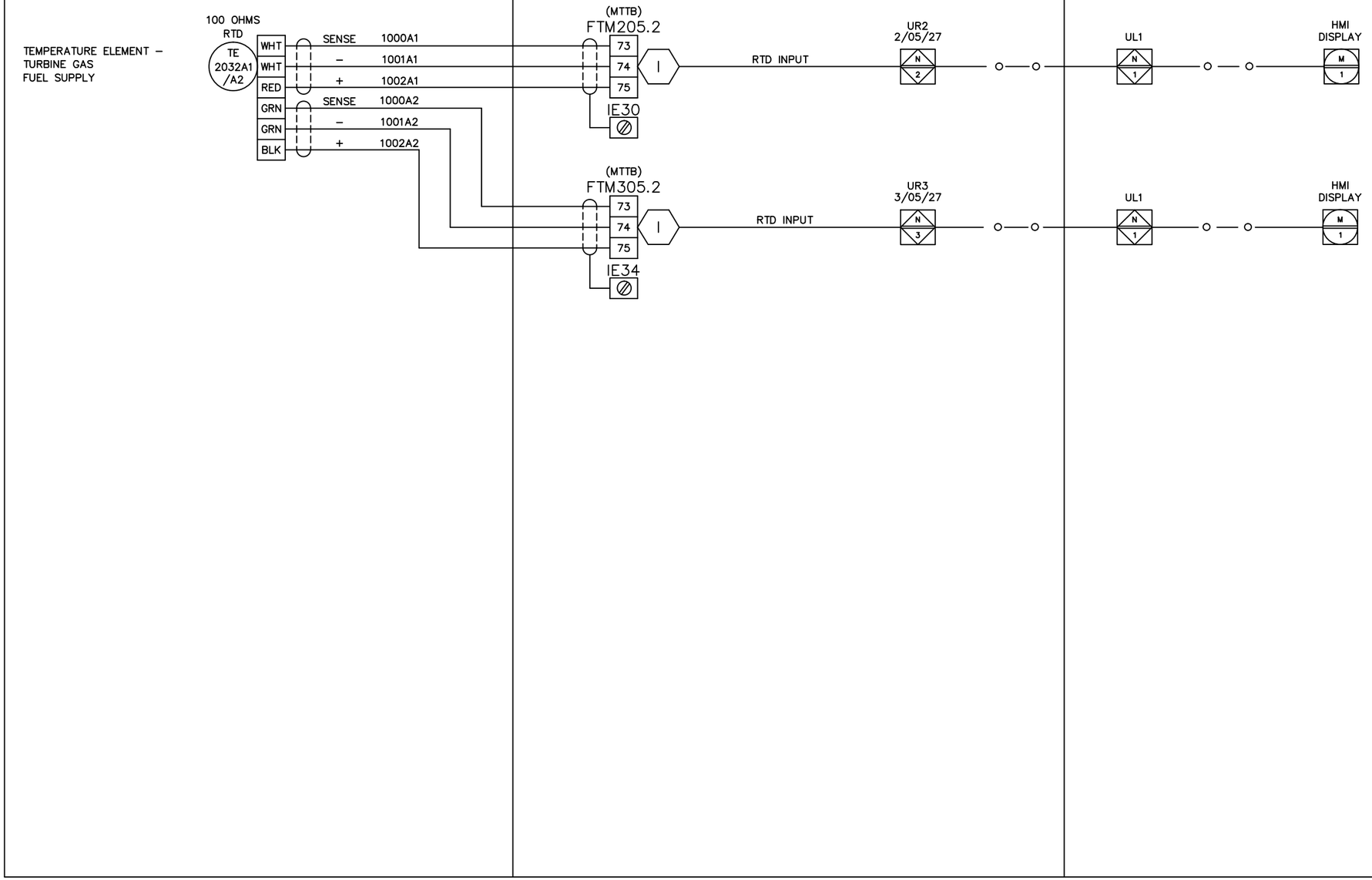
DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 6 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

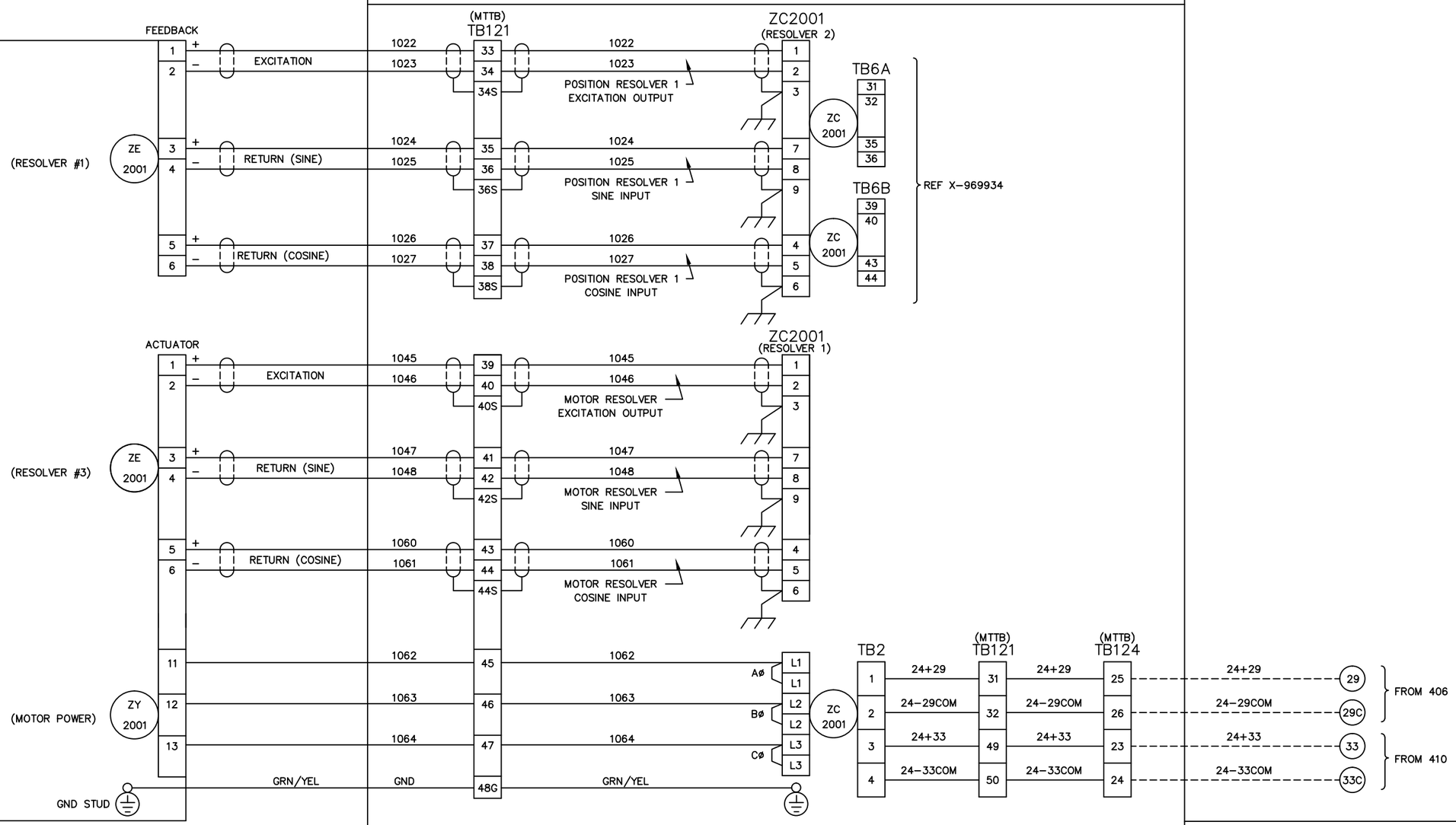
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

DWG NO. 7253049-969751
REV. A
SCALE NONE
SHEET 7 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX (RIGHT DOOR)	TERMINATION CUBICLE
	GAS FUEL METERING VALVE DRIVER	



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM FUEL SYSTEM

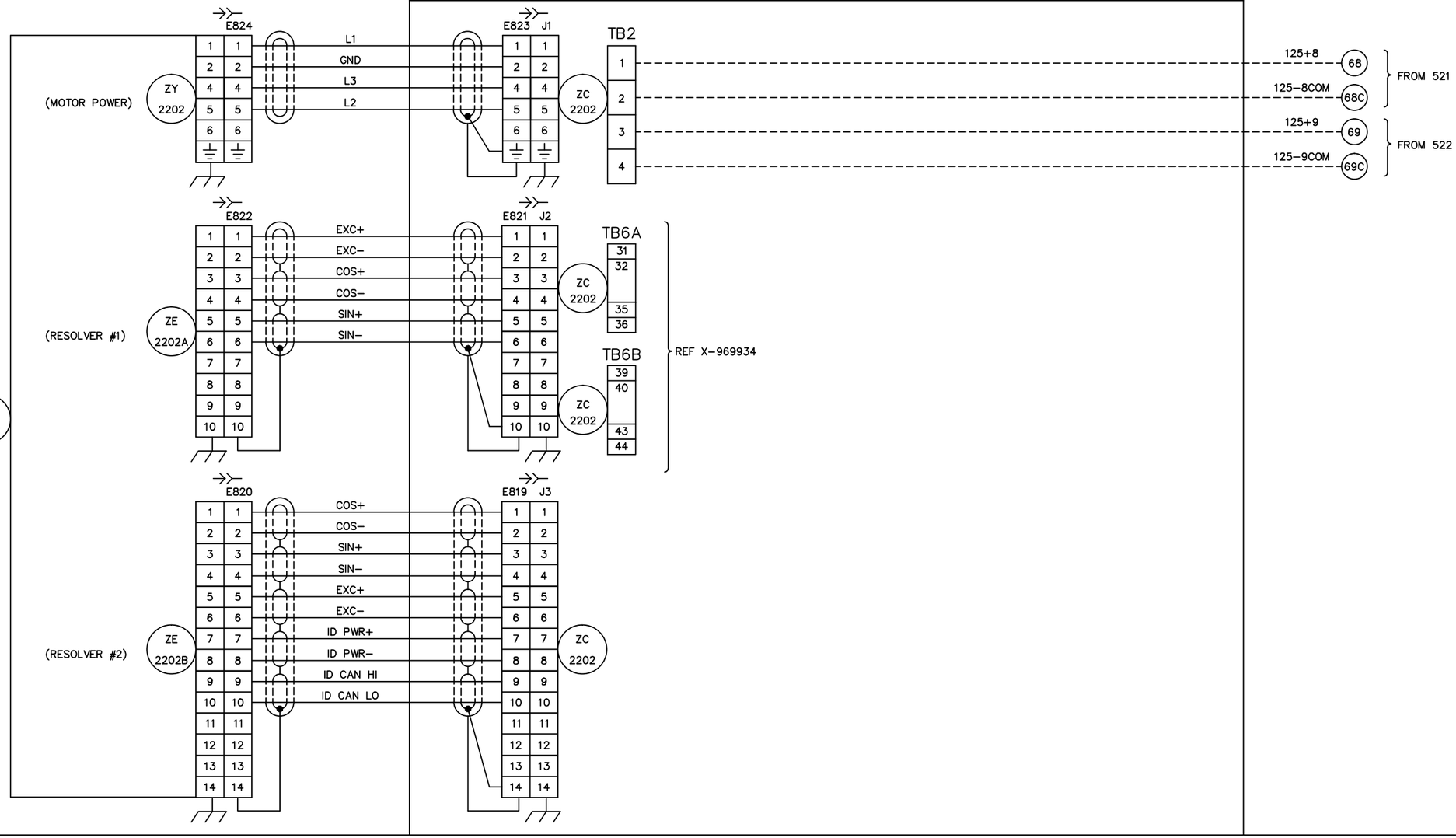
DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 8 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX (RIGHT DOOR)	TERMINATION CUBICLE
	GAS FUEL METERING VALVE DRIVER	



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
FUEL SYSTEM

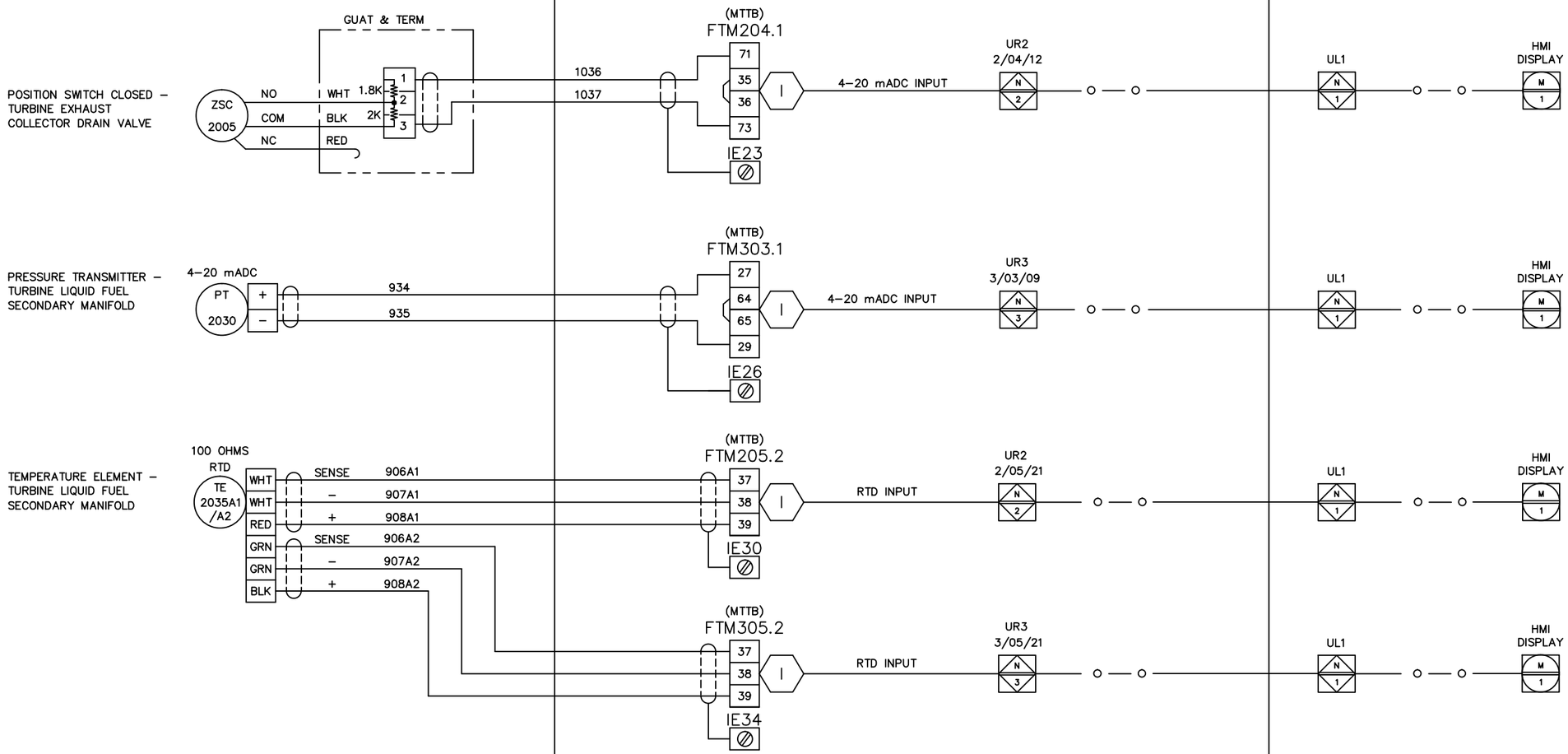
DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 9 OF 10

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM FUEL SYSTEM

DWG NO. 7253049–969751

REV. A

SCALE NONE

SHEET 10 OF 10

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING CONSIST OF: X–(STANDARD DRAWING NUMBER) WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS

   XX/XX/XX
   - EXAMPLE: 01/03/04
   - CHANNEL
   - BOARD
   - CHASSIS

5. REPRESENTS "CHASSIS/NETWORK/NODE/CHANNEL" ADDRESS

   X/X/XX/XX
   - EXAMPLE: 2/1/03/04
   - CHANNEL
   - NODE
   - NETWORK
   - CHASSIS

6. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK

   NX.X.XX
   - NODE
   - NETWORK
   - CHASSIS

7. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969262	FLOW & INSTRUMENT DIAGRAM, WATER WASH SYSTEM
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

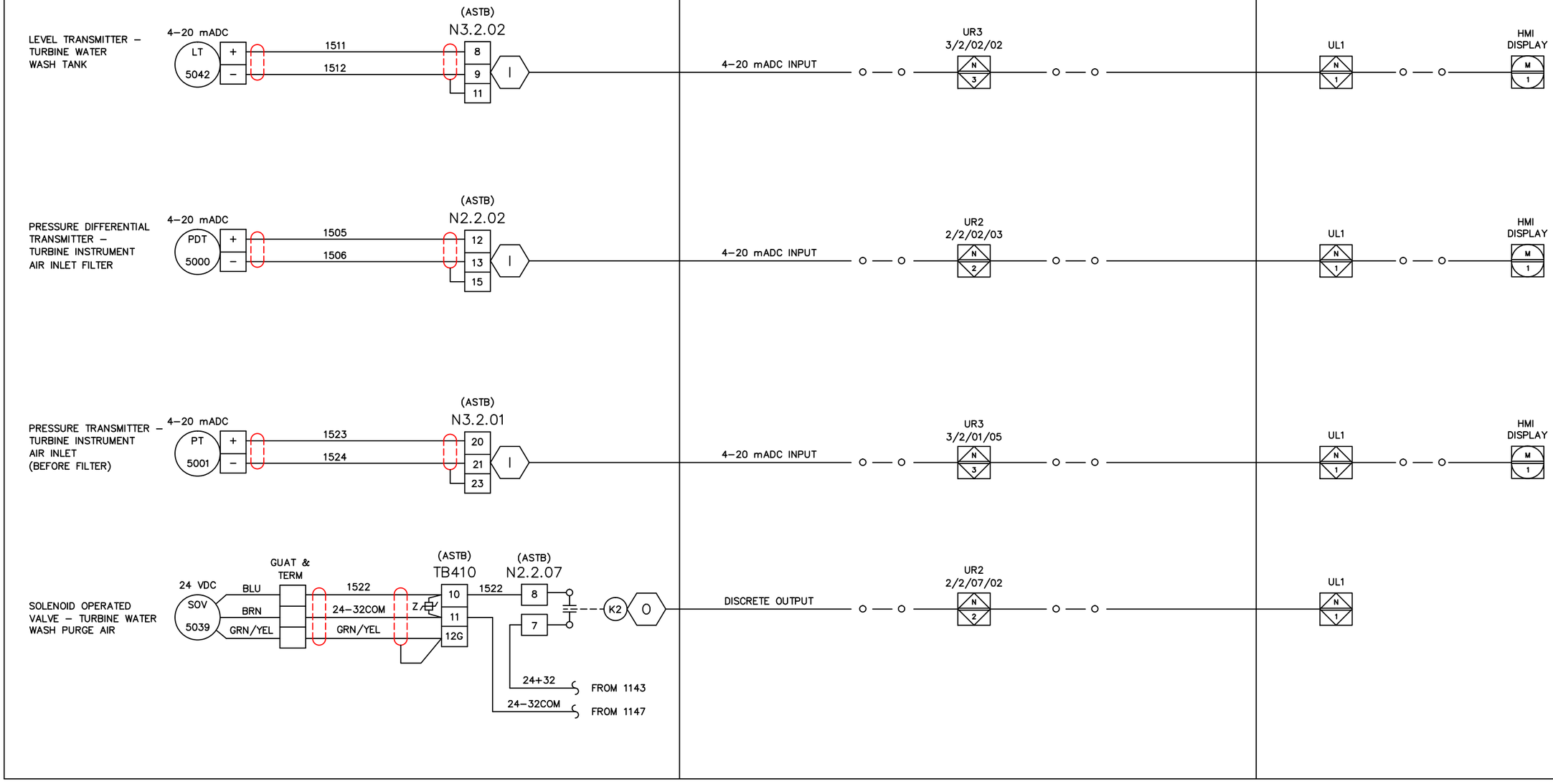
GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM WATER WASH SYSTEM

DWG NO. 7253049–969753 REV. A

SCALE NONE SHEET 1 OF 3

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
WATER WASH SYSTEM

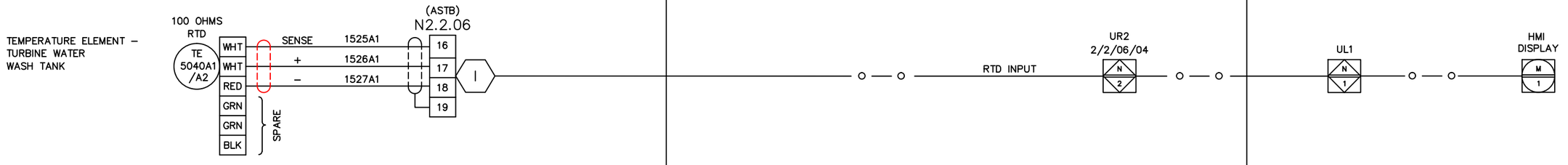
DWG NO. 7253049–969753

REV. A

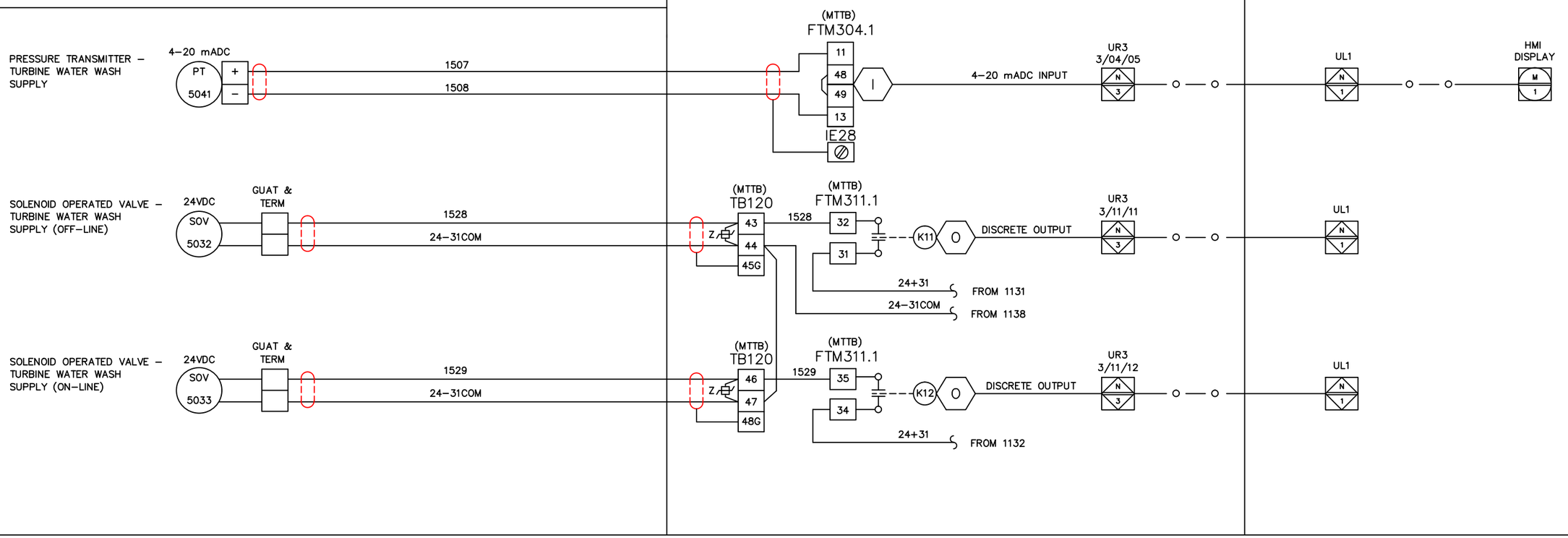
SCALE NONE

SHEET 2 OF 3

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
AUXILIARY SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



TURBINE SKID



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000PC

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM WATER WASH SYSTEM

DWG NO. 7253049–969753

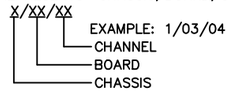
REV. A

SCALE NONE

SHEET 3 OF 3

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(CONFIG. OR SITE)–(STANDARD DRAWING NUMBER). WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE)
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. ESX/EX (ES1/E1) INDICATES TURBINE ELECTRICAL SERVICE CONNECTION/ELECTRICAL CABLE, WHERE INDICATED.
6. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS–THRU BAR AT THAT TERMINAL FOR SHIELD CONNECTION, UNLESS OTHERWISE INDICATED.
7. FOR 6XXX SERIES REFERENCE LINE NUMBERS, SEE X–969768.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABREVIATIONS, AND REFERENCE DATA
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969768	SCHEMATIC DIAGRAM, CRITICAL SHUTDOWN PATH
X–969930	SYSTEM SCHEMATIC, LIGHTING AND DISTRIBUTION
X–969932	INSTRUMENT LOOP DIAGRAM, VIBRATION SYSTEM
X–969272	FLOW & INSTRUMENT DIAGRAM, AUXILIARY SYSTEMS

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE

INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

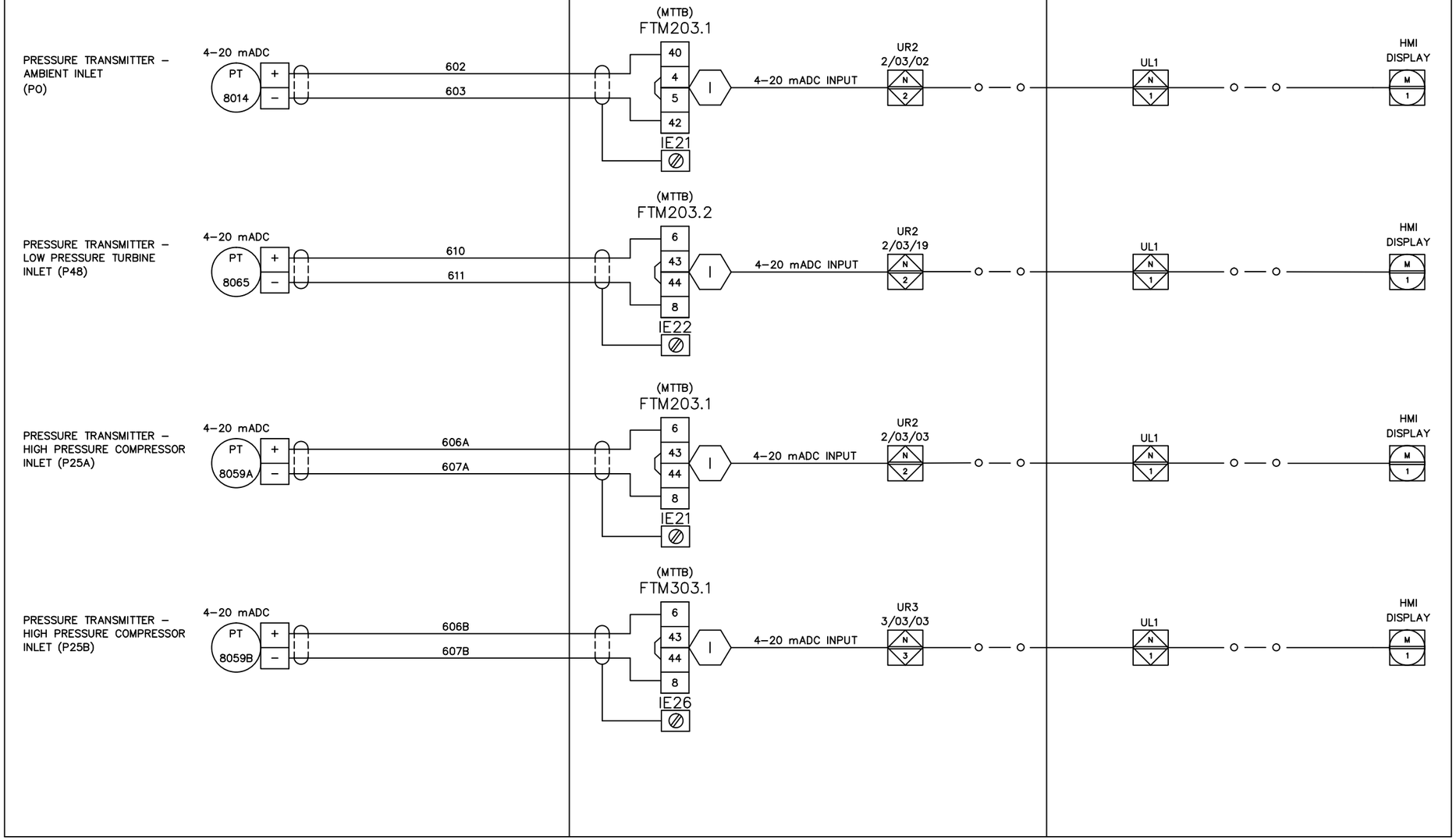
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 1 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	JDD	10/09/13	ARA

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

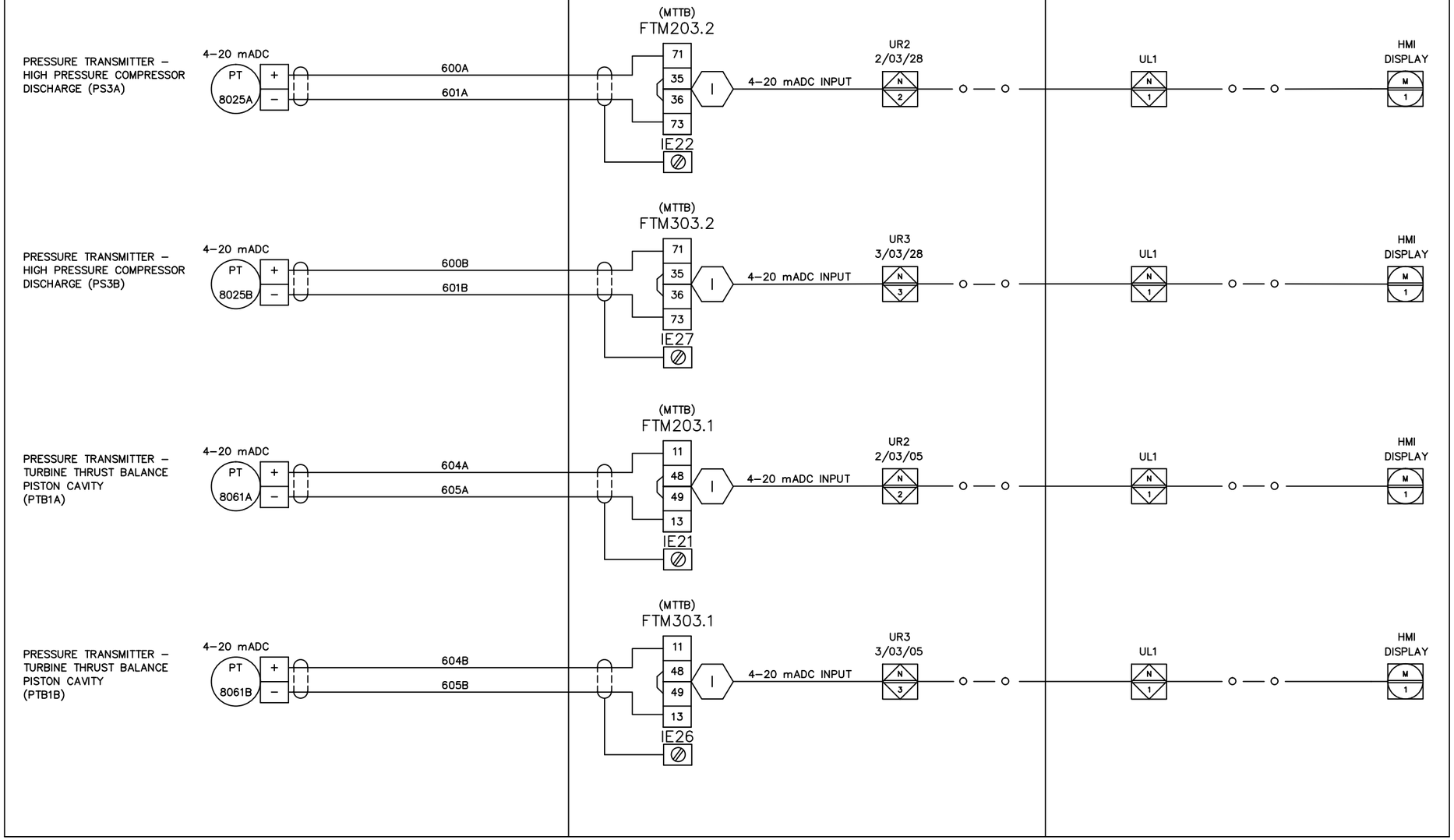
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 2 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

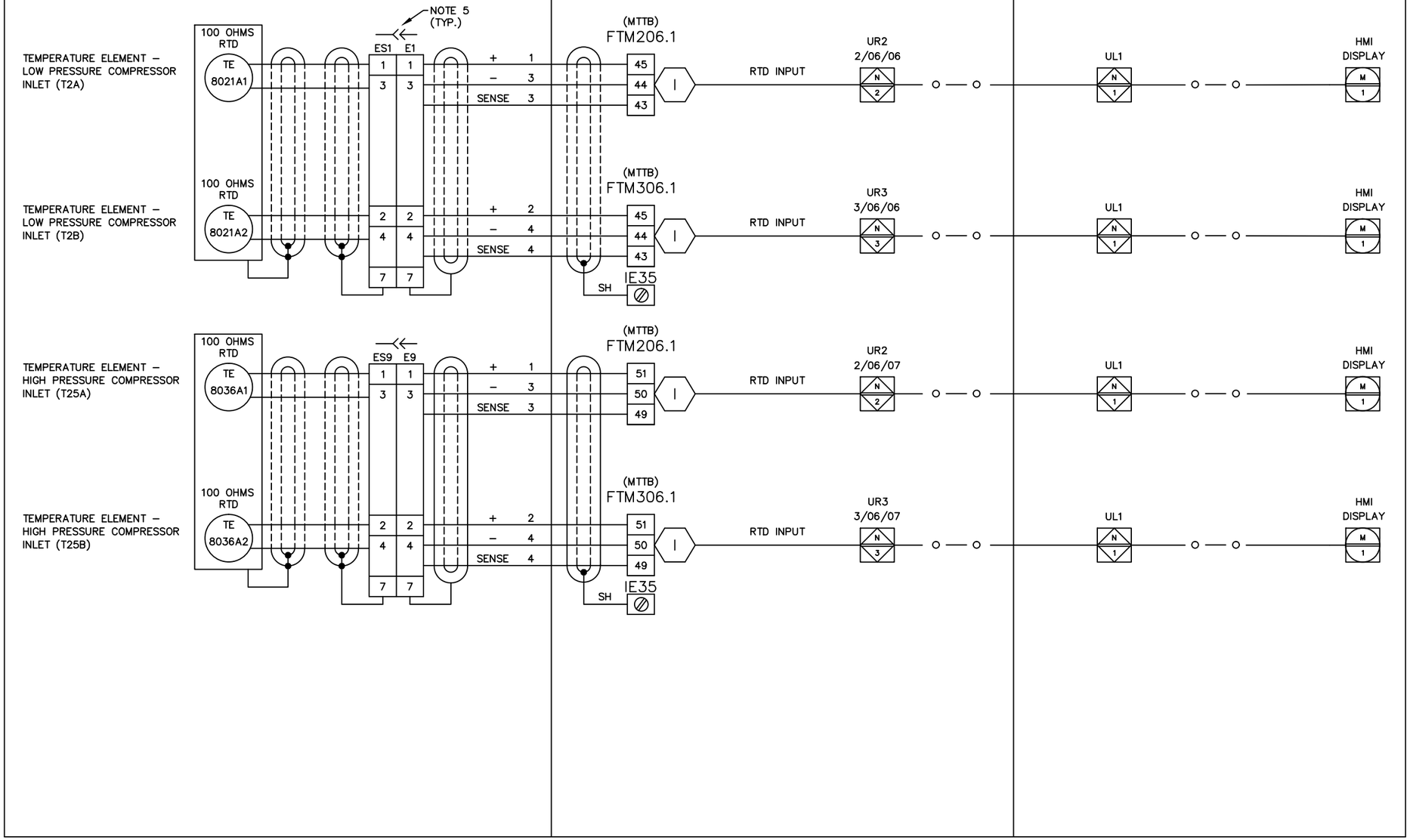
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 3 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

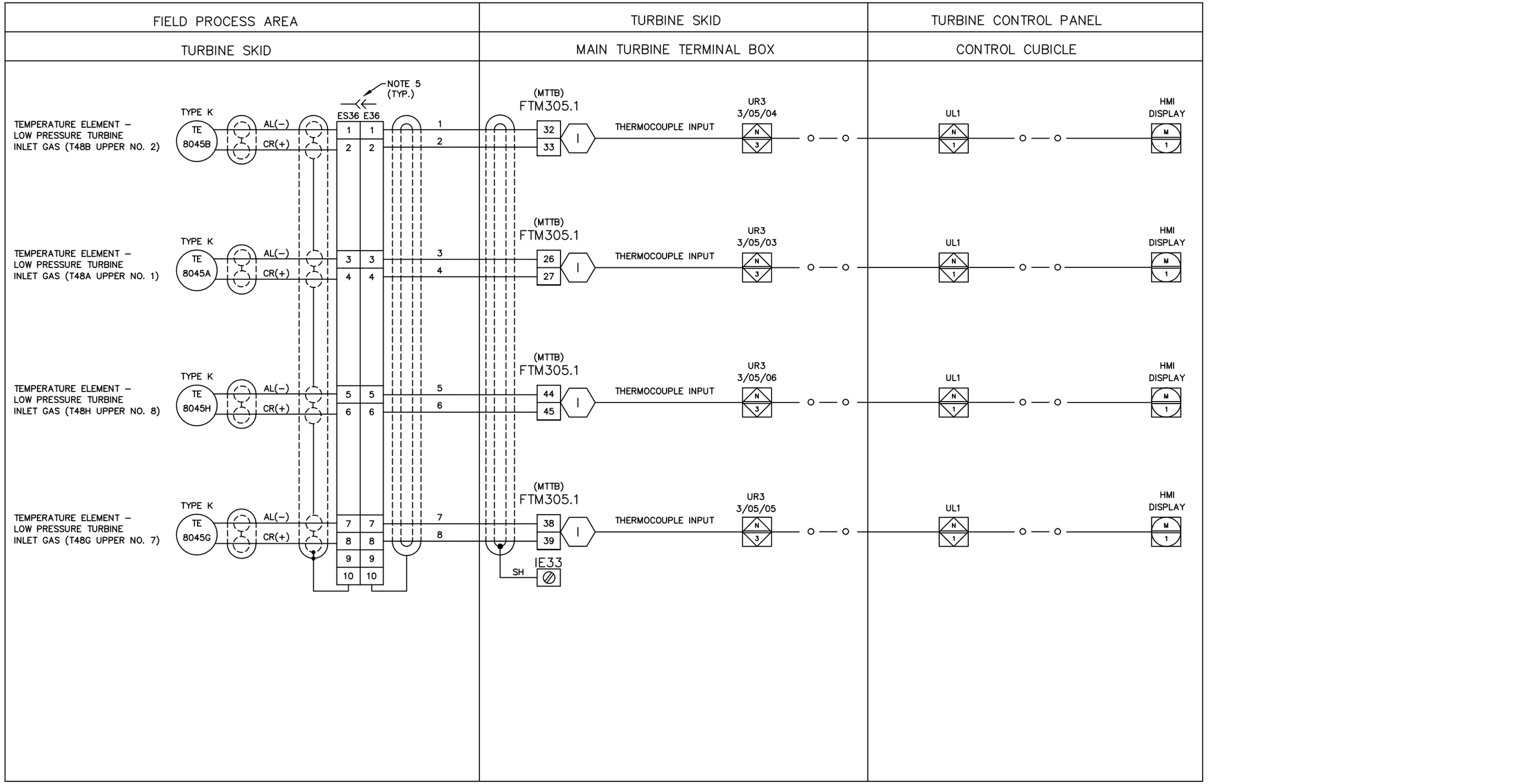
TITLE: INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 4 OF 14



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

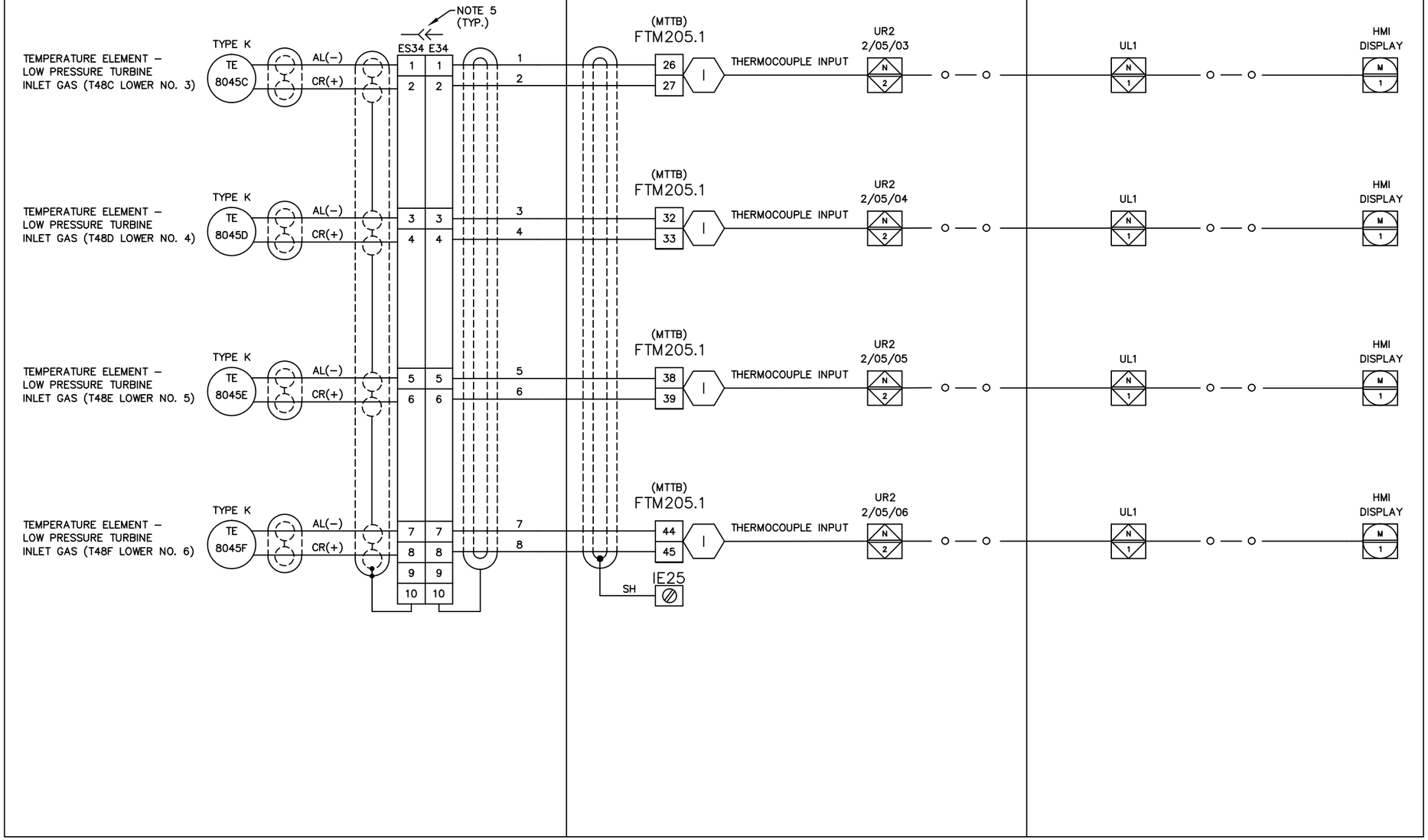
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 5 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

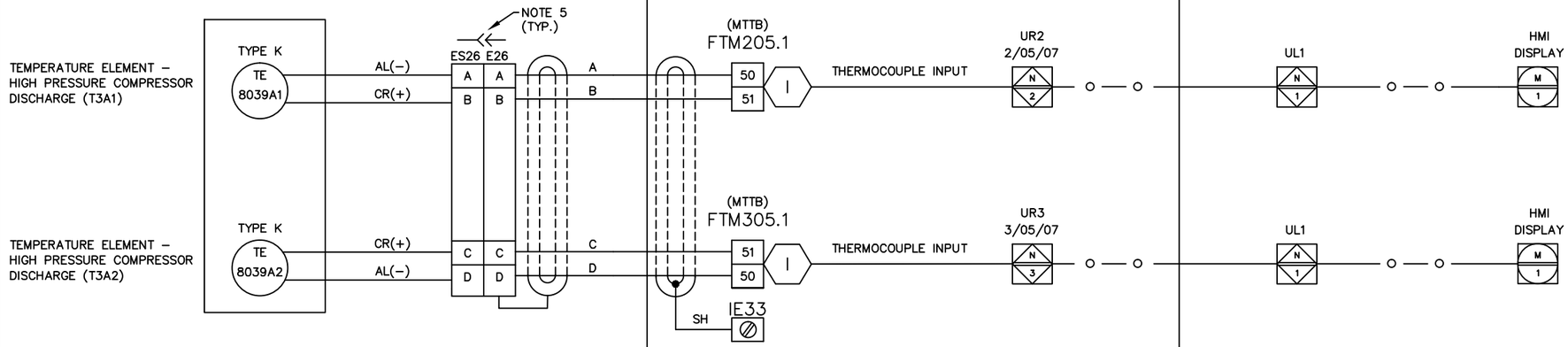
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 6 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

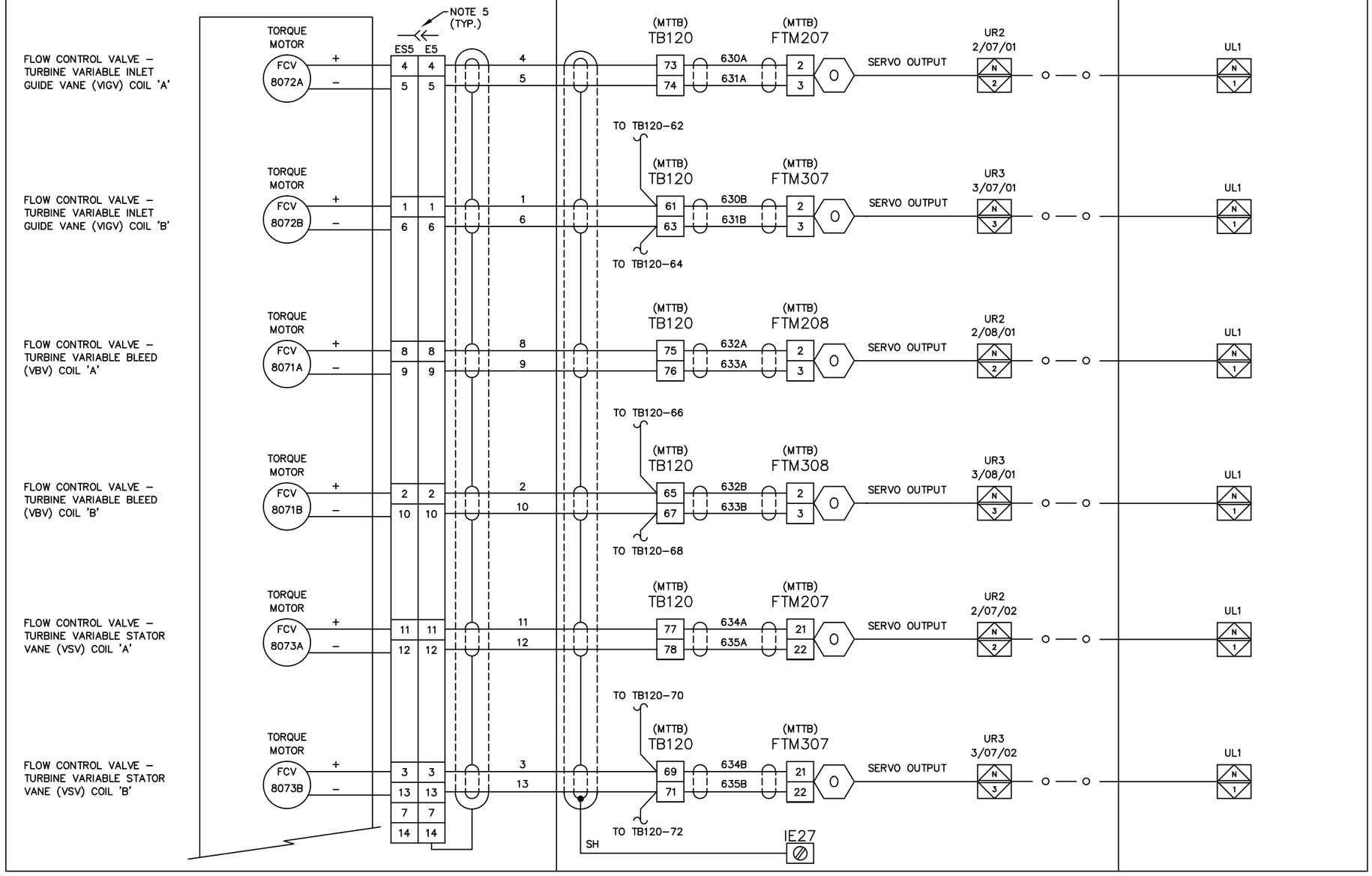
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 7 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

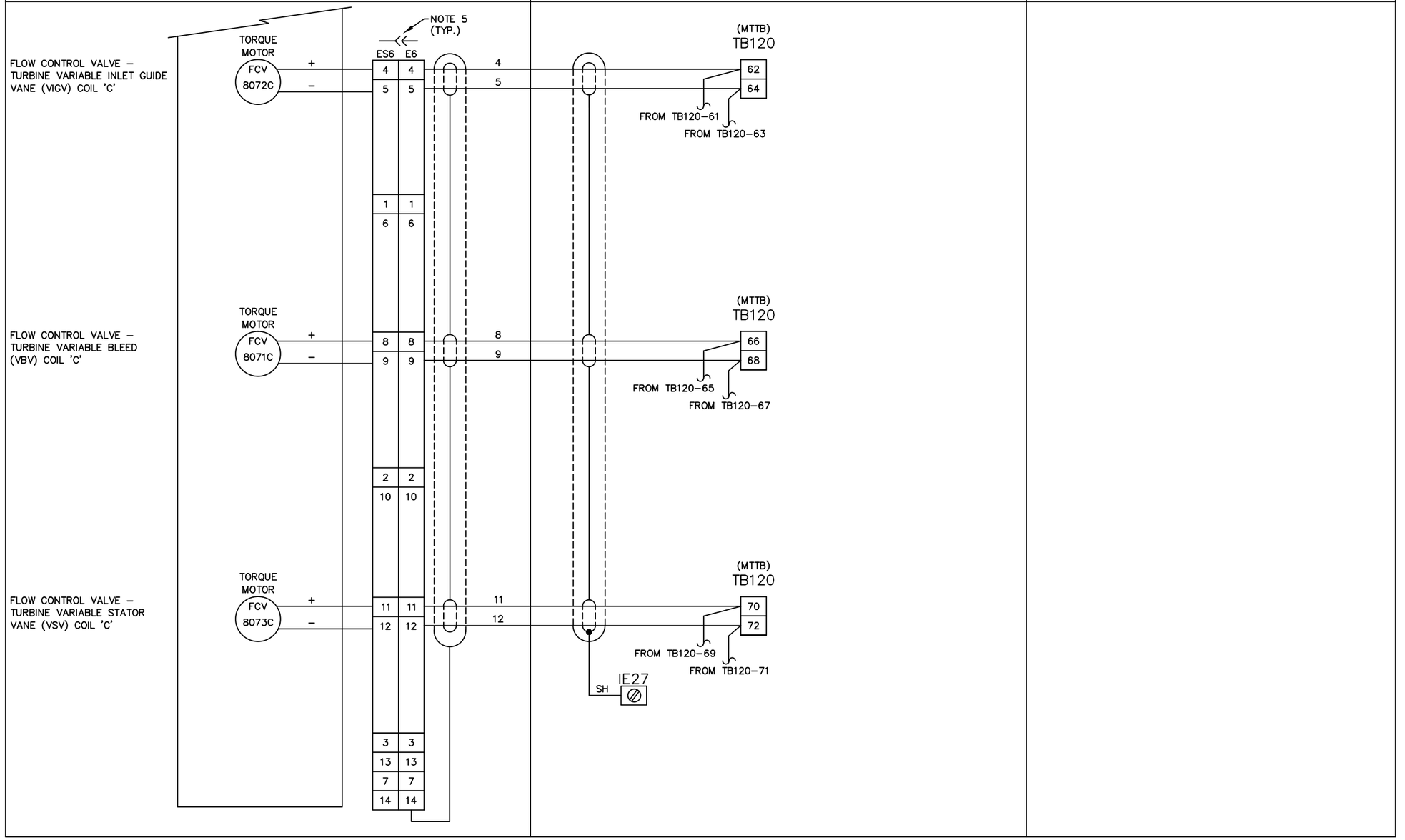
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 8 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
AUXILIARY SYSTEMS

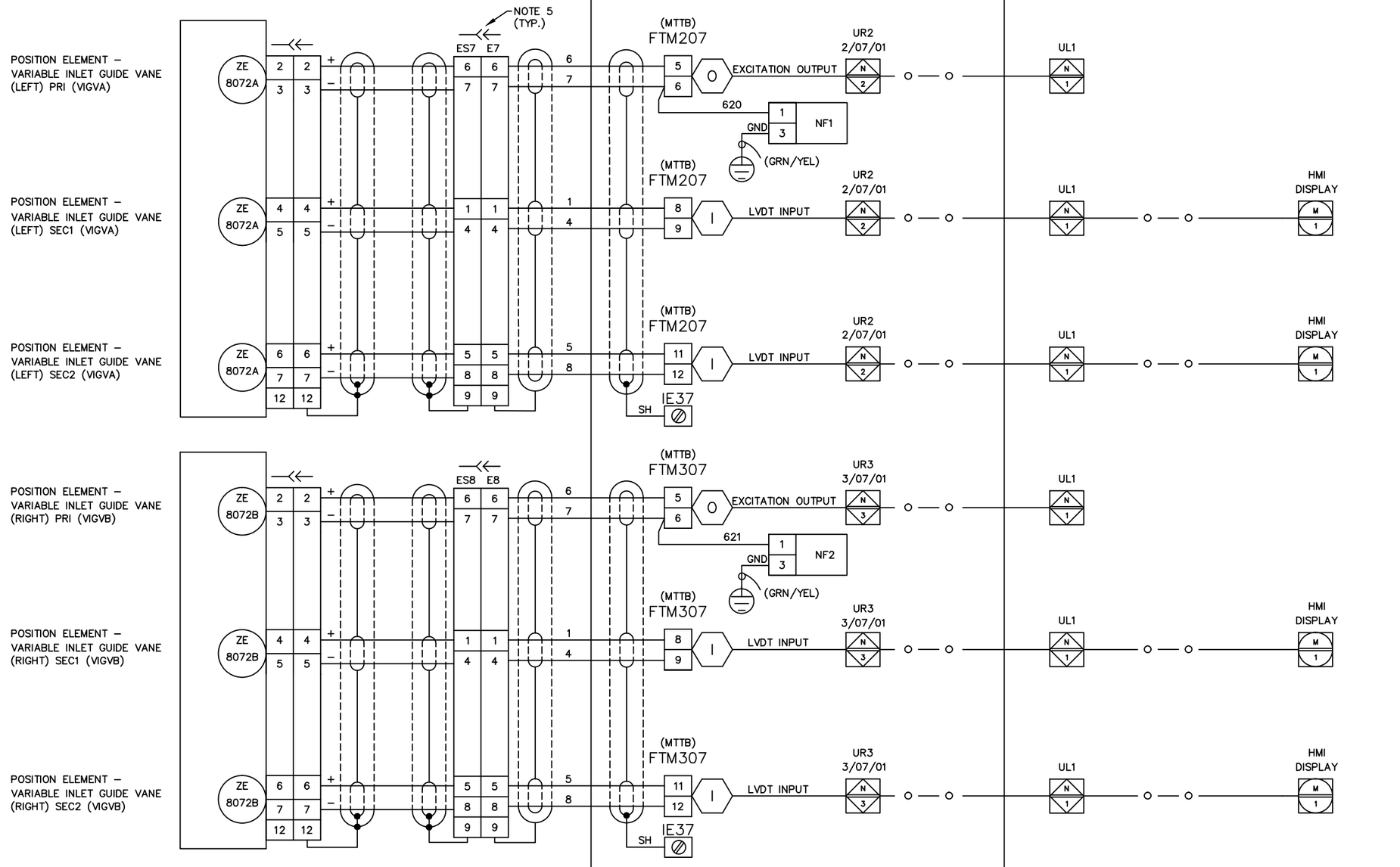
DWG NO. 7253049–969755

REV. A

SCALE NONE

SHEET 9 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

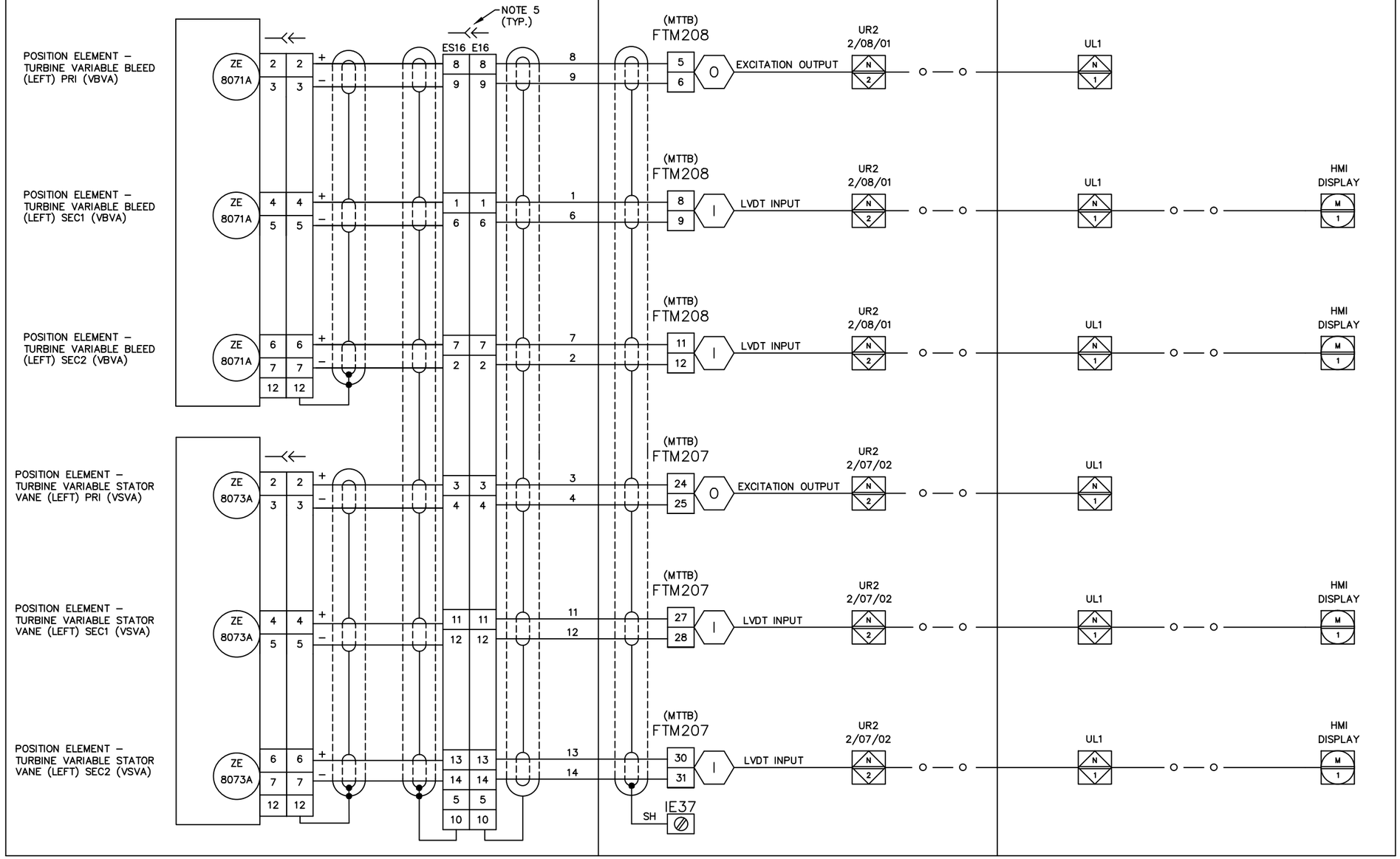
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REV. A

SCALE NONE

SHEET 10 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

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TITLE

INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

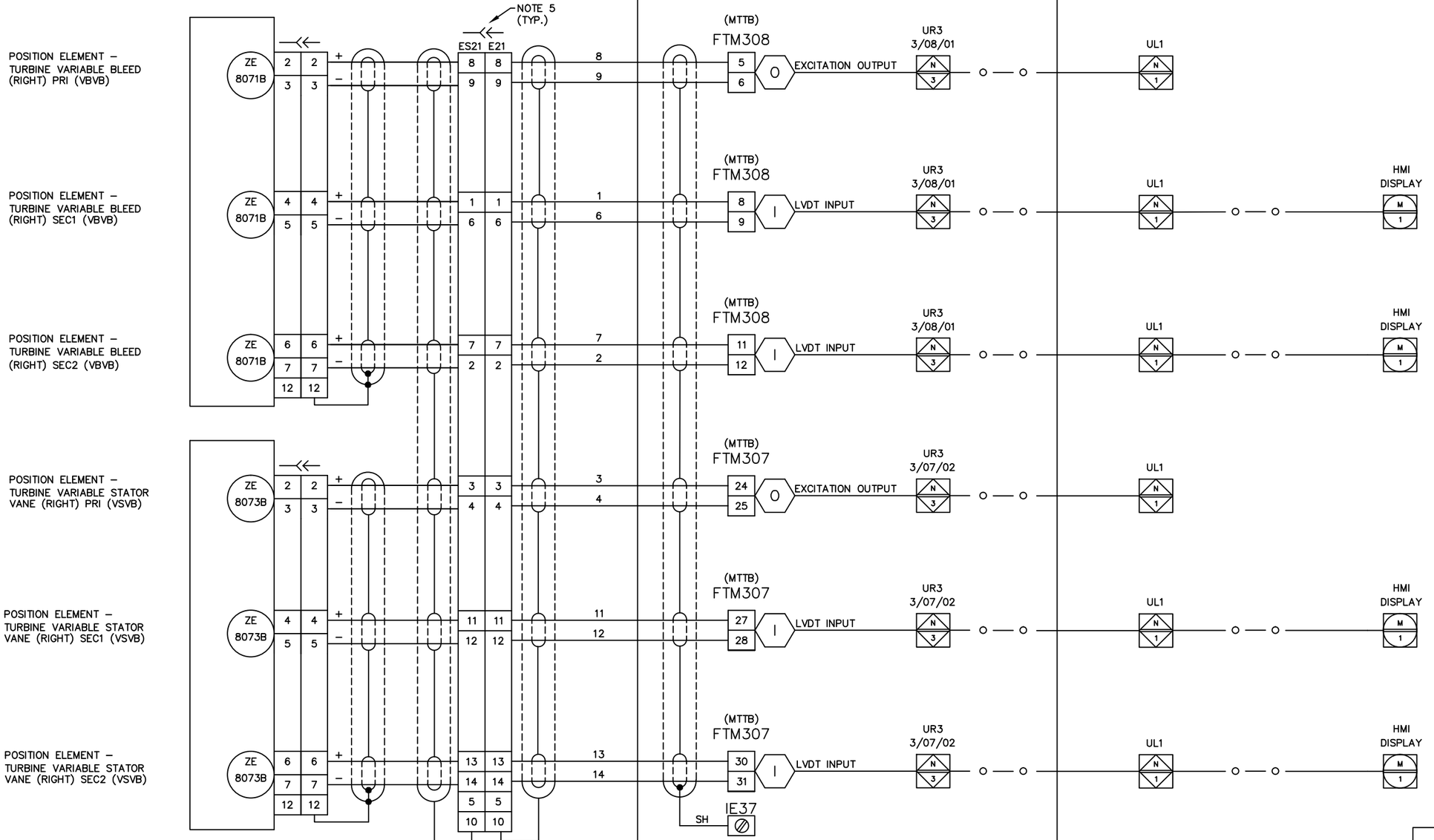
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REV. A

SCALE NONE

SHEET 11 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

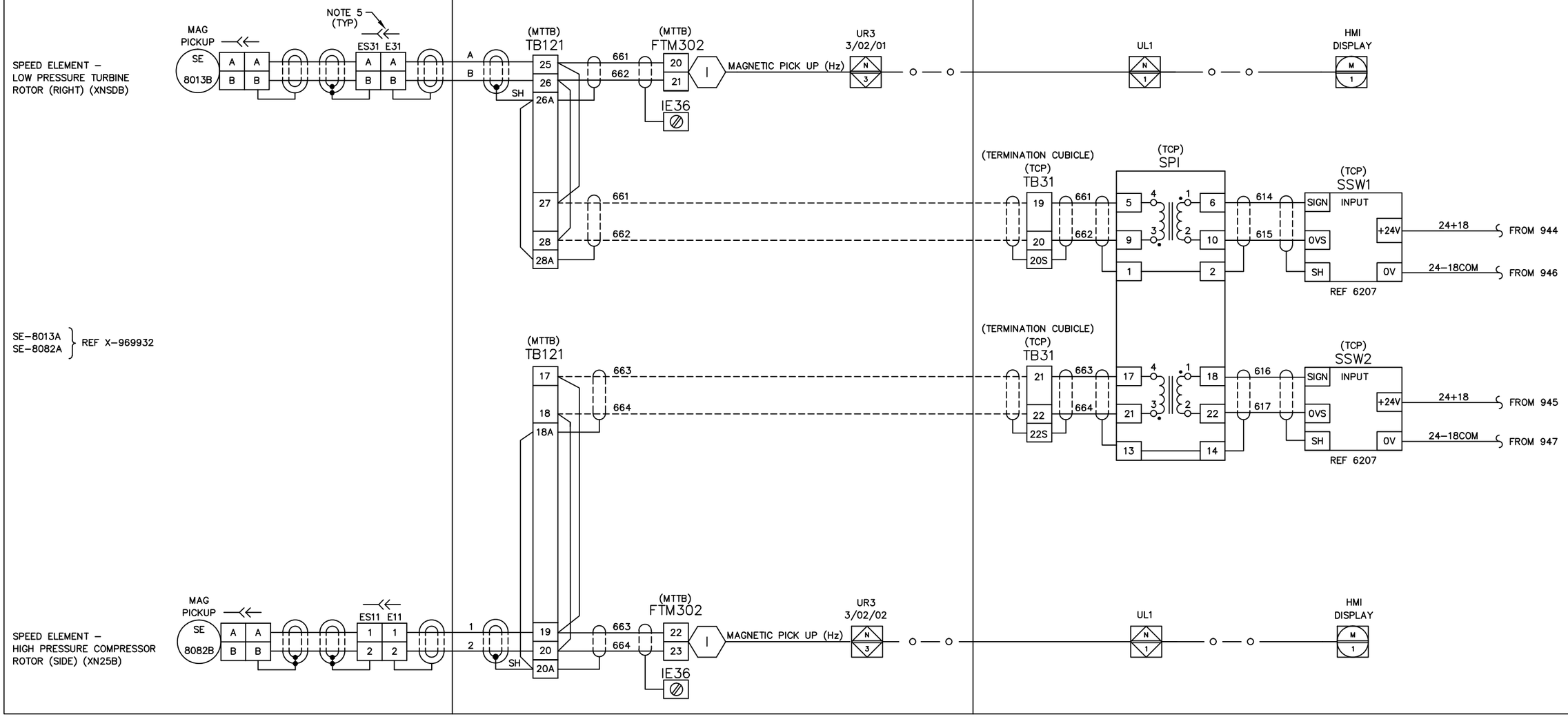
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REV. A

SCALE NONE

SHEET 12 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
AUXILIARY SYSTEMS

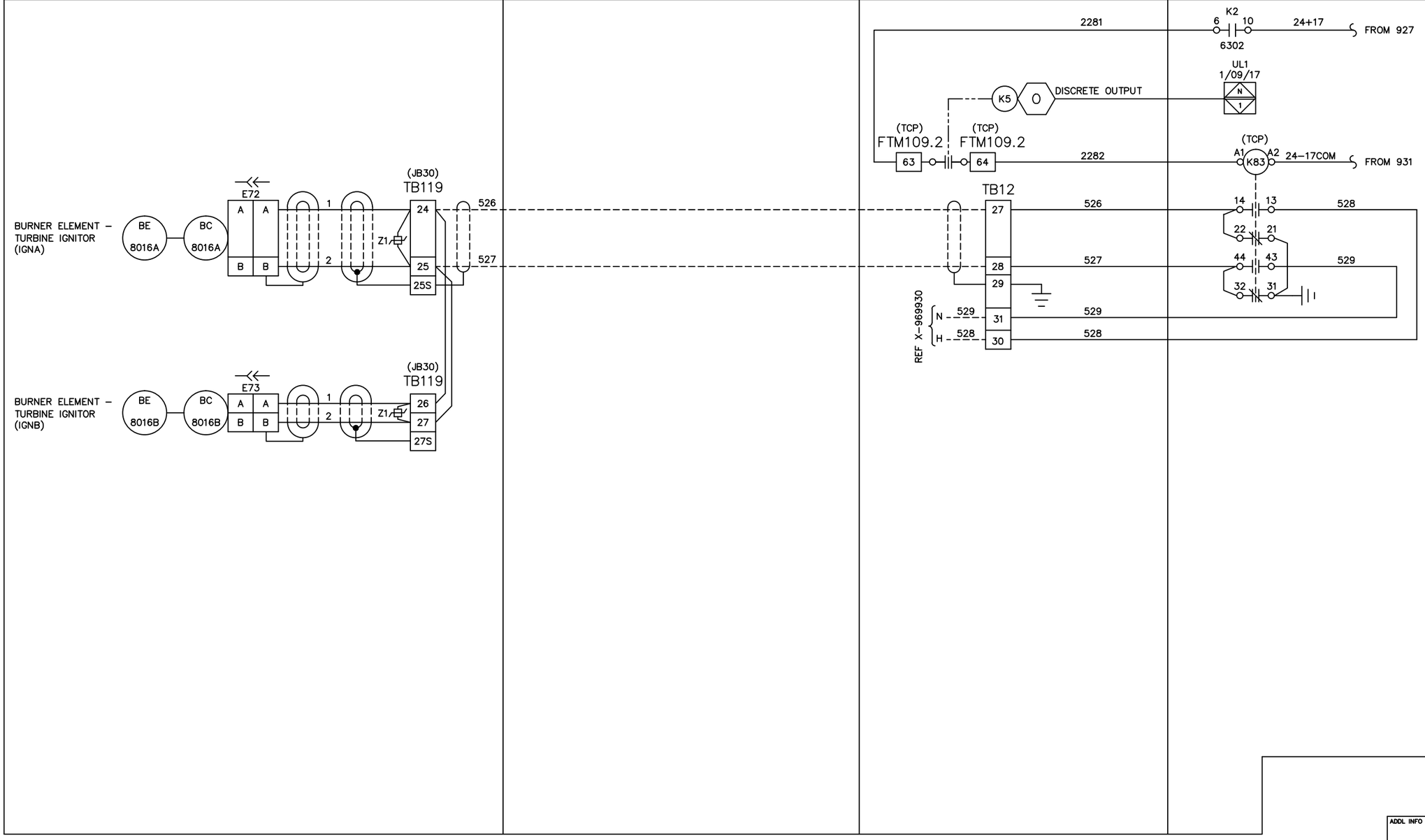
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REV. A

SCALE NONE

SHEET 13 OF 14

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL	
TURBINE SKID	MAIN TURBINE TERMINAL BOX	TERMINATION CUBICLE	CONTROL CUBICLE



REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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THIRD ANGLE PROJECTION

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DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTRUMENT LOOP DIAGRAM AUXILIARY SYSTEMS

DWG NO.: 7253049–969755

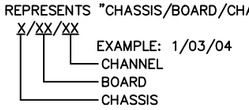
REV.: A

SCALE NONE

SHEET 14 OF 14

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315-1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE-ENERGIZED (SHELF STATE).
4. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



5. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
6. TERMINATION SUFFIXED WITH AN "S" INDICATES A PASS-THRU BAR AT THAT TERMINAL FOR SHIELD CONNECTION, UNLESS OTHERWISE INDICATED.
7. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X-969767.

LEGEND:

SEE X-969005

REFERENCE DRAWINGS:

X-969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X-969268 FLOW & INSTRUMENT DIAGRAM, SPRINT SYSTEM, MAIN UNIT
X-969270 FLOW & INSTRUMENT DIAGRAM, SPRINT SYSTEM, SPRINT SKID
X-969767 SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X-969768 SCHEMATIC DIAGRAM, CRITICAL SHUTDOWN PATH

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DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

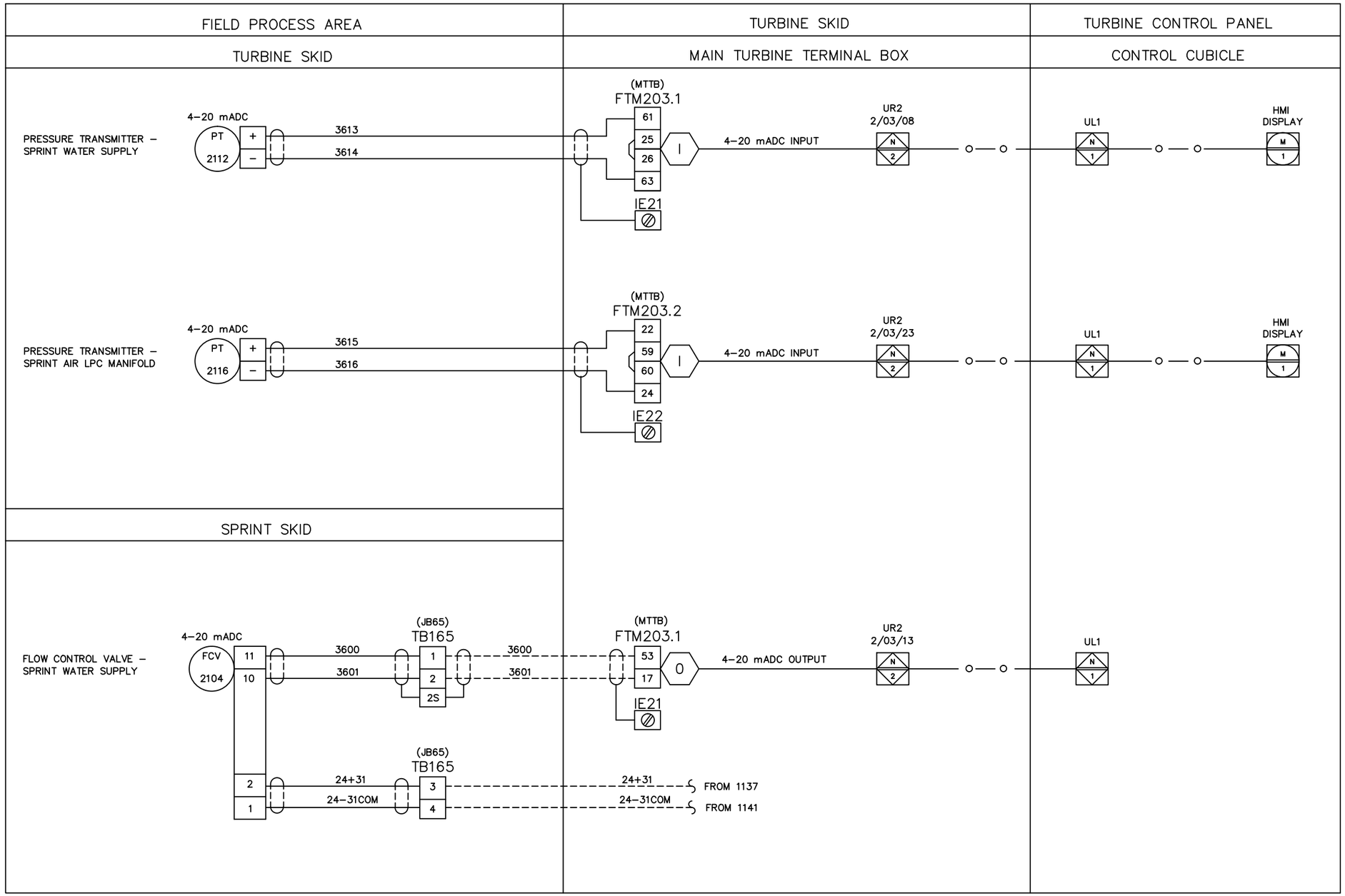
UNIT TYPE
LM6000PD

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
SPRINT SYSTEM

DWG NO. 7253049-969758
REV. A
SCALE NONE
SHEET 1 OF 4



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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
SPRINT SYSTEM

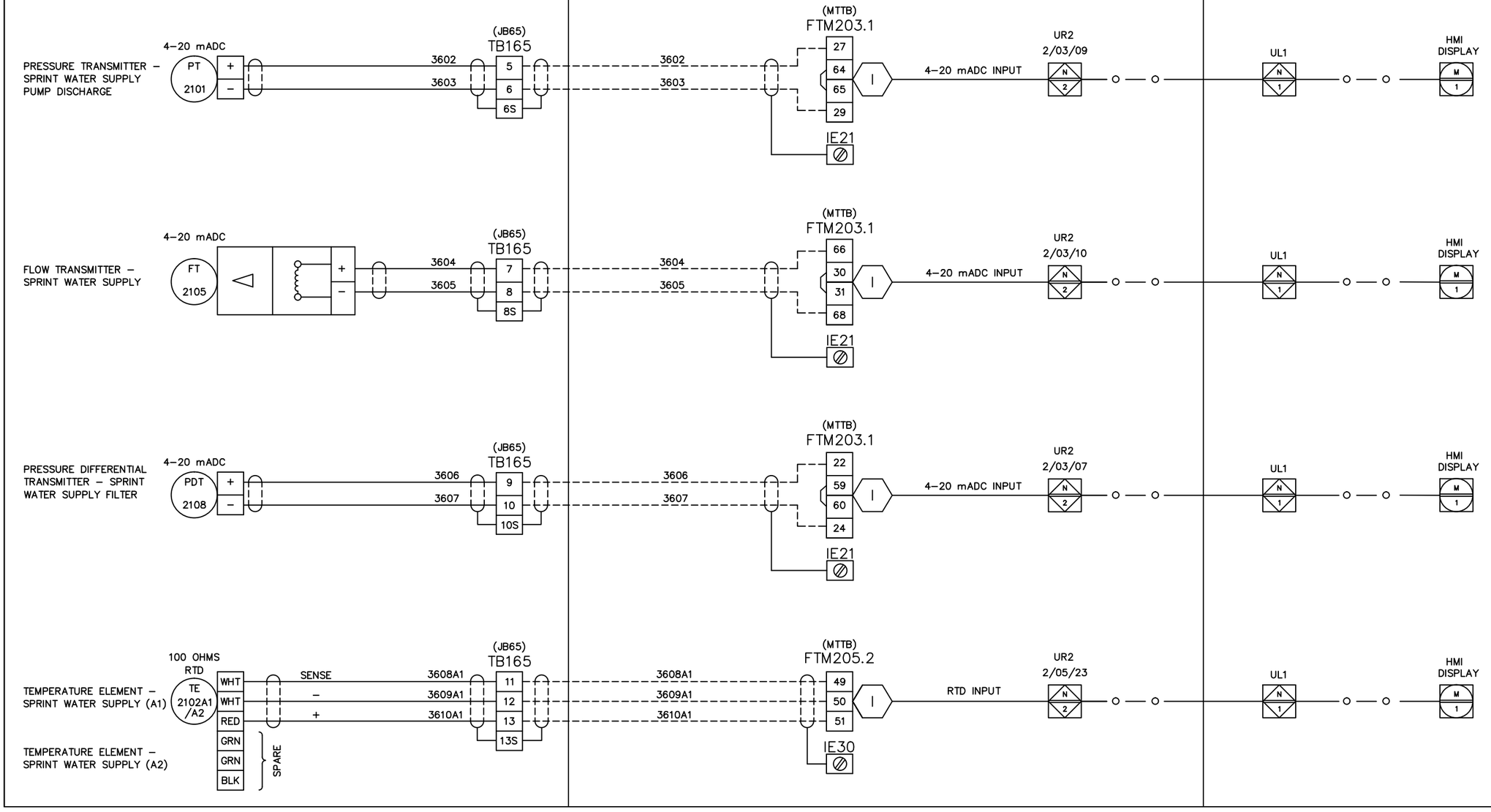
DWG NO. 7253049–969758

REV. A

SCALE NONE

SHEET 2 OF 4

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
SPRINT SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM SPRINT SYSTEM

DWG NO. 7253049–969758

REV. A

SCALE NONE

SHEET 3 OF 4

FIELD PROCESS AREA	TURBINE SKID	TURBINE CONTROL PANEL
TURBINE SKID	MAIN TURBINE TERMINAL BOX	CONTROL CUBICLE

SOLENOID OPERATED VALVE – SPRINT WATER LPC MANIFOLD
24 VDC SOV 2110
GUAT & TERM
3617
24–31COM
(MTTB) TB120 49 50 51G
3617
(MTTB) FTM311.1 92 91
K31
DISCRETE OUTPUT
UR3 3/11/31
UL1
24+31 FROM 1133

SOLENOID OPERATED VALVE – SPRINT WATER DRAIN
24 VDC SOV 2111
GUAT & TERM
3618
24–31COM
(MTTB) TB120 52 53 54G
3618
(MTTB) FTM311.1 83 82
K28
DISCRETE OUTPUT
UR3 3/11/28
UL1
24+31 FROM 1134
24–31COM FROM 1138

SPRINT SKID

SOLENOID OPERATED VALVE – SPRINT WATER BLOCK BEFORE LPC MANIFOLD
24 VDC SOV 2174
GUAT & TERM
3611
24–31COM
(JB65) TB165 14 15 15G
3611
(MTTB) TB120 79 80
3611
(MTTB) FTM311.2 2 1
K1
DISCRETE OUTPUT
UR3 3/11/33
UL1
24+31 FROM 1135

SOLENOID OPERATED VALVE – SPRINT WATER MANIFOLD BLOWDOWN
24 VDC SOV 2107
BLU
BRN
GRN/YEL
(JB65) TB165 16 17 17G
3612
24–31COM
(MTTB) TB120 81 82
3612
(MTTB) FTM311.2 5 4
K2
DISCRETE OUTPUT
UR3 3/11/34
UL1
24+31 FROM 1136
24–31COM FROM 1139

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000PC

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
INSTRUMENT LOOP DIAGRAM
SPRINT SYSTEM

DWG NO. 7253049–969758

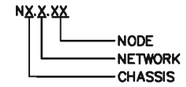
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SCALE NONE

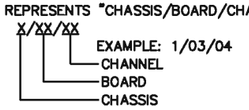
SHEET 4 OF 4

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
4. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
5. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK



6. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



7. FOR 5XXX SERIES REFERENCE LINE NUMBERS, SEE X–969041.
8. FOR 6XXX SERIES REFERENCE LINE NUMBERS, SEE X–969768.
9. FOR 7XXX SERIES REFERENCE LINE NUMBERS, SEE X–969769.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969032	THREE LINE DIAGRAM, GENERATOR METERING
X–969037	SYSTEM SCHEMATIC, GENERATOR EXCITATION
X–969041	SCHEMATIC DIAGRAM, CIRCUIT BREAKER CONTROL
X–969046	SCHEMATIC DIAGRAM, 125VDC MOTOR STARTER
X–969742	INSTRUMENT LOOP DIAGRAM, VENTILATION AND COMBUSTION AIR SYSTEM
X–969743	INSTRUMENT LOOP DIAGRAM, MINERAL LUBE OIL SYSTEM
X–969744	INSTRUMENT LOOP DIAGRAM, TURBINE LUBE OIL SYSTEM
X–969750	INSTRUMENT LOOP DIAGRAM, NOX WATER INJECTION SYSTEM
X–969751	INSTRUMENT LOOP DIAGRAM, FUEL SYSTEM
X–969753	INSTRUMENT LOOP DIAGRAM, WATER WASH SYSTEM
X–969755	INSTRUMENT LOOP DIAGRAM, AUXILIARY SYSTEMS
X–969758	INSTRUMENT LOOP DIAGRAM, SPRINT SYSTEM
X–969768	SCHEMATIC DIAGRAM, CRITICAL SHUTDOWN PATH
X–969769	SCHEMATIC DIAGRAM, MISCELLANEOUS
X–969930	SYSTEM SCHEMATIC, LIGHTING AND DISTRIBUTION
X–969932	INSTRUMENT LOOP DIAGRAM, VIBRATION
X–969991	SCHEMATIC DIAGRAM, MTTB HEAT EXCHANGERS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SCHEMATIC DIAGRAM DC POWER DISTRIBUTION

DWG NO. 7253049–969767

REV. A

SCALE NONE

SHEET 1 OF 12

LIST OF 24VDC POWER FEEDS				
	FUNCTION	CB DES	CB RATING	FEEDER
1	TCP CONTROLLER RACK #1 (MAIN)	CB1	30 AMP	24+1 24–1COM
2	MTTB CONTROLLER RACK #2 (MAIN)	CB2	30 AMP	24+2 24–2COM
3	MTTB CONTROLLER RACK #3 (MAIN)	CB3	30 AMP	24+3 24–3COM
4	MGTB DISTRIBUTIVE I/O #1	CB4	10 AMP	24+4 24–4COM
5	TCP CONTROLLER RACK #1 (BACKUP)	CB5	30 AMP	24+5 24–5COM
6	MTTB CONTROLLER RACK #2 (BACKUP)	CB6	30 AMP	24+6 24–6COM
7	MTTB CONTROLLER RACK #3 (BACKUP)	CB7	30 AMP	24+7 24–7COM
8	MGTB DISTRIBUTIVE I/O #2	CB8	10 AMP	24+8 24–8COM
9	TCP DISCRETE I/O	CB9	15 AMP	24+9 24–9COM
10	MTTB DISCRETE I/O	CB10	15 AMP	24+10 24–10COM
11	DC LIGHTING	CB11	20 AMP	24+11 24–11COM
12	RESERVED	CB12	5 AMP	24+12 24–12COM
13	VIBRATION MONITOR	CB13	15 AMP	24+13 24–13COM
14	DMMF	CB14	10 AMP	24+14 24–14COM
15	IGPS	CB15	10 AMP	24+15 24–15COM
16	ETHERNET SWITCHES	CB16	10 AMP	24+16 24–16COM
17	TCP RELAYS	CB17	15 AMP	24+17 24–17COM
18	TCP MISCELLANEOUS	CB18	10 AMP	24+18 24–18COM
19	IGPS2	CB19	10 AMP	24+19 24–19COM
20	ETHERNET SWITCHES	CB20	10 AMP	24+20 24–20COM
21	TCP HEATERS, LIGHTS, BLOWERS	CB21	10 AMP	24+21 24–21COM
22	FLOW TRANSMITTERS	CB22	10 AMP	24+22 24–22COM
23	ASTB DISTRIBUTIVE I/O #1	CB23	10 AMP	24+23 24–23COM
24	ASTB DISTRIBUTIVE I/O #2	CB24	10 AMP	24+24 24–24COM
25	RESERVED	CB25	15 AMP	24+25 24–25COM
26	MGTB HEATER, BLOWER	CB26	10 AMP	24+26 24–26COM
27	FUEL SOLENOIDS	CB27	20 AMP	24+27 24–27COM
28	TURBINE LUBE OIL SOV'S NOX WATER INJ SOV'S	CB28	20 AMP	24+28 24–28COM
29	GAS FUEL METERING VALVE DRIVER (MAIN)	CB29	15 AMP	24+29 24–29COM
30	GAS FUEL OFF–TURBINE SKID SOV'S	CB30	10 AMP	24+30 24–30COM
31	TURBINE SKID WATER WASH SOV'S SPRINT SOV'S	CB31	20 AMP	24+31 24–31COM
32	AUXILIARY SKID MISCELLANEOUS SOV'S & ASTB HEATER	CB32	10 AMP	24+32 24–32COM

LIST OF 24VDC POWER FEEDS				
	FUNCTION	CB DES	CB RATING	FEEDER
33	GAS FUEL METERING VALVE DRIVER (BACKUP)	CB33	20 AMP	24+33 24–33COM
34	GE AVR	CB34	20 AMP	24+34 24–34COM
35	RESERVED	CB35	5 AMP	24+35 24–35COM
36	RESERVED	CB36	5 AMP	24+36 24–36COM
37	FUEL DOWNSTREAM BLOCK SOV'S	CB37	20 AMP	24+37 24–37COM
38	HMI CPU	CB38	20 AMP	24+38 24–38COM
39	HMI DISPLAY	CB39	20 AMP	24+39 24–39COM
40	RESERVED	CB40	5 AMP	24+40 24–40COM
41	SPARE	CB41	5 AMP	24+41 24–41COM
42	SPARE	CB42	15 AMP	24+42 24–42COM
43	RESERVED	CB43	15 AMP	24+43 24–43COM
44	RESERVED	CB44	10 AMP	24+44 24–44COM
45	RESERVED	CB45	10 AMP	24+45 24–45COM
46	SPARE	CB46	5 AMP	24+46 24–46COM
47	SPARE	CB47	5 AMP	24+47 24–47COM
48	ON SITE MONITOR	CB48	10 AMP	24+48 24–48COM

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

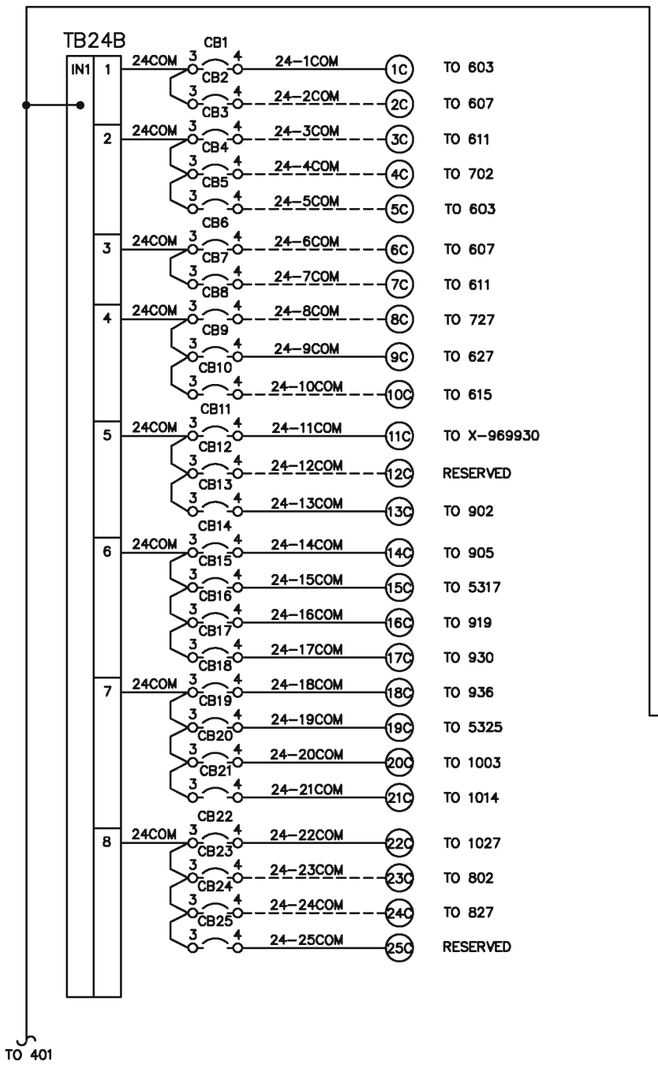
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DC POWER DISTRIBUTION

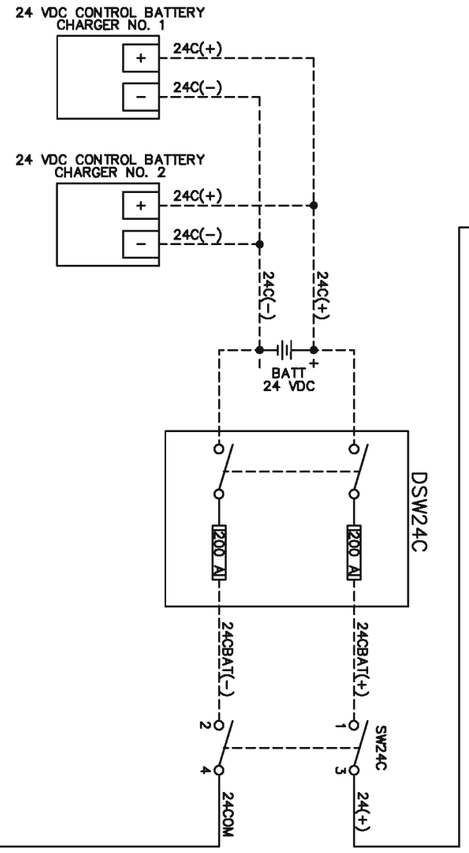
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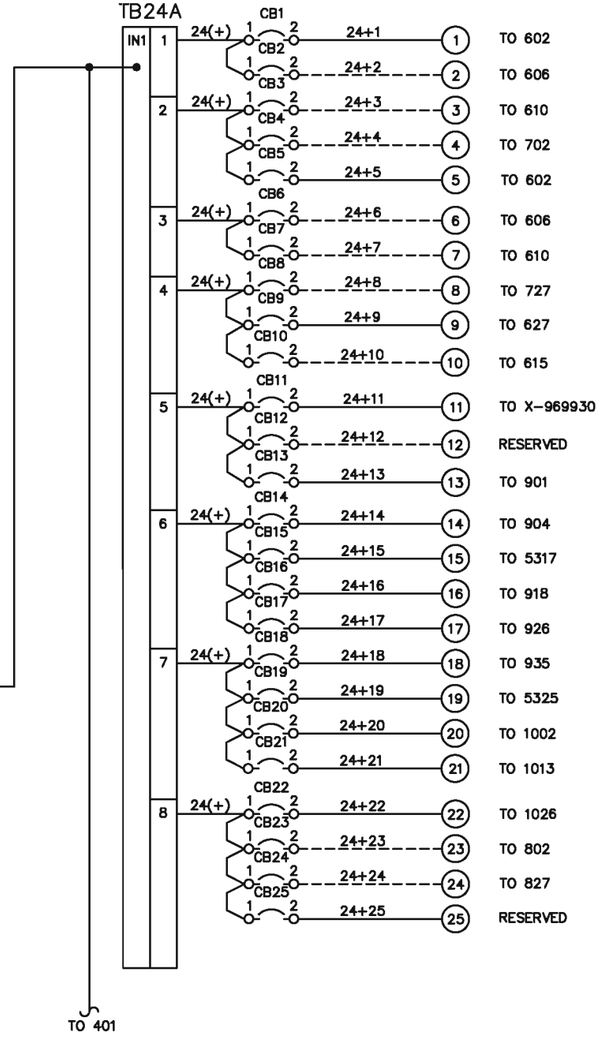
REV. A

SCALE NONE

SHEET 2 OF 12







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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

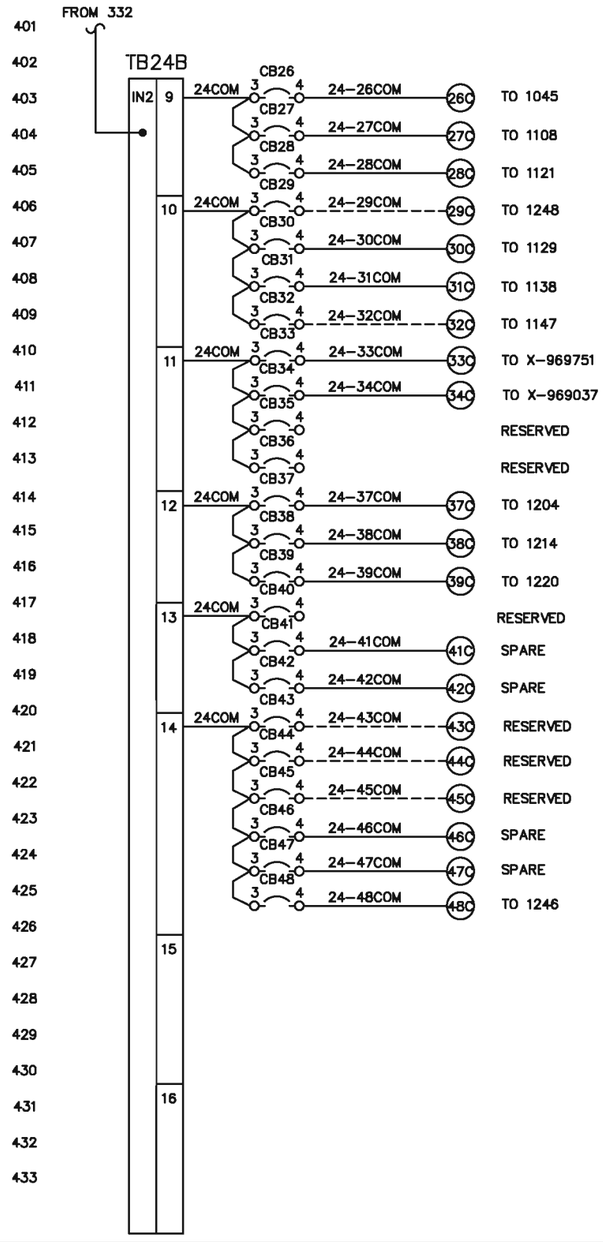
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SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

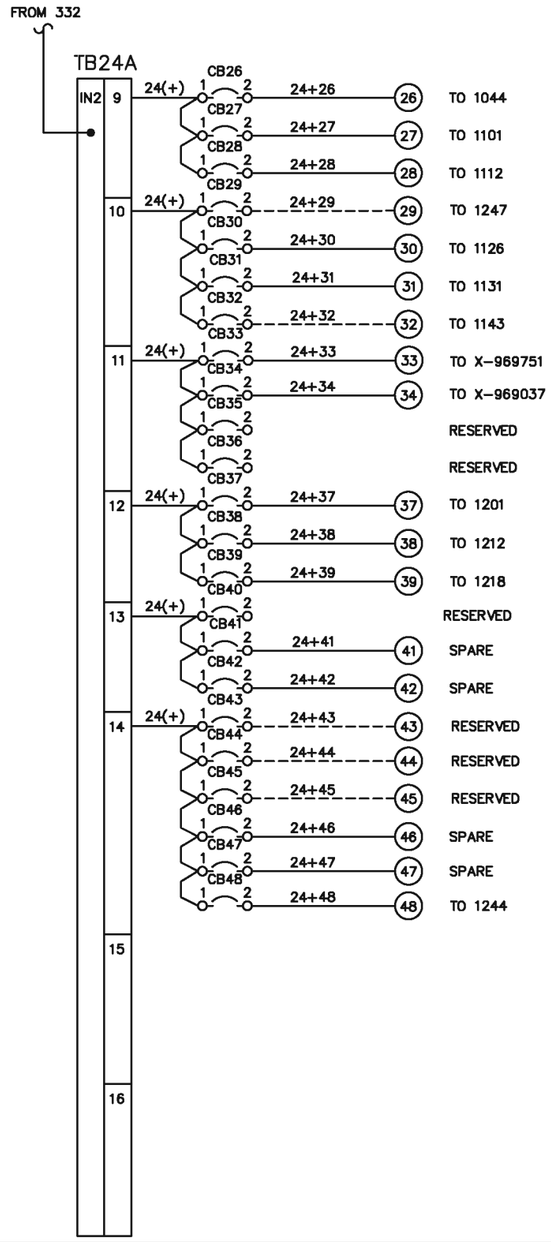
DWG NO. 7253049–969767

REV. A

SCALE NONE

SHEET 3 OF 12





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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS: .XX ± .03, .XXX ± .010
FRACTIONAL: ±1/16"
ANGULAR: ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

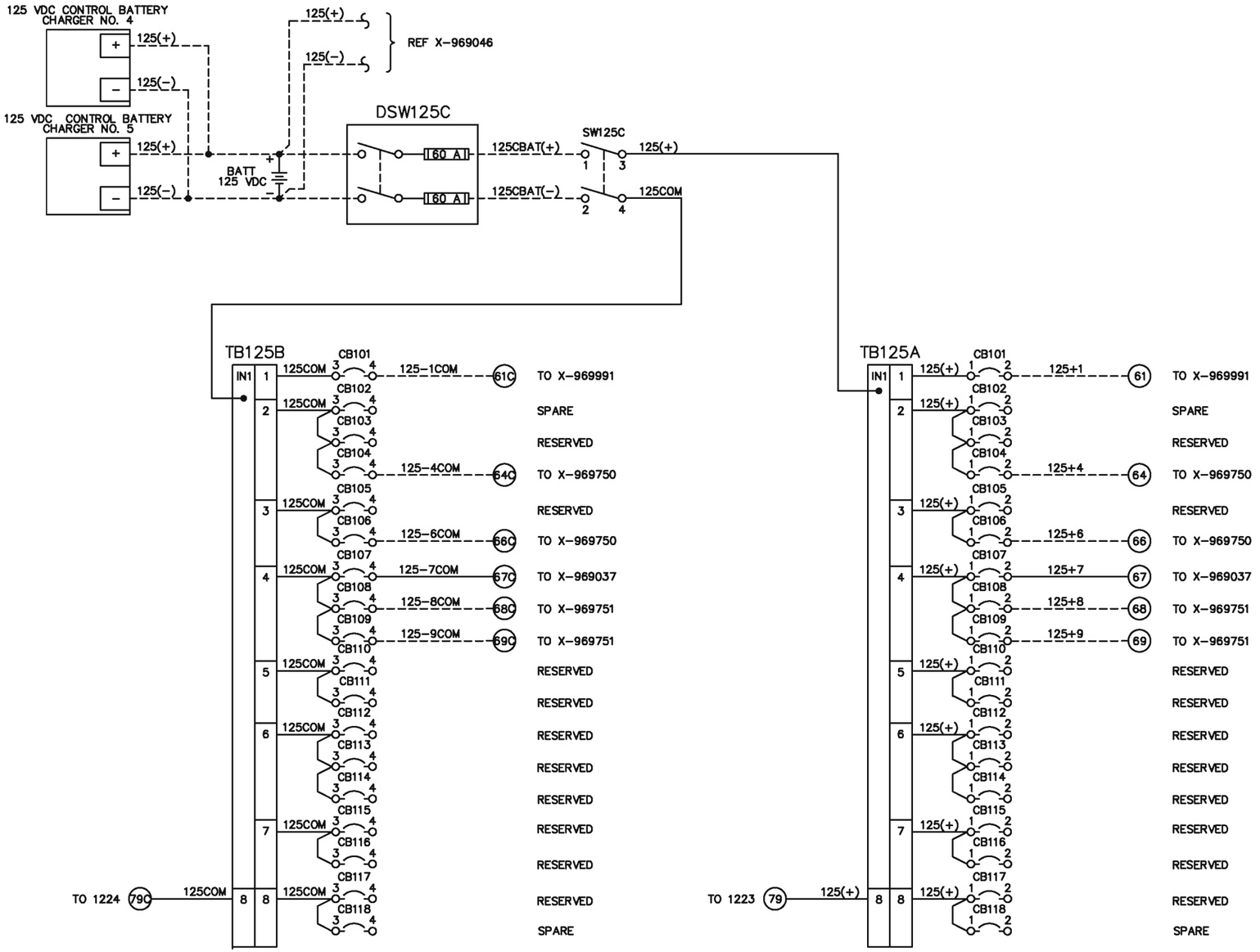
TITLE
SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 4 OF 12



LIST OF 125VDC POWER FEEDS				
	FUNCTION	CB DES	CB RATING	FEEDER
1	MTTB HEAT EXCHANGERS	CB101	60 AMP	125+1 125-1COM
2	SPARE	CB102	32 AMP	125+2 125-2COM
3	RESERVED	CB103	20 AMP	125+3 125-3COM
4	NOX WATER INJECTION DRIVER (MAIN)	CB104	20 AMP	125+4 125-4COM
5	RESERVED	CB105	20 AMP	125+5 125-5COM
6	NOX WATER INJECTION DRIVER (BACKUP)	CB106	20 AMP	125+6 125-6COM
7	GE AVR	CB107	20 AMP	125+7 125-7COM
8	GAS FUEL METERING VALVE DRIVER (MAIN)	CB108	20 AMP	125+8 125-8COM
9	GAS FUEL METERING VALVE DRIVER (BACKUP)	CB109	20 AMP	125+9 125-9COM
10	RESERVED	CB110	20 AMP	125+10 125-10COM
11	RESERVED	CB111	20 AMP	125+11 125-11COM
12	RESERVED	CB112	20 AMP	125+12 125-12COM
13	RESERVED	CB113	20 AMP	125+13 125-13COM
14	RESERVED	CB114	20 AMP	125+14 125-14COM
15	RESERVED	CB115	20 AMP	125+15 125-15COM
16	RESERVED	CB116	20 AMP	125+16 125-16COM
17	RESERVED	CB117	20 AMP	125+17 125-17COM
18	SPARE	CB118	20 AMP	125+18 125-18COM

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

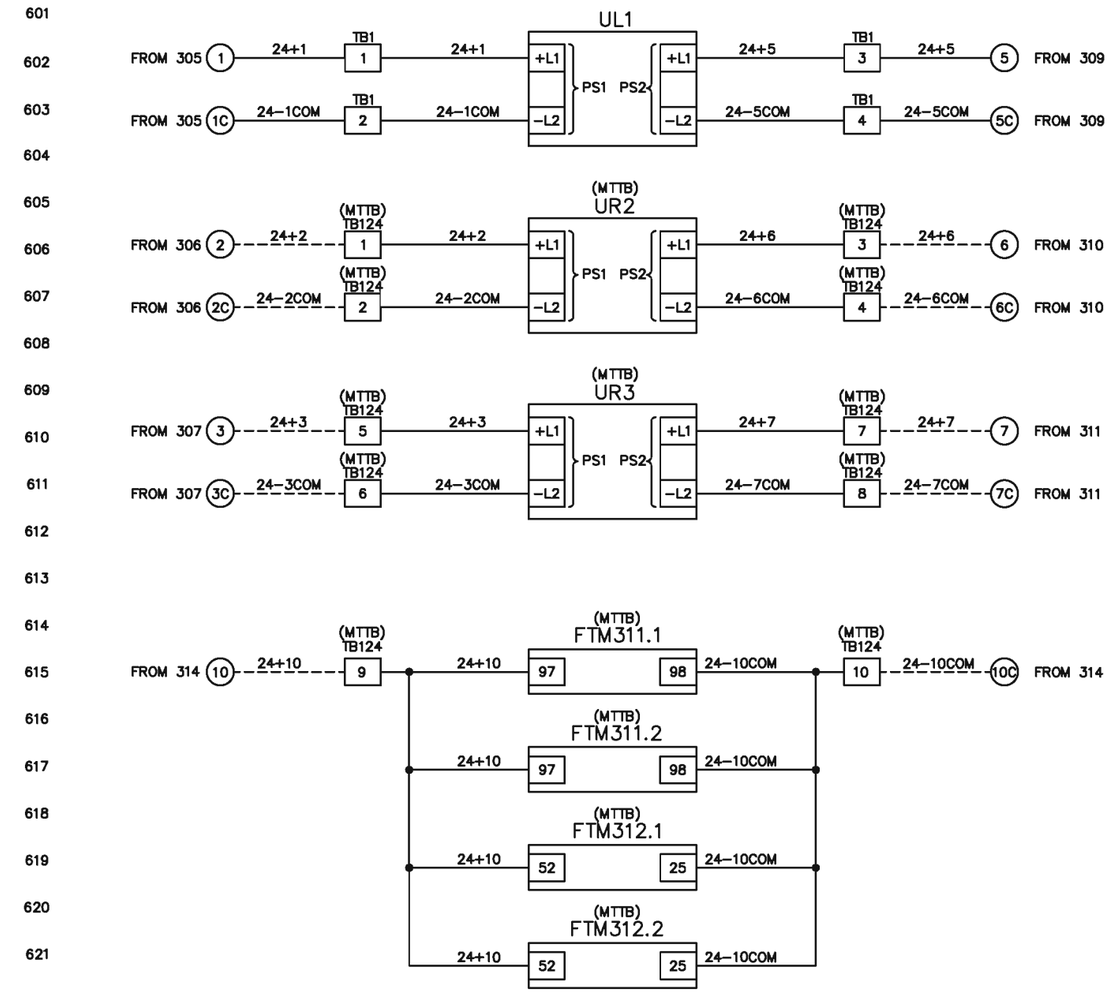
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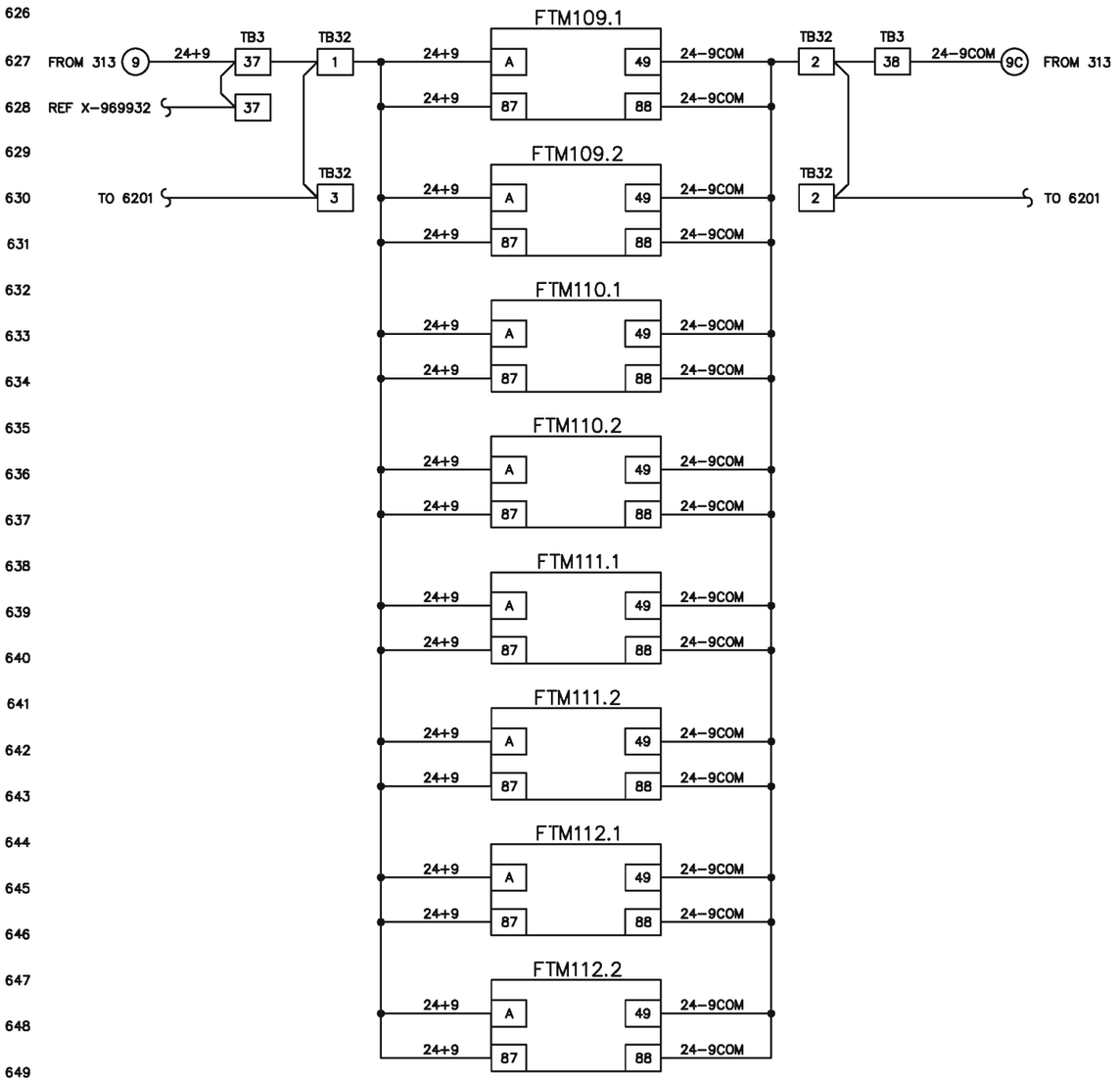
DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 5 OF 12





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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

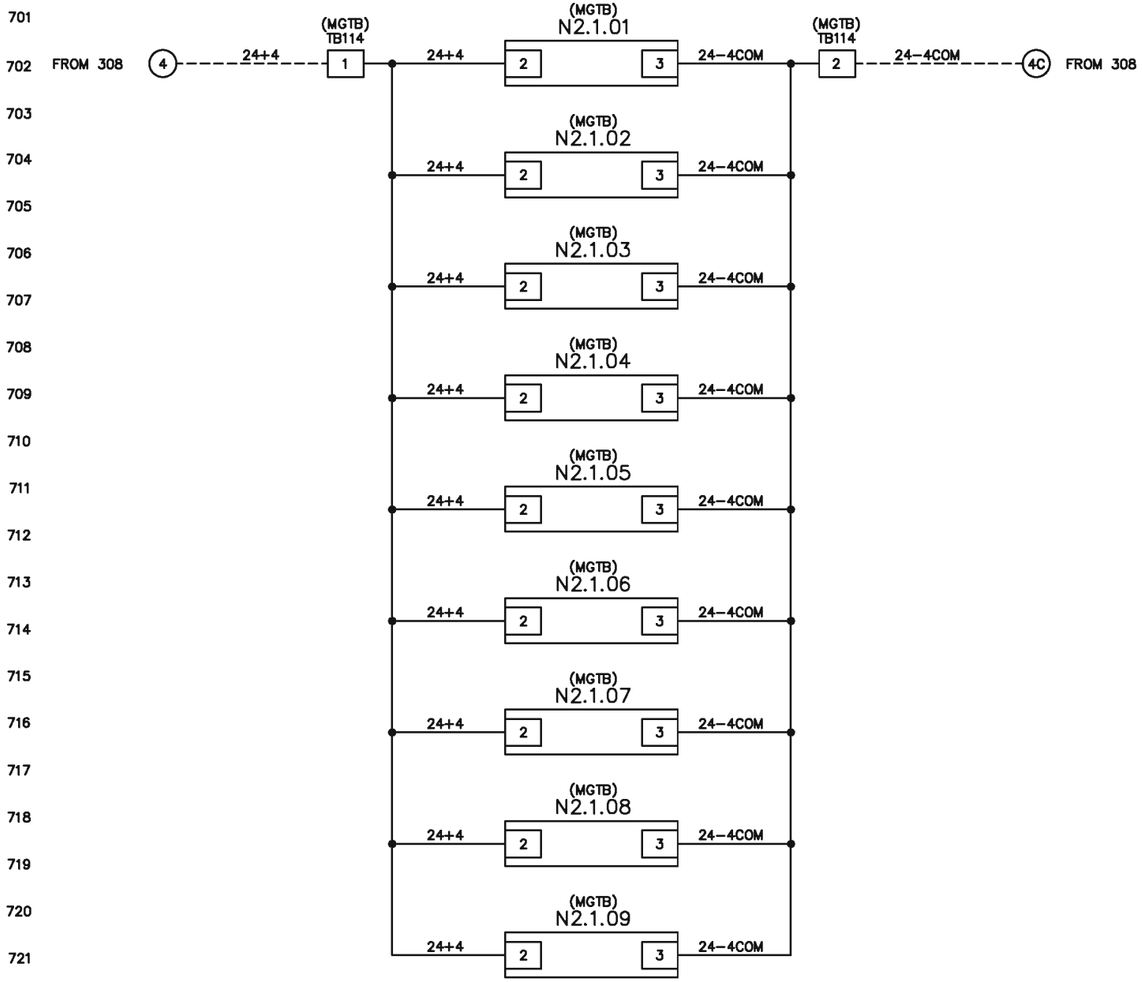
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DC POWER DISTRIBUTION

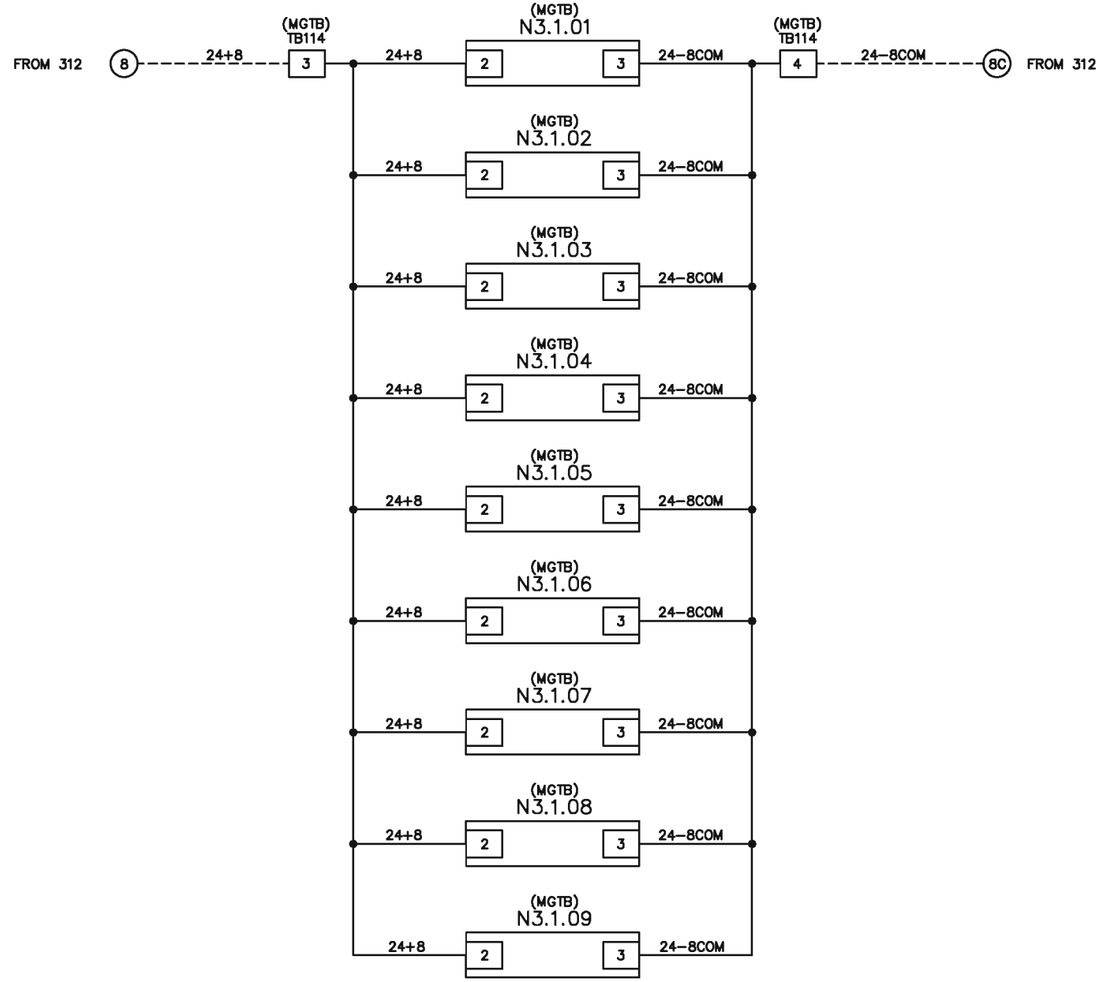
DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 6 OF 12





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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS: .XX ± .03, .XXX ± .010
FRACTIONAL: ±1/16"
ANGULAR: ±1°

NEXT ASSY.

UNIT TYPE: LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

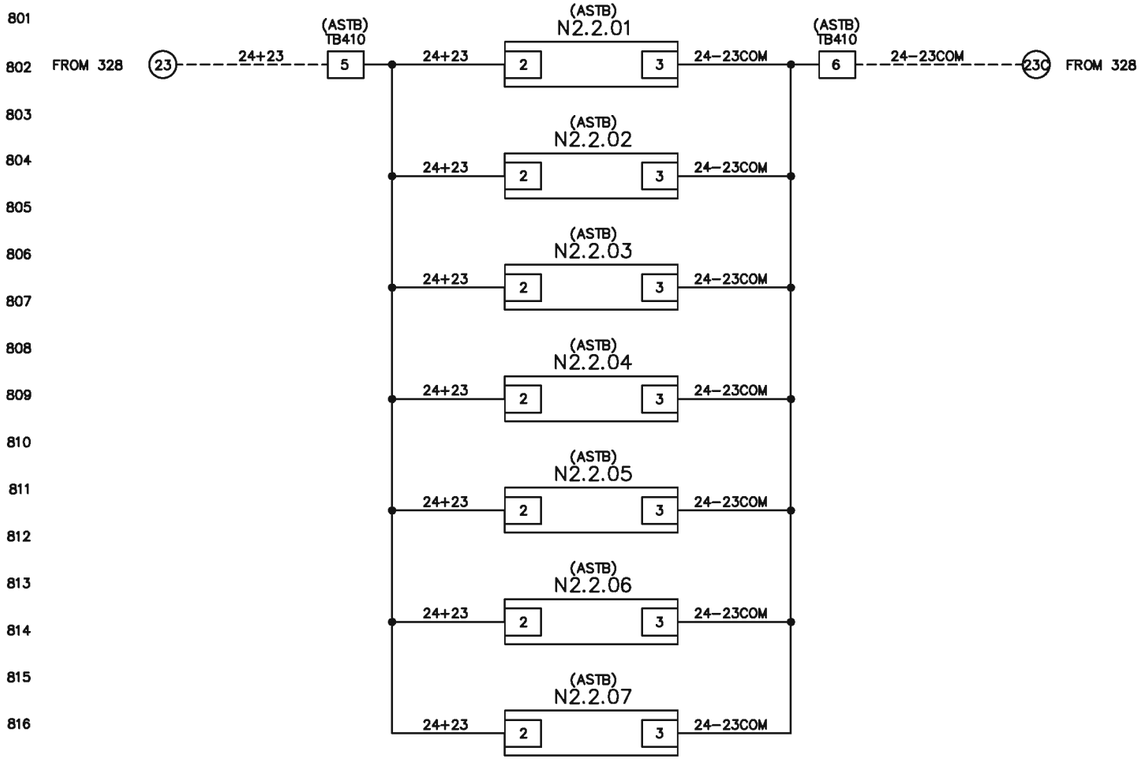
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DC POWER DISTRIBUTION

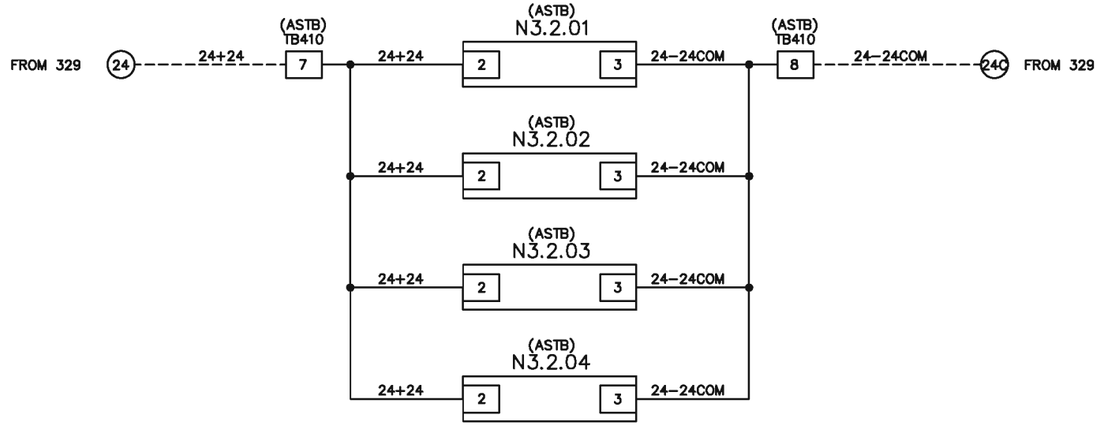
DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 7 OF 12





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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000©

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

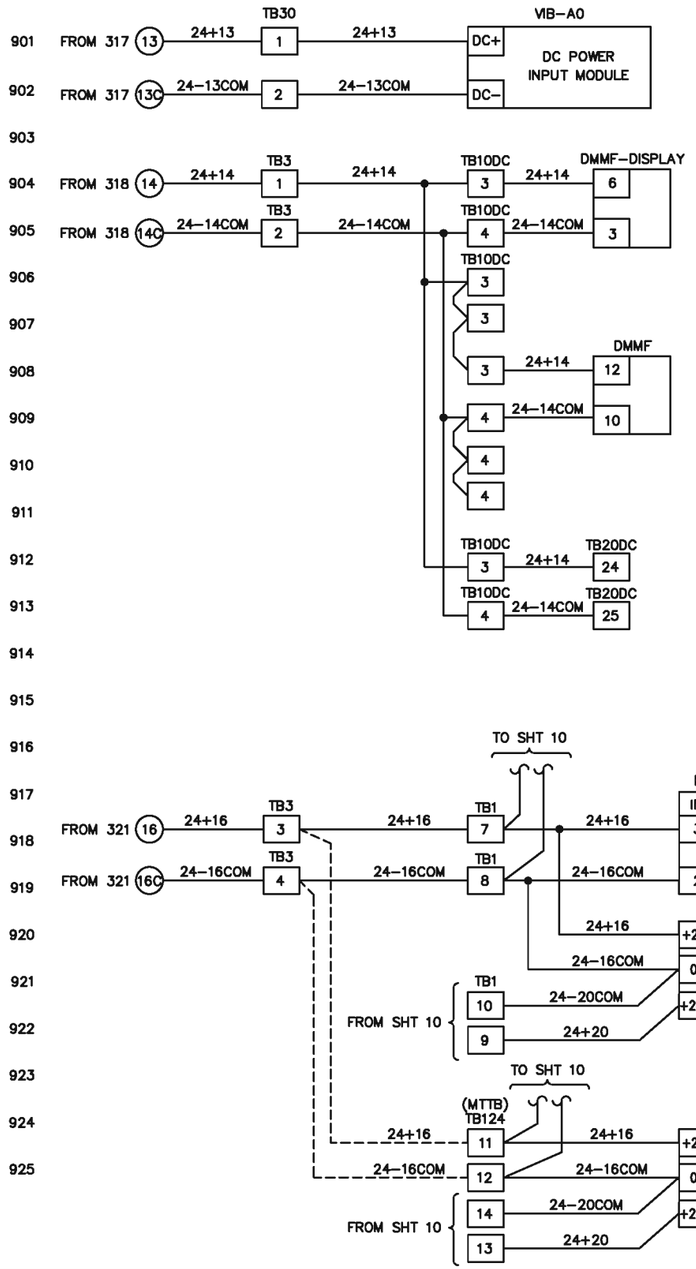
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SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

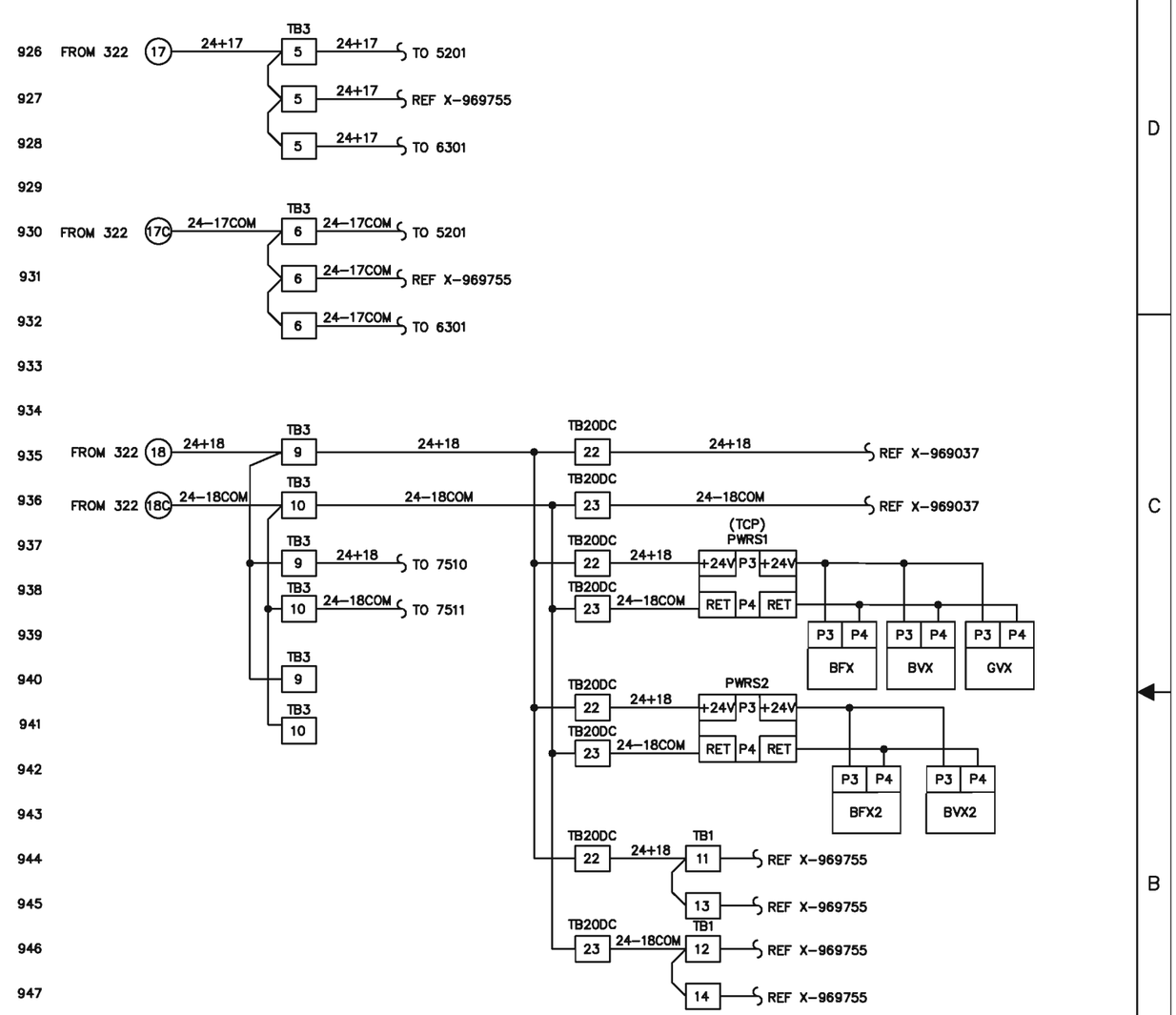
DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 8 OF 12





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REVISIONS

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

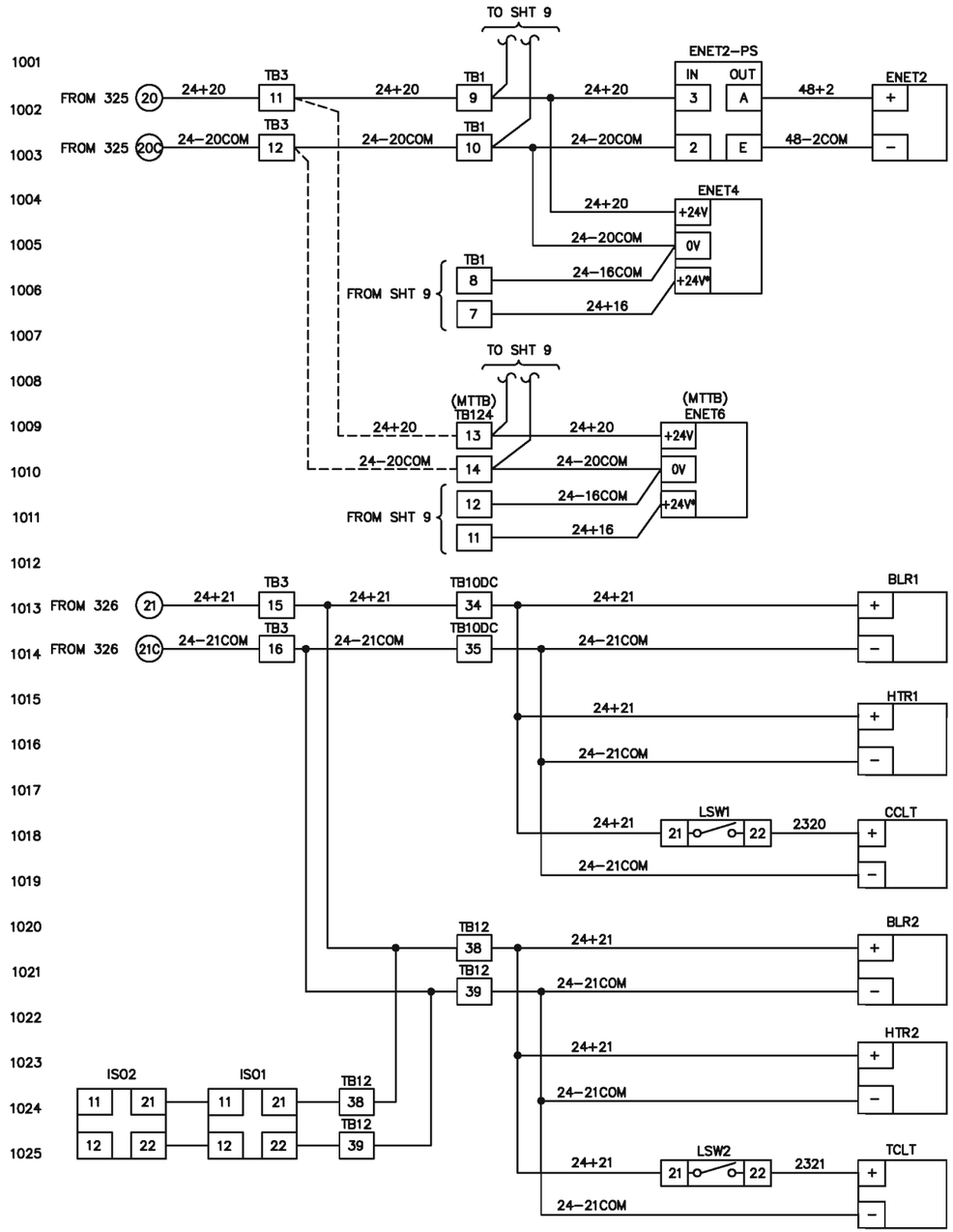
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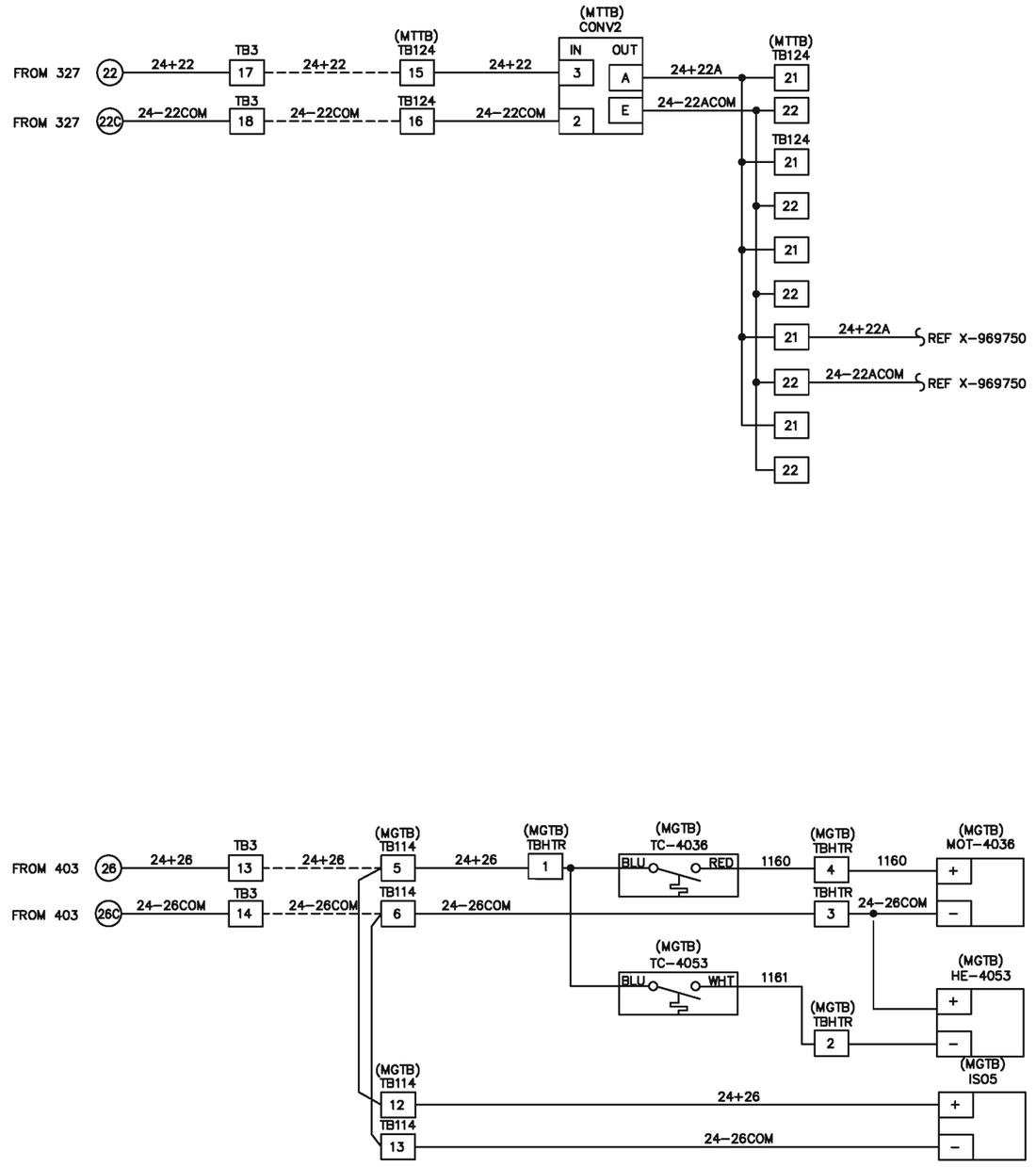
DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 9 OF 12





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REVISIONS

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

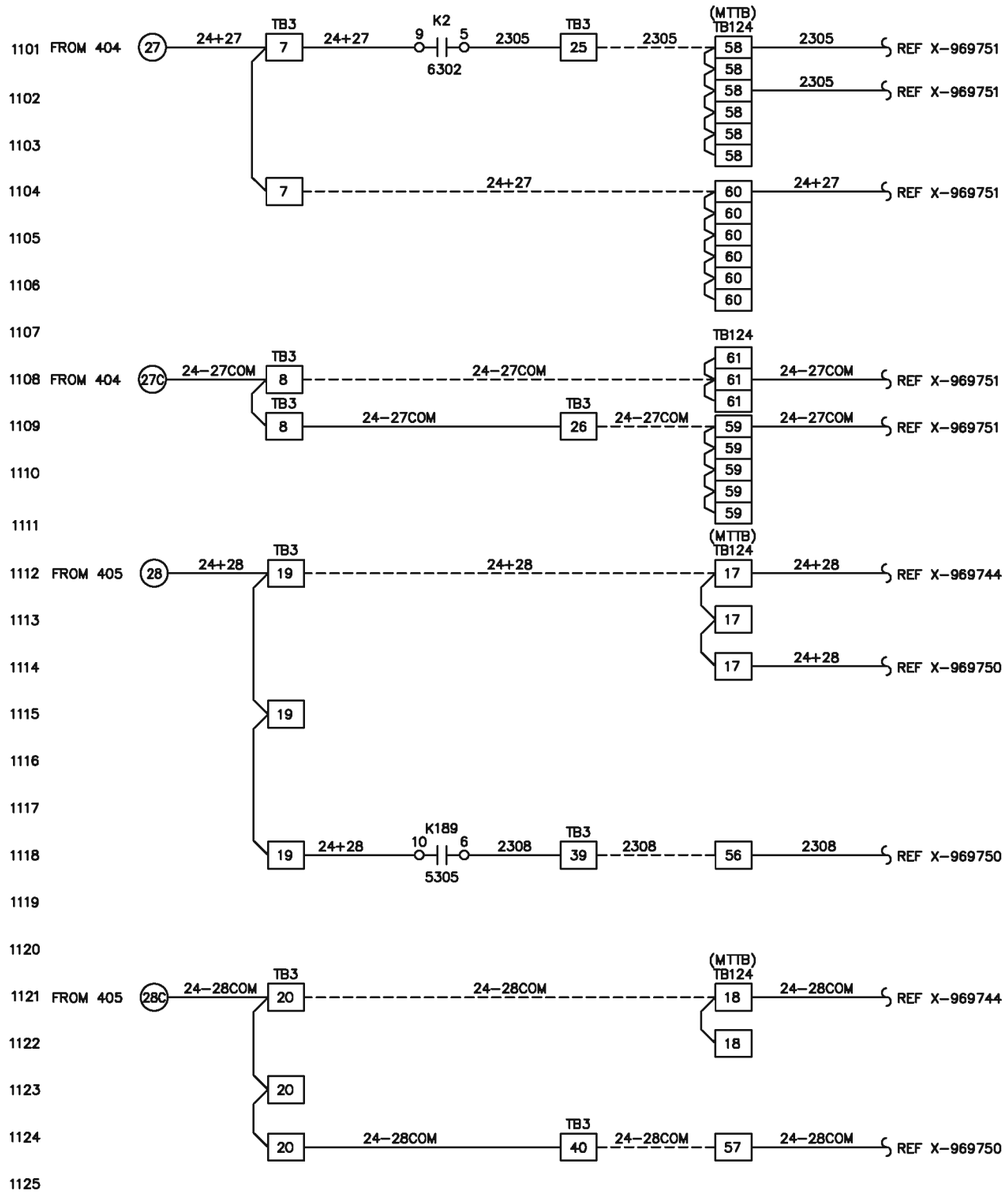
TITLE
SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

DWG NO. 7253049–969767

REV. A

SCALE NONE

SHEET 10 OF 12



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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

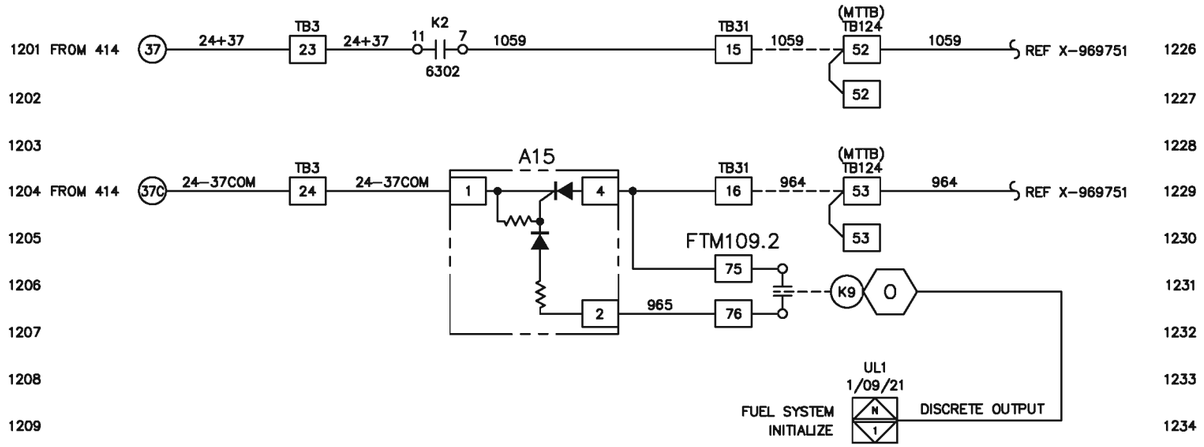
TITLE: SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

DWG NO. 7253049-969767

REV. A

SCALE NONE

SHEET 11 OF 12



RESERVED

GAS FUEL OPTION

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SCHEMATIC DIAGRAM
DC POWER DISTRIBUTION

DWG NO. 7253049-969767

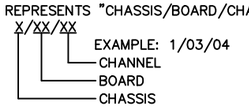
REV. A

SCALE NONE

SHEET 12 OF 12

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975
   GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–
   (CONFIG. OR SITE)–(STANDARD DRAWING NUMBER).
   WHERE X = ORDER NUMBER.
3. REPRESENTS "CHASSIS/BOARD/CHANNEL" ADDRESS



4. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
5. ALL TERMINAL BLOCKS ARE LOCATED IN THE TURBINE CONTROL PANEL,
   UNLESS OTHERWISE INDICATED.
6. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
7. IF SIGNAL IS NOT REQUIRED, ADD JUMPER BETWEEN ITS TERMINAL
   POINTS, WHERE INDICATED.
8. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.
9. FOR 5XXX SERIES REFERENCE LINE NUMBERS, SEE X–969041.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969041	SCHEMATIC DIAGRAM, CIRCUIT BREAKER CONTROL
X–969044	SCHEMATIC DIAGRAM, MOTOR CONTROL CENTER
X–969751	INSTRUMENT LOOP DIAGRAM, FUEL SYSTEM
X–969755	INSTRUMENT LOOP DIAGRAM, AUXILIARY SYSTEMS
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X–969932	INSTRUMENT LOOP DIAGRAM, VIBRATION SYSTEM

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REVISIONS

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

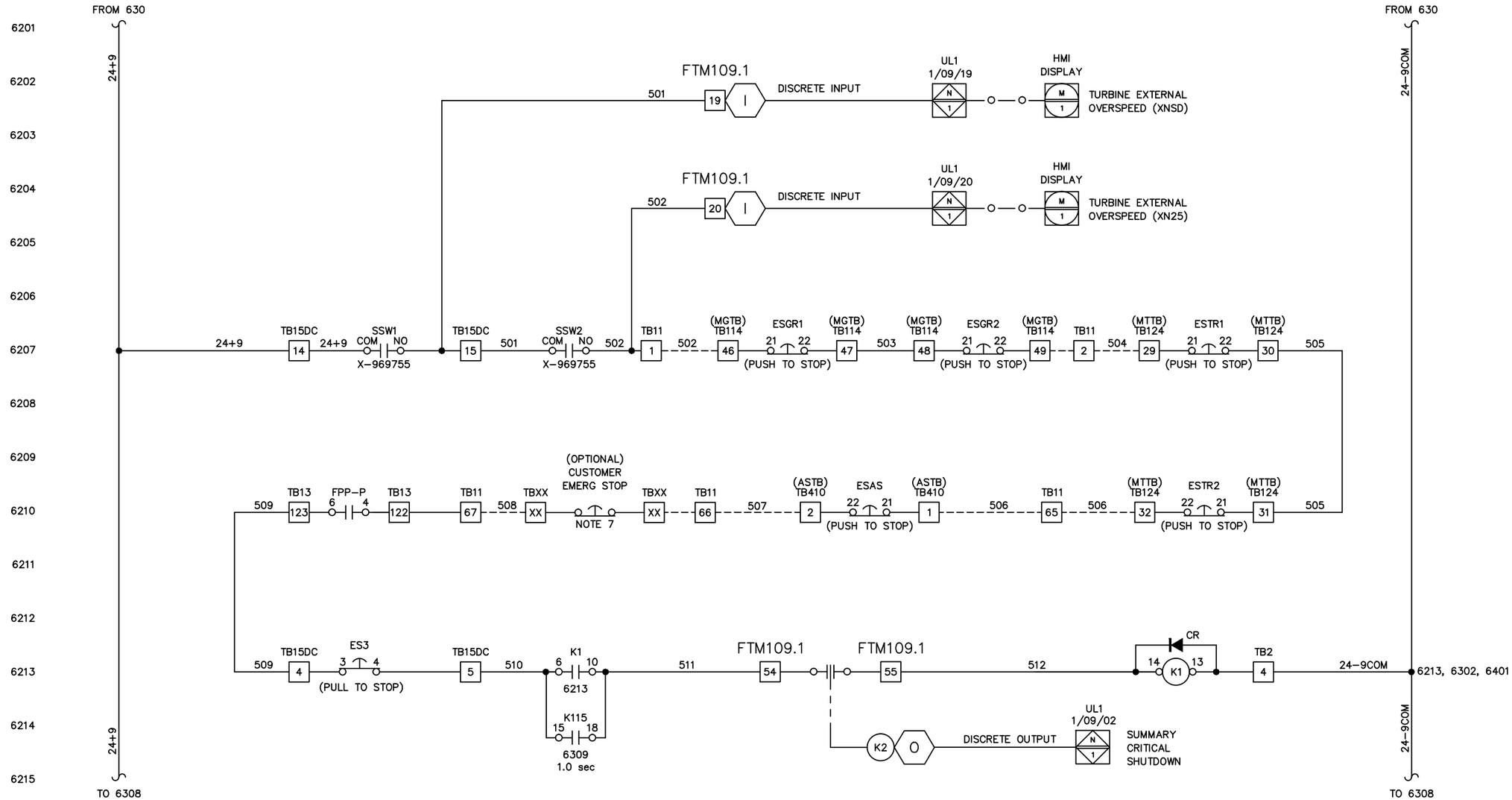
TITLE
SCHEMATIC DIAGRAM
CRITICAL SHUTDOWN PATH

DWG NO. 7253049–969768

REV. A

SCALE NONE

SHEET 1 OF 4



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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

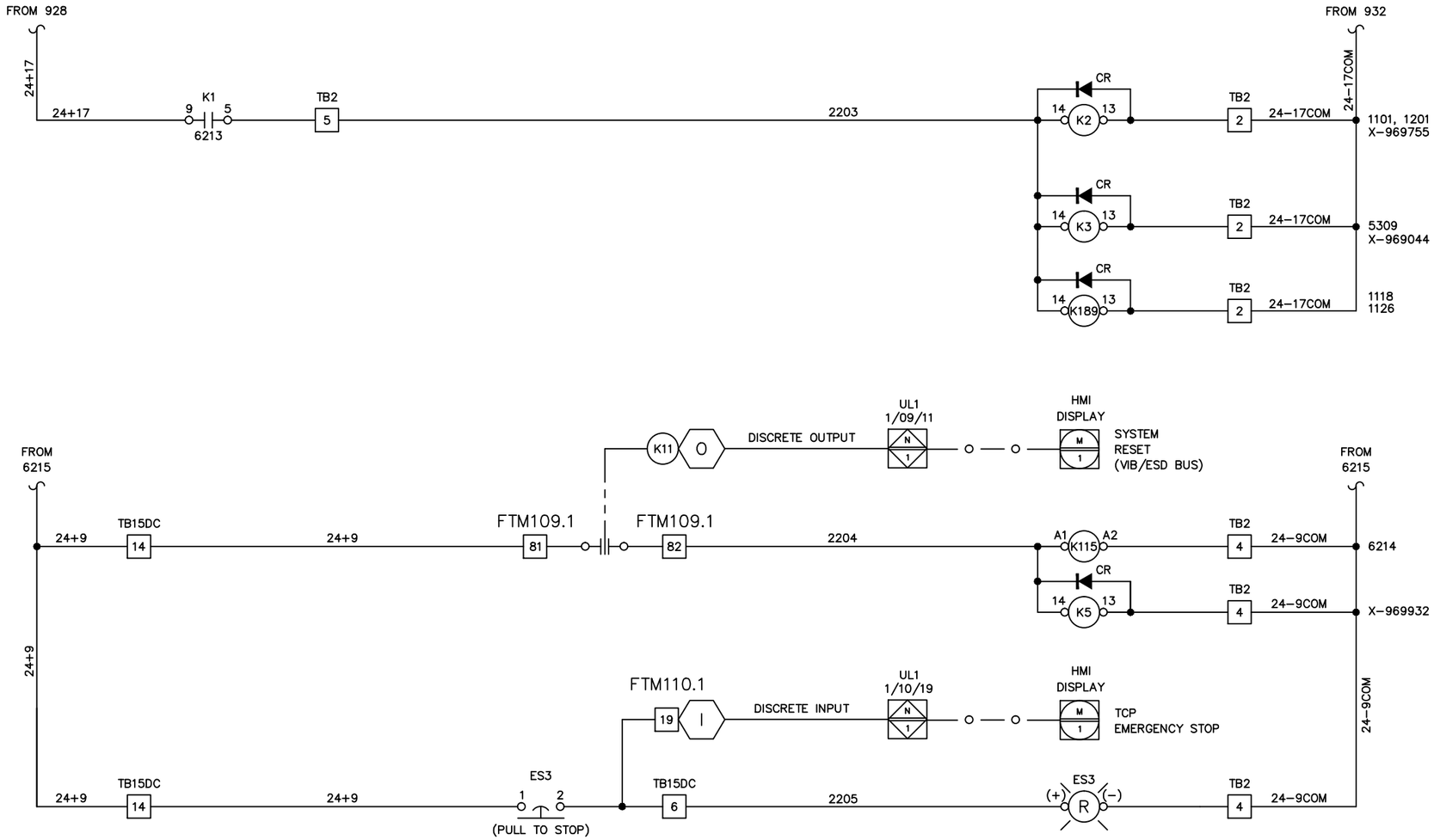
TITLE
SCHEMATIC DIAGRAM
CRITICAL SHUTDOWN PATH

DWG NO. 7253049-969768

REV. A

SCALE NONE

SHEET 2 OF 4



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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

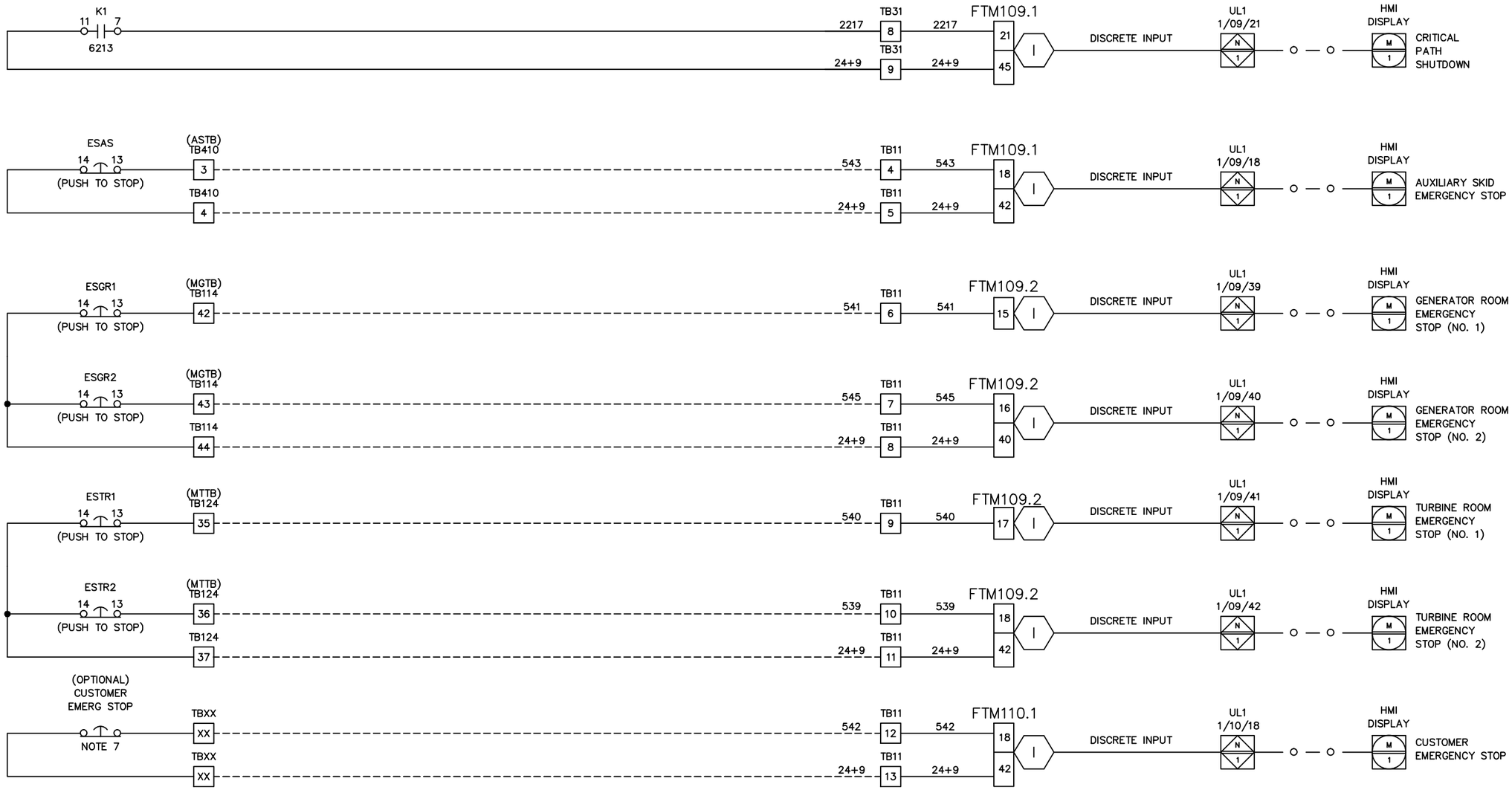
TITLE
SCHEMATIC DIAGRAM
CRITICAL SHUTDOWN PATH

DWG NO. 7253049-969768

REV. A

SCALE NONE

SHEET 3 OF 4



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REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SCHEMATIC DIAGRAM
CRITICAL SHUTDOWN PATH

DWG NO. 7253049-969768

REV. A

SCALE NONE

SHEET 4 OF 4

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. XX/XX/XX
   - EXAMPLE: 1/03/04
   - CHANNEL
   - BOARD
   - CHASSIS
4. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
5. ALL TERMINAL BLOCKS ARE LOCATED IN THE TURBINE CONTROL PANEL, UNLESS OTHERWISE INDICATED.
6. FOR CLARITY, SOME TERMINAL BLOCKS MAY HAVE BEEN OMITTED.
7. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X–969767.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005	ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA
X–969032	THREE LINE DIAGRAM, GENERATOR METERING
X–969037	SYSTEM SCHEMATIC, GENERATOR EXCITATION
X–969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION

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REVISIONS

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

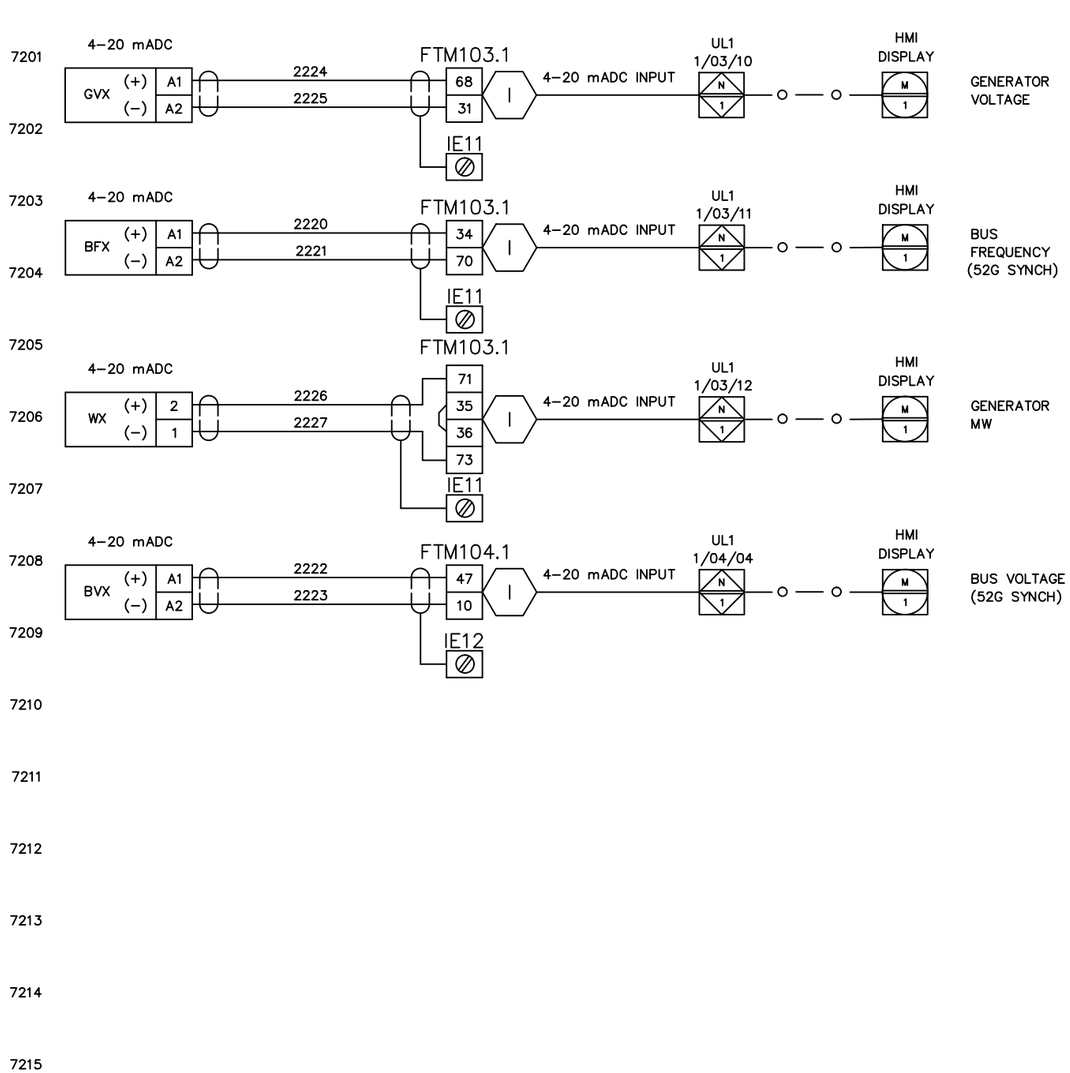
TITLE: SCHEMATIC DIAGRAM MISCELLANEOUS

DWG NO. 7253049–969769

REV. A

SCALE NONE

SHEET 1 OF 5



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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

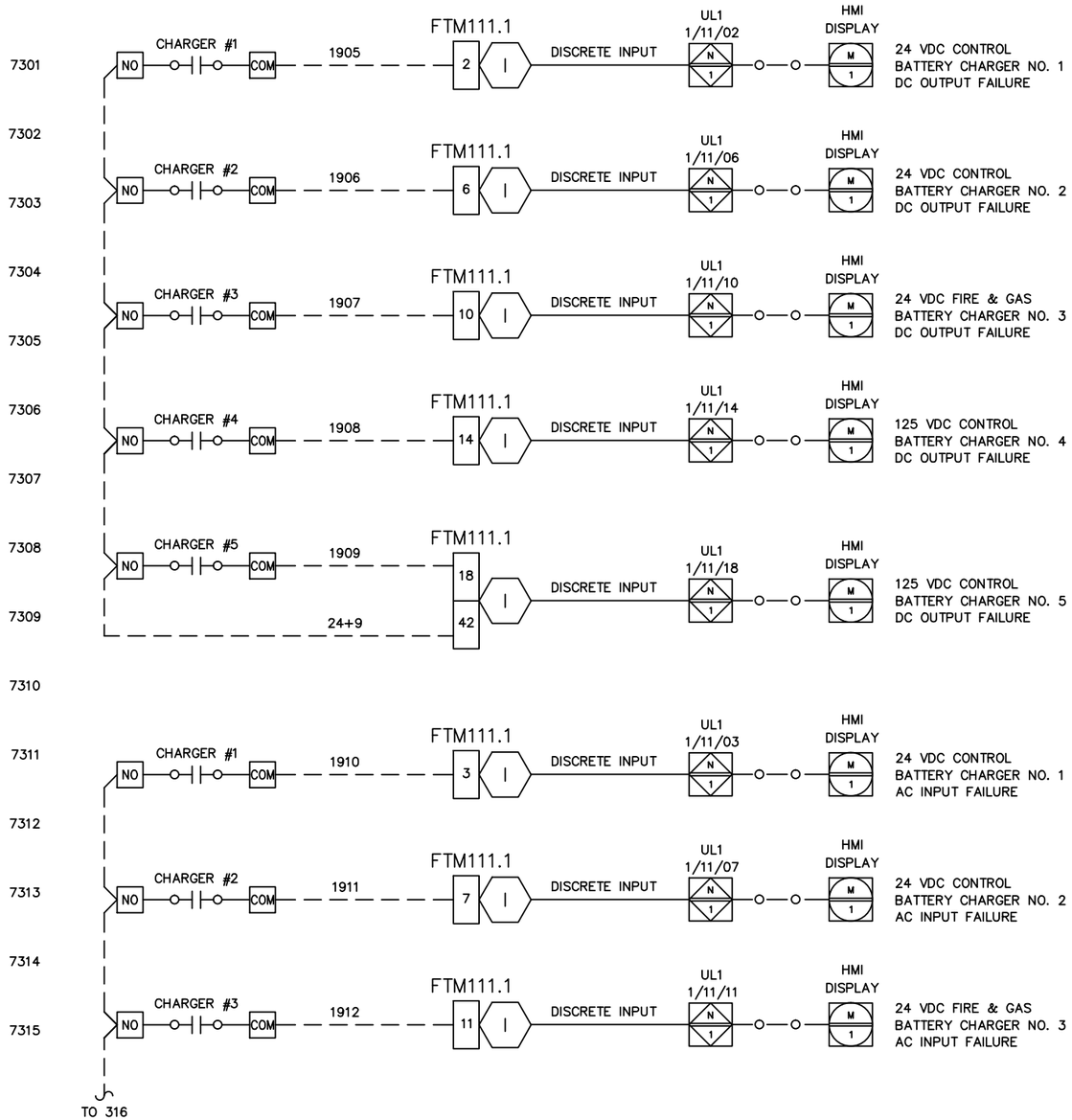
TITLE
SCHEMATIC DIAGRAM
MISCELLANEOUS

DWG NO. 7253049–969769

REV. A

SCALE NONE

SHEET 2 OF 5



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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

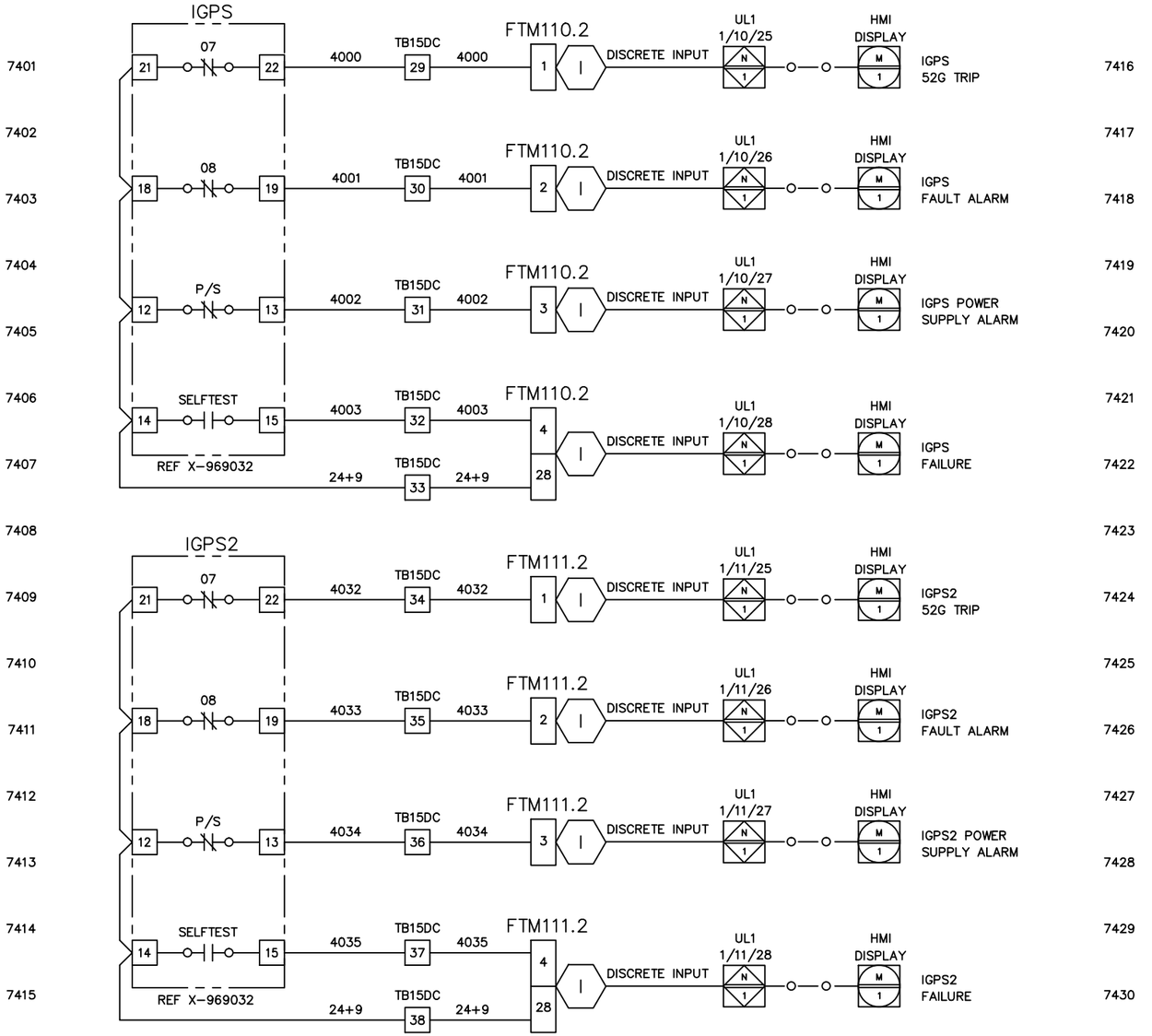
TITLE
SCHEMATIC DIAGRAM
MISCELLANEOUS

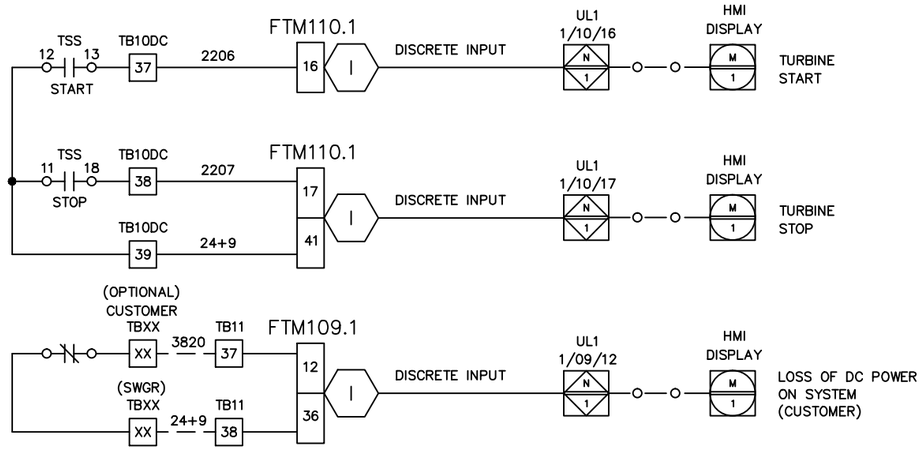
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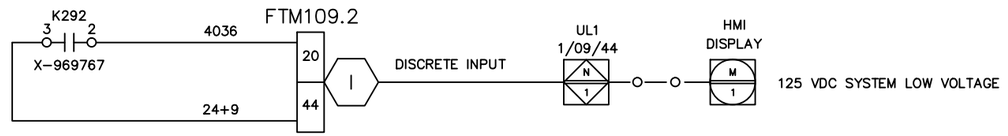
REV. A

SCALE NONE

SHEET 3 OF 5







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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

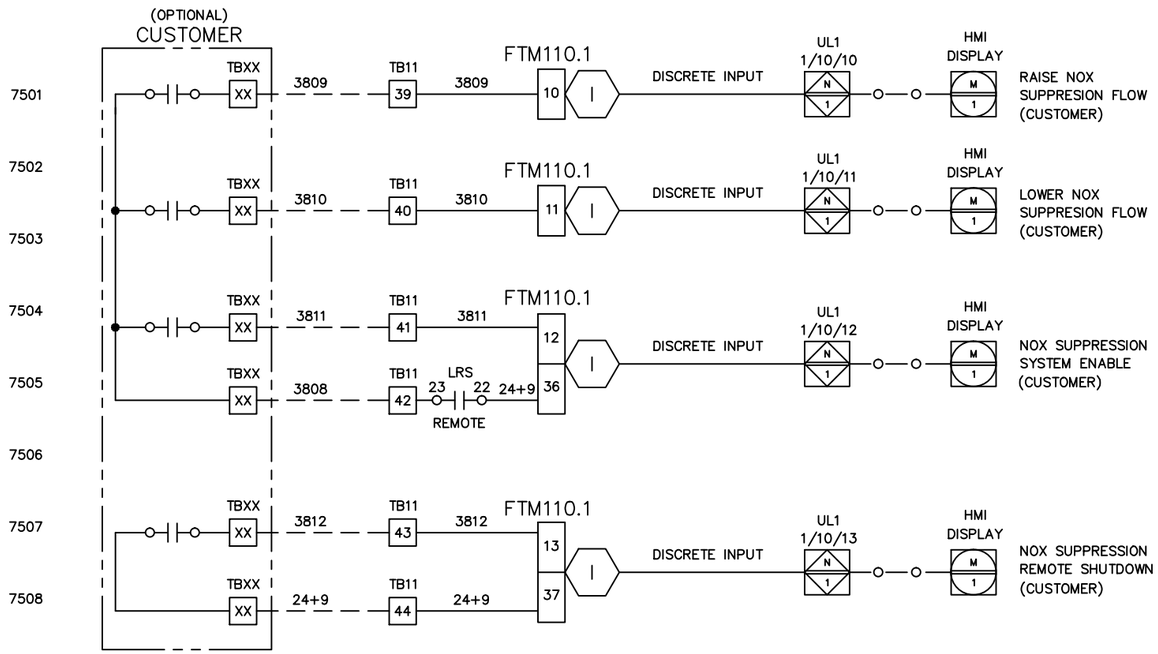
TITLE
SCHEMATIC DIAGRAM
MISCELLANEOUS

DWG NO. 7253049-969769

REV. A

SCALE NONE

SHEET 4 OF 5



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REVISIONS

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A	ORIGINAL ISSUE	11814	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

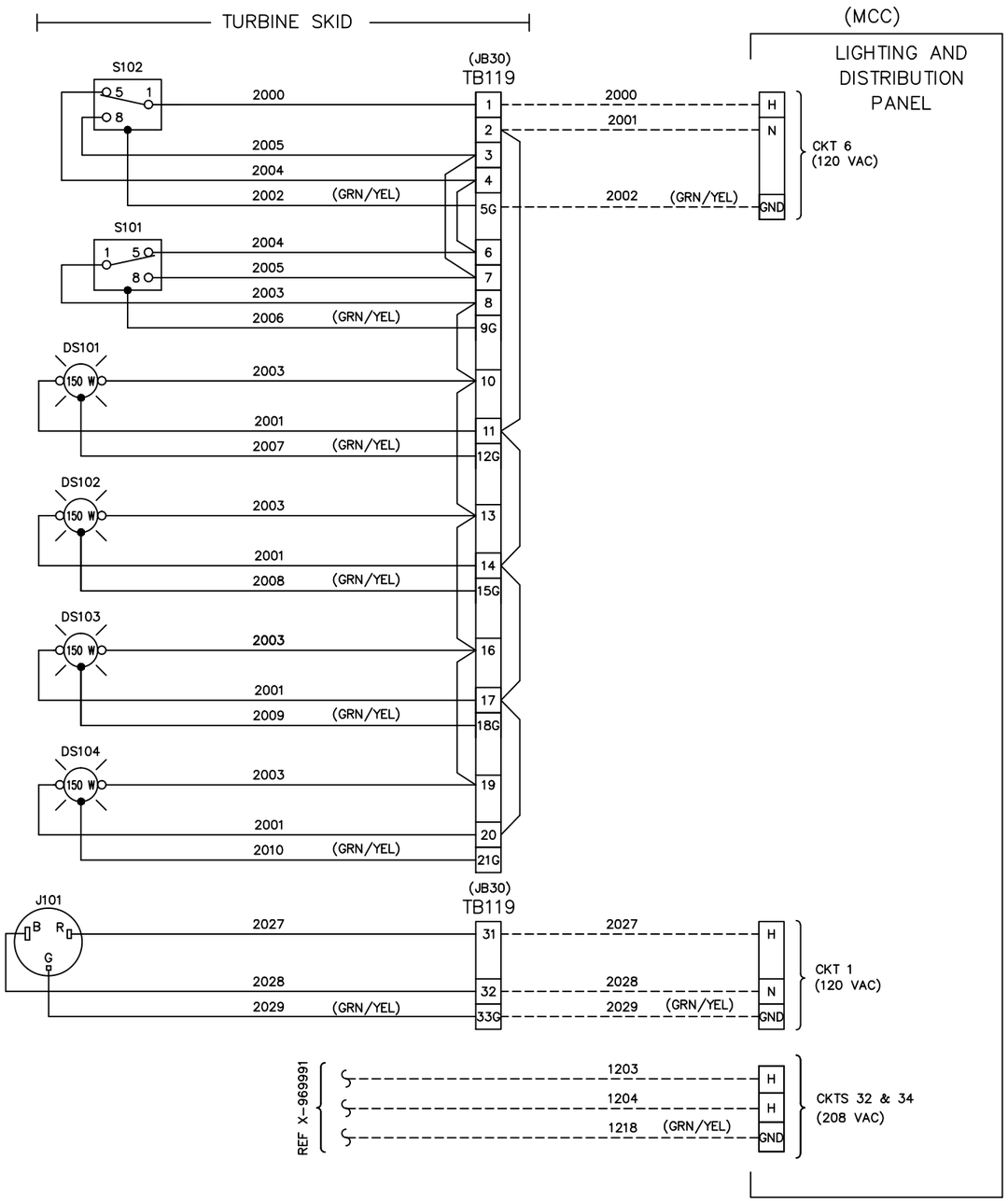
TITLE
SCHEMATIC DIAGRAM
MISCELLANEOUS

DWG NO.
7253049–969769

REV.
A

SCALE NONE

SHEET 5 OF 5



LEGEND:
SEE X-969005

REFERENCE DRAWINGS:

X-969005	ELECTRICAL SYMBOLS, ABBREVIATIONS AND REFERENCE DATA
X-969044	SCHEMATIC DIAGRAM, MOTOR CONTROL CENTER
X-969755	INSTRUMENT LOOP DIAGRAM, AUXILIARY SYSTEMS
X-969767	SCHEMATIC DIAGRAM, DC POWER DISTRIBUTION
X-969991	SCHEMATIC DIAGRAM, MTTB HEAT EXCHANGERS

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315-1975 GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. ALL DEVICES SHOWN DE-ENERGIZED (SHELF STATE).
4. TERMINATION SUFFIXED WITH A "G" INDICATES HALF GREEN/HALF YELLOW GROUND TERMINAL.
5. FOR REFERENCE LINE NUMBERS LESS THAN 5000, SEE X-969767.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

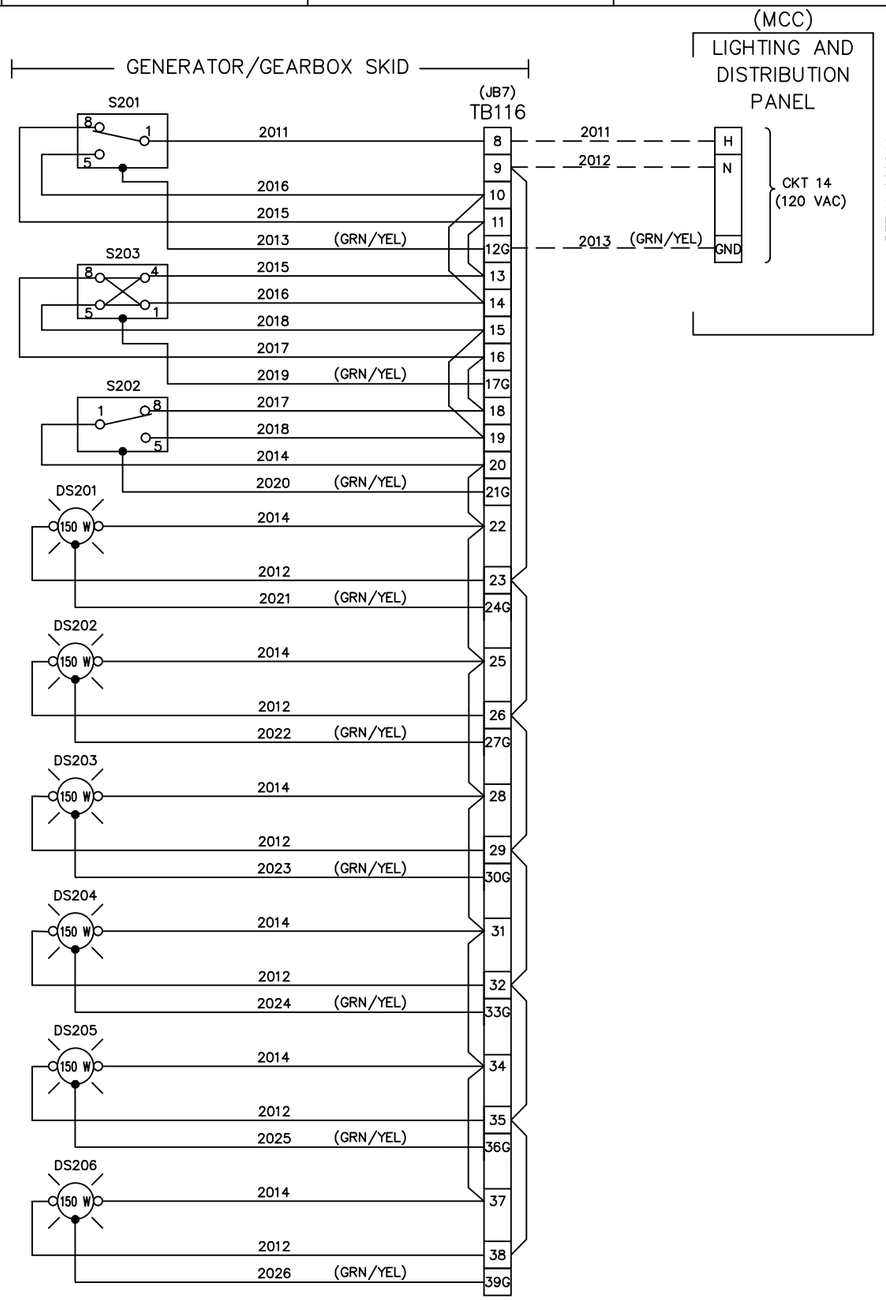
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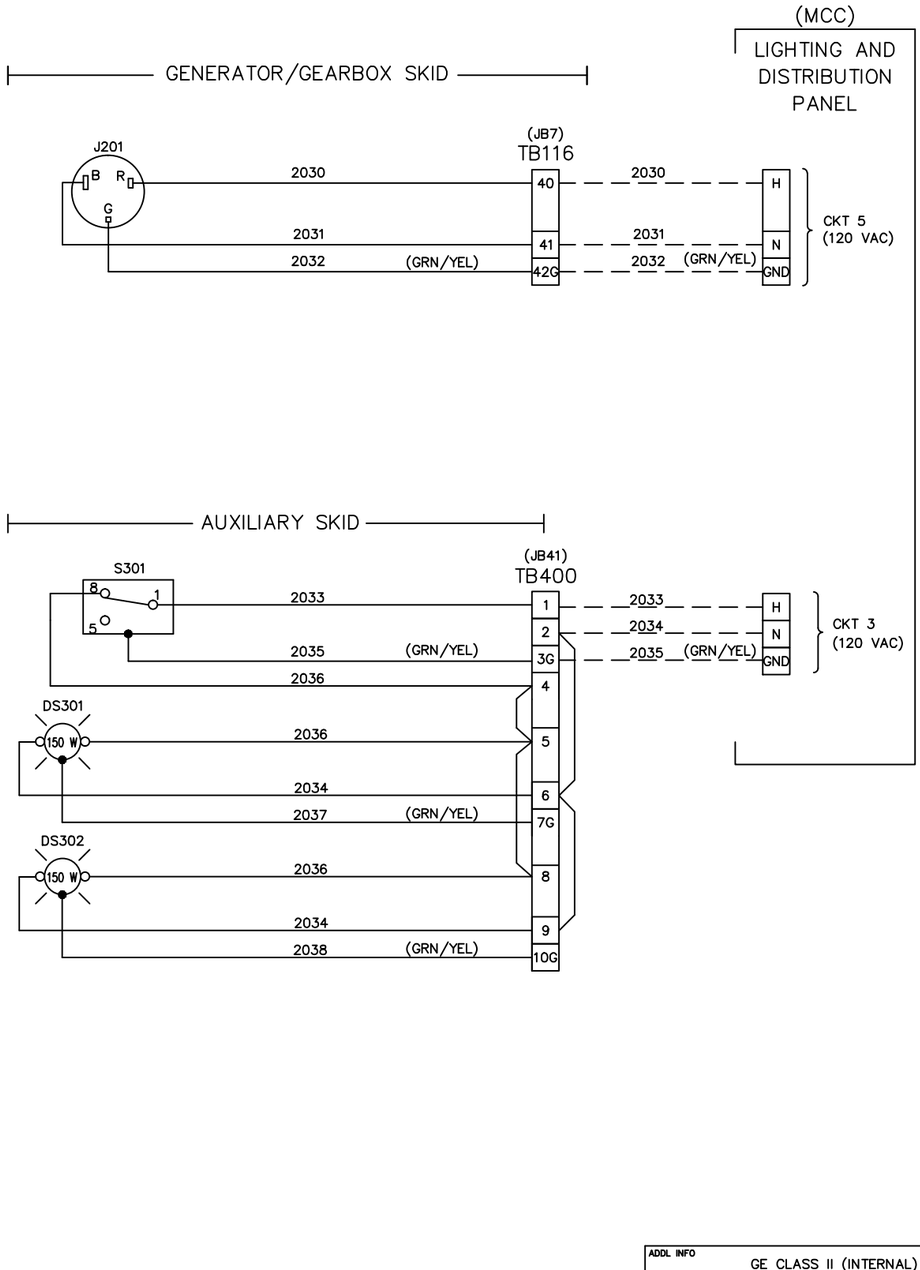
DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 1 OF 8





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REVISIONS

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A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

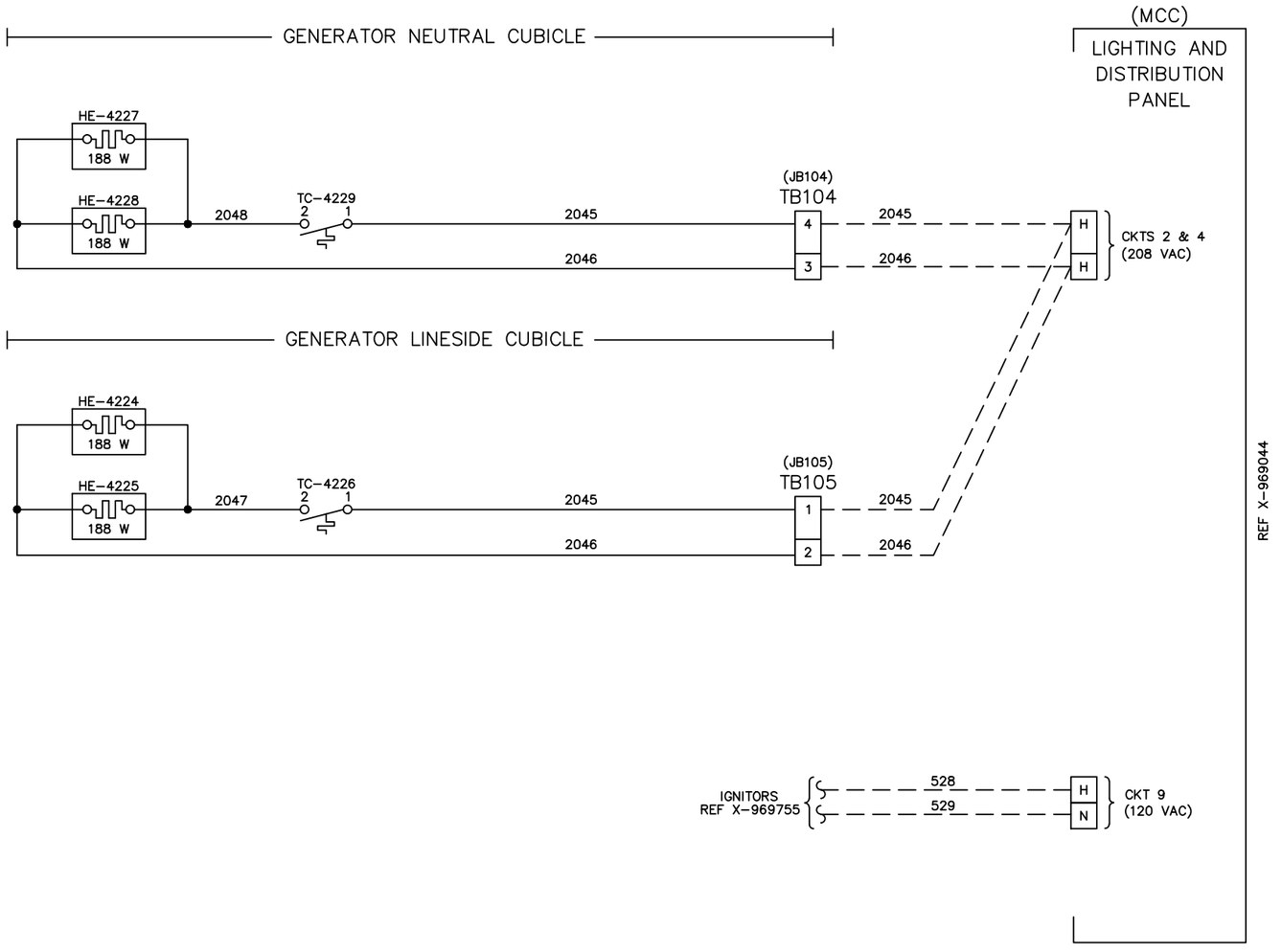
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SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 2 OF 8



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

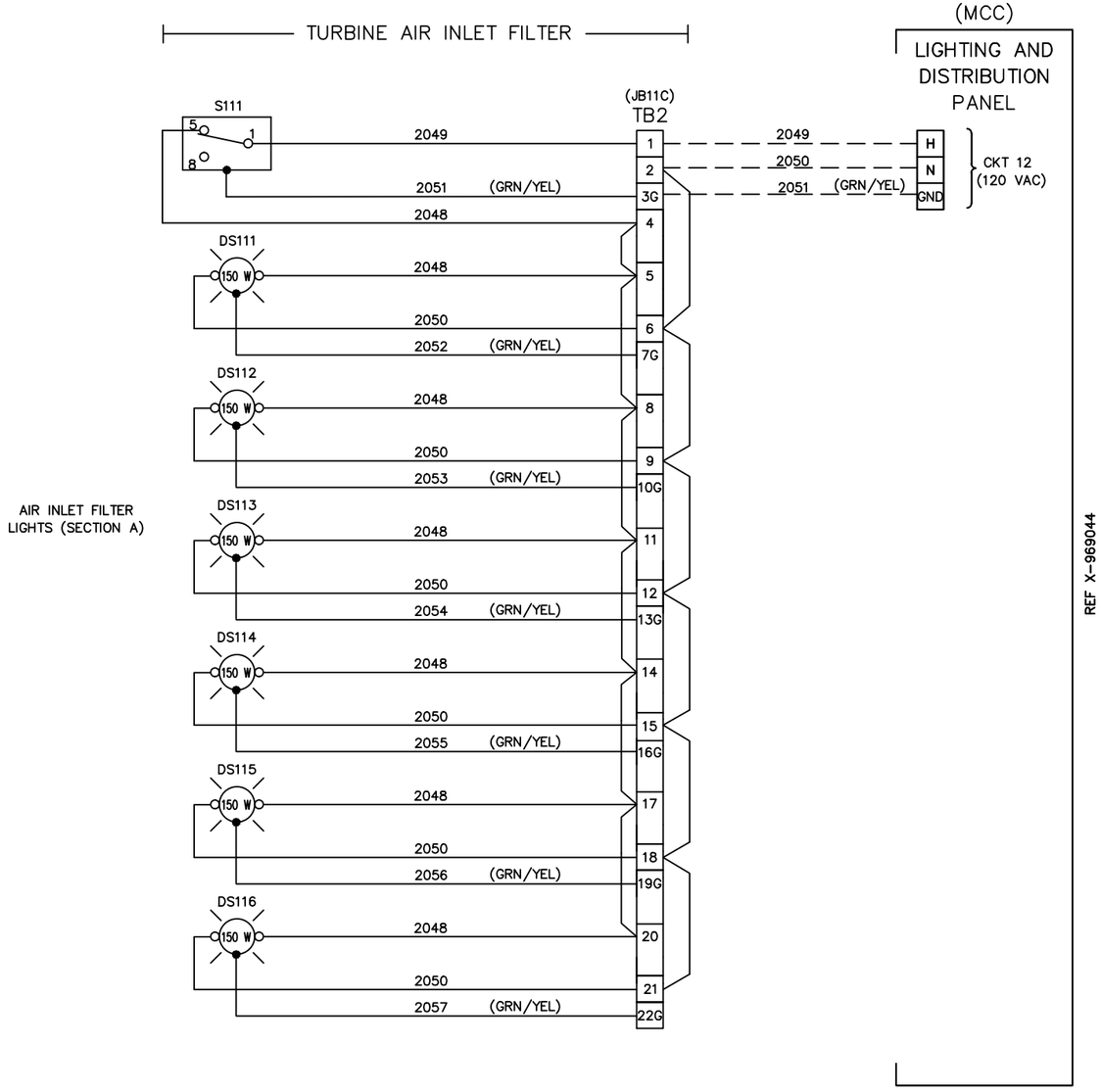
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SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

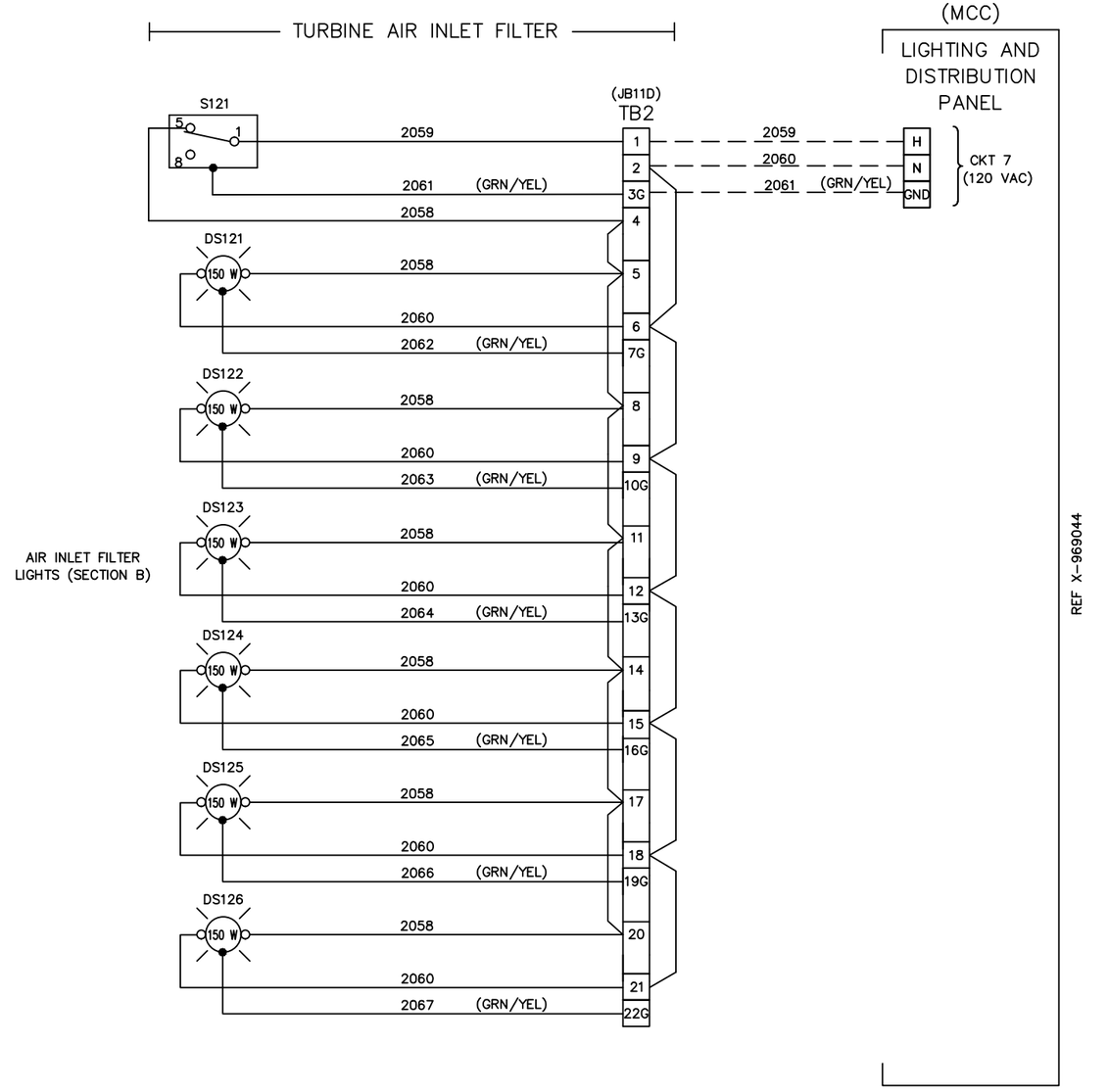
DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 3 OF 8





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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 4 OF 8

(MCC)

LIGHTING AND DISTRIBUTION PANEL

REF X-969044

(MCC)

LIGHTING AND DISTRIBUTION PANEL

REF X-969044

CHG #1

24 VDC CONTROL BATTERY CHARGER #1

H — 2081 — H
H — 2082 — H
GND — 2083 (GRN/YEL) — GND

CKTS 23 & 25 (208 VAC)

CHG #2

24 VDC CONTROL BATTERY CHARGER #2

H — 2084 — H
H — 2085 — H
GND — 2086 (GRN/YEL) — GND

CKTS 27 & 29 (208 VAC)

CHG #3

24 VDC FIRE & GAS BATTERY CHARGER #3

H — 2087 — H
H — 2088 — H
GND — 2089 (GRN/YEL) — GND

CKTS 28 & 30 (208 VAC)

CHG #4

125 VDC CONTROL BATTERY CHARGER #4

H — 2090 — H
H — 2091 — H
GND — 2092 (GRN/YEL) — GND

CKTS 31 & 33 (208 VAC)

CHG #5

125 VDC CONTROL BATTERY CHARGER #5

H — 2093 — H
H — 2094 — H
GND — 2095 (GRN/YEL) — GND

CKTS 36 & 38 (208 VAC)

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

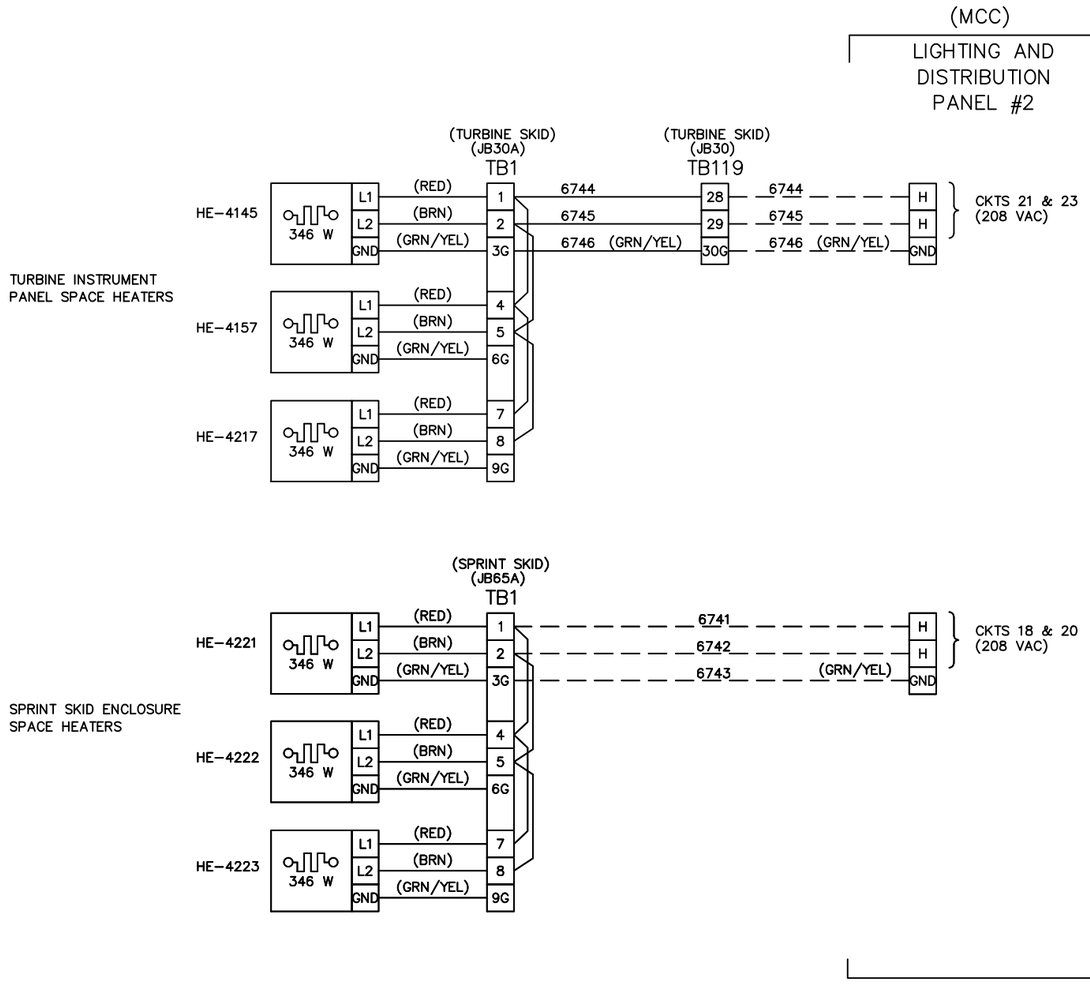
TITLE
SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

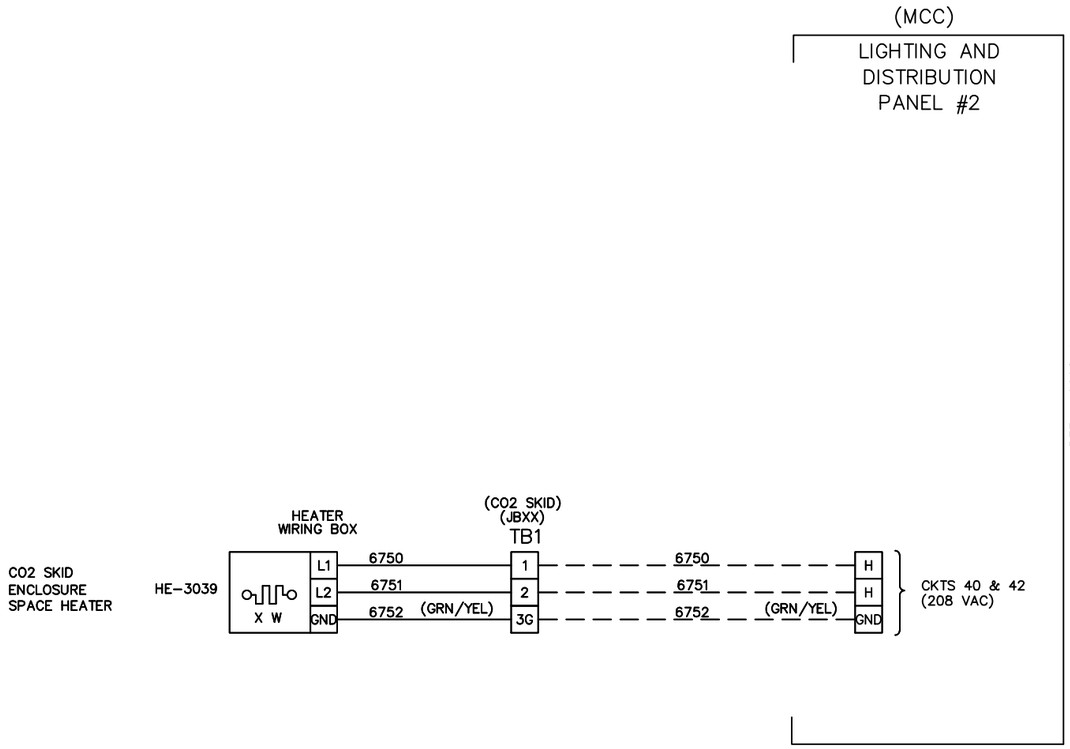
DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 5 OF 8





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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 6 OF 8

(MCC)

LIGHTING AND DISTRIBUTION PANEL #2

(TURBINE SKID)
(JB90)
TB1

TURBINE SKID HEAT TRACING

1	6700		H	CKTS 1 & 3 (208 VAC)
2	6701		H	
3G	6702	(GRN/YEL)	GND	

(TURBINE SKID)
(JB90)
TB1

TURBINE SKID HEAT TRACING

4	6703		H	CKTS 2 & 4 (208 VAC)
5	6704		H	
6G	6705	(GRN/YEL)	GND	

(GENERATOR/GEARBOX SKID)
(JB91)
TB1

GENERATOR/GEARBOX SKID HEAT TRACING

1	6706		H	CKTS 5 & 7 (208 VAC)
2	6707		H	
3G	6708	(GRN/YEL)	GND	

(AUXILIARY SKID)
(JB92)
TB1

AUXILIARY SKID HEAT TRACING

1	6709		H	CKTS 6 & 8 (208 VAC)
2	6710		H	
3G	6711	(GRN/YEL)	GND	

(MINERAL LUBE OIL SKID)
(JB96)
TB1

MINERAL LUBE OIL SKID HEAT TRACING

1	6712		H	CKTS 10 & 12 (208 VAC)
2	6713		H	
3G	6714	(GRN/YEL)	GND	

REF X-969044

(MCC)

LIGHTING AND DISTRIBUTION PANEL #2

(SPRINT SKID)
(JB94)
TB1

SPRINT SKID HEAT TRACING

1	6715		H	CKTS 13 & 15 (208 VAC)
2	6716		H	
3G	6717	(GRN/YEL)	GND	

REF X-969044

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

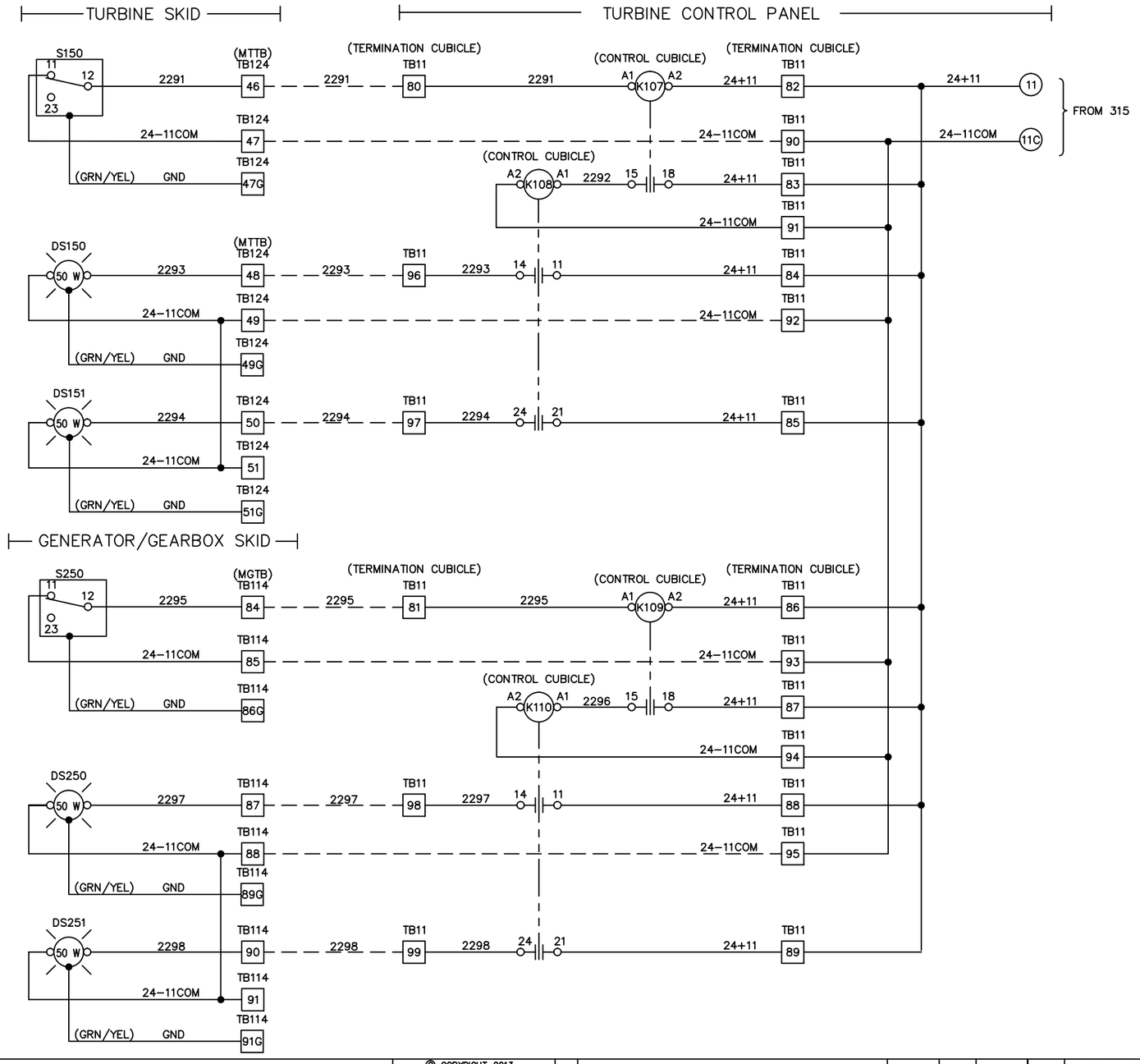
TITLE
SYSTEM SCHEMATIC
LIGHTING AND DISTRIBUTION

DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 7 OF 8



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		REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN	
		A	ORIGINAL ISSUE	11810	AMP	10/09/13	ARA	
		REVISIONS						

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: SYSTEM SCHEMATIC LIGHTING AND DISTRIBUTION

DWG NO. 7253049-969930

REV. A

SCALE NONE

SHEET 8 OF 8

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: IEEE 315–1975
   GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONIC DIAGRAMS.
2. CUSTOMER DRAWING NUMBERS CONSIST OF:
   (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE
   REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE
   X = ORDER NUMBER.
3. REPRESENTS NODE IN DISTRIBUTIVE I/O NETWORK

   NX.X.XX
   - NODE
   - NETWORK
   - CHASSIS

4. ALL COMPONENTS SHOWN DE–ENERGIZED (SHELF STATE).
5. PORTS 1–8 ARE PDH (PLANT DATA HIGHWAY) OR CUSTOMER DCS.
   PORTS 9–20 ARE THE UDH (UNIT DATA HIGHWAY).
   PORT 21 IS THE ADH (ATLANTA DATA HIGHWAY–REMOTE MONITORING &
   DIAGNOSTIC PORT). PORTS 22–26 ARE TRUNK WITH 25 & 26 BEING THE
   SC FIBER PORTS.
6. SYSTEM SUPPLIED BY GEPPLP, INSTALLATION AND LOCATION IS
   UNDER CUSTOMER SCOPE AND MUST COMPLY WITH THE INSTALLATION
   INSTRUCTIONS STATED IN THE OEM SUPPLIED WITH THE SYSTEM.
   THE MAXIMUM LENGTH OF THE CABLE FROM ANTENNA TO HMI IS
   300FT [91.44 M] PER GEPPLP DESIGN.
7. SYSTEM SUPPLIED BY CUSTOMER, GEPPLP RECOMMEND TO USE
   GE PART #398A4893P0001 (SUPPLIED BY MEINBERG).
8. INSTALLATION AND LOCATION IS UNDER CUSTOMER SCOPE AND MUST
   COMPLY WITH THE INSTALLATION INSTRUCTIONS STATED IN THE OEM
   SUPPLIED WITH THE SYSTEM. THE MAXIMUM LENGTH OF THE CABLE
   FROM ANTENNA TO HMI IS 300 FT [91.44 M] PER GEPPLP DESIGN.
9. ENET8 IS SUPPLIED BY GE WHEN THE REMOTE HMI OPTION IS PURCHASED.
   THE ETHERNET SWITCH IS AN ALLIED TELESYN INTERNATIONAL AT–8026FC MODEL.
10. THE WOBBE METER CAN SUPPORT UP TO 3 GAS TURBINE GENERATOR SETS, FOR CAT5e ETHERNET CABLE
    INSTALLATION THE WOBBE METER CAN DIRECT CONNECT TO EACH UNIT FEATURING ONBOARD ETHERNET
    SWITCH (ENET7), PORT 3 IS FOR UNIT 1, PORT 4 IS FOR UNIT 2, AND PORT 5 IS FOR UNIT 3.
11. THE WOBBE METER CAN SUPPORT UP TO 3 GAS TURBINE GENERATOR SETS, FOR FIBER OPTIC CABLE INSTALLATION THE
    WOBBE METER CAN DIRECT CONNECT TO ONE UNIT FEATURING ONBOARD ETHERNET SWITCH WITH FIBER OPTIC PORT.
    THE FIBER PORT SHALL INTERFACE WITH ENET1 FIBER OPTIC PORT, IF MULTIPLE UNIT INSTALLATION IS REQUIRED ENET1
    AND ENET2 AS APPLICABLE SHALL BE LINKED TO ENET1 AND ENET2 AS APPLICABLE OF ADDITIONAL UNITS UP TO 3.

LEGEND:

SEE X–969005

REFERENCE DRAWINGS:

X–969005 ELECTRICAL SYMBOLS, ABBREVIATIONS, AND REFERENCE DATA

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934

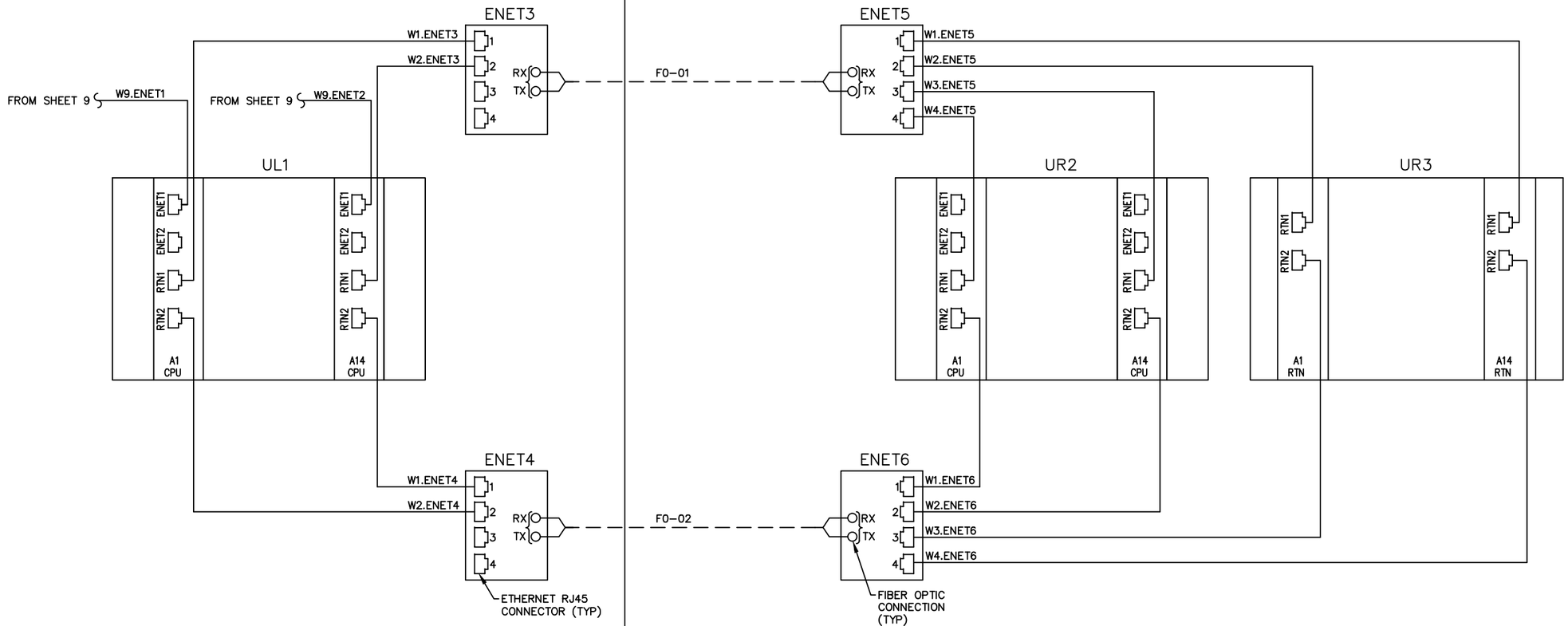
REV. A

SCALE NONE

SHEET 1 OF 10

TURBINE CONTROL PANEL | FIELD PROCESS

CONTROL CUBICLE | MAIN TURBINE TERMINAL BOX



CONTROLLER

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
A	ORIGINAL ISSUE	11809	AMP	10/09/13	ARA

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

DECIMALS	TOLERANCES FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

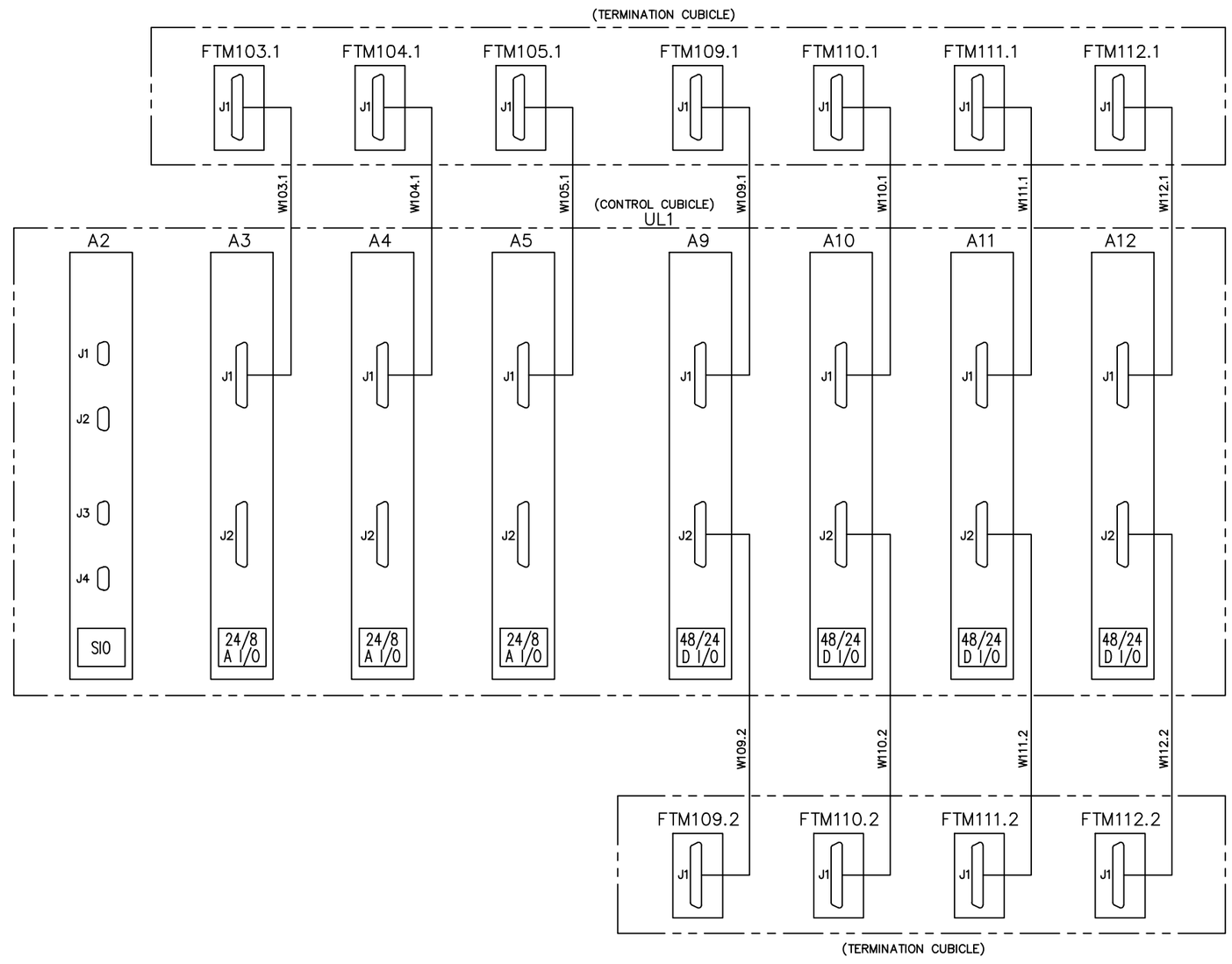
TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049-969934

REV. A

SCALE NONE

SHEET 2 OF 10



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REVISIONS

THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934

REV. A

SCALE NONE

SHEET 3 OF 10

MAIN TURBINE TERMINAL BOX

FTM202 FTM203.1 FTM204.1 FTM205.1 FTM206.1

W202 W203.1 W204.1 W205.1 W206.1

UR2

A2 A3 A4 A5 A6 A7 A8 A12 A13

SPEED SENSOR

24/8 A I/O

24/8 A I/O

24/8 A I/O

24/8 A I/O

2C ACT CNTRLR

2C ACT CNTRLR

RT SIO

NTWK CNTRLR

NTWK1 NTWK2 NTWK3 NTWK4

W203.2 W204.2 W205.2 W206.2 W207 W208

FTM203.2 FTM204.2 FTM205.2 FTM206.2 FTM207 FTM208

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934

REV. A

SCALE NONE

SHEET 4 OF 10

MAIN TURBINE TERMINAL BOX

UR3

FTM302 — W302 — A2 — SPEED SENSOR
FTM303.1 — W303.1 — A3 — 24/8 A I/O
FTM304.1 — W304.1 — A4 — 24/8 A I/O
FTM305.1 — W305.1 — A5 — 24/8 A I/O
FTM306.1 — W306.1 — A6 — 24/8 A I/O
A7 — 2C ACT CNTRLR
A8 — 2C ACT CNTRLR
FTM311.1 — W311.1 — A11 — 64 DO
FTM312.1 — W312.1 — A12 — 48 DI
A13 — NTWK1, NTWK2, NTWK3, NTWK4 — NTWK CNTRLR

FTM303.2 — W303.2
FTM305.2 — W305.2
FTM307 — W307
FTM308 — W308
FTM311.2 — W311.2
FTM312.2 — W312.2

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

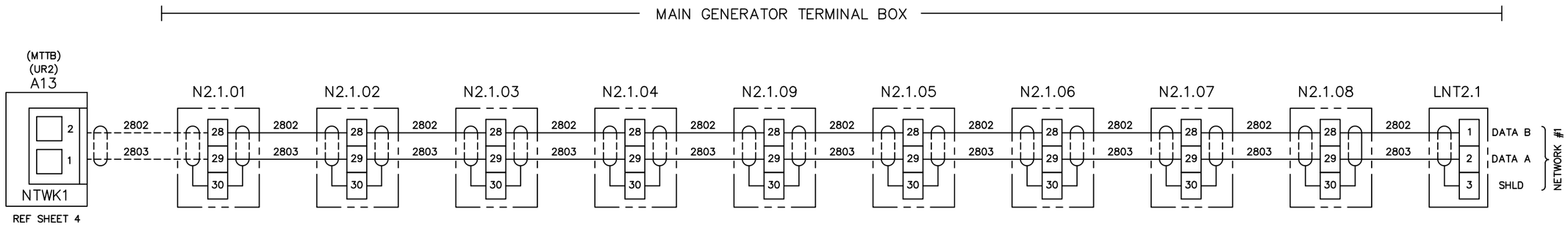
UNIT TYPE
LM6000®

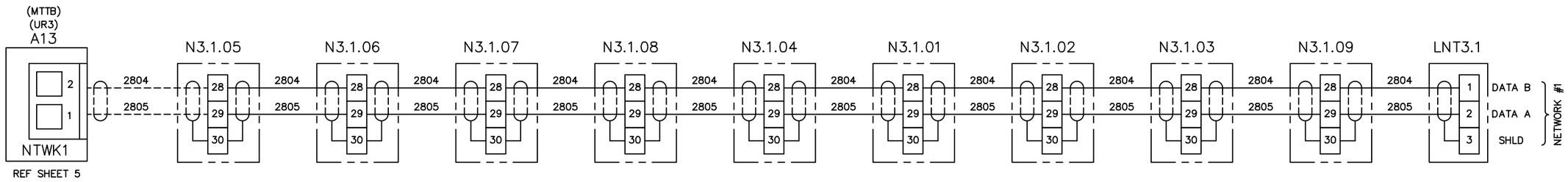
ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934
REV. A
SCALE NONE
SHEET 5 OF 10





LINKNET–MGTB I/O MODULES

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DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE
SYSTEM SCHEMATIC
COMMUNICATION

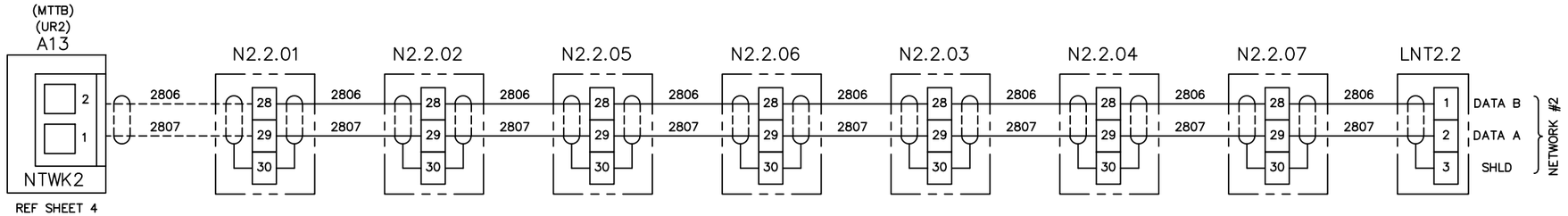
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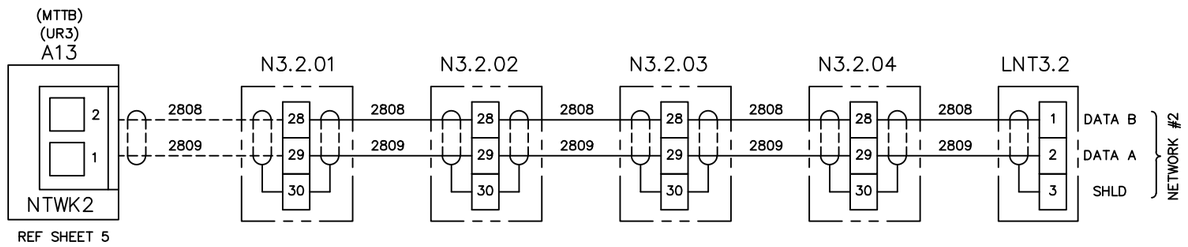
REV. A

SCALE NONE

SHEET 6 OF 10

AUXILIARY SKID TERMINAL BOX





LINKNET–ASTB I/O MODULES

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000PC

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

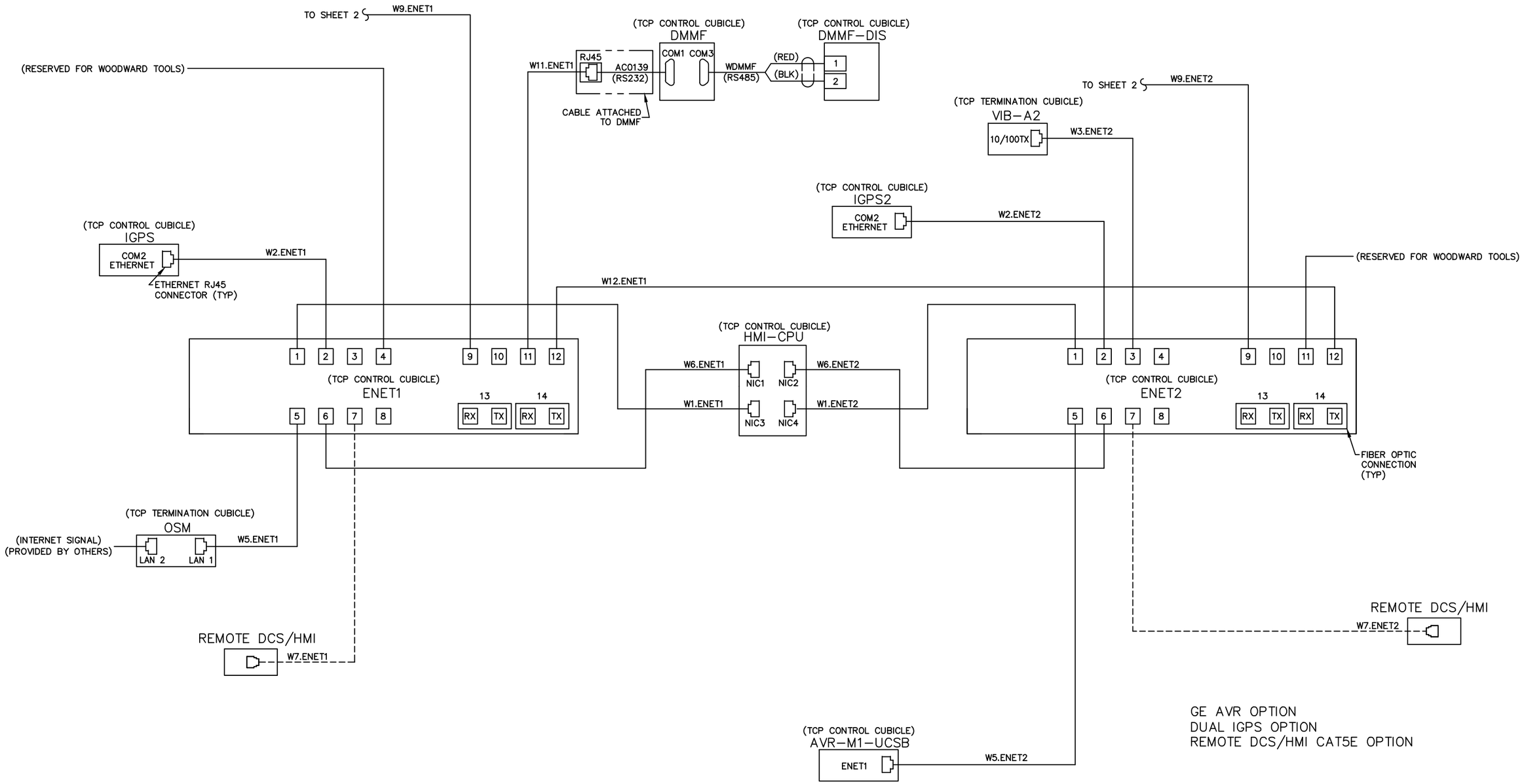
TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934

REV. A

SCALE NONE

SHEET 7 OF 10



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

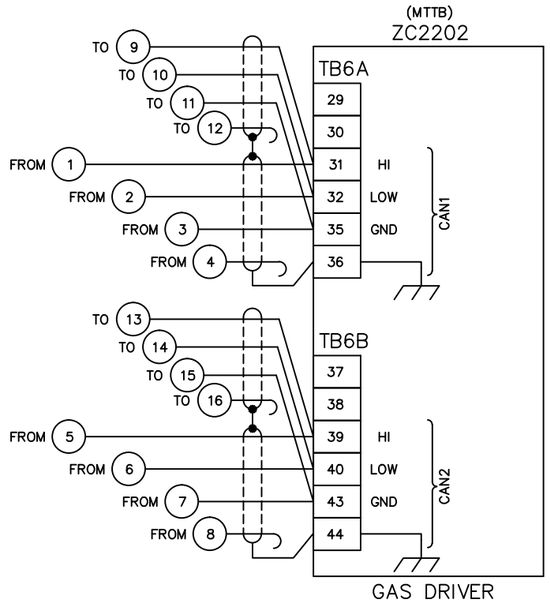
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SYSTEM SCHEMATIC
COMMUNICATION

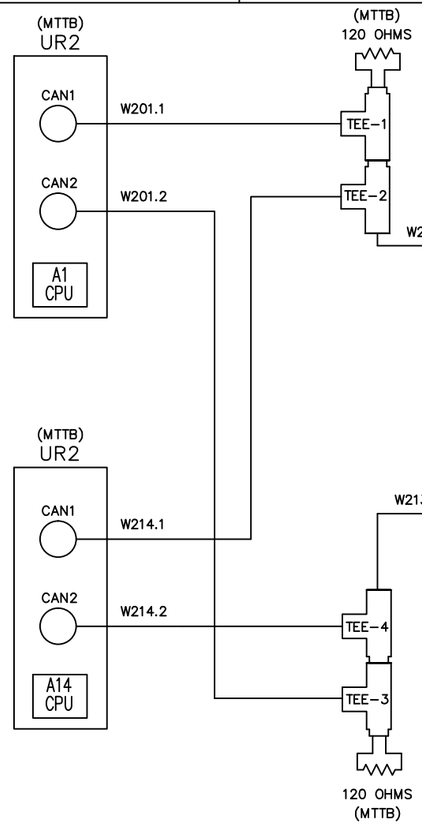
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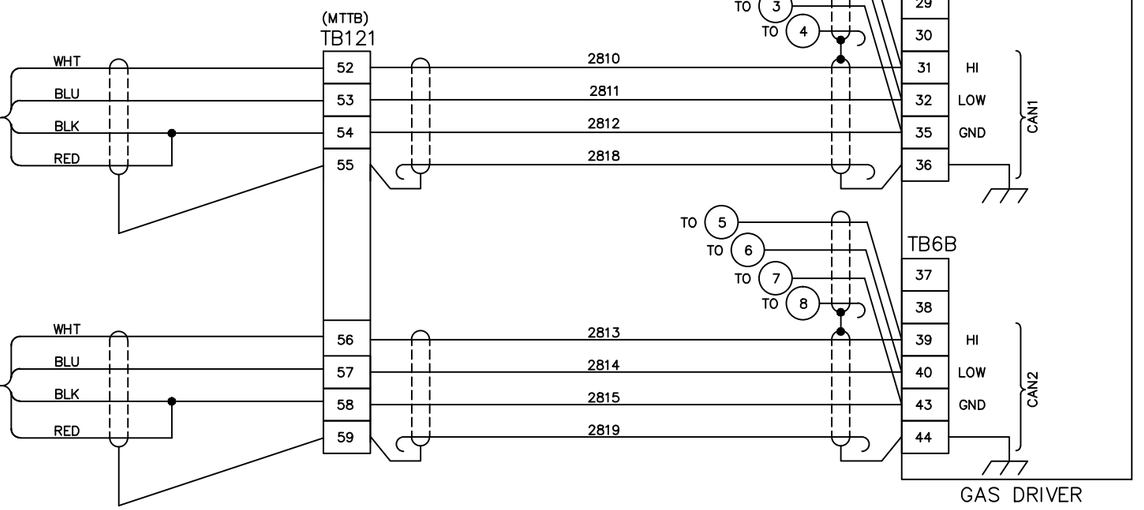
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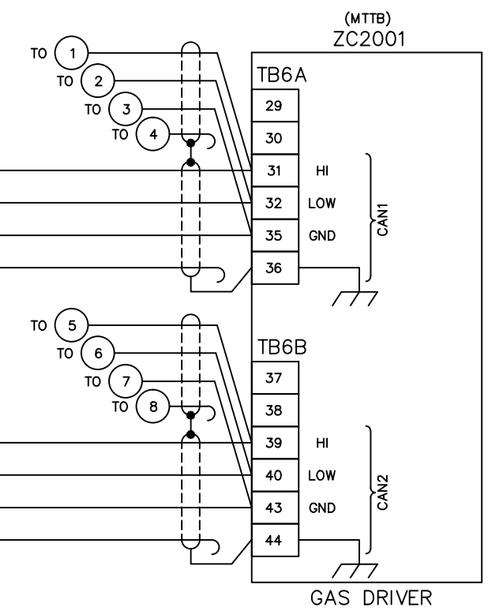
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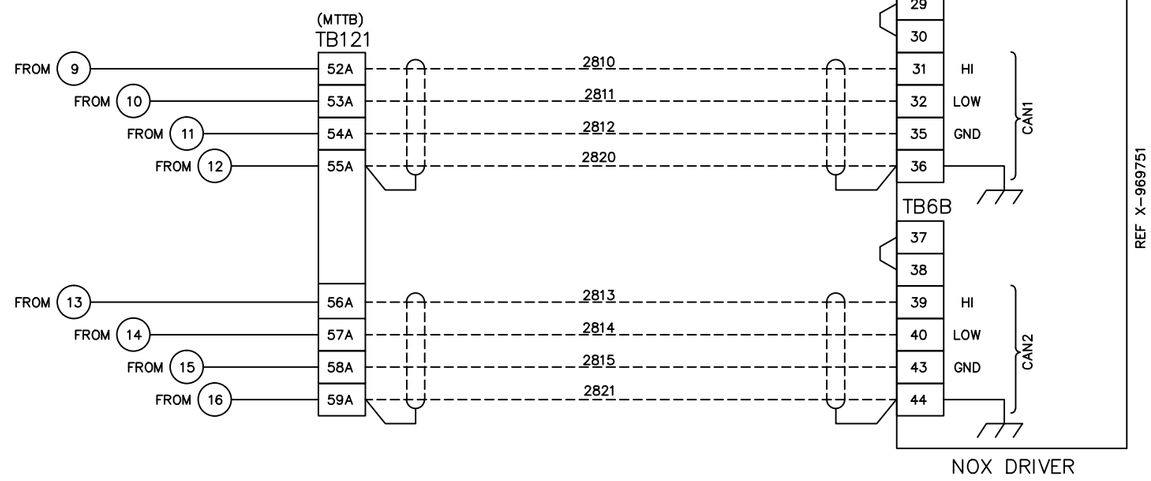
SHEET 8 OF 10











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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

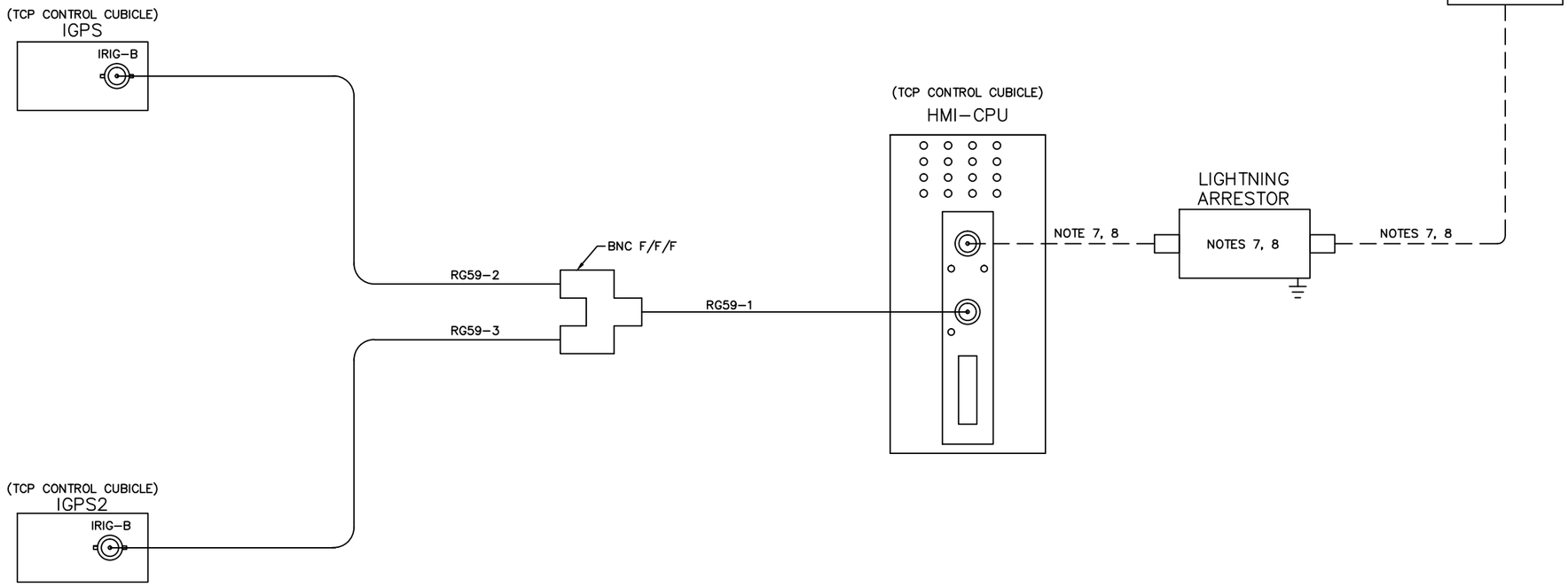
TITLE: SYSTEM SCHEMATIC COMMUNICATION

DWG NO. 7253049-969934

REV. A

SCALE NONE

SHEET 9 OF 10



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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000PC

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

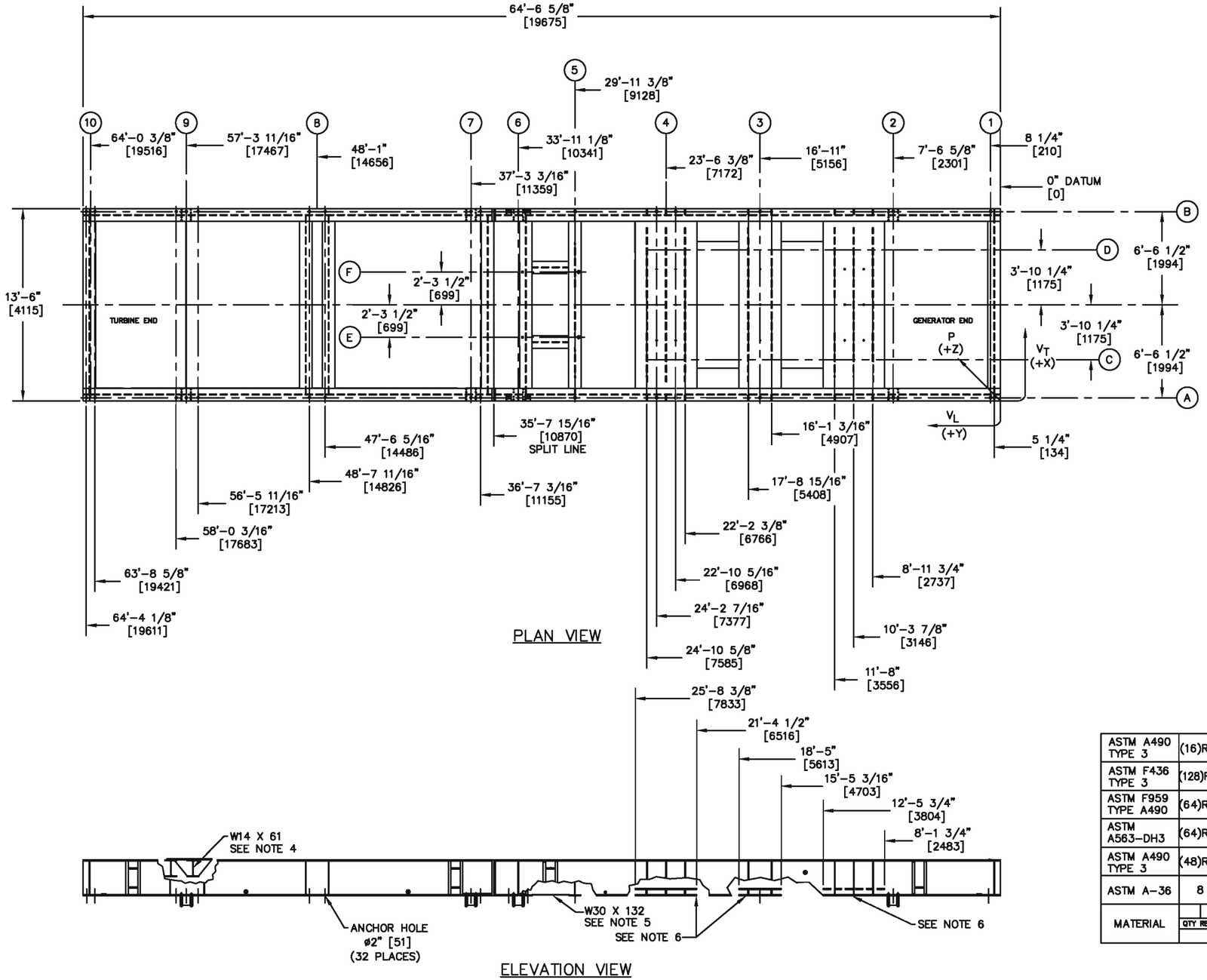
TITLE
SYSTEM SCHEMATIC
COMMUNICATION

DWG NO. 7253049–969934

REV. A

SCALE NONE

SHEET 10 OF 10



PLAN VIEW

ELEVATION VIEW

LEGEND:

- ● ANCHOR BOLT
- P VERTICAL LOAD
- V_T TRANSVERSE SHEAR
- V_L LONGITUDINAL SHEAR

NOTES:

1. BOLT HOLE TOLERANCE: ± 1/8" [3], TRUE POSITION.
2. LEVELING AND GROUTING TO BE PERFORMED PER GUIDELINES OF INSTALLATION MANUAL.
3. ALL ANCHORING HARDWARE AND EMBEDDED STEEL TO BE SUPPLIED BY CUSTOMER AND SHALL BE ASTM F1554 Gr. 105 ANCHOR BOLT WITH A MIN. YIELD STRENGTH OF 105,000 PSI.
4. W14 X 61# BEAMS ILLUSTRATED AT ANCHOR POINT 10 DO NOT EXTEND TO BOTTOM OF SKID. ALL OTHER BEAMS SHOWN ARE W30 X 132#.
5. W30 X 132# BEAMS ILLUSTRATED AT ANCHOR POINTS 5 AND 6 ARE JOINED BY PLATE AT BOTTOM FLANGES. GROUTING BENEATH PLATE AND BEAMS IS REQUIRED. SEE SHEET 2.
6. FLAT PLATES ILLUSTRATED AT ANCHOR POINTS 2, 3 AND 4 EXTEND TO THE BOTTOM OF SKID. GROUTING OF THESE PLATES IS REQUIRED. SEE SHEET 2.
7. SHEAR LUGS ARE SHIPPED LOOSE FOR FIELD INSTALLATION. HOLES FOR SHEAR LUGS NOT SHOWN FOR CLARITY.
8. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
9. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
10. TOLERANCES: LINEAR DIMENSION: ± 1/8" [3 mm] ANGULAR: ±0.5°
11. LIFTING PINS ARE NOT SHOWN ON PLAN VIEW FOR CLARITY.
12. FOR GROUT INFORMATION AND SHIM LOCATIONS, REFER TO GEPPLP LM6000 60HZ INSTALLATION MANUAL.
13. BOLT TORQUE CAN BE VERIFIED BY ENSURING THAT THE PROTRUSIONS ON THE LOAD INDICATING WASHERS HAVE BEEN COMPRESSED. SUFFICIENT TORQUE WILL COMPRESS THE PROTRUSIONS TO THE EXTENT THAT A MAXIMUM GAP OF 0.005" [0.127 mm] EXISTS BETWEEN THE PROTRUSIONS. NOTE THAT THE MAXIMUM GAP MAY BE INCREASED TO 0.015" [0.381 mm] IF THE LOAD INDICATING WASHER IS USED UNDER THE UNTURNED ELEMENT.
14. DATUM DIMENSIONS ARE FROM GENERATOR END OF SKID.
15. CUSTOMER SUPPLIED GENERATOR AND GEARBOX ANCHOR BOLTS TO BE EMBEDDED INTO FOUNDATION. SEE SHEETS 7 & 8.

MATERIAL	QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	DESCRIPTION	ITEM NO.
			PARTS LIST		
ASTM A490 TYPE 3	(16)REF	A490P37184T3	BOLT, HEAVY HEX	7/8"–9NC X 11 1/2" LG	6
ASTM F436 TYPE 3	(128)REF	386A6980P0001	WASHER	7/8"	5
ASTM F959 TYPE A490	(64)REF	386A6976P0001	WASHER	7/8", LOAD INDICATING	4
ASTM A563–DH3	(64)REF	386A6979P0001	NUT, HEAVY HEX	7/8"–9NC	3
ASTM A490 TYPE 3	(48)REF	386A6978P0001	BOLT, HEAVY HEX	7/8"–9NC X 10 1/2" LG	2
ASTM A–36	8	287728	SHEAR LUG		1

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REVISIONS

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	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

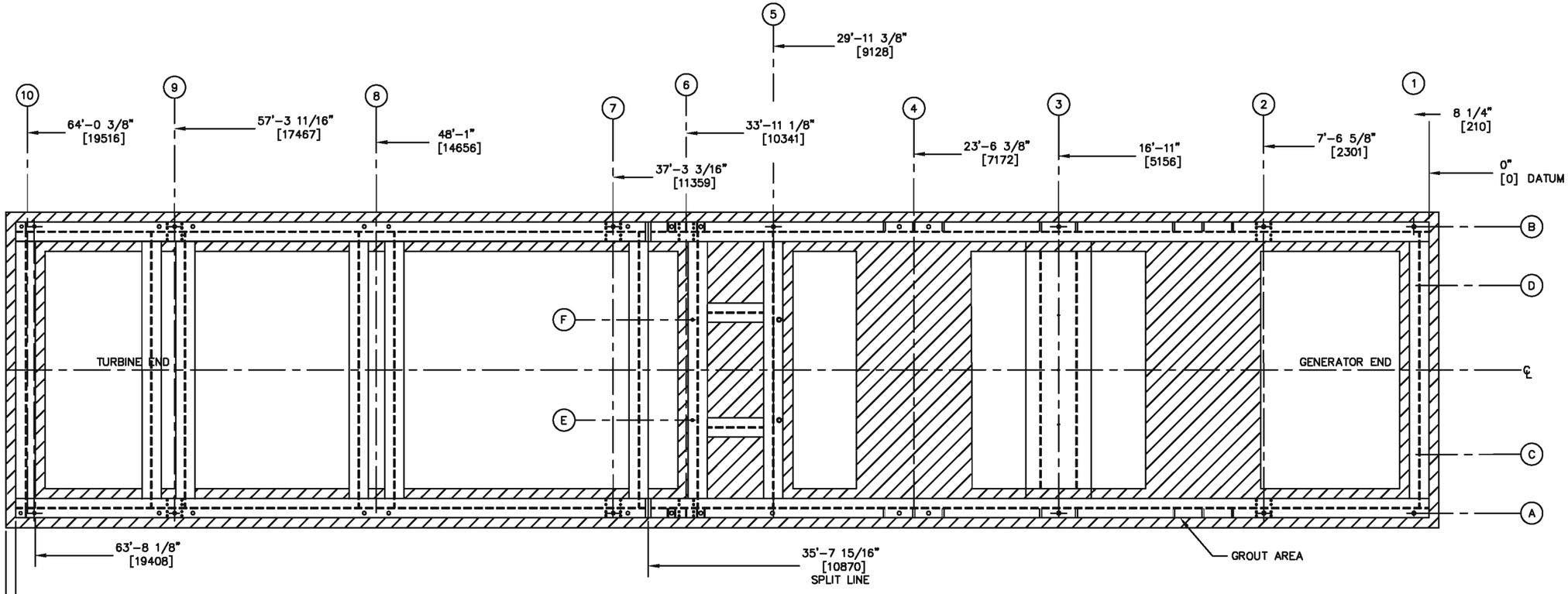
ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

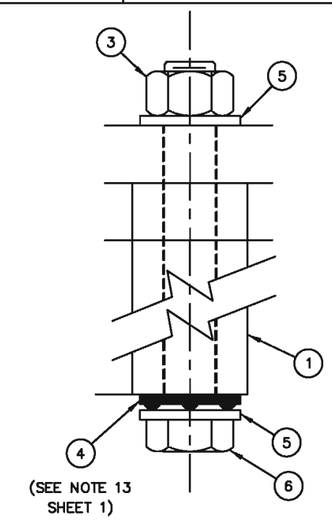
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 REV. H

SCALE 1/4" = 1'-0" SHEET 1 OF 12



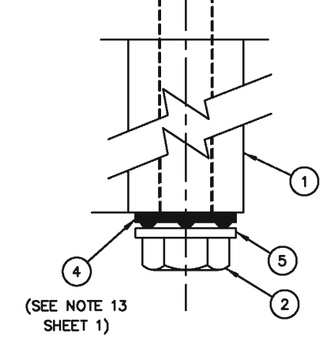
GROUTING DETAIL



(SEE NOTE 13 SHEET 1)

LOAD INDICATING WASHER DETAIL

(DETAIL SHEET 6, ANCHOR POINTS 7A & 7B)



(SEE NOTE 13 SHEET 1)

LOAD INDICATING WASHER DETAIL

(TYPICAL DETAILS SHEETS 3, 5 & 6)

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

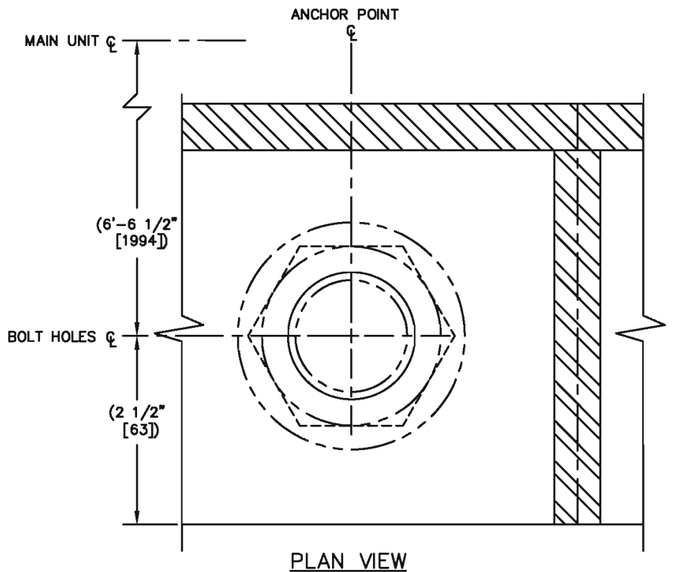
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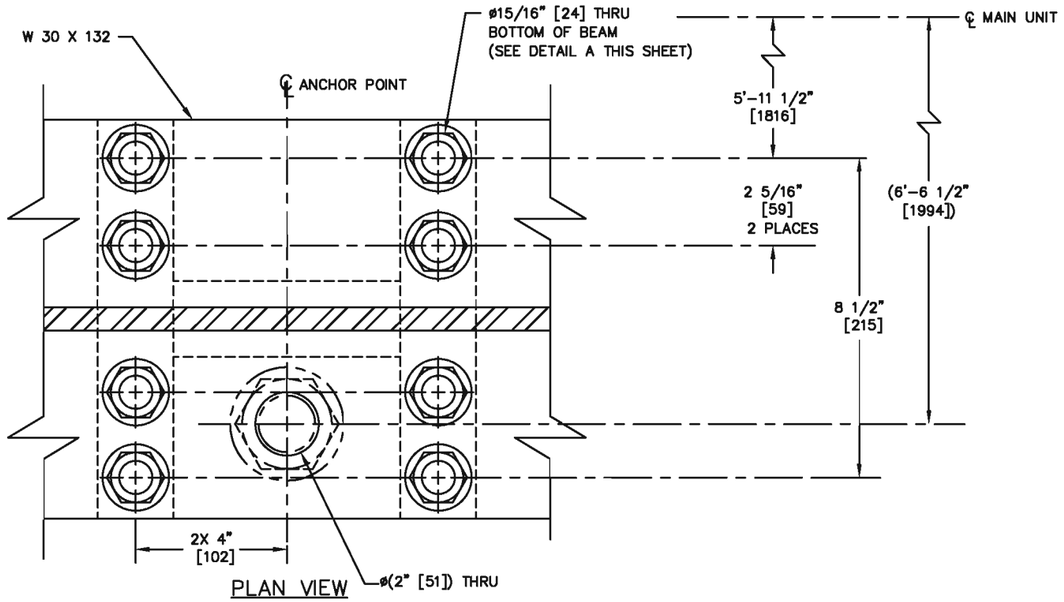
TITLE INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 | REV. H

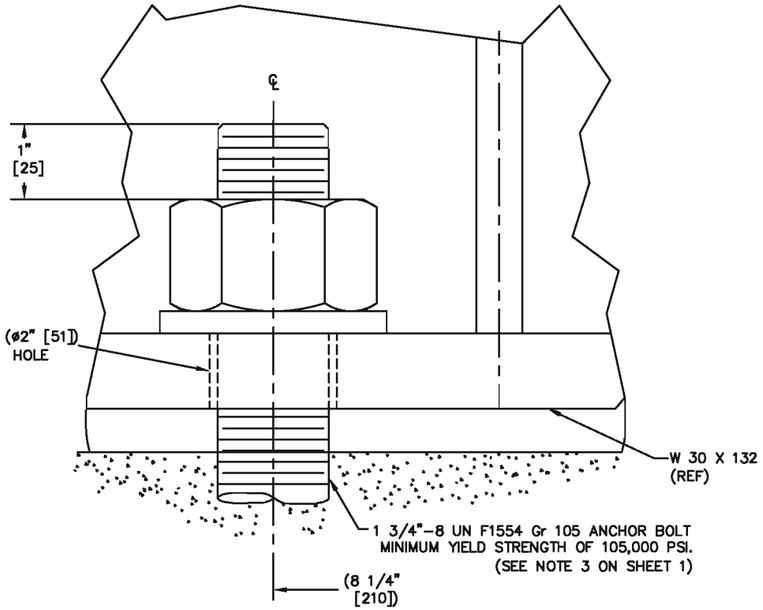
SCALE 3/8" = 1'-0" | SHEET 2 OF 12



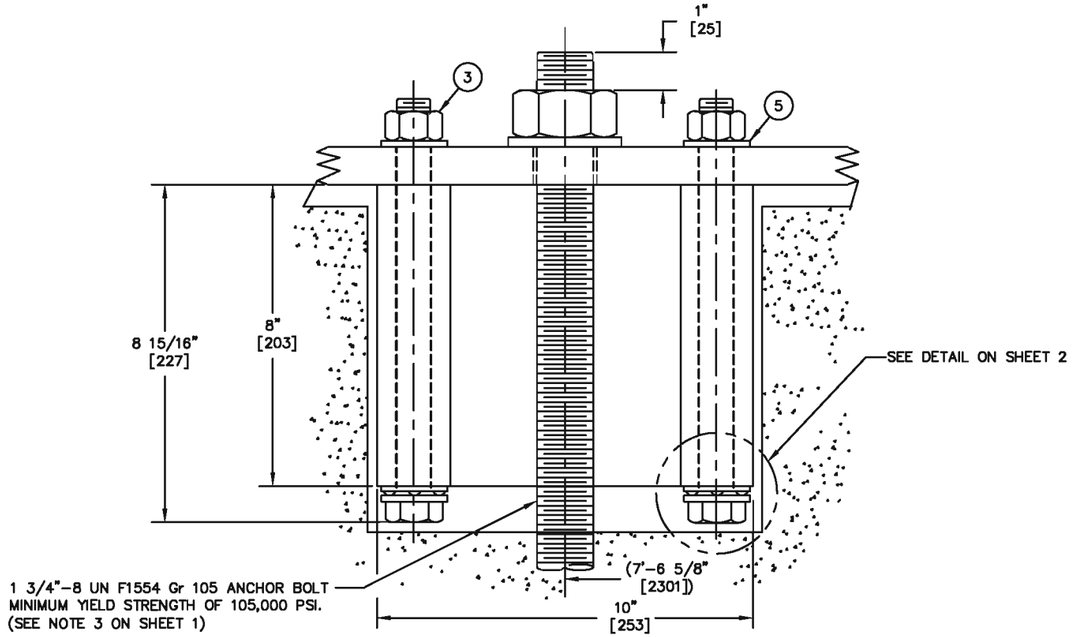
PLAN VIEW
ANCHOR POINTS 1A & 1B



PLAN VIEW
ANCHOR POINTS 2A & 2B



ELEVATION



ELEVATION

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REVISIONS

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THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

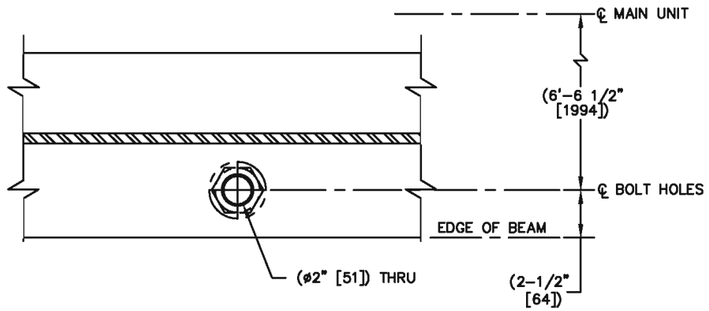
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO.: TYPICAL DRAWING 969224

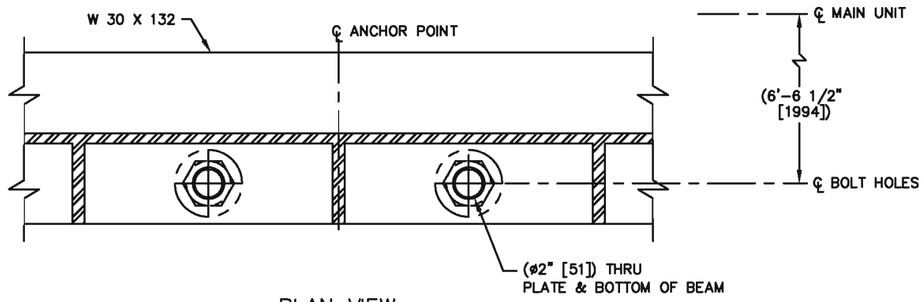
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SCALE 1 1/2" = 1'–0"

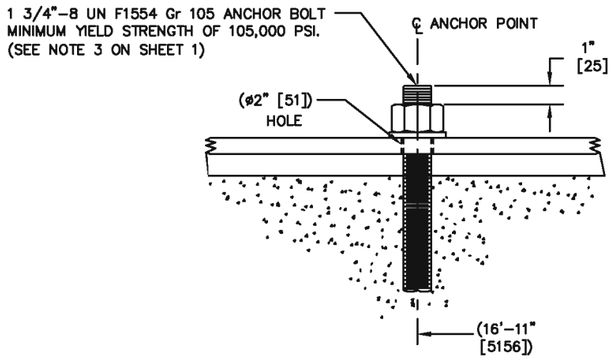
SHEET 3 OF 12



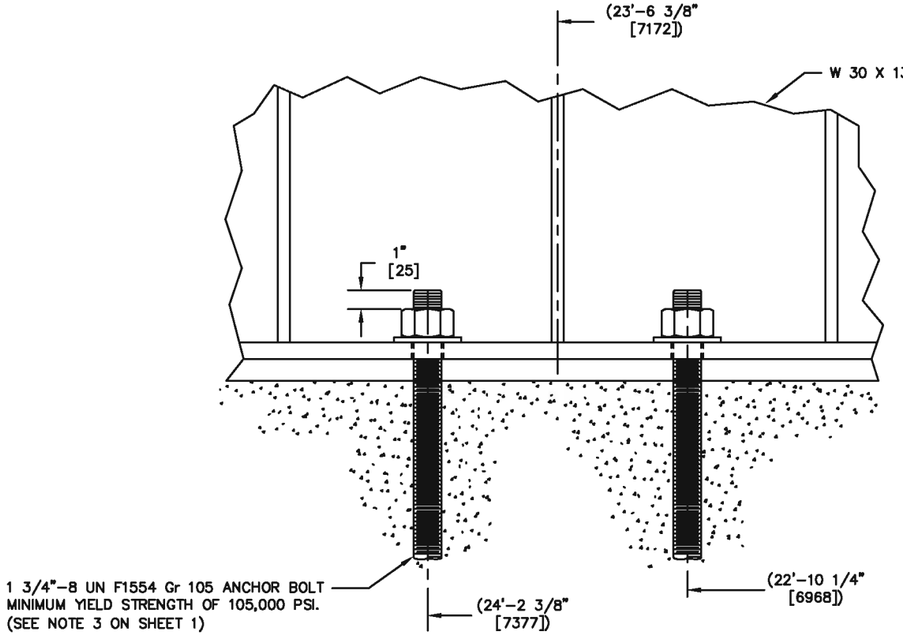
PLAN VIEW
ANCHOR POINTS 3A & 3B



PLAN VIEW
ANCHOR POINTS 4A & 4B



ELEVATION



ELEVATION

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

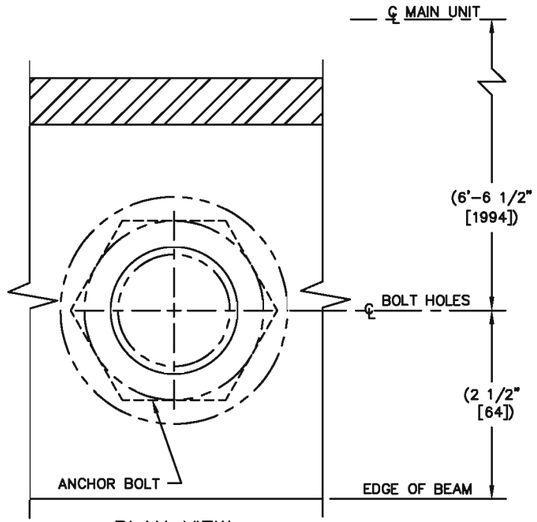
TITLE
INSTALLATION FOOTPRINT
ANCHOR BOLT AND SHEAR LUG
LOCATION

DWG NO.
TYPICAL DRAWING 969224

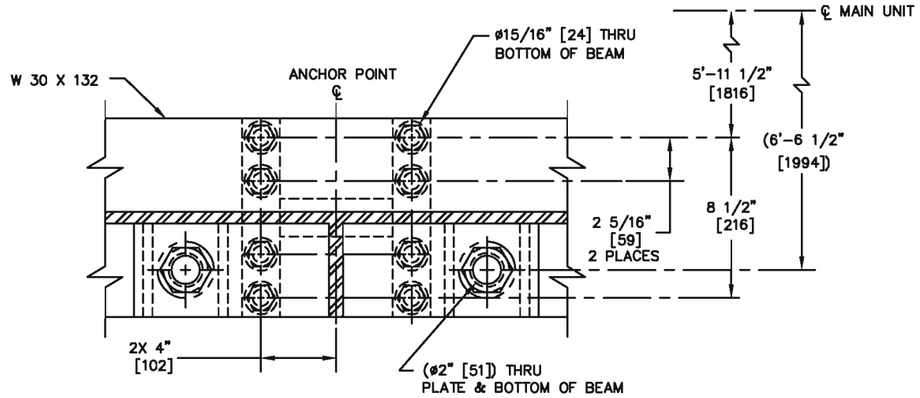
REV.
H

SCALE 1 1/2" = 1'-0"

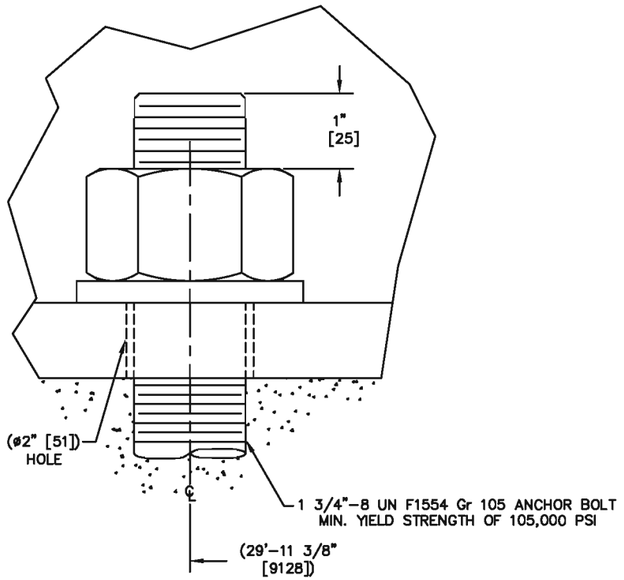
SHEET 4 OF 12



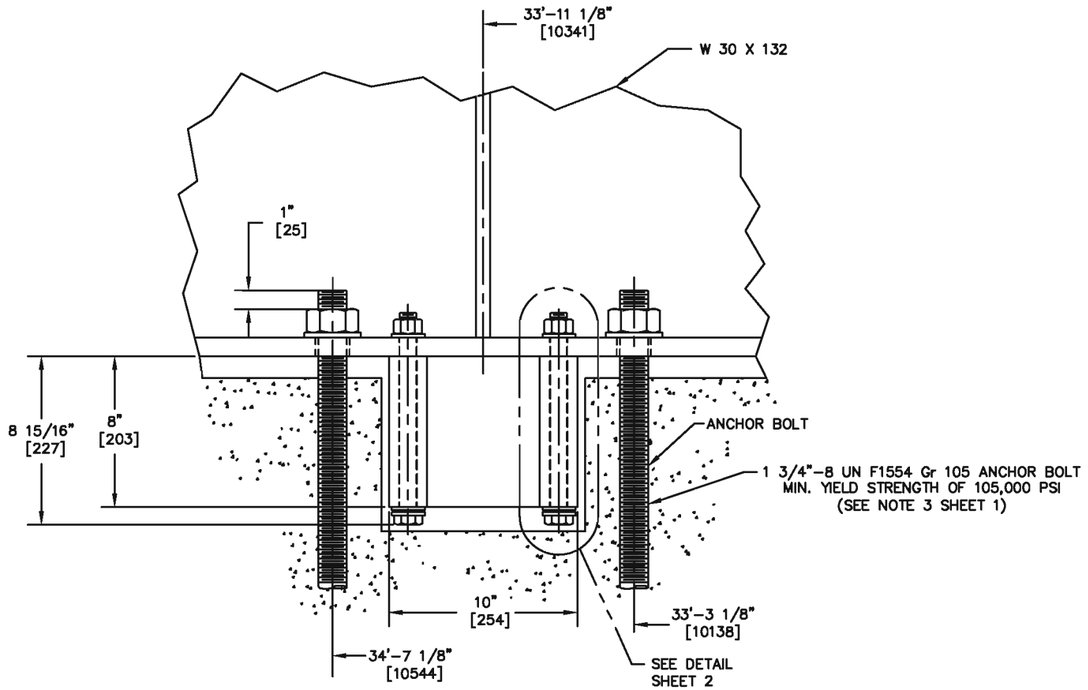
PLAN VIEW
ANCHOR POINTS 5A & 5B



PLAN VIEW
ANCHOR POINTS 6A & 6B



ELEVATION
SCALE 4:1



ELEVATION

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THIRD ANGLE PROJECTION

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TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000®

ADDL INFO
GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

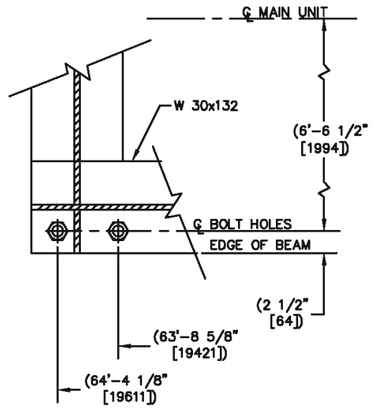
TITLE
INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO.
TYPICAL DRAWING 969224

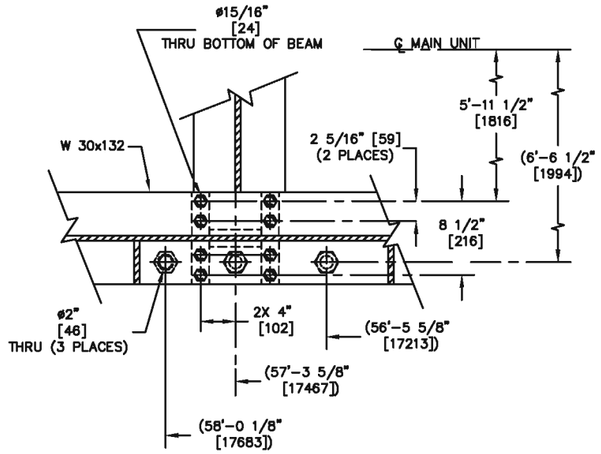
REV.
H

SCALE 1 1/2" = 1'-0"

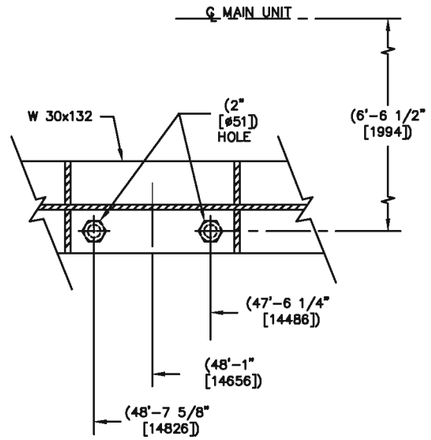
SHEET 5 OF 12



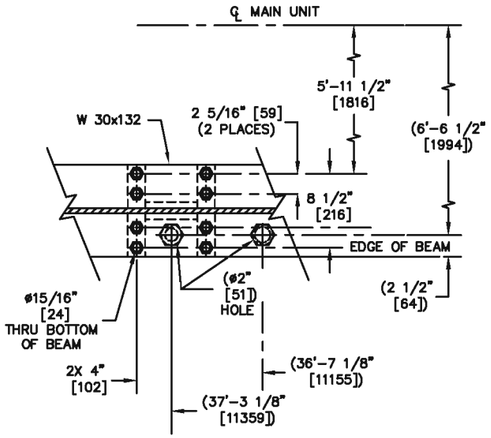
PLAN VIEW
ANCHOR POINTS 10A & 10B



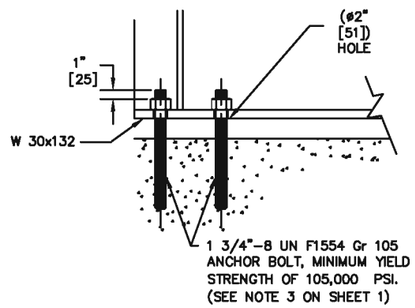
PLAN VIEW
ANCHOR POINTS 9A & 9B



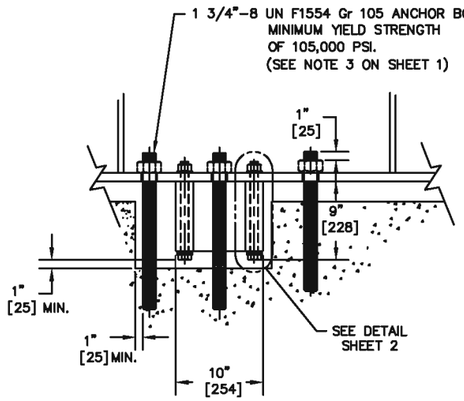
PLAN VIEW
ANCHOR POINTS 8A & 8B



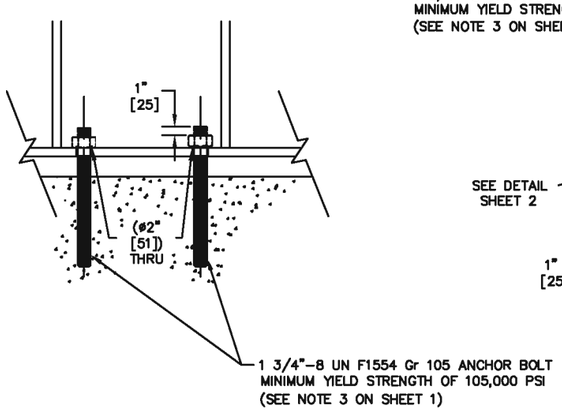
PLAN VIEW
ANCHOR POINTS 7A & 7B



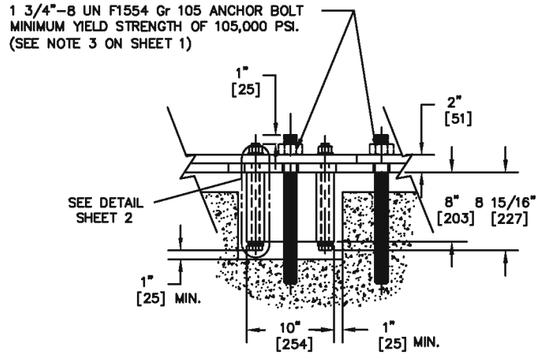
ELEVATION



ELEVATION



ELEVATION



ELEVATION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

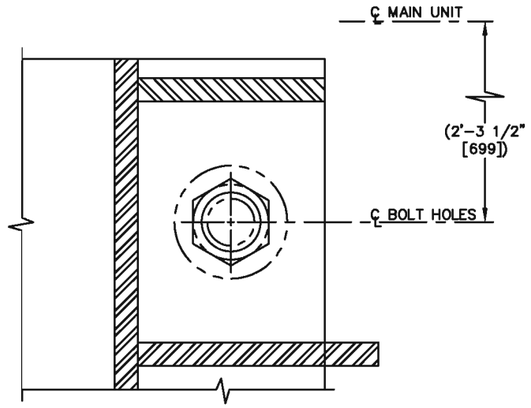
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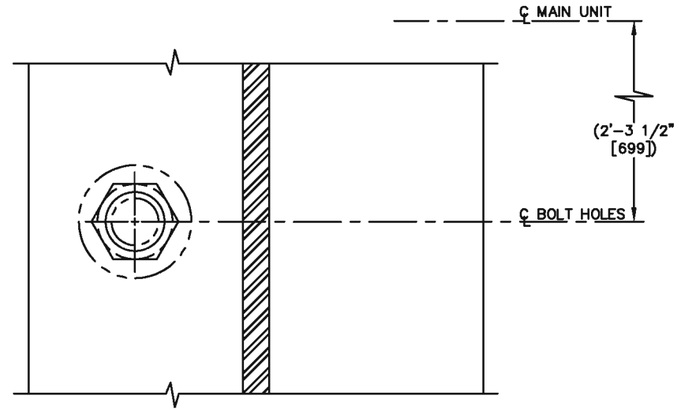
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 REV. H

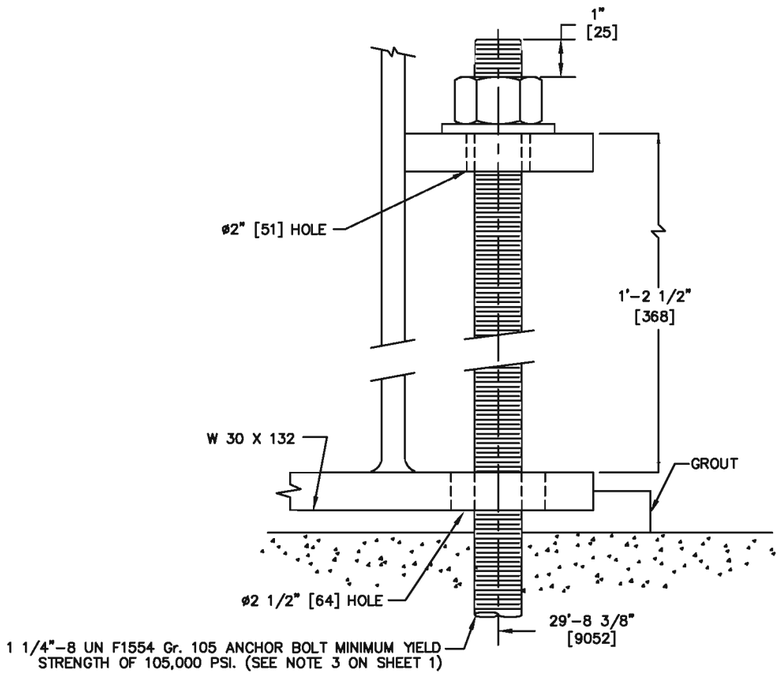
SCALE 1 1/2" = 1'-0" SHEET 6 OF 12



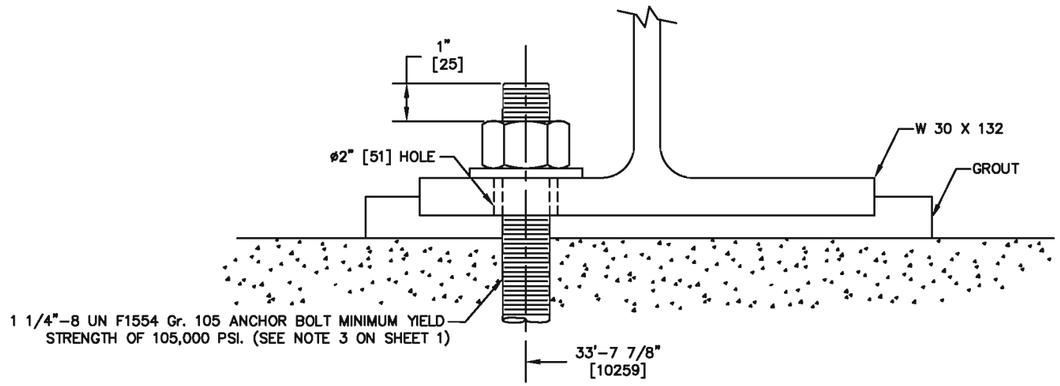
PLAN VIEW
ANCHOR POINTS 5E & 5F



PLAN VIEW
TYPICAL AT ANCHOR POINTS 6E & 6F



ELEVATION
SCALE 2:1



ELEVATION
SCALE 2:1

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

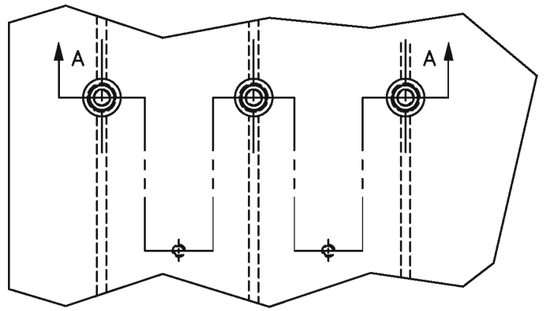
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GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

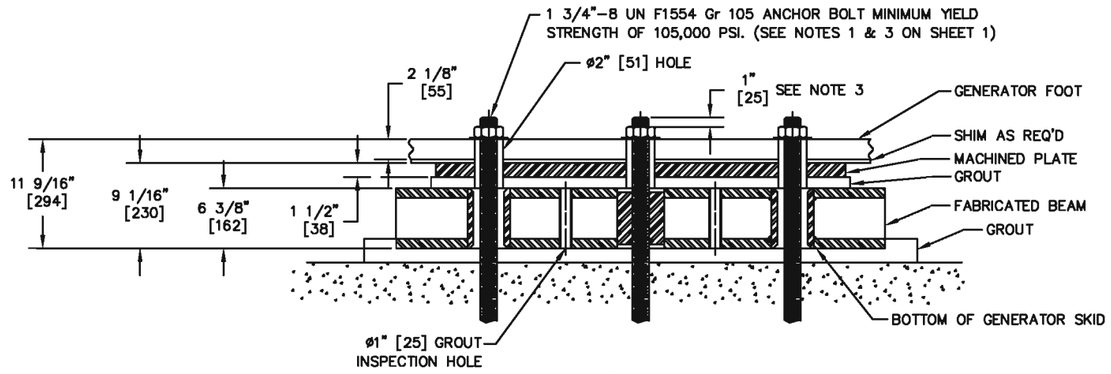
DWG NO. TYPICAL DRAWING 969224 REV. H

SCALE 1/4" = 1'-0" SHEET 7 OF 12



PLAN VIEW

TYPICAL AT ANCHOR POINTS 2C, 2D, 4C & 4D



SECTION A–A

NOTES:

1. GENERATOR ANCHOR BOLT LENGTH SHOULD HAVE ADDITIONAL 3/8" [10] FOR SHIM ALLOWANCE.
2. BOLTS MUST WITHSTAND LOADS REPRESENTED ON SHEET 10 & 11. CLEARANCE REQUIRED FOR SETTING DOWN MAIN UNIT AND GENERATOR ALIGNMENT.
3. RECOMMENDED ANCHOR BOLT EXTENSION LENGHT.

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NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO.: TYPICAL DRAWING 969224

REV.: H

SCALE 1/4" = 1'-0"

SHEET 8 OF 12

LM6000 PC – PACKAGE MOUNTED AIR FILTER 60Hz (7-290 ERJT)

STATIC FOUNDATION LOAD TABLE (KIPS)

ANCHOR POINTS	DEAD LOAD			ROOF LL (60 PSF)			SEISMIC (TRANSVERSE)			SEISMIC (LONGITUDINAL)			SEISMIC (VERTICAL)			WIND (150 MPH) (TRANSVERSE)			WIND (150 MPH) (LONGITUDINAL)			GENERATOR FAULT TORQUE (Brush Method)			GEN+ENG+GEAR OPERATING LOAD			ENGINE SEIZURE LOADS		
	VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ	
	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL
1–A	7.4	0.0	0.0	2.4	0.0	0.0	–42.1	0.0	0.0	–10.0	0.0	0.0	2.2	0.0	0.0	–30.8	0.0	0.0	–9.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1–B	7.8	0.0	0.0	2.5	0.0	0.0	41.2	0.0	0.0	–10.6	0.0	0.0	2.3	0.0	0.0	24.1	0.0	0.0	–7.8	0.0	0.0	–0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–A*	10.5	0.0	0.0	1.8	0.0	0.0	–11.8	–20.0	–5.9	5.9	1.5	–33.8	2.9	0.1	0.4	–12.9	–7.2	–3.0	1.5	–0.3	–10.8	–7.4	0.1	0.0	–0.1	0.1	–0.1	0.0	0.2	–0.2
2–B*	10.4	0.0	0.0	1.6	0.0	0.0	11.9	–19.5	5.8	4.1	1.4	–33.0	2.9	–0.1	–0.4	5.9	–6.9	3.1	1.8	–0.3	–11.0	7.4	0.1	0.0	0.1	0.1	0.1	0.0	0.2	0.2
3–A	11.4	0.0	0.0	0.9	0.0	0.0	–3.2	0.0	0.0	1.0	0.0	0.0	2.7	0.0	0.0	–6.0	0.0	0.0	–0.9	0.0	0.0	–4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3–B	11.3	0.0	0.0	0.9	0.0	0.0	3.2	0.0	0.0	0.5	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	–0.9	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–A	21.6	0.0	0.0	9.5	0.0	0.0	–32.3	0.0	0.0	–27.8	0.0	0.0	6.6	0.0	0.0	–27.2	0.0	0.0	–16.8	0.0	0.0	–8.7	0.0	0.0	–0.6	0.0	0.0	–0.1	0.0	0.0
4–B	22.7	0.0	0.0	9.9	0.0	0.0	26.3	0.0	0.0	–25.5	0.0	0.0	6.1	0.0	0.0	9.0	0.0	0.0	–17.1	0.0	0.0	8.7	0.0	0.0	0.5	0.0	0.0	0.1	0.0	0.0
5–A	21.5	0.0	0.0	10.9	0.0	0.0	–34.3	0.0	0.0	–40.8	0.0	0.0	7.4	0.0	0.0	–26.9	0.0	0.0	–23.2	0.0	0.0	–7.4	0.0	0.0	–2.8	0.0	0.0	–0.1	0.0	0.0
5–B	24.3	0.0	0.0	11.5	0.0	0.0	28.9	0.0	0.0	–36.3	0.0	0.0	6.7	0.0	0.0	9.2	0.0	0.0	–23.6	0.0	0.0	7.4	0.0	0.0	2.6	0.0	0.0	0.1	0.0	0.0
6–A*	16.7	0.0	0.0	3.9	0.0	0.0	–36.9	–35.8	–6.2	–49.6	0.7	–33.9	4.5	–0.2	0.4	–27.3	–19.8	–3.3	–28.8	0.1	–10.9	–5.9	0.1	0.0	–2.5	–0.3	–0.1	–0.3	–0.5	–0.2
6–B*	19.9	0.0	0.0	4.6	0.0	0.0	40.1	–35.8	6.0	–42.9	–0.6	–33.1	3.9	0.2	–0.4	18.3	–19.8	3.3	–28.8	0.1	–11.1	5.9	0.1	0.0	2.6	–0.3	0.1	0.3	–0.5	0.2
7–A*	43.9	0.0	0.0	7.0	0.0	0.0	–97.8	–28.0	–6.3	10.1	–0.5	–33.7	7.5	0.1	0.4	–64.5	–15.8	–3.3	–13.6	0.1	–10.9	–1.9	0.0	0.0	–0.2	–0.3	–0.1	–0.2	–0.5	–0.2
7–B*	46.8	0.0	0.0	7.7	0.0	0.0	117.7	–28.0	6.1	20.6	–0.4	–33.0	7.4	–0.1	0.4	44.5	–15.8	3.3	–10.3	0.1	–11.0	1.9	0.0	0.0	1.5	–0.3	0.1	0.2	–0.5	0.2
8–A	62.9	0.0	0.0	8.4	0.0	0.0	–95.6	0.0	0.0	128.8	0.0	0.0	10.7	0.0	0.0	–55.4	0.0	0.0	33.1	0.0	0.0	–0.2	0.0	0.0	3.7	0.0	0.0	–2.9	0.0	0.0
8–B	38.1	0.0	0.0	4.2	0.0	0.0	81.4	0.0	0.0	96.2	0.0	0.0	6.9	0.0	0.0	21.1	0.0	0.0	36.5	0.0	0.0	0.1	0.0	0.0	6.4	0.0	0.0	2.3	0.0	0.0
9–A*	18.4	0.1	0.0	1.5	0.0	0.0	–47.5	–59.4	–6.4	0.9	–1.4	–34.0	4.8	0.2	–0.4	–33.2	–35.0	–3.4	–1.7	0.5	–10.9	0.0	0.0	0.0	–4.9	–0.9	–0.1	–15.8	–2.0	–0.2
9–B*	19.2	–0.1	0.0	1.6	0.0	0.0	47.0	–59.3	6.2	–2.4	–1.4	–33.2	4.6	–0.2	–0.3	27.7	–35.0	3.4	–5.6	0.5	–11.1	0.0	0.0	0.0	8.2	–0.8	0.1	11.6	–1.7	0.2
10–A	15.7	0.0	0.0	2.1	0.0	0.0	–115.2	0.0	0.0	12.3	0.0	0.0	5.8	0.0	0.0	–77.9	0.0	0.0	13.7	0.0	0.0	–0.1	0.0	0.0	–0.6	0.0	0.0	–1.2	0.0	0.0
10–B	21.4	0.0	0.0	3.4	0.0	0.0	120.1	0.0	0.0	18.5	0.0	0.0	5.8	0.0	0.0	73.7	0.0	0.0	9.8	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.6	0.0	0.0
AT BRUSH GENERATOR																														
2–C*	40.4	0.0	0.3	0.1	0.0	0.0	–31.8	–26.3	–3.7	–13.0	1.7	–32.9	10.8	0.1	0.4	13.3	–8.8	–1.8	–3.1	–0.3	–10.3	–143.3	–0.1	0.0	–2.1	0.1	–0.1	0.4	0.2	–0.1
2–D*	40.4	0.0	0.3	0.1	0.0	0.0	30.9	–26.3	3.5	–15.7	1.7	–32.6	10.7	–0.1	0.4	–11.4	–8.8	1.8	–3.7	–0.3	–10.4	143.2	–0.1	0.0	2.1	0.1	0.1	–0.4	0.2	0.1
4–C*	40.8	0.0	–0.3	0.6	0.0	0.0	–35.9	–30.2	–3.5	12.6	0.9	–33.0	10.8	0.1	–0.4	–1.9	–14.4	–1.7	–3.7	–0.1	–10.3	–143.0	–0.1	0.0	–2.5	–0.1	–0.1	–0.4	–0.2	–0.1
4–D*	40.8	0.0	–0.3	0.7	0.0	0.0	36.9	–30.2	3.3	13.2	–0.9	–32.6	10.7	–0.1	–0.4	1.8	–14.4	1.7	–3.6	–0.1	–10.5	142.9	–0.1	0.0	2.4	–0.1	0.1	0.4	–0.2	0.1
AT LUFKIN GEAR BOX																														
5–E	12.8	0.0	0.0	2.7	0.0	0.0	–10.2	0.0	0.0	–17.9	0.0	0.0	3.2	0.0	0.0	–6.6	0.0	0.0	–5.8	0.0	0.0	–14.2	0.0	0.0	–5.8	0.0	0.0	0.0	0.0	0.0
5–F	13.5	0.0	0.0	2.9	0.0	0.0	8.8	0.0	0.0	–17.1	0.0	0.0	3.2	0.0	0.0	2.1	0.0	0.0	–5.9	0.0	0.0	14.2	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0
6–E	11.7	0.0	0.0	1.0	0.0	0.0	–8.8	0.0	0.0	–6.2	0.0	0.0	3.0	0.0	0.0	–5.5	0.0	0.0	–7.8	0.0	0.0	–14.0	0.0	0.0	–5.8	0.0	0.0	–0.1	0.0	0.0
6–F	12.5	0.0	0.0	1.2	0.0	0.0	9.8	0.0	0.0	–3.9	0.0	0.0	2.8	0.0	0.0	3.4	0.0	0.0	–7.6	0.0	0.0	14.1	0.0	0.0	5.8	0.0	0.0	0.1	0.0	0.0
TOTAL	664.5	0.0	0.0	105.6	0.0	0.0	0.9	–398.7	–1.2	5.0	2.6	–398.7	159.5	0.0	0.1	–133.3	–201.6	0.0	–133.3	0.0	–129.4	–0.2	0.0	0.0	14.2	–2.7	–0.1	–5.4	–5.0	0.1

* SHEAR LUG LOCATIONS

NOTES:

1. REFER SHEET 10 FOR ADDITIONAL DESIGN INFORMATION.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO.: TYPICAL DRAWING 969224

REV.: H

SCALE: NONE

SHEET 9 OF 12

NOTES:

1. FOR P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENT A LOAD AT EACH ANCHOR LOCATION.
3. ROOF LIVE LOAD IS APPLIED AS PER IBC 2009 TABLE 1607.1, REPRESENTS A UNIFORM LOAD OF 60 PSF ON PACKAGE AND AIR FILTER AND 100 PSF ON WALKWAYS APPLIED AT EXPOSED SECTION OF THE MAIN UNIT AND ON THE AIR FILTER ROOF.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE LONGITUDINAL AND TRANSVERSE DIRECTION AS PER EQUIVALENT LATERAL FORCE PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER IBC 2009 CODE SECTION 1613 THAT REFERENCES ASCE 7–05.

SITE CLASS	D
OCCUPANCY CATEGORY, TABLE 1604.5	III
SEISMIC DESIGN CATEGORY – SECTION 1613.5.6	E
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7–05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7–05, TABLE 15.4–1	2.50
SDS – SPECTRAL RESPONSE ACCEL.AT 0.2 SEC – G	1.20
SD1 – SPECTRAL RESPONSE ACCEL.AT 1 SEC – G	0.70
G–LEVELS FOR BASE ACCELERATIONS FOR DESIGN PER IBC 2009	0.60

SEISMIC LOAD MAY BE POSITIVE OR NEGATIVE
CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT Ev = +/–0.2SDS D = 0.24 D IN THE FOUNDATION LOADS AS PER ASCE 7–05 SECTION 12.4.

5. WIND LOAD ARE PER ASCE 7–05 CODE, 150 MPH FOR LOW RISE BUILDING, H <60 FT

WIND PRESSURE (PSF), EQ 6–18	p = qh (GCpf – GCpi)	75.533(GCpf–GCpi)
EXTERNAL PRESSURE COEF., FIGURE 6–10	GCpf	
INTERNAL PRESSURE COEF., FIGURE 6–5	GCpi	+/–0.18
VELOCITY PRESSURE (psf) , Eq 6–15	qh = 0.00256 Kz Kzt Kd V2 I	75.53
VELOCITY PRESSURE EXPOSURE COEF. – TABLE 6–3	Kz	0.98
TOPOGRAPHIC FACTOR, Eq. 6–3	Kzt = (1 + K1 K2 K3)2	1.369
FIGURE 6–4	K1	0.17
FIGURE 6–4	K2	1
FIGURE 6–4	K3	1
WIND DIRECTIONALLITY FACTOR, TABLE 6–4	Kd	0.85
WIND VELOCITY (MPH)	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15
EXPOSURE CATEGORY	C	C

6. OPERATING LOADS REPRESENT THE FOLLOWING:
   A. AXIAL THRUST – DUE TO THE MOMENTUM CHANGE THROUGH THE TURBINE.
   B. PRESSURE DIFFERENCE – DUE TO THE PRESSURE DIFFERENCE BETWEEN THE INLET AND THE EXHAUST.
   C. NORMAL OPERATION TORQUE – DUE TO THE OVERTURNING TORQUE PRODUCED BY THE FLUID COUPLING.
   D. THERMAL EXPANSION – DUE TO THE MECHANICAL RESISTANCE TO THE THERMAL GROWTH OF THE TURBINE.
7. GENERATOR FAULT TORQUE IS DECOUPLED INTO UPWARD AND DOWNWARD COMPONENTS. GENERATOR FAULT CAN BE CONSIDERED AS EMERGENCY LOAD CASE.
8. GENERATOR FAULT AND ENGINE SEIZURE CAN BE CONSIDERED AS EMERGENCY LOAD CASE.
9. THE PEAK VIBRATION VELOCITY AT ANY POINT OF THE FOUNDATION SHOULD BE LESS THAN 0.06 IN/SEC AT THE RATED TURBINE SPEED OF 3600 RPM.
10. FOUNDATION SHALL NOT EXCEED +/– 1/8" FLATNESS AND +/– 1/4" SLOPE. FOUNDATION SHALL NOT BOW MORE THAN 1/8" AT ANY LOCATION ON THE SKID.
11. ONE END OF THE FOUNDATION MUST NOT BE 1/4" HIGHER OR LOWER THAN THE OTHER END OF THE SKID.

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 | REV. H

SCALE NONE | SHEET 10 OF 12

LM6000 PG – PACKAGE MOUNTED AIR FILTER 60Hz (7–290 ERJT)
DYNAMIC FOUNDATION LOADS (KIPS)

ANCHOR POINTS	HPC STAGE 1 SHORT TERM			HPT STAGE 2 SHORT TERM			LPC STAGE 0 SHORT TERM			LPT STAGE 5 SHORT TERM			GENERATOR CONTINUOUS UNBALANCE			GEAR BOX CONTINUOUS UNBALANCE			HPC STAGE 1 CONTINUOUS UNBALANCE			HPT STAGE 2 CONTINUOUS UNBALANCE			LPC STAGE 0 CONTINUOUS UNBALANCE			LPT STAGE 5 CONTINUOUS UNBALANCE		
	VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ	
	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL
1–A	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–A*	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.5	0.1	0.0	1.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2–B*	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.9	0.1	0.0	1.7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
3–A	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–A	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–B	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–A	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	1.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5–B	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6–A*	0.1	0.4	0.1	0.2	0.7	0.2	0.8	1.7	2.7	2.3	8.6	4.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1
6–B*	0.1	0.4	0.1	0.2	0.7	0.1	0.7	1.9	1.9	2.3	8.3	3.7	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1
7–A*	0.3	0.2	0.3	0.2	0.1	0.3	4.9	16.7	4.5	14.2	66.4	10.2	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.2	0.5	2.4	0.4
7–B*	0.2	0.2	0.2	0.2	0.2	0.2	3.3	16.0	2.7	15.3	65.7	5.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.1	0.6	2.4	0.2
8–A	11.7	0.0	0.0	12.4	0.0	0.0	34.1	0.0	0.0	94.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.5	0.0	0.0	1.2	0.0	0.0	3.4	0.0	0.0
8–B	11.2	0.0	0.0	9.4	0.0	0.0	29.0	0.0	0.0	82.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.0	0.0	1.1	0.0	0.0	3.0	0.0	0.0
9–A*	17.7	8.2	2.5	23.6	8.1	0.6	34.9	15.5	4.1	123.9	75.0	9.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.3	0.1	0.9	0.3	0.0	1.3	0.6	0.2	4.5	2.7	0.3
9–B*	4.6	5.8	2.1	8.3	7.0	1.0	16.0	18.8	1.7	104.7	129.6	6.3	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.2	0.1	0.3	0.3	0.0	0.6	0.7	0.1	3.8	4.7	0.2
10–A	1.4	0.0	0.0	0.8	0.0	0.0	0.5	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
10–B	2.1	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
AT BRUSH GENERATOR																														
2–C*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2–D*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4–C*	0.1	0.0	0.0	0.3	0.0	0.0	1.0	0.0	0.0	1.7	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
4–D*	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	1.6	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
AT LUFKIN GEAR BOX																														
5–E	2.7	0.0	0.0	5.4	0.0	0.0	8.5	0.0	0.0	4.3	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0
5–F	1.9	0.0	0.0	3.6	0.0	0.0	7.1	0.0	0.0	6.9	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0
6–E	3.2	0.0	0.0	5.6	0.0	0.0	6.3	0.0	0.0	8.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0
6–F	4.8	0.0	0.0	7.9	0.0	0.0	10.9	0.0	0.0	10.6	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0

* SHEAR LUG LOCATION

NOTES:

1. REFER SHEET 12 FOR ADDITIONAL DESIGN INFORMATION.

RESERVED

THESE DRAWINGS ARE TYPICAL DRAWINGS ONLY AND ARE FOR REFERENCE AND ILLUSTRATIVE PURPOSES ONLY. THEY ARE NOT PROJECT SPECIFIC DRAWINGS AND INFORMATION CONTAINED HEREIN, INCLUDING NUMBERS, POWER RANGES, INTERCONNECTION POINTS, ETC., ARE NOT A CONTRACTUAL OBLIGATIONS OF GE.

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

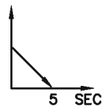
TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 REV. H

SCALE NONE SHEET 11 OF 12

NOTES:

1. P IS VERTICAL LOAD (TENSION/COMPRESSION), VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. SHORT TERM LOAD CASES ARE THE RESULT OF THE FOLLOWING BLADE-OUT CONDITIONS AT THE INDICATED ROTOR POSITION.
   A. TWO STAGE 0 LOW PRESSURE COMPRESSOR AIRFOILS: 27840 gm-in (982.03 OZ.-in), SPEED RANGE 0-4300 RPM FOR 50 Hz UNIT AND 60 Hz UNIT.
   B. TWO STAGE 1 HIGH PRESSURE COMPRESSOR AIRFOILS: 2752 gm-in (97.07 OZ-in), SPEED RANGE 0-10800 RPM.
   C. THREE STAGE 2 HIGH PRESSURE TURBINE AIRFOILS: 4911 gm-in (173.23 OZ-in), SPEED RANGE 0-10800 RPM.
   D. TWO STAGE 5 LOW PRESSURE TURBINE AIRFOILS: 41158 gm-in (1451.81 OZ-in), SPEED RANGE 0-4300 RPM FOR 50 Hz UNIT AND 60 Hz UNIT.
3. SHORT TERM IS DEFINED AS FIVE SECONDS FOR TURBINE LOAD DECAY DURING COASTDOWN.
4. THE CONTINUOUS UNBALANCE LOAD CASES ARE THE RESULT OF THE ALLOWABLE ROTOR UNBALANCE AT THE INDICATED ROTOR POSITION.
   A. TWO STAGE 0 LOW PRESSURE COMPRESSOR AIRFOILS: 300 gm-in (10.58 OZ-in), DESIGN SPEED 3911 RPM FOR 50 Hz UNIT AND 3905 RPM FOR 60 Hz UNIT.
   B. TWO STAGE 1 HIGH PRESSURE COMPRESSOR AIRFOILS: 100 gm-in (3.53 OZ-in), DESIGN SPEED 10600 RPM.
   C. THREE STAGE 2 HIGH PRESSURE TURBINE AIRFOILS: 150 gm-in (5.29 OZ-in), DESIGN SPEED 10600 RPM.
   D. TWO STAGE 5 LOW PRESSURE TURBINE AIRFOILS: 200 gm-in (7.05 OZ-in), DESIGN SPEED 3911 RPM FOR 50 Hz UNIT AND 3905 RPM FOR 60 Hz UNIT.
   E. GENERATOR, BRUSH 7-290ER, CONTINUOUS UNBALANCE LOAD OF 987 gm-in (34.82 OZ-in) AT MIDDLE OF ROTOR PER BRUSH SPECIFICATION.
   F. GEAR BOX, LUFKIN, CONTINUOUS UNBALANCE LOAD OF 152 gm-in (5.36 OZ-in) AT MIDDLE OF SHAFT AS PER LUFKIN SPECIFICATION.
5. THE LOADS IN THE DYNAMIC FOUNDATION LOAD TABLE ARE THE MAXIMUM (0 TO PEAK) LOADS OF EACH ANCHOR BOLT IN THE OPERATING RANGE THESE LOADS MAY OCCUR AT DIFFERENT FREQUENCIES OR PHASES, AND THEREFORE, IT MAY BE TOO CONSERVATIVE TO TREAT LOADS AS STATIC LOAD CASES.
6. DYNAMIC LOADS SHORT TERM: FROM MAX TO ZERO IN 5 SEC. THESE LOAD CASES ARE ASSUMED NOT TO ACT SIMULTANEOUSLY.



7. THE PEAK TO PEAK VIBRATION VELOCITY AT ANY POINT OF THE FOUNDATION SHOULD BE LESS THAN 0.06 in/SEC AT THE RATED TURBINE SPEED OF 3605 RPM FOR 60 Hz UNIT AND 3911 RPM FOR 50 Hz UNIT.

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO: GE CLASS II (INTERNAL)

GE PACKAGED POWER, L.P.

TITLE: INSTALLATION FOOTPRINT ANCHOR BOLT AND SHEAR LUG LOCATION

DWG NO. TYPICAL DRAWING 969224 REV. H

SCALE NONE SHEET 12 OF 12

ELECTRICAL DATA SHEET

Falcon Works, Nottingham Road, Loughborough, Leics. LE11 1EX, England
Telephone: +44 (0) 1509 611511 Fax: +44 (0) 1509 610440 E-mail: salesuk@brush.eu

1. RATING DETAILS

1.1	Frame size	BDAX 7-290ERHJT
1.2	Terminal voltage	13.80 kV
1.3	Frequency	60 Hz
1.4	Speed	3600 rev/min
1.5	Altitude	up to 1000 m
1.6	Applicable national standard	IEEE C50.13
1.7	Rated coolant (CACW) temperature	26.7 °C
1.8	Rated output	59.100 MW, 69.529 MVA
1.9	Power factor	0.850
1.10	Rated stator line current	2909 Amps
1.11	Generator air flow	21.0 m^3/sec

2. PERFORMANCE CURVES

2.1	Output vs coolant (CACW) temperature	H.E.P. 34267
2.2	Reactive capability diagram	H.E.P. 34268
2.3	Efficiency vs output	H.E.P. 32376
2.4	Open and short circuit curves	H.E.P. 32377
2.5	Permitted duration of negative sequence current	H.E.P. 1216
2.6	Exciter saturation	H.E.P. 13726
2.7	Generator V curves	H.E.P. 34269

3. NEGATIVE SEQUENCE CAPABILITY

3.1	Max short time negative sequence I^2_2t	30
3.2	Max continuous I_2 unbalance	15

Notes:

1. The electrical details provided are calculated values. Unless otherwise stated, all values are subject to tolerances as given in the relevant national standards.

Date: 23-Oct-2013

I.D.: OPP04106A1

ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850 pf, 13.800 kV, 60.0 Hz

4. REACTANCE AND SEQUENCE RESISTANCES

A) Direct Axis Reactances:

4.1	Saturated synchronous reactance, $X_{d(v)}$	206%
4.2	Unsaturated synchronous reactance, $X_{d(i)}$	230%
4.3	Saturated transient reactance, $X'_{d(v)}$	19.4 %
4.4	Unsaturated transient reactance, $X'_{d(i)}$	23.8 %
4.5	Saturated subtransient reactance, $X''_{d(v)}$	14.1 %
4.6	Unsaturated subtransient reactance, $X''_{d(i)}$	17.7 %
4.7	Saturated negative sequence reactance, $X_{2(v)}$	13.7 %
4.8	Unsaturated negative sequence reactance, $X_{2(i)}$	17.2 %
4.9	Zero sequence reactance, X_0	9.3 %
4.10	Potier reactance, X_P	20.3 %
4.11	Saturated stator leakage, $X_{sl(v)}$	8.1 %
4.12	Unsaturated stator leakage, $X_{sl(i)}$	12.7 %
4.13	Short circuit ratio	0.48

B) Quadrature Axis Reactances:

4.14	Saturated synchronous reactance, $X_{q(v)}$	165 %
4.15	Unsaturated synchronous reactance, $X_{q(i)}$	210 %
4.16	Saturated transient reactance, $X'_{q(v)}$	23 %
4.17	Unsaturated transient reactance, $X'_{q(i)}$	34 %
4.18	Saturated subtransient reactance, $X''_{q(v)}$	17 %
4.19	Unsaturated subtransient reactance, $X''_{q(i)}$	21 %

C) Sequence resistances:

4.20	Positive sequence resistance, R_1	0.0052 p.u at 75 °C
4.21	Negative sequence resistance, R_2	0.0266 p.u at 75 °C
4.22	Zero sequence resistance, R_O	0.0077 p.u at 75 °C

Notes:

1. The electrical details provided are calculated values. Unless otherwise stated, all values are subject to tolerances as given in the relevant national standards.

BRUSH ELECTRICAL MACHINES LTD

ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850pf, 13.800 kV, 60.0 Hz

5. TIME CONSTANTS AT 20°C

A) Direct Axis:

5.1	Transient O.C. time constant, T'_{do}	9.5 seconds
5.2	Transient S.C. time constant, 3 ph, T'_{d3}	0.64 seconds
5.3	Transient S.C. time constant, L-L, T'_{d2}	1.30 seconds
5.4	Transient S.C. time constant, L-N, T'_{d1}	1.60 seconds
5.5	Subtransient O.C. time constant, T''_{do}	0.05 seconds
5.6	Subtransient S.C. time constant, 3 ph, T''_{d3}	0.04 seconds
5.7	Subtransient S.C. time constant, L-L, T''_{d2}	0.04 seconds
5.8	Subtransient S.C. time constant, L-N, T''_{d1}	0.04 seconds

B) Quadrature Axis:

5.9	Transient O.C. time constant, T'_{qo}	2.9 seconds
5.10	Transient S.C. time constant, 3 ph, T'_{q3}	0.32 seconds
5.11	Transient S.C. time constant, L-L, T'_{q2}	0.48 seconds
5.12	Transient S.C. time constant, L-N, T'_{q1}	0.58 seconds
5.13	Subtransient O.C. time constant, T''_{qo}	0.05 seconds
5.14	Subtransient S.C. time constant, 3 ph, T''_{q3}	0.04 seconds
5.15	Subtransient S.C. time constant, L-L, T''_{q2}	0.04 seconds
5.16	Subtransient S.C. time constant, L-N, T''_{q1}	0.04 seconds

C) Miscellaneous:

5.17	D.C. Armature time constant, 3 ph, T_{a3}	0.30 seconds
5.18	D.C. Armature time constant, L-L, T_{a2}	0.30 seconds
5.19	D.C. Armature time constant, L-N, T_{a1}	0.27 seconds

Notes:

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BRUSH ELECTRICAL MACHINES LTD

ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850 pf, 13.800 kV, 60.0 Hz

6. GENERATOR SATURATION FACTOR

6.1	Saturation factor 1.0	0.11
6.2	Saturation factor 1.2	0.49

7. INERTIA

7.1	Moment of inertia, WR^2	970 $kg.m^2$
7.2	Inertia constant, H	0.99 kWsecs/kVA

8. EXCITATION

A) No load (cold):

8.1	Excitation current at no load, rated voltage	325 amps
8.2	Excitation voltage at no load, rated voltage	46 volts
8.3	Exciter field current at no load	1.9 amps
8.4	Exciter field voltage at no load	10 volts

B) Rated load (hot):

8.5	Excitation current at rated load and P.F	934 amps
8.6	Excitation voltage at rated load and P.F	178 volts
8.7	Exciter field current at rated load and P.F	6.1 amps
8.8	Exciter field voltage at rated load and P.F	46 volts

C) Short circuit clearance of 2.7 p.u rated line amps (hot):

8.9	Excitation current on clearance	1810 amps
8.10	Excitation voltage on clearance	345 volts
8.11	Exciter field current on clearance	13.7 amps
8.12	Exciter field voltage on clearance	103 volts

Notes:

1. The electrical details provided are calculated values. Unless otherwise stated, all values are subject to tolerances as given in the relevant national standards.
2. The rotor inertia value may vary slightly with generator / turbine Interface. In the event of conflict, the figure quoted on the rotor Geometry drawing takes precedence.

BRUSH ELECTRICAL MACHINES LTD

ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850 pf, 13.800 kV, 60.0 Hz

9. INHERENT VOLTAGE REGULATION

9.1	F.L. to N.L. rated pf, constant excitation	35 %
9.2	F.L. to N.L. unity pf, constant excitation	27 %
9.3	F.L. to N.L. steady state under full AVR control	± 0.5 %

10. EFFICIENCY AND LOSSES

These losses below are calculated values. The total loss and the resulting efficiencies are guaranteed, subject to the tolerance specified in EN 60034-1.

MW output	59.100	59.100
Power factor	0.850	Unity
Friction & windage loss(kW)	320	320
Stator core iron loss(kW)	140	140
Stator copper loss at 95°C(kW)	110	79
Stray load loss at 95°C(kW)	245	177
Rotor copper loss at 95°C(kW)	158	80
Exciter loss(kW)	12	6
Total loss(kW)	985	802

Efficiencies:

% load	100	75	50	25
0.85 power factor	98.36 %	98.29 %	97.95 %	96.59 %
Unity power factor	98.66 %	98.53 %	98.14 %	96.72 %

11. CAPACITANCE AND SURGE IMPEDANCE

11.1	Capacitance per phase of stator winding to earth	0.19 microfarad
11.2	Surge impedance per phase	96 Ohms

Notes:

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ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850 pf, 13.800 kV, 60.0 Hz

12. RESISTANCES AT 20°C

12.1	Stator resistance per phase	0.0033 ohms
12.2	Rotor resistance	0.140 ohms
12.3	Exciter armature resistance per phase	0.00130 ohms
12.4	Exciter field resistance	5.39 ohms
12.5	Pilot exciter resistance	0.084 ohms

13. EXCITER

13.1	Exciter frame size	BXF 10.20-3S
13.2	Voltage rating	196 Volts D.C
13.3	Current rating	1028 Amps D.C
13.4	Output	201 kW
13.5	Frequency	180 Hz
13.6	A.C. voltage at full load	177 Volts RMS
13.7	A.C. current at full load	707 Amps RMS
13.8	Power factor	0.74
13.9	Number of phases	3
13.10	Response ratio	3.5 $Secs^{-1}$

14. ROTATING RECTIFIER

14.1	Number of diodes	12
14.2	Arrangement	3 ph full wave bridge; 6 arms; 2 fused diodes in parallel per arm.
14.3	Diode repetitive peak reverse voltage	2000 Volts
14.4	Diode rated mean forward current	330 Amps
14.5	Diode mean forward current at rated load	156 Amps
14.6	Diode reverse voltage at rated load	178 Volts
14.7	Fuse rating	450 Amps

Notes:

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Date: 23-Oct-2013

I.D.: OPP04106A1

BRUSH ELECTRICAL MACHINES LTD

ELECTRICAL DATA SHEET - CONTINUATION

BDAX 7-290ERHJT, 59.100 MW, 0.850 pf, 13.800 kV, 60.0 Hz

15. PERMANENT MAGNET PILOT EXCITER

15.1	Pilot exciter frame size	MXI 44.07-A1
15.2	Open circuit volts	270 Volts
15.3	Full load voltage	264 Volts
15.4	Full load current	3.3 Amps
15.5	Power factor	0.32
15.6	Rated frequency	480 Hz
15.7	Number of phases	1

16. INSTANTANEOUS INITIAL FAULT CURRENTS

16.1	3 ph symmetrical fault from no load	20700 Amps RMS
16.2	L-L symmetrical fault from no load	18150 Amps RMS
16.3	L-N symmetrical fault from no load	23550 Amps RMS

17. MISCELLANEOUS GENERATOR DATA

17.1	X/R ratio	95.7
17.2	Synchronising coefficient	85 MW/radian
17.3	No load synchronising power	33 MW/radian
17.4	Full load synchronising power	70 MW/radian
17.5	Damping torque coefficient	17
17.6	Magnetic centering force for an axial displacement of 20mm	798 kg
17.7	Motoring power	481 kW
17.8	Anti-condensation space heaters approximate power rating	4 kW
17.9	Generator air outlet temperature	75 °C

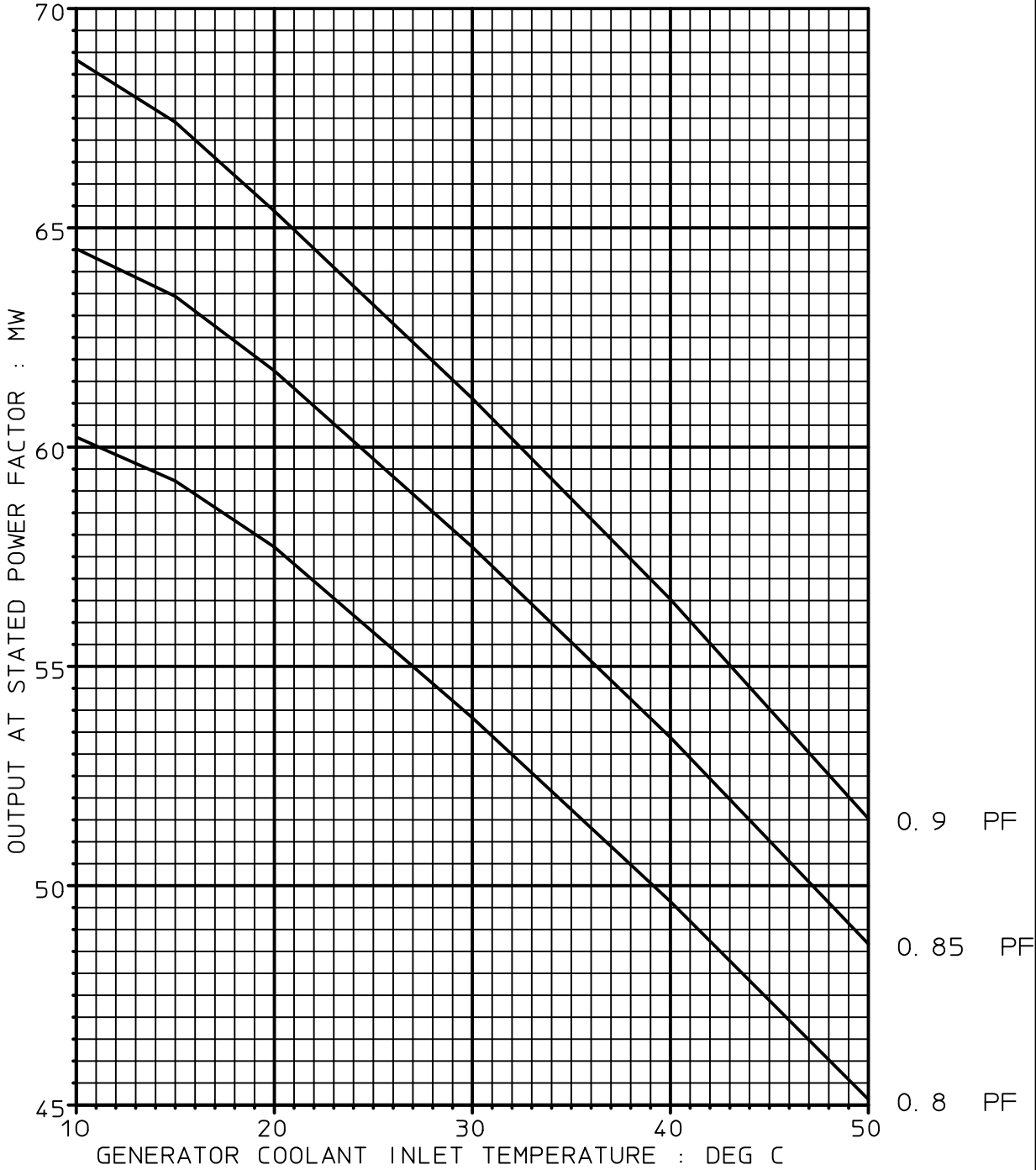
Notes:

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BRUSH ELECTRICAL MACHINES LTD.

H. E. P 34267

VARIATION OF GENERATOR OUTPUT WITH COOLANT TEMP



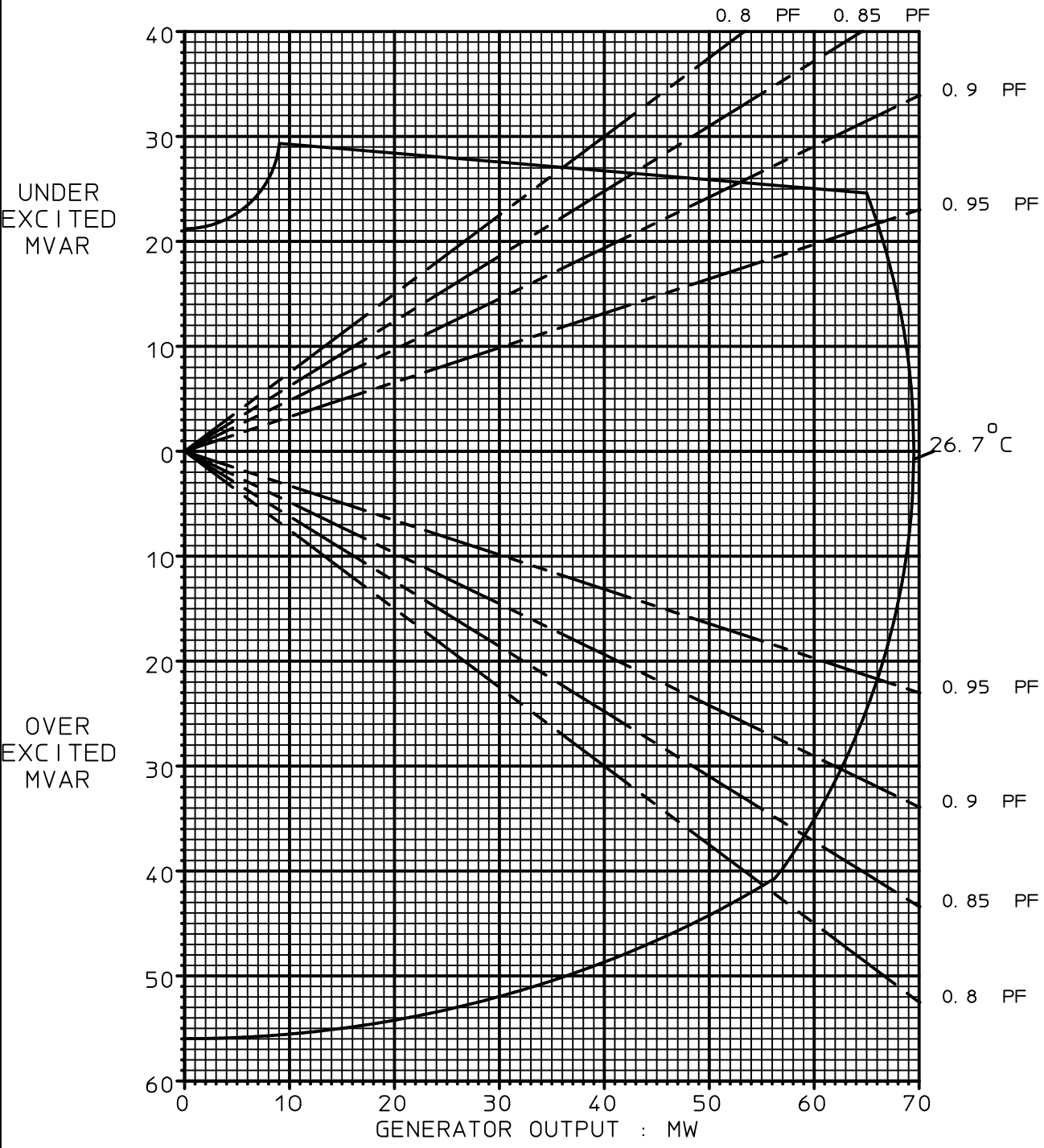
BDAX 7-290ERHJT	IN ACCORDANCE WITH
13. 80KV, 3 Ph, 60Hz.	IEEE C50. 13
	Class B temperatures.
Up to 1000 meters ASL	Total temperatures Stator 123 Deg C
	Rotor 125 Deg C
Coolant:	Fresh Water

Issue No. 1 : 23-Oct-2013

BRUSH ELECTRICAL MACHINES LTD.

H. E. P 34268

GENERATOR CAPABILITY DIAGRAM



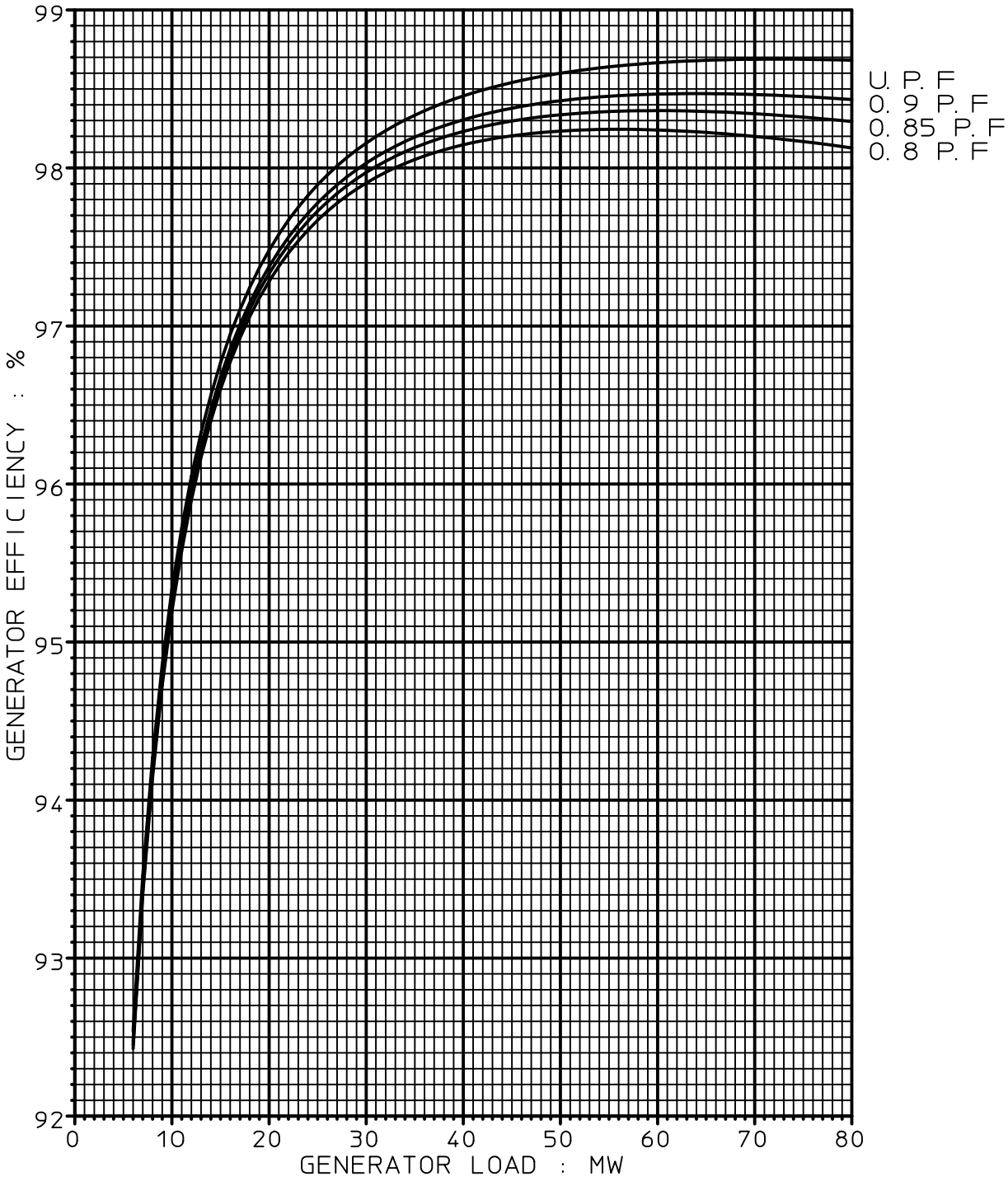
BDAX 7-290ERHJT	IN ACCORDANCE WITH
13. 80KV, 3 Ph, 60Hz.	IEEE C50. 13
	Class B temperatures.
Up to 1000 meters ASL	Total temperatures Stator 123 Deg C
	Rotor 125 Deg C
Coolant:	Fresh Water

Issue No. 1 : 23-Oct-2013

BRUSH ELECTRICAL MACHINES LTD.

H. E. P 32376

VARIATION OF GENERATOR EFFICIENCY WITH LOAD



BDAX 7-290ERJT
13. 8 KV, 3 Ph, 60 Hz.

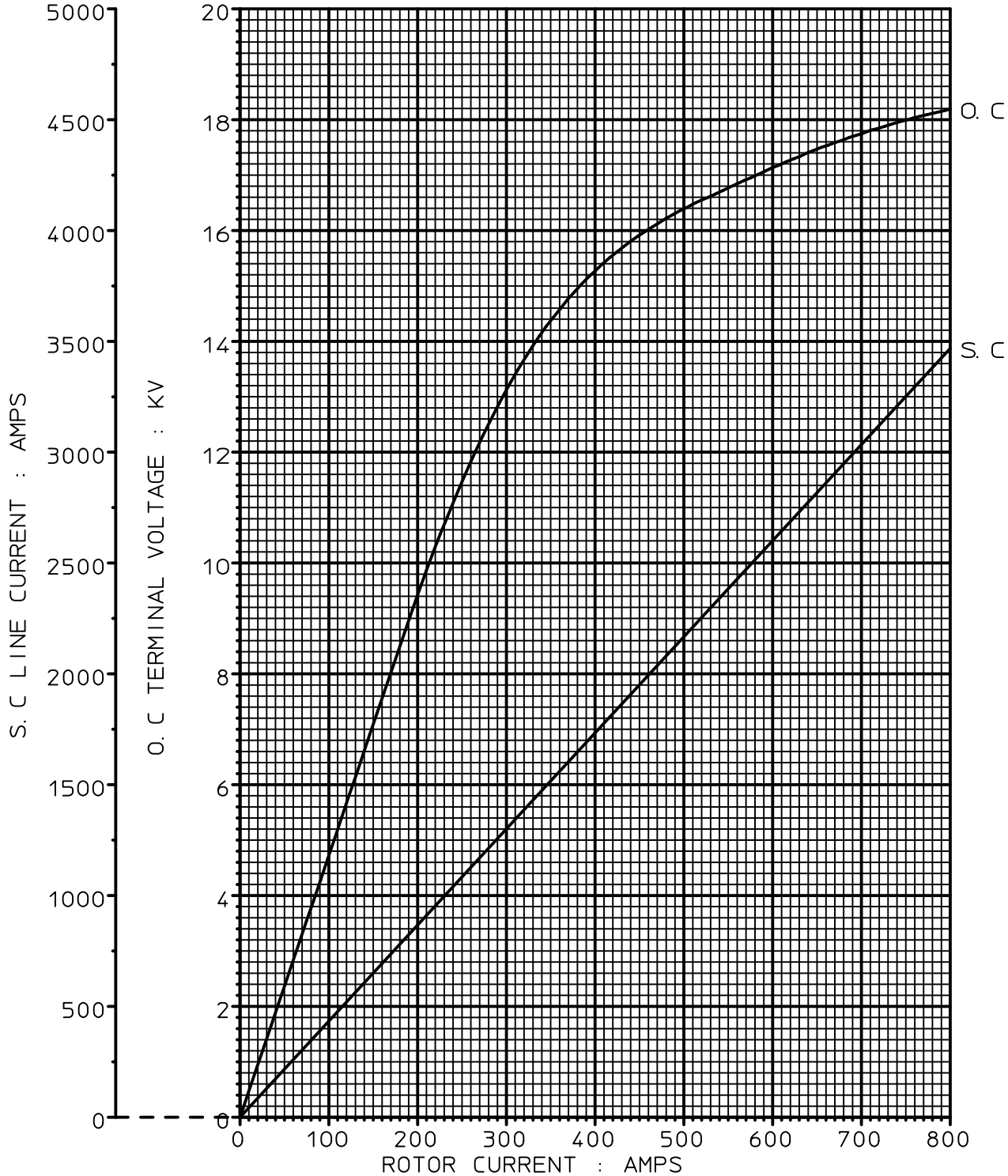
Efficiencies shown are guaranteed subject to the tolerance specified in IEC 60034-1.

Issue No. 1: 15-May-2012

BRUSH ELECTRICAL MACHINES LTD.

H. E. P 32377

OPEN CIRCUIT AND SHORT CIRCUIT CHARACTERISTIC

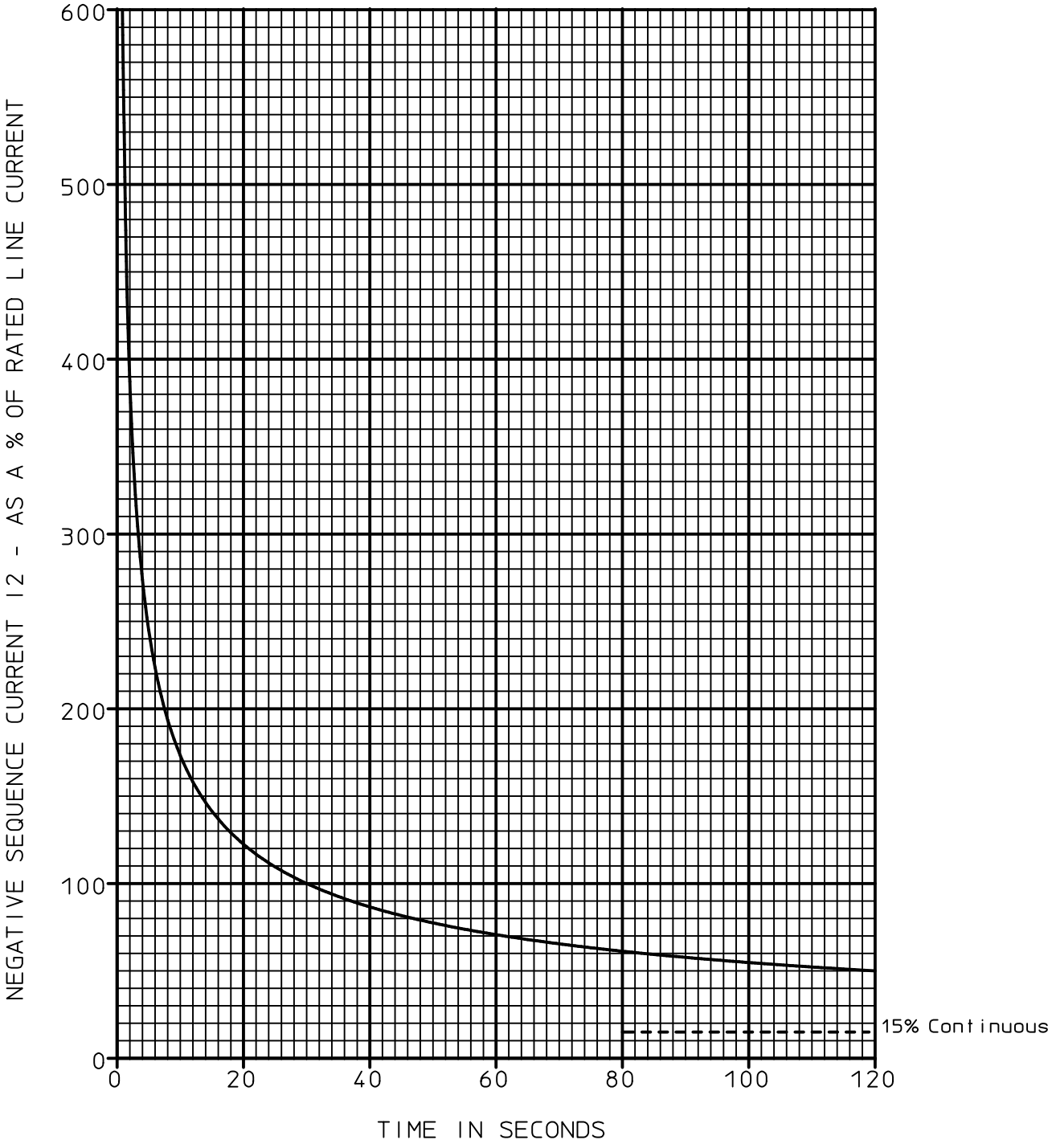


BDAX 7-290ERJT
3Ph, 60Hz, 3600 RPM.

Issue No. 1 : 15-May-2012

PERMISSIBLE DURATION OF NEGATIVE SEQUENCE CURRENT

$I_2^2 t = 30$

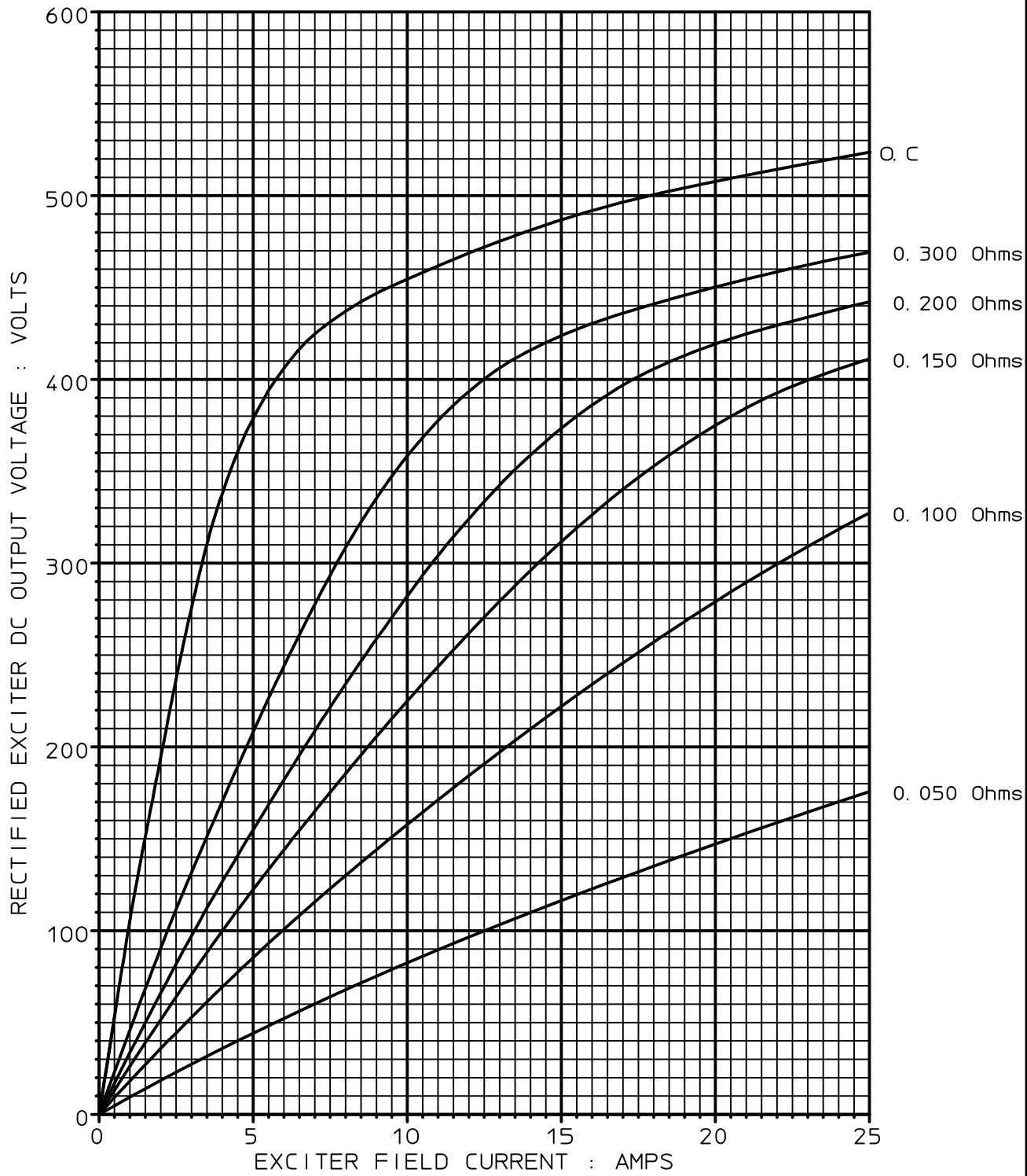


NOTE: For continuous operation rated current must not be exceeded in any one phase.

BRUSH ELECTRICAL MACHINES LTD.

H. E. P 13726

EXCITER OPEN CIRCUIT AND LOADED CHARACTERISTIC



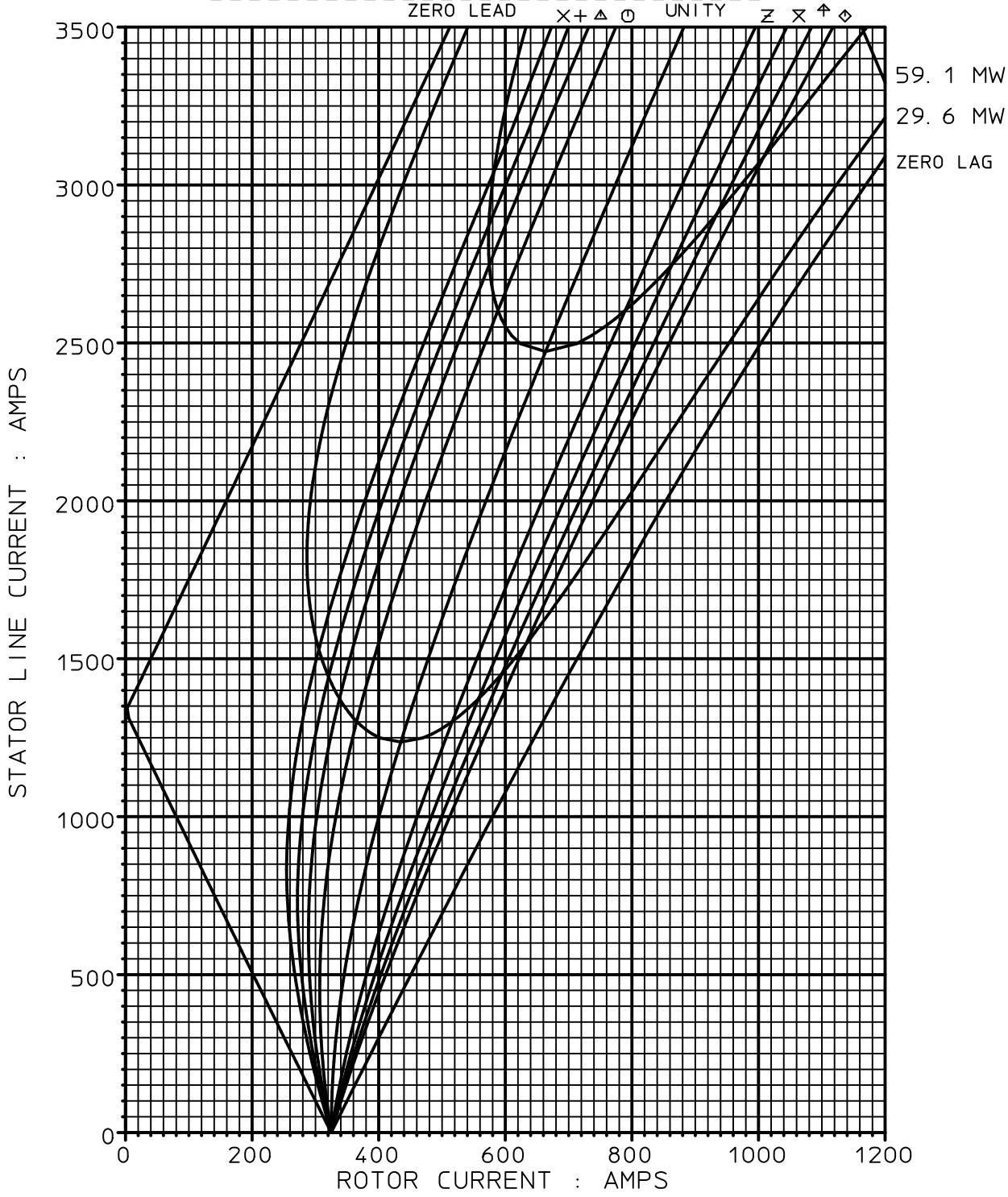
BXF 10. 20-3S
3600 RPM, 6 Poles, 180 HZ

Issue No. 5 : 17-Aug-2011

BRUSH ELECTRICAL MACHINES LTD.

H. E. P 34269

CALCULATED GENERATOR V-CURVES



BDAX 7-290ERHJT
13. 80KV, 3 Ph, 60 Hz.

KEY TO POWER FACTORS SHOWN

⏲	-0. 95	PF LEAD	◇	-0. 80	PF LAG
△	-0. 90	PF LEAD	↑	-0. 85	PF LAG
+	-0. 85	PF LEAD	⧖	-0. 90	PF LAG
×	-0. 80	PF LEAD	Z	-0. 95	PF LAG

Issue No. 1 : 23-Oct-2013

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DWG. NO.			
REV	ZONE	REVISION DESCRIPTION	APPROVAL / DATE

DRAWING INDEX AND SPECIFICATIONS FOR GE–AEP / GDX LM6000 W/ CHILLER COIL

UNIT SPECIFICATION				
PARAMETER		U.S. UNITS	S.I. UNITS	REFERENCE
GAS TURBINE INTAKE AIR		358,000 SCFM	10,137 CMM	NOTE 6
AIR FLOW–COMBUSTION		253,000 SCFM	7,164 CMM	NOTE 6
AIRFLOW–VENTILATION		105,000 SCFM	2,973 CMM	NOTE 6
INITIAL CLEAN	COMBUSTION	0.75 IN. WG	187 Pa	NOTE 7
	VENTILATION	0.64 IN. WG	159 Pa	NOTE 7
PULSE CLEAN	START	2.50 IN. WG	622 Pa	NOTE 7
	STOP	2.00 IN. WG	498 Pa	NOTE 7
ALARM SWITCH SETTING	WARNING	5.00 IN. WG	1245 Pa	NOTE 7
	SHUTDOWN	8.00 IN. WG	1992 Pa	NOTE 7
COMPRESSED CLEAN DRY AIR REQUIRED	PRESSURE	100 PSI	690 kPa	NOTE 8
	FLOW RATE	30 SCFM	.85 CMM	
	MAX. TEMP.	140° F	60° C	

GDX FILTER SECTION

NO. OF ELEMENTS – 256 CYLINDRICAL (176 ELEMENTS FOR COMBUSTION/80 ELEMENTS FOR VENTILATION)
– 256 CONICAL (176 ELEMENTS FOR COMBUSTION/80 ELEMENTS FOR VENTILATION)

NOTES:

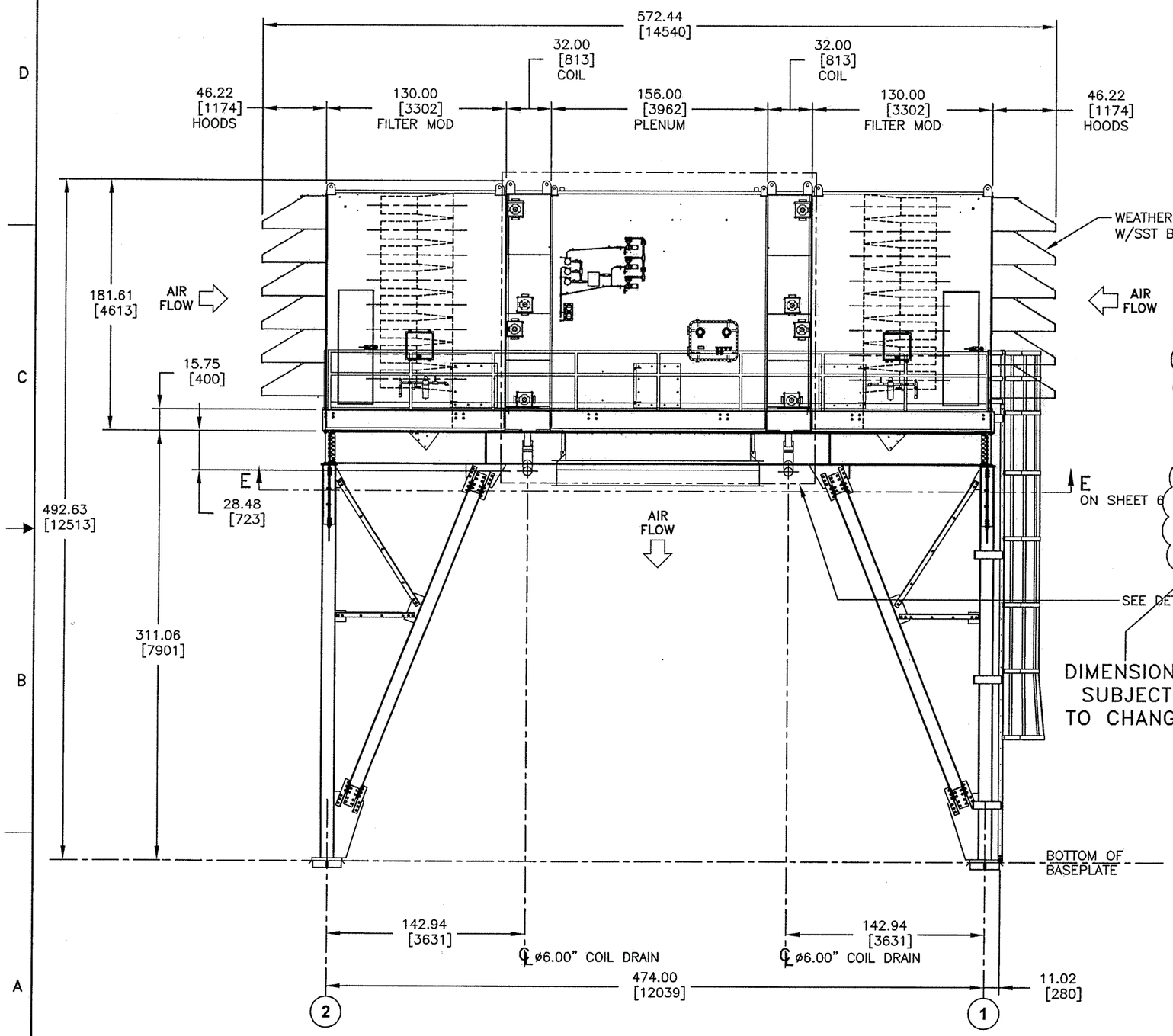
1. SURFACE FINISH SHALL BE AS SPECIFIED IN COATING SPECIFICATION DRAWING.
2. FILTER ELEMENT TYPE SHALL BE AS SPECIFIED IN FILTER HOUSE DEFINITION.
3. ALL DIMENSIONS ARE IN INCHES AND [MILLIMETERS].
4. MATERIALS:
   MATERIALS AS SPECIFIED IN P.O. REQUIREMENTS.
5. **CAUTION: IF FREEZING TEMPERATURES ARE ANTICIPATED THE WATER COIL SYSTEM MUST BE FULLY DRAINED OR THE APPROPRIATE AMOUNT OF ETHYLENE GLYCOL ADDED TO PREVENT FREEZING.**
6. MEASURED AT 59° F (15° C), 1 ATMOSPHERE, 60% RELATIVE HUMIDITY (ISO CONDITIONS).
7. STATIC PRESSURE AS MEASURED ON THE CLEAN AIR SIDE OF THE FILTER STAGE RELATIVE TO ATMOSPHERE AT RATED FLOW.
8. AS MEASURED AT CUSTOMER CONNECTION POINT.
9. ELECTRICAL SYSTEM AS SPECIFIED IN FILTER HOUSE DEFINITION.
10. BOTTOM OF BASEPLATE = MACHINE BASELINE

MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000
		DATE	
		EXP DATE	
		DWN B. MAILE	NUMBER: CD19671
REFERENCE		DATE 2/10/12	
EWR--		CHK	
PATH: ...\CD\		DATE	SCALE NONE | SHT 1 OF 9 | REVISION
CAD FILE: CD19671001_000.dwg		APVD	C/C AUTOCAD | 0
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED	2 PL ± / 3 PL ± / ANGLES ±	DATE
		THIRD ANGLE PROJECTION	SECTIONAL SIZE | X | OUTLINE SIZE | NO | DESIGN CONTROL A005 | DWG LOCATION A101 | VERSION

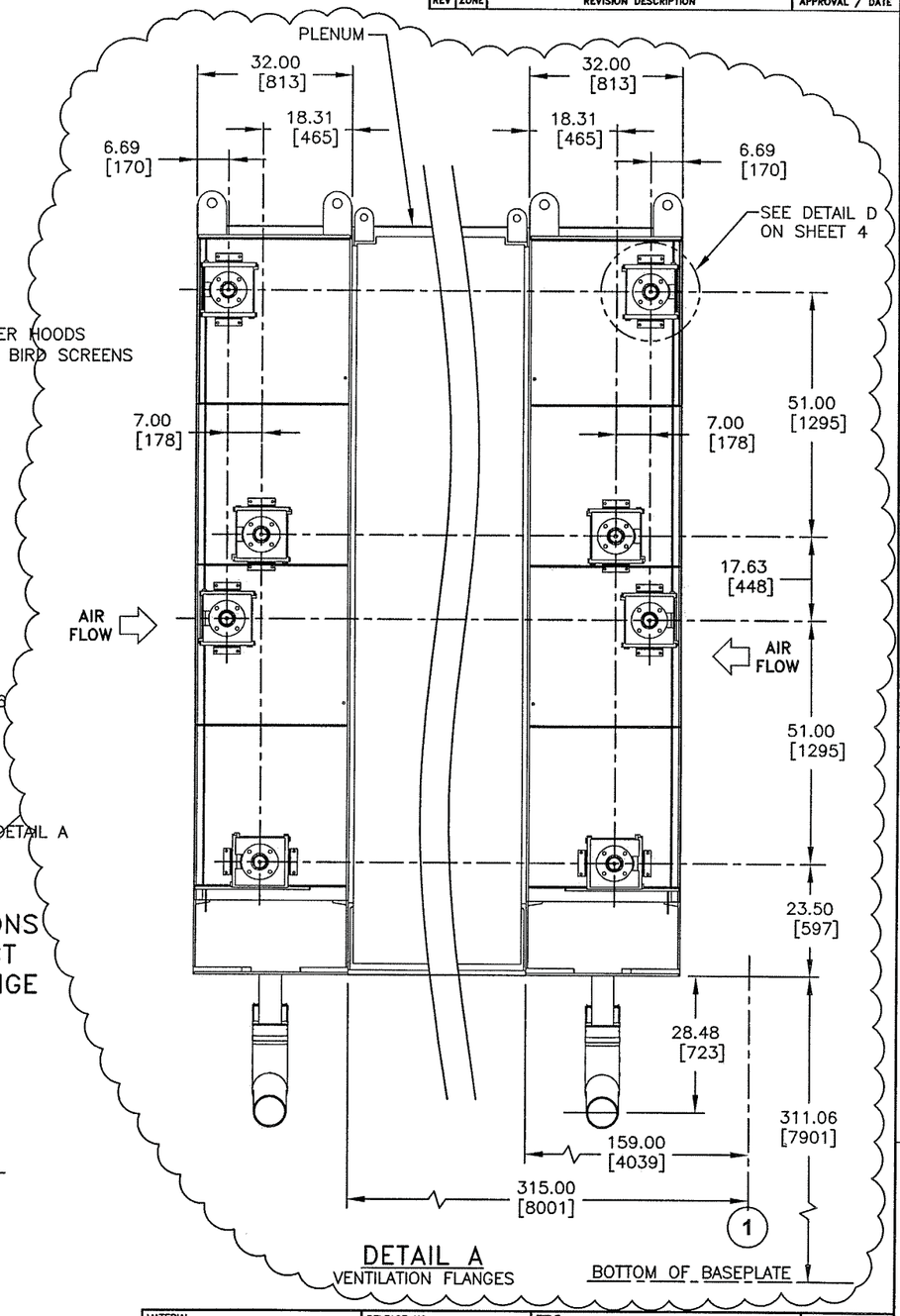
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FRONT ELEVATION



DETAIL A
VENTILATION FLANGES

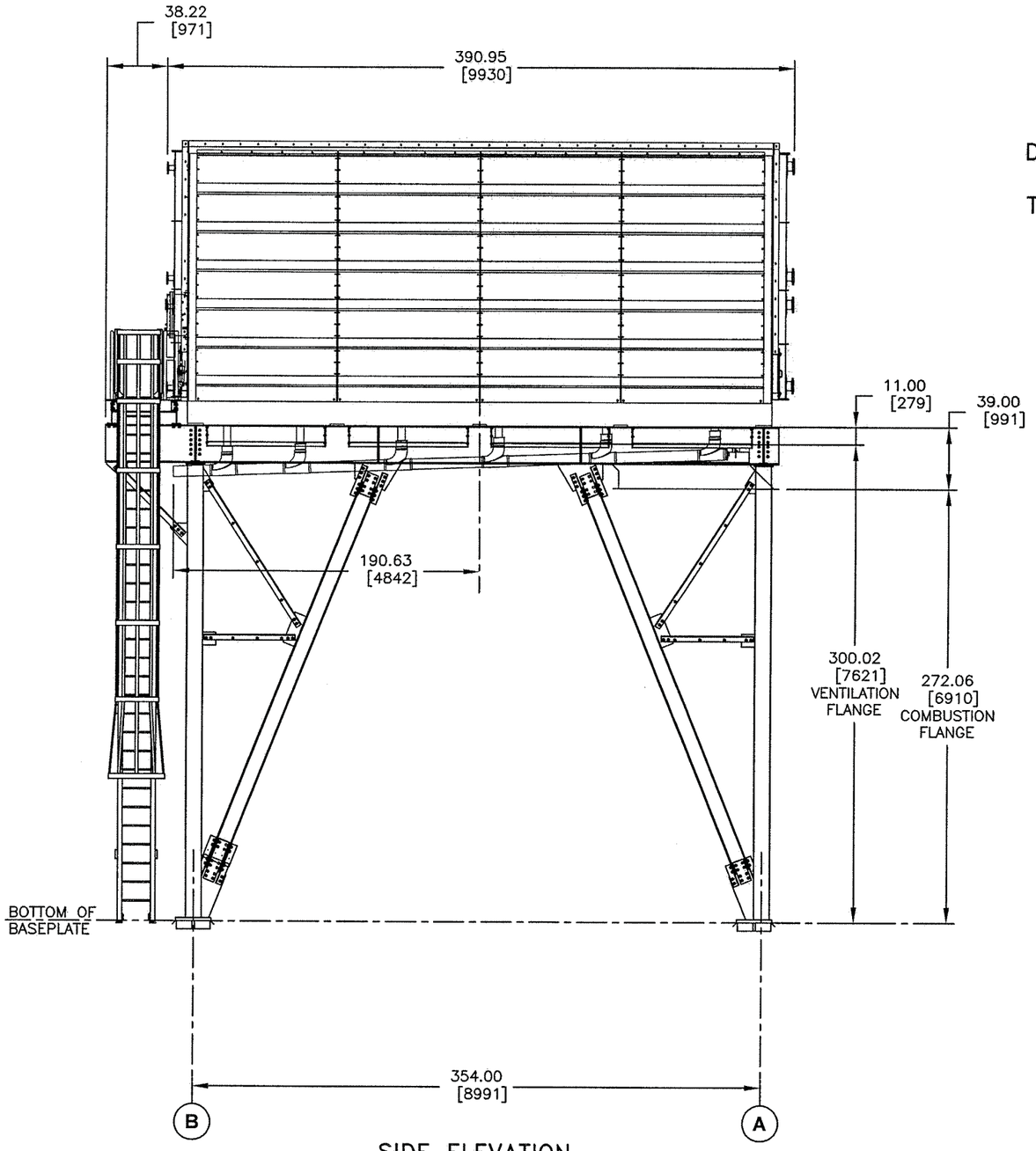
MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000
		DATE	
		EXP DATE	
		DWN B. MAILE	NUMBER: CD19671
REFERENCE		DATE 2/10/12	
EWR--		CHK	
PATH: ...\CD\		DATE	SCALE NONE | SHT 2 OF 9 | REVISION
CAD FILE: CD19671001_000.dwg		APVD	C/C AUTOCAD | 0
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED: 2 PL ±, 3 PL ±, ANGLES ±	DATE 2/10/12	SECTIONAL SIZE X OUTLINE SIZE NO
		THIRD ANGLE PROJECTION	DESIGN CONTROL A005 | DWG LOCATION A101 | VERSION

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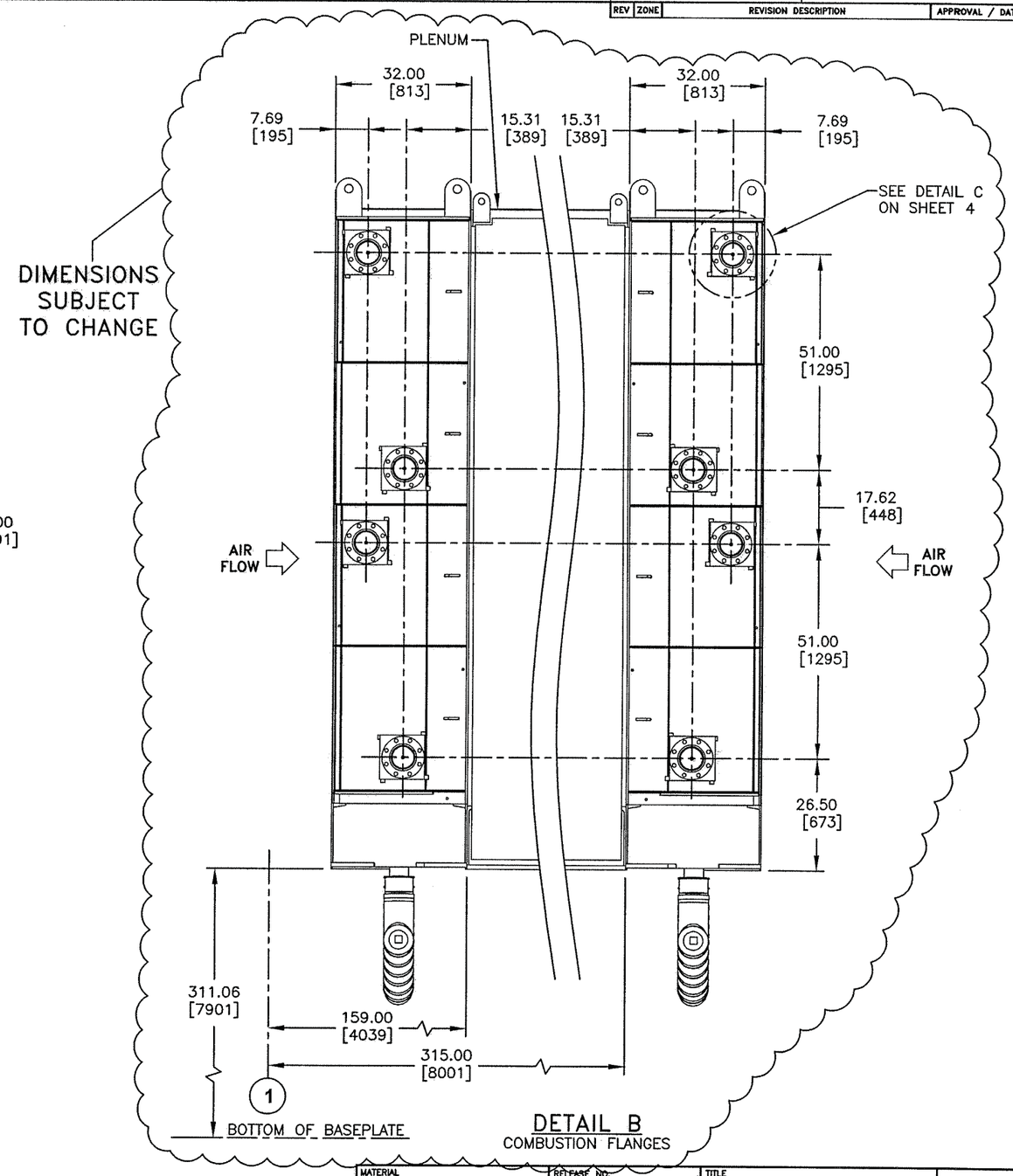
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SIDE ELEVATION



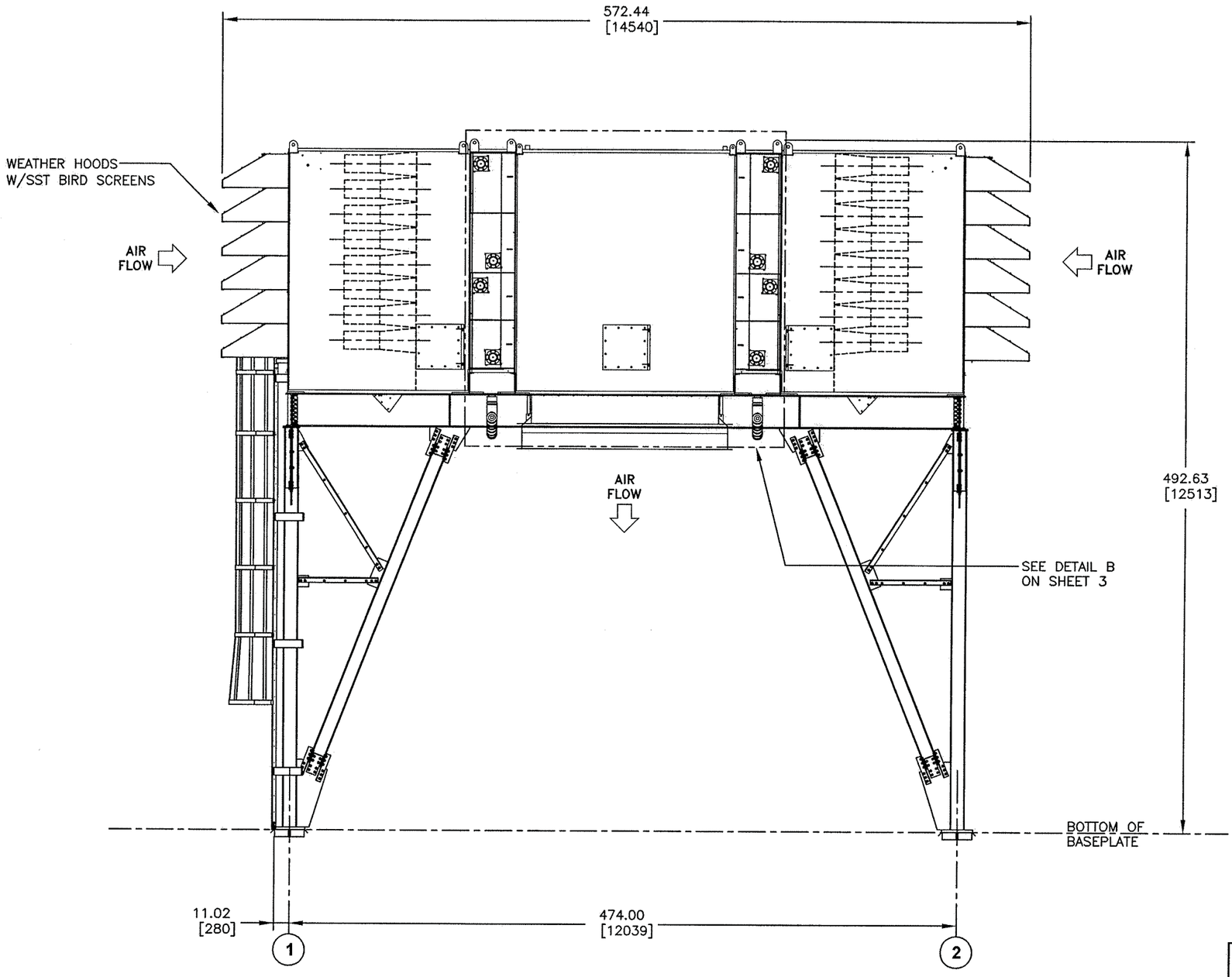
DETAIL B
COMBUSTION FLANGES

MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000
		DATE	
		EXP DATE	
		DWN B. MAILE	NUMBER: CD19671
REFERENCE		DATE 2/10/12	
EWR--		CHK	
PATH: ...\CD\		DATE	SCALE NONE | SHT 3 OF 9 | REVISION
CAD FILE: CD19671001_000.dwg		APVD	C/C AUTOCAD | 0
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED: 2 PL ±, 3 PL ±, ANGLES ±	DATE 2/10/12	SECTIONAL SIZE X | OUTLINE SIZE NO
		THIRD ANGLE PROJECTION	DESIGN CONTROL A005 | DWG LOCATION A101 | VERSION

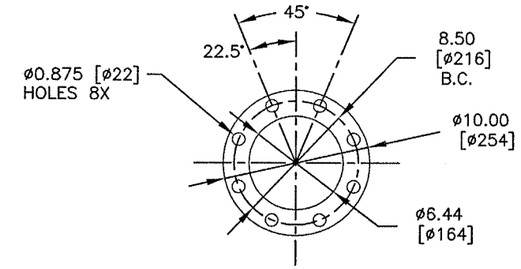
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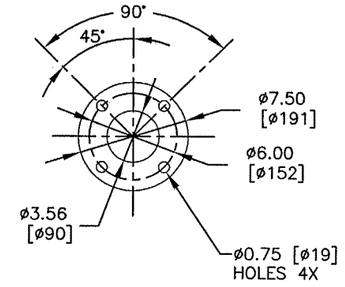
DWG. NO.			
REV	ZONE	REVISION DESCRIPTION	APPROVAL / DATE



BACK ELEVATION



DETAIL C
FROM SHEET 3



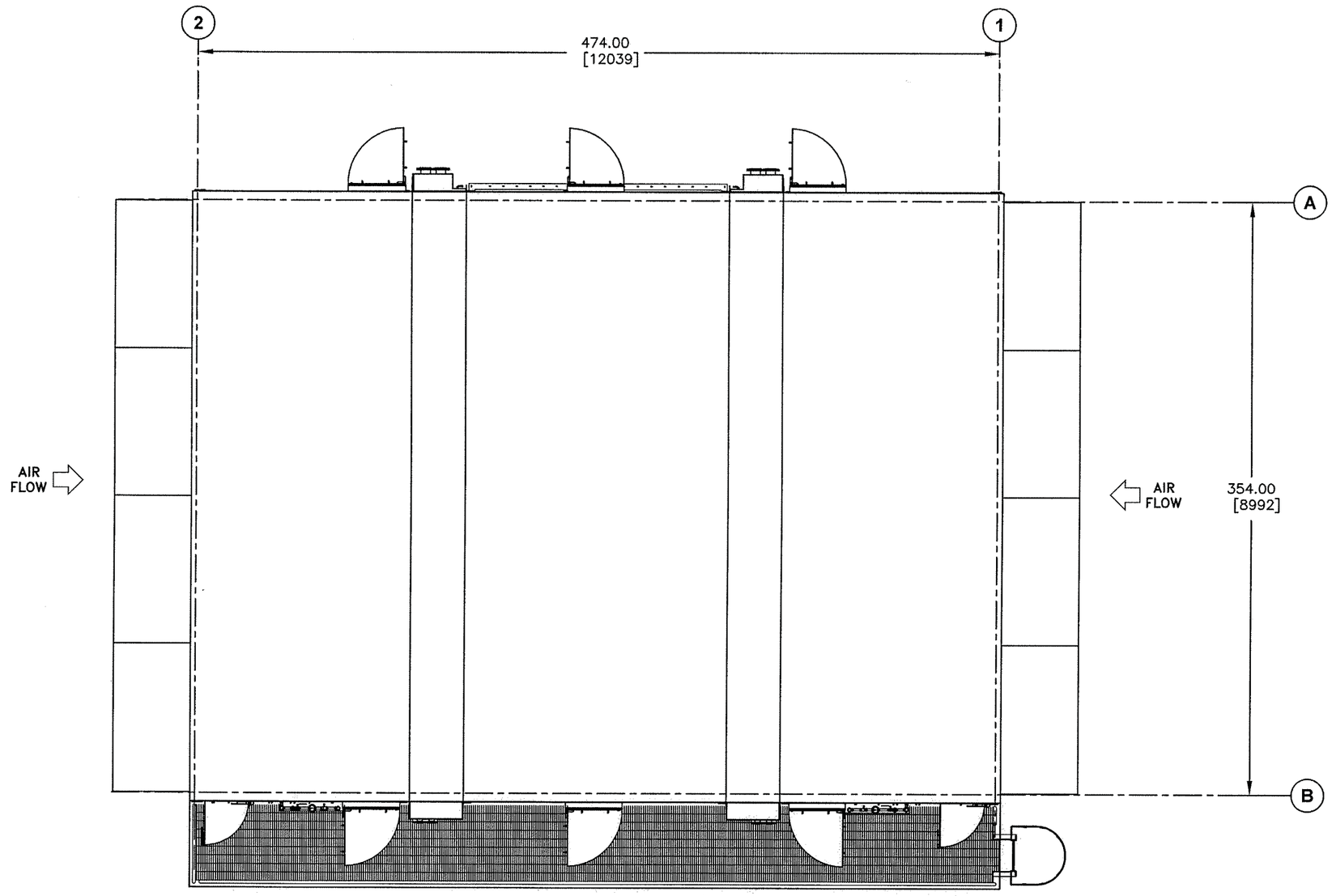
DETAIL D
FROM SHEET 2

MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000		
		DATE			
		EXP DATE			
		DWN B. MAILE	NUMBER: CD19671		
REFERENCE		DATE 2/10/12			
EWR–		CHK			
PATH: ...\CD\		DATE	SCALE NONE	SHT 4 OF 9	REVISION
CAD FILE: CD19671001_000.dwg		APVD T. Lynn	C/C	AUTOCAD	0
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED	2 PL ±	DATE 2/10/12	SECTIONAL SIZE X OUTLINE SIZE NO	
		3 PL ±	THIRD ANGLE PROJECTION	DESIGN CONTROL A005 DWG LOCATION A101	VERSION
		ANGLES ±		COPYRIGHT © DONALDSON COMPANY, INC.	L D

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REV	ZONE	REVISION DESCRIPTION	APPROVAL / DATE



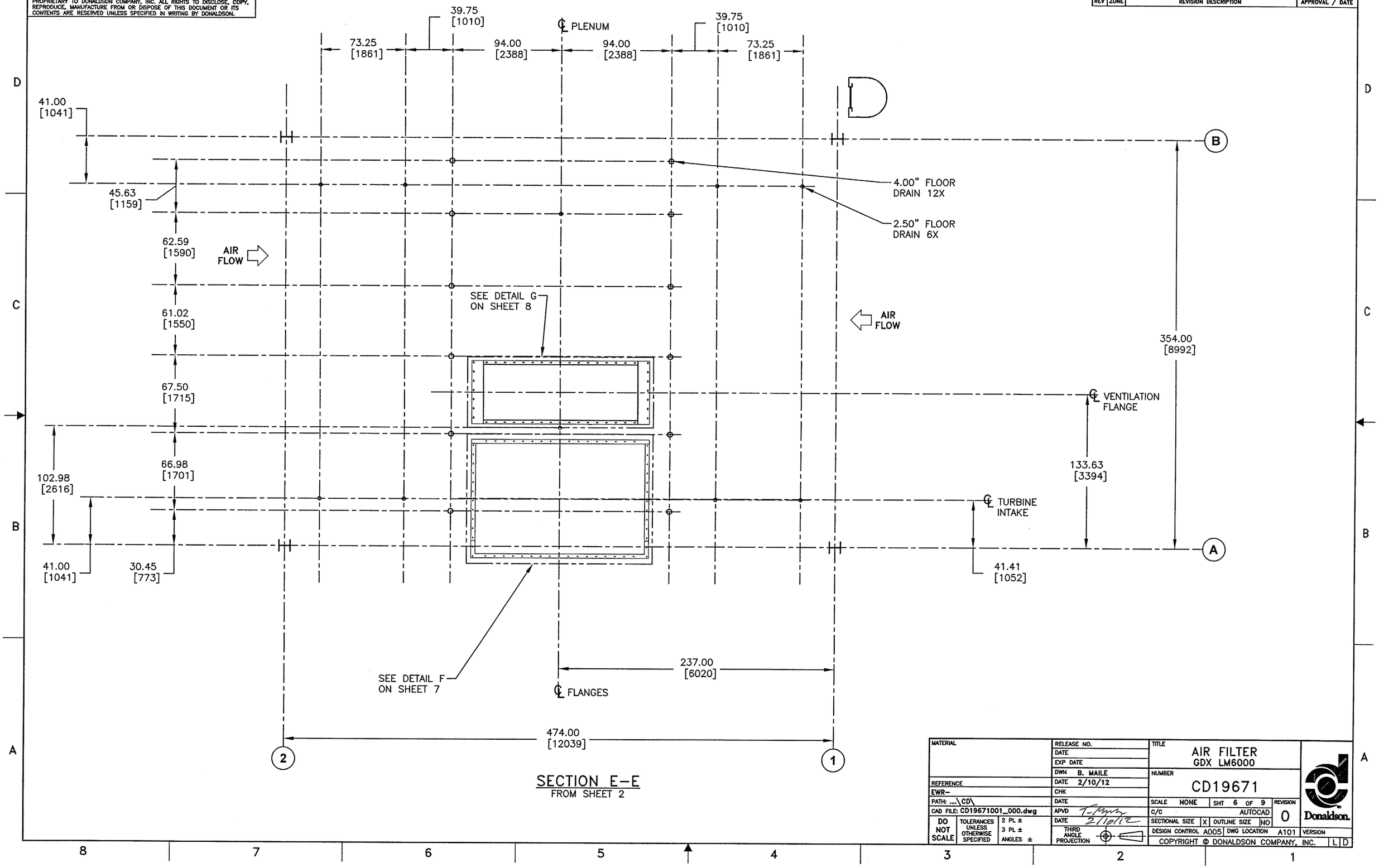
PLAN VIEW

MATERIAL		RELEASE NO.	TITLE	AIR FILTER GDX LM6000	
		DATE			
		EXP DATE			
		DWN B. MAILE	NUMBER	CD19671	
REFERENCE		DATE 2/10/12			
EWR–		CHK			
PATH: ...\CD\		DATE	SCALE NONE	SHT 5 OF 9	REVISION 0
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DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED: 2 PL ±, 3 PL ±, ANGLES ±	DATE 2/16/12	SECTIONAL SIZE X	OUTLINE SIZE NO	
		THIRD ANGLE PROJECTION	DESIGN CONTROL A005	DWG LOCATION A101	VERSION
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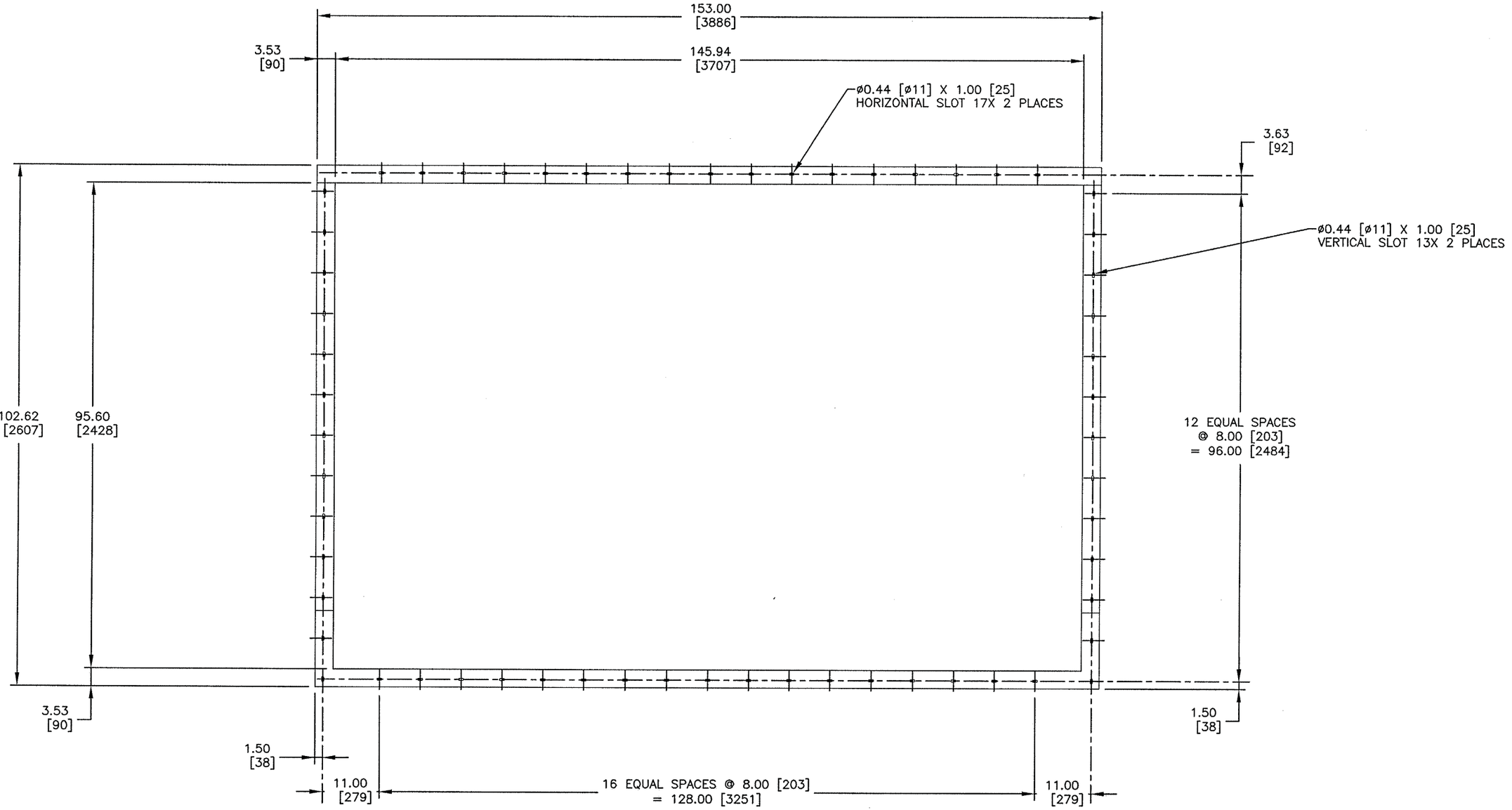
SECTION E–E
FROM SHEET 2

MATERIAL		RELEASE NO.	TITLE	AIR FILTER GDX LM6000	
		DATE			
		EXP DATE			
		DWN B. MAILE	NUMBER	CD19671	
REFERENCE		DATE 2/10/12			
EWR–		CHK			
PATH: ...\CD\		DATE	SCALE NONE	SHT 6 OF 9	REVISION 0
CAD FILE: CD19671001_000.dwg		APVD	C/C	AUTOCAD	
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED	2 PL ± 3 PL ± ANGLES ±	DATE 2/10/12	SECTIONAL SIZE X OUTLINE SIZE NO	
			THIRD ANGLE PROJECTION	DESIGN CONTROL A005 DWG LOCATION A101	VERSION
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DETAIL F
FROM SHEET 6

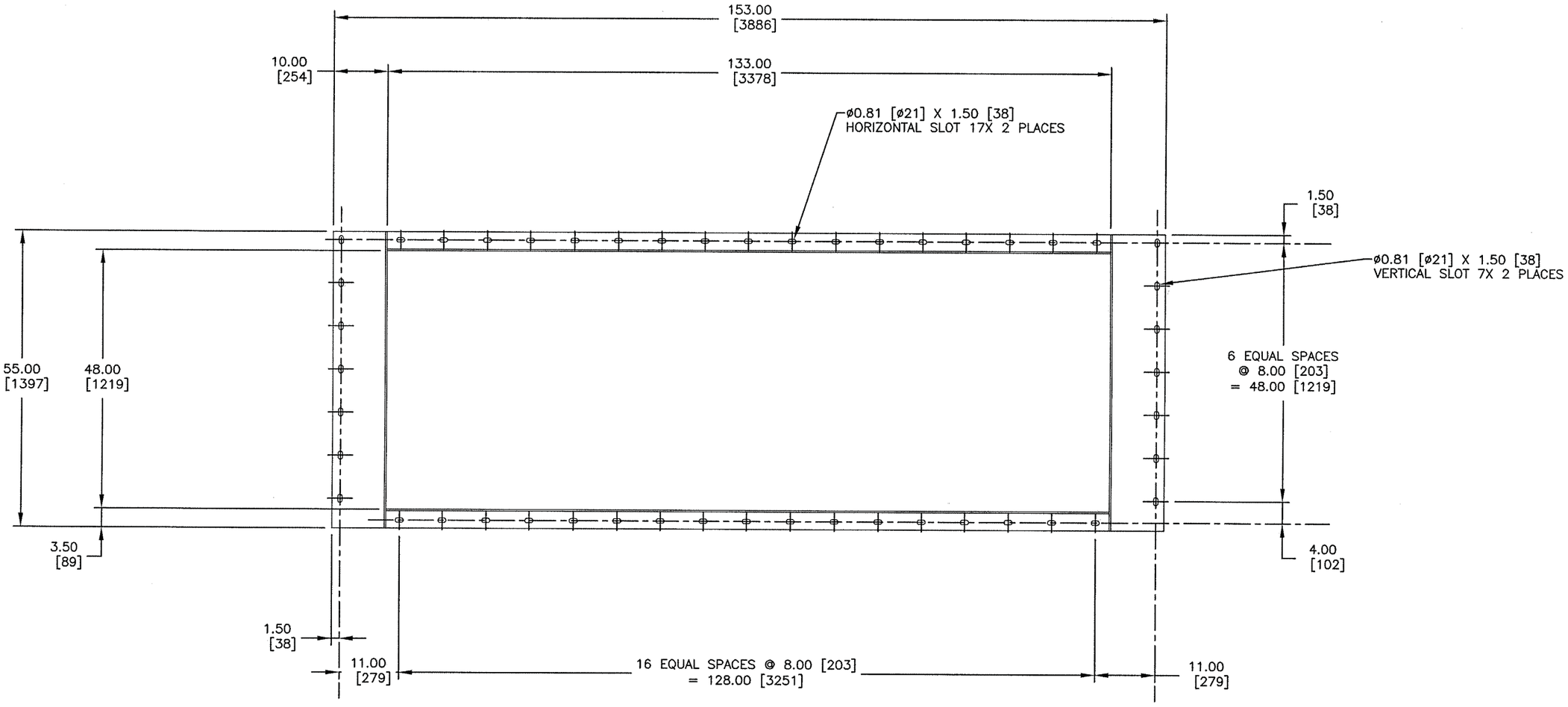
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	DATE		
	EXP DATE		
	DWN B. MAILE	NUMBER	CD19671
REFERENCE	DATE 2/10/12		
EWR--	CHK		
PATH: ...\CD\	DATE	SCALE NONE	SHT 7 OF 9
CAD FILE: CD19671001_000.dwg	APVD	C/C	AUTOCAD
DO NOT SCALE — TOLERANCES UNLESS OTHERWISE SPECIFIED: 2 PL ±, 3 PL ±, ANGLES ±	DATE 2/10/12	SECTIONAL SIZE X	OUTLINE SIZE NO
	THIRD ANGLE PROJECTION	DESIGN CONTROL A005	DWG LOCATION A101
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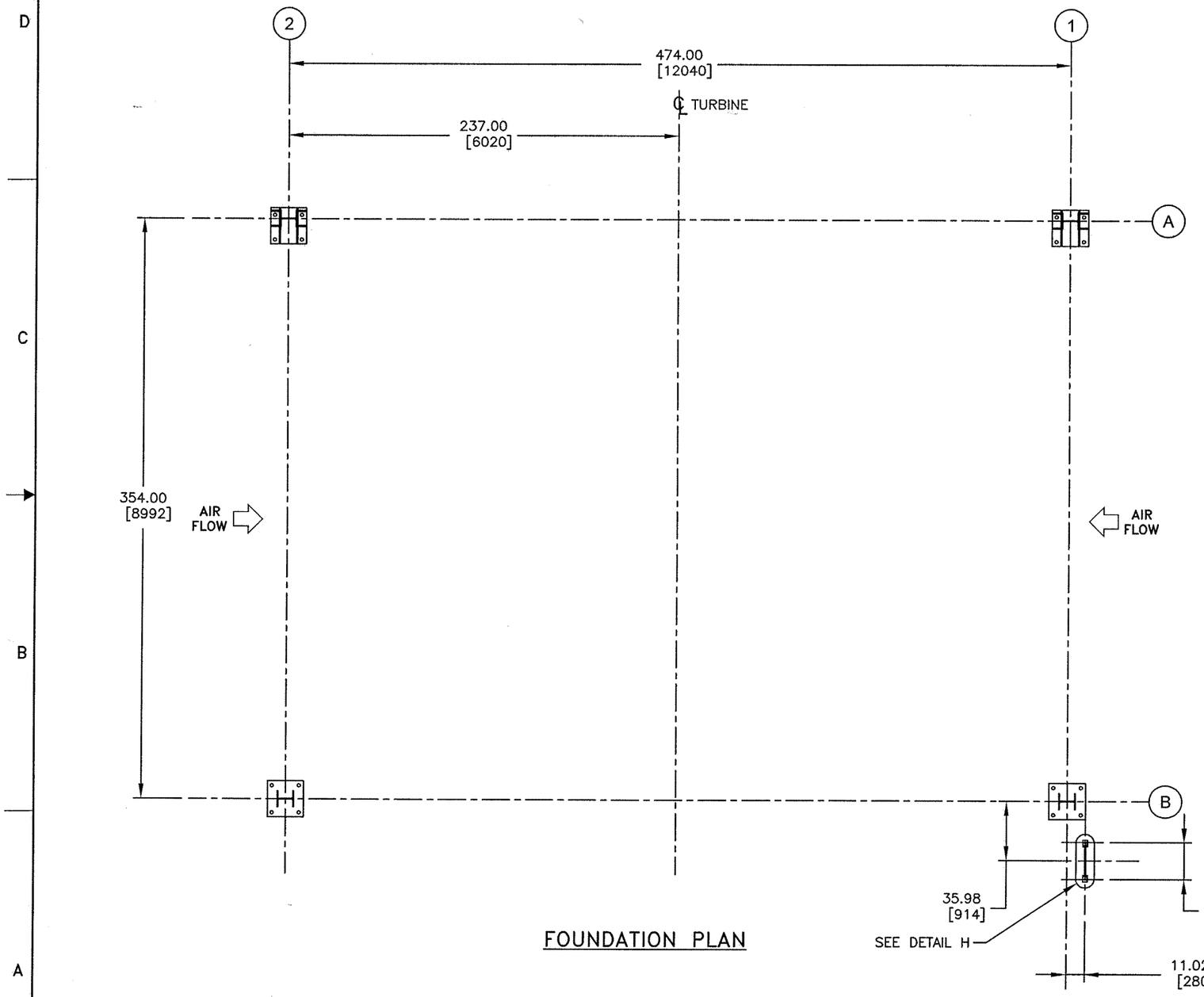
DETAIL G
FROM SHEET 6

MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000
		DATE	
		EXP DATE	
		DWN B. MAILE	NUMBER: CD19671
REFERENCE		DATE 2/10/12	
EWR-		CHK	
PATH: ...\CD\		DATE	SCALE NONE | SHT 8 OF 9 | REVISION
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		THIRD ANGLE PROJECTION	DESIGN CONTROL A005 | DWG LOCATION A101 | VERSION

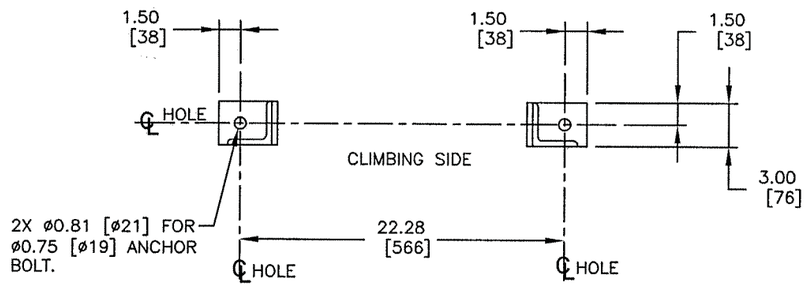
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REV	ZONE	REVISION DESCRIPTION	APPROVAL / DATE



FOUNDATION PLAN



DETAIL H
ROTATED 90° CW

MATERIAL		RELEASE NO.	TITLE: AIR FILTER GDX LM6000
		DATE	
		EXP DATE	
		DWN B. MAILE	NUMBER: CD19671
REFERENCE		DATE 2/10/12	
EWR--		CHK	
PATH: ...\CD\		DATE	SCALE NONE SHT 9 OF 9 REVISION
CAD FILE: CD19671001_000.dwg		APVD	C/C AUTOCAD 0
DO NOT SCALE	TOLERANCES UNLESS OTHERWISE SPECIFIED	2 PL ±	DATE 2/10/12
		3 PL ±	SECTIONAL SIZE X OUTLINE SIZE NO
		ANGLES ±	THIRD ANGLE PROJECTION
			DESIGN CONTROL A005 DWG LOCATION A101 VERSION

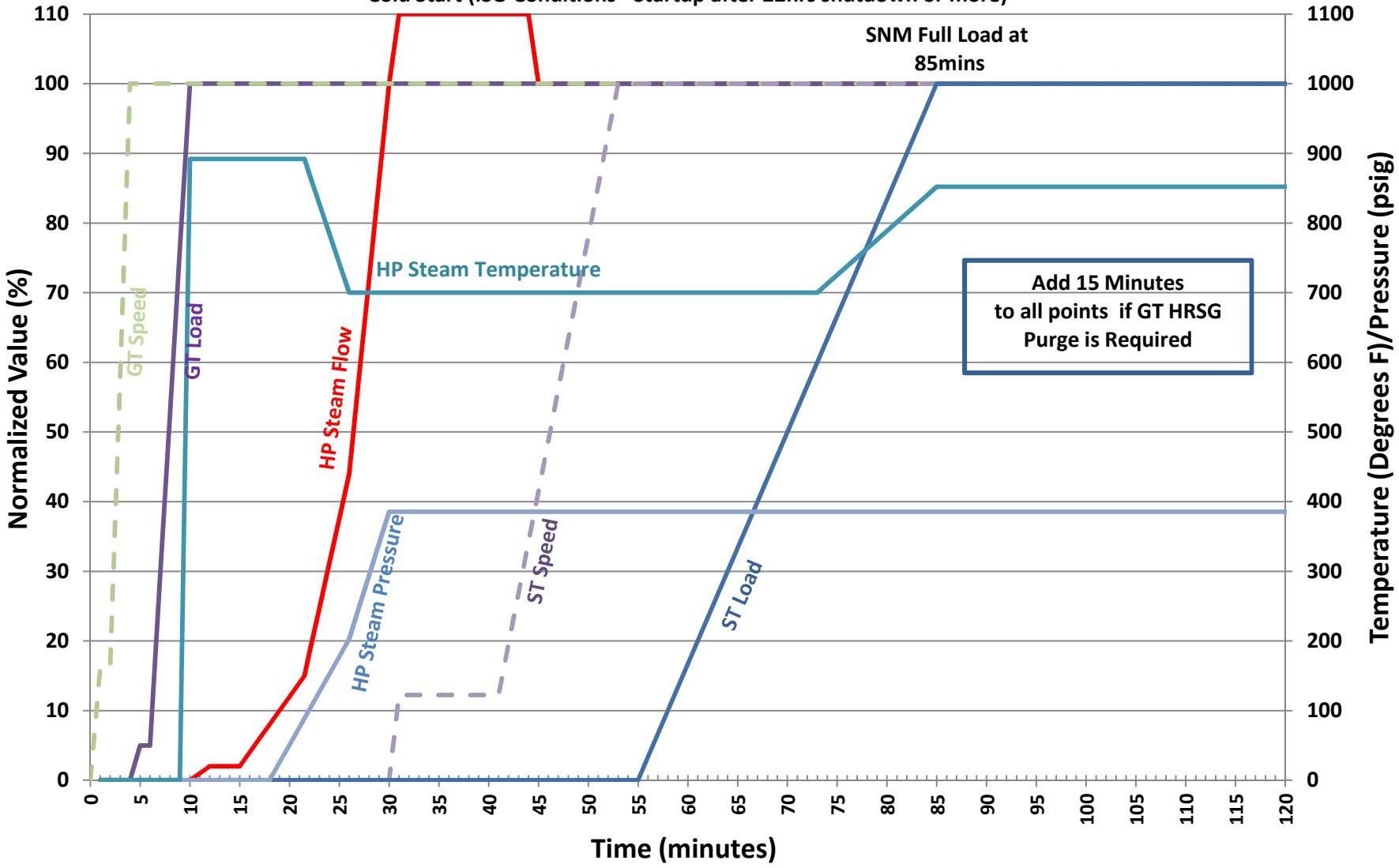
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423049 1xLM6000 Combined Cycle Power Plant with IST OTSG

Cold Start (ISO Conditions - Startup after 22hrs shutdown or more)



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DIMENSIONS

Electric Resistance Steam Boilers

Model S Dimensions

MODEL NO	CONNECTION SIZE (NPT)					DIMENSIONS (IN.)				CLEARANCES		APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET*		FEED-WATER	WIDTH	DEPTH	HEIGHT	LWCO	TOP	SIDES	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG		A	B	C	D	E	F		
S-120	3/4	3/4	1-1/2	1-1/4	1/2	38	38	58	18	12	16	600	675
S-161	3/4	3/4	2	1-1/4	1/2	44	42	69	35	12	20	750	880
S-162	3/4	3/4	2	2	1/2	44	42	69	35	12	20	800	930
S-200	1	1	3 flg	2	3/4	46	47	76	42	12	20	1150	1480
S-241	1-1/4	1	4 flg	2	3/4	43	58	78	42	12	20	1400	1900
S-242	1-1/4	1	4 flg	2	3/4	43	58	78	42	12	20	1600	2000
S-301	1-1/2	1	6 flg	3 flg	3/4	49	62	94	50	15	20	2100	3000
S-302	1-1/2	1	6 flg	3 flg	3/4	49	66	94	50	15	20	2200	3300
S-361	1-1/2	1	8 flg	4 flg	3/4	56	72	79	41	18	36	2900	4000
S-362	1-1/2	1	8 flg	4 flg	3/4	56	78	94	52	18	36	3200	4800
S-421	1-1/2	1	8 flg	4 flg	1	62	84	82	44	18	36	4150	5800
S-422	1-1/2	1	8 flg	4 flg	1	62	84	94	52	18	36	4500	6700
S-480	2	1-1/4	10 flg	6 flg	1	72	90	104	52	18	36	5450	8000

Model CR Dimensions

MODEL NO	CONNECTION SIZE (NPT)						DIMENSIONS (IN.)				APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET*		COND. RETURN	OVER-FLOW	WIDTH	DEPTH	HEIGHT	LWCO	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG			A	B	C	D		
CR-120	3/4	3/4	1-1/2	1-1/4	3/4	3/4	40	46	58	18	850	950
CR-161	3/4	3/4	2	1-1/4	1	1	44	50	69	35	1050	1200
CR-162	3/4	3/4	2	2	1	1	44	50	69	35	1150	1280
CR-200	1	1	3 flg	2	1-1/4	1-1/4	48	54	76	42	1650	2030
CR-241	1-1/4	1	4 flg	2	1-1/2	1-1/2	43	58	78	42	2000	2600
CR-242	1-1/4	1	4 flg	2	1-1/2	1-1/2	43	58	78	42	2200	2700

Model HSB Dimensions

MODEL NO	CONNECTION SIZE (NPT)					DIMENSIONS (IN.)				CLEARANCES		APPROXIMATE WEIGHTS (LBS.)	
	BLOWDOWN		STEAM OUTLET**		FEED-WATER	WIDTH	DEPTH	HEIGHT	LWCO	TOP	SIDES	SHIPPING	OPERATING
	15 PSIG	150 PSIG	15 PSIG	150 PSIG		A	B	C	D	E	F		
HSB-423	2	1-1/2	10	4	1	155	70	72	34	24	36	5700	8000
HSB-424	2	1-1/2	10	6	1	172	72	72	34	24	36	6400	9300
HSB-425	2	1-1/2	10	6	1	189	72	72	34	24	36	7100	10600

Dimensional heights are for the boilers only. Control panel size varies based on the number of steps and optional equipment.

* Steam Outlet is MPT connection unless otherwise noted.

** Steam Outlet is 150# ANSI Flange connection unless otherwise noted.

RATINGS

Electric Resistance Steam Boilers

Model S/CR Ratings 208V, 240V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES	
					Qty	kW	208/240V	208/240V	208V	240V
S-120 or CR-120	9	7	12	42	3	4	1	1 @ 12	34	30
			24	84	6	4	2	1 @ 24	68	59
			36	126	9	4	3	1 @ 36	101	88
			48	168	12	4	4	2 @ 24	134	116
S-161 or CR-161	23	16	60	210	9	6.7	3	1 @40, 1 @20	168	145
			80	280	12	6.7	4	2 @ 40	223	193
S-162 or CR-162	23	16	100	350	15	6.7	5	2 @40, 1 @20	279	242
			120	420	18	6.7	6	3 @ 40	334	290
			140	490	21	6.7	7	3 @ 40, 1 @ 20	390	338
S-200 or CR-200	48	26	160	560	24	6.7	8	4 @ 40	445	386
			180	630	27	6.7	9	4 @40, 1 @20	501	434
			200	700	30	6.7	10	5 @ 40	556	482
			220	770	33	6.7	11	5 @40, 1 @ 20	612	530
			240	840	36	6.7	12	6 @ 40	667	578
S-241 or CR-241	62	53	260	910	39	6.7	13	6 @40, 1 @ 20	723	626
			280	980	42	6.7	14	7 @ 40	778	675
			300	1050	45	6.7	15	7 @ 40, 1 @ 20	834	723
			320	1120	48	6.7	16	8 @ 40	889	771
S-242 or CR-242	62	53	340	1190	51	6.7	17	8 @ 40, 1 @ 20	945	819
			360	1260	54	6.7	18	2 @ 60, 6 @ 40	1000	867
			380	1330	57	6.7	19	3 @ 60, 5 @ 40	1056	915
			400	1400	60	6.7	20	4 @ 60, 4 @ 40	1111	963

RATINGS

Electric Resistance Steam Boilers

Table B4-6. Model S/CR Ratings 380V, 415V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212^{0}F	No. of Elements Qty @ kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
								380 V	415 V
S-161 or CR-161	23	16	15	51	3 @ 5	1	1 @ 15	23	21
			30	102	6 @ 5	1	1@30	46	42
			45	154	9 @ 5	2	1@15, 1@30	68	63
			60	205	12 @ 5	2	2@30	91	83
S-162 or CR-162	23	16	75	256	15 @ 5	3	1@15, 2@30	114	104
			90	307	18 @ 5	3	3@30	137	125
			105	358	21 @ 5	4	1@15, 3@30	160	146
			120	409	24 @ 5	4	4@30	182	167
S-200 or CR-200	48	26	135	461	27 @ 5	5	1@15, 4@30	205	188
			150	512	30 @ 5	5	5@30	228	209
			165	563	33 @ 5	6	1@15, 5@30	251	230
			180	614	36 @ 5	6	6@30	273	250
S-241 or CR-241	62	53	210	717	21 @ 10	7	7@30	319	292
			240	819	24 @ 10	8	8@30	365	334
S-242 or CR-242	62	53	270	921	27 @ 10	9	7@30, 1@60	410	376
			300	1024	30 @ 10	10	6@30, 2@60	456	417
			330	1126	33 @ 10	11	5@30, 3@60	501	459
			360	1228	36 @ 10	12	4@30, 4@60	547	501
			390	1331	39 @ 10	13	3@30, 5@60	593	543
			420	1433	42 @ 10	14	2@30, 6@60	638	584
			450	1535	45 @ 10	15	1@30, 7@60	684	626
			480	1638	48 @ 10	16	8@60	729	668
S-301	110	53	510	1740	51 @ 10	17	3@30, 7@60	775	710
			540	1842	54 @ 10	18	2@30, 8@60	821	752
			570	1945	57 @ 10	19	1@30, 9@60	867	793
			600	2047	60 @ 10	20	10@60	912	835
			630	2150	63 @ 10	21	3@30, 9@60	958	877
			660	2252	66 @ 10	22	2@30, 10@60	1003	919
			690	2354	69 @ 10	23	1@30, 11@60	1049	960
			720	2457	72 @ 10	24	12@60	1094	1002
S-362	200	130	750	2559	75 @ 10	25	11@60, 1@90	1140	1044
			780	2661	78 @ 10	26	10@60, 2@90	1186	1086
			810	2764	81 @ 10	27	9@60, 3@90	1231	1127
			840	2866	84 @ 10	28	8@60, 4@90	1277	1169
			870	2968	87 @ 10	29	7@60, 5@90	1322	1211
			900	3071	90 @ 10	30	6@60, 6@90	1368	1253
			930	3173	93 @ 10	31	5@60, 7@90	1413	1294
			960	3276	96 @ 10	32	4@60, 8@90	1459	1336
			990	3378	99 @ 10	33	3@60, 9@90	1505	1378

RATINGS

Electric Resistance Steam Boilers

Table B4-6. Model S/CR Ratings 380V, 415V Supplies (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212^{0}F	No. of Elements Qty @ kW	**# of CONTACTORS**	No. of Steps @ kW	**3-PHASE AMPERES**	
								380 V	**415 V**
S-421	210	180	1020	3480	102 @ 10	34	2@60, 10@90	1550	1420
			1050	3583	105 @ 10	35	1@60, 11@90	1596	1461
			1080	3686	108 @ 10	36	12@90	1641	1503
S-422	270	180	1110	3787	111 @ 10	37	5@60, 9@90	1687	1545
			1140	3890	114 @ 10	38	4@60, 10@90	1733	1586
			1170	3992	117 @ 10	39	3@60, 11@90	1778	1628
			1200	4094	120 @ 10	40	2@60, 12@90	1824	1670
			1230	4197	123 @ 10	41	1@60, 13@90	1869	1712
			1260	4299	126 @ 10	42	14@90	1915	1753
			1290	4401	129 @ 10	43	5@60, 11@90	1960	1795
			1320	4504	132 @ 10	44	4@60, 12@90	2006	1837
			1350	4606	135 @ 10	45	3@60, 13@90	2052	1879
S-480	360	235	1380	4709	138 @ 10	46	2@60, 14@90	2097	1920
			1410	4811	141 @ 10	47	1@60, 15@90	2142	1962
			1440	4913	144 @ 10	48	16@90	2188	2003
			1470	5016	147 @ 10	49	5@60, 13@90	2233	2045
			1500	5118	150 @ 10	50	4@60, 14@90	2279	2087
			1530	5220	153 @ 10	51	3@60, 15@90	2325	2129
			1560	5323	156 @ 10	52	2@60, 16@90	2370	2170
			1590	5425	159 @ 10	53	1@60, 17@90	2416	2212
			1620	5527	162 @ 10	54	18@90	2461	2254

RATINGS

Electric Resistance Steam Boilers

Table B4-7. Model S/CR Ratings 480V Supplies

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of Contactors	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	480 V	480 V	480 V
S-120 or CR-120	9	7	12	42	3	4	1	1 @ 12	15
			24	84	6	4	1	1 @ 24	29
			36	126	9	4	1	1 @ 36	44
			48	168	12	4	2	2 @ 24	58
S-161 or CR-161	23	16	60	210	9	6.7	2	1 @40, 1 @20	73
			80	280	12	6.7	2	2 @ 40	97
S-162 or CR-162	23	16	100	350	15	6.7	3	2 @40, 1 @20	121
			120	420	18	6.7	3	3 @ 40	145
			140	490	21	6.7	4	3 @40, 1 @20	169
S-200 or CR-200	48	26	160	560	24	6.7	4	4 @ 40	193
			180	630	27	6.7	5	4 @40, 1 @20	217
			200	700	30	6.7	5	5 @ 40	241
			220	770	33	6.7	6	5 @40, 1 @20	265
			240	840	36	6.7	6	6 @ 40	289
S-241 or CR-241	62	53	260	910	39	6.7	7	6 @40, 1 @20	314
			280	980	42	6.7	7	7 @ 40	338
			300	1050	45	6.7	8	7 @40, 1 @20	362
			320	1120	48	6.7	8	8 @ 40	386
S-242 or CR-242	62	53	340	1190	51	6.7	9	8 @40, 1 @20	410
			360	1260	54	6.7	9	1 @80, 7 @40	434
			380	1330	57	6.7	10	1@80,6@40,1@60	458
			400	1400	60	6.7	10	2 @80, 6 @40	482
			420	1470	63	6.7	11	2@80,5@40,1@60	506
CR-242	62	53	440	1540	66	6.7	11	3 @80, 5 @40	530
			460	1610	69	6.7	12	3@80,4@40,1@60	554
			480	1680	72	6.7	12	4 @80, 4 @40	578
S-301	110	70	440	1540	66	6.7	11	3 @80, 5 @40	530
			460	1610	69	6.7	12	3@80,4@40,1@60	554
			480	1680	72	6.7	12	4 @80, 4 @40	578

RATINGS

Electric Resistance Steam Boilers

Table B4-7. Model S/CR Ratings 480V Supplies (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of Contactors	NUMBER and kW of STEPS	3-PHASE AMPERE
					Qty	kW	480 V	480 V	480 V
S-302	140	90	500	1750	75	6.7	13	4 @80, 3 @40, 1@60	603
			520	1820	78	6.7	13	5 @80, 3 @40	627
			540	1890	81	6.7	14	5 @80, 2 @40, 1@60	651
			560	1960	84	6.7	14	6 @80, 2 @40	675
			580	2030	87	6.7	15	6 @80, 1 @40, 1@60	699
			600	2100	90	6.7	15	7 @80, 1 @40	723
			620	2170	93	6.7	16	7 @80, 1 @60	747
			640	2240	96	6.7	16	8 @ 80	771
			660	2310	99	6.7	17	6 @80, 3 @40, 1@60	795
			680	2380	102	6.7	17	7 @80, 3 @40	819
			700	2450	105	6.7	18	7 @80, 2 @40, 1@60	843
			720	2520	108	6.7	18	8 @ 80, 2 @40	867
S-361	150	100	756	2646	63	12	21	9 @72, 3 @36	911
			792	2772	66	12	22	10 @72, 2 @36	954
			828	2898	69	12	23	11 @72, 1 @36	998
			864	3024	72	12	24	12 @ 72	1041
S-362	200	130	900	3276	75	12	25	12 @72, 1 @36	1084
			936	3402	78	12	26	13 @ 72	1128
			972	3528	81	12	27	13 @72, 1 @36	1171
			1008	3780	84	12	28	14 @ 72	1214
S-421	210	140	1044	3654	87	12	29	14 @72, 1 @36	1258
			1080	3780	90	12	30	15 @ 72	1301
			1116	3906	93	12	31	15 @72, 1 @36	1344
			1152	4032	96	12	32	16 @ 72	1388
			1188	4158	99	12	33	16 @72, 1 @36	1431
			1224	4284	102	12	34	17 @ 72	1474
			1260	4410	105	12	35	17 @72, 1 @36	1518
			1296	4536	108	12	36	18 @ 72	1560

RATINGS

Electric Resistance Steam Boilers

Table B4-7. Model S/CR Ratings 480V Supplies (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of Contactors	NUMBER and kW of STEPS	3-PHASE AMPERE
					Qty	kW	480 V	480 V	480 V
S-422	270	180	1332	4662	111	12	37	18 @ 72, 1 @36	1605
			1368	4788	114	12	38	19 @ 72	1648
			1404	4914	117	12	39	19 @ 72, 1 @36	1691
S-480	360	235	1440	5040	120	12	40	20 @ 72	1735
			1476	5166	123	12	41	9 @108, 7 @72	1778
			1512	5290	126	12	42	10 @108, 6 @72	1821
			1548	5418	129	12	43	11 @108, 5 @72	1864
			1584	5540	132	12	44	12 @108, 4 @72	1908
			1620	5670	135	12	45	13 @108, 3 @72	1951
			1656	5790	138	12	46	14 @108, 2 @72	1995
			1692	5922	141	12	47	15 @108, 1 @72	2038
			1728	6050	144	12	48	16 @ 108	2081
			1764	6174	147	12	49	13@108, 5@72	2125
			1800	6300	150	12	50	14@108, 4@72	2168
			1836	6426	153	12	51	15@108, 3@72	2211
			1872	6552	156	12	52	16@108, 2@72	2254
			1908	6678	159	12	53	17@108, 1@72	2298
			1944	6804	162	12	54	18@108	2341

RATINGS

Electric Resistance Steam Boilers

Table B4-8. Model S/CR Ratings 600V Supply

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	600 V	600 V	600 V
S-120 or CR-120	9	7	19	66	3	6.3	1	1 @ 19	19
			38	131	6	6.3	1	1 @ 37	37
CR-120	9	7	56	197	9	6.3	2	1 @37, 1 @19	54
S-161	23	16	56	197	9	6.3	2	1 @37, 1 @19	54
			70	246	9	7.8	2	1 @47, 1 @23	68
			75	263	12	6.3	2	2 @ 37	73
			94	328	12	7.8	2	2 @ 47	91
CR-161	23	16	70	246	9	7.8	2	1 @47, 1 @23	68
			94	328	12	7.8	2	2 @ 47	91
S-162	23	16	117	410	15	7.8	3	2 @47, 1 @23	113
			141	492	18	7.8	3	3 @ 47	136
CR-162	23	16	164	574	21	7.8	4	3 @47, 1 @23	158
S-200	48	26	164	574	21	7.8	4	3 @47, 1 @23	158
S-200 or CR-200	48	26	188	656	24	7.8	4	4 @ 47	182
			211	738	27	7.8	5	4 @47, 1 @23	204
			234	820	30	7.8	5	5 @ 47	226
			258	902	33	7.8	6	5 @47, 1 @23	249
			281	984	36	7.8	6	6 @ 47	271
S-241 or CR-241	62	53	305	1066	39	7.8	7	6 @47, 1 @23	294
			328	1148	42	7.8	7	7 @ 47	316
			352	1230	45	7.8	8	7 @47, 1 @23	340
			375	1313	48	7.8	8	8 @ 47	362
S-242 or CR-242	62	53	398	1395	51	7.8	9	7 @47, 1 @70	384
			422	1477	54	7.8	9	1 @94, 7 @47	407
			445	1559	57	7.8	10	1 @94, 6 @47, 1@70	429
CR-242	62	53	469	1641	60	7.8	10	2 @94, 6 @47	452
			492	1724	63	7.8	10	2 @94, 5 @47, 1@70	474
			516	1805	66	7.8	11	3 @94, 5 @47	498
			539	1889	69	7.8	11	3 @94, 4 @47, 1@70	520
			563	1969	72	7.8	12	4 @94, 4 @47	543
S-301	110	70	469	1641	60	7.8	10	2 @94, 6 @47	452
			492	1724	63	7.8	10	2 @94, 5 @47, 1@70	474
			516	1805	66	7.8	11	3 @94, 5 @47	498
			539	1889	69	7.8	11	3 @94, 4 @47, 1@70	520
			563	1969	72	7.8	12	4 @94, 4 @47	543

RATINGS

Electric Resistance Steam Boilers

Table B4-8. Model S/CR Ratings 600V Supply (Continued)

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	ASME (Steam lbs/ hr)	ELEMENTS		# of CONTACTORS	NUMBER and kW of STEPS	3-PHASE AMPERES
					Qty	kW	600 V	600 V	600 V
S-302	140	90	586	2054	75	7.8	12	4 @94, 3 @47, 1@70	565
			609	2133	78	7.8	13	5 @94, 3 @47	587
			633	2218	81	7.8	13	5 @94, 2 @47, 1@70	610
			656	2297	84	7.8	14	6 @94, 2 @47	632
			672	2355	87	7.8	14	6 @94, 1 @47, 1@70	648
			703	2461	90	7.8	15	7 @94, 1 @47	678
S-361	150	100	750	2625	48	15.6	16	6 @94, 4 @47	723
			797	2789	51	15.6	17	7 @94, 3 @47	768
			844	2953	54	15.6	18	8 @94, 2 @47	814
			891	3117	57	15.6	19	9 @94, 1 @47	859
			938	3281	60	15.6	20	10 @ 94	904
			984	3445	63	15.6	21	9 @94 3 @47	948
			1031	3609	66	15.6	22	10 @94, 2 @47	994
S-421	210	140	1078	3773	69	15.6	23	11 @94, 1 @47	1039
			1125	3938	72	15.6	24	12 @ 94	1084
			1172	4102	75	15.6	25	12 @94, 1 @47	1129
			1219	4266	78	15.6	26	13 @ 94	1175
			1266	4430	81	15.6	27	13 @94, 1 @47	1220
			1313	4594	84	15.6	28	14 @ 94	1265
			1359	4758	87	15.6	29	14 @94, 1 @47	1310
			1406	4922	90	15.6	30	15 @ 94	1355
			1453*	5086	93	15.6	31	15 @94, 1 @47	1400
			1500*	5250	96	15.6	32	16 @ 94	1445
			1547*	5414	99	15.6	33	16 @94, 1 @47	1491
			1594*	5578	102	15.6	34	17 @ 94	1536
			1641*	5742	105	15.6	35	17 @94, 1 @47	1581
			1688*	5906	108	15.6	36	18 @ 94	1627
S-480	360	235	1734	6070	111	15.6	37	17 @94, 3 @47	1671
			1781	6234	114	15.6	38	18 @94, 2 @47	1716
			1828	6398	117	15.6	39	19 @94, 1 @47	1761
			1875	6563	120	15.6	40	20 @ 94	1807
			1922*	6727	123	15.6	41	9 @ 141, 7 @94	1852
			1969*	6891	126	15.6	42	10 @141, 6 @94	1897
			2016*	7055	129	15.6	43	11 @141, 5 @94	1943
			2063*	7219	132	15.6	44	12 @141, 4 @94	1988
			2109*	7383	135	15.6	45	13 @141, 3 @94	2032
			2156*	7547	138	15.6	46	14 @141, 2 @94	2077
			2203*	7711	141	15.6	47	15 @141, 1 @94	2123
			2250*	7875	144	15.6	48	16 @ 141	2168

* High pressure only

RATINGS

Electric Resistance Steam Boilers

Table B4-9. Model HSB Ratings 380V, 415V Supply

Model	Vessel Capacity (gallons)	Steam Space (gallons)	Rating kW	Steam lb./hr @ 212^{0}F	No. of Elements Qty @ kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES	
								380 V	415 V
HSB-424	385	260	1650	5630	165 @ 10	55	5@60, 15@90	2507	2296
			1680	5732	168 @ 10	56	4@60, 16@90	2553	2337
			1710	5835	171 @ 10	57	3@60, 17@90	2598	2379
			1740	5937	174 @ 10	58	2@60, 18@90	2644	2421
			1770	6039	177 @ 10	59	1@60, 19@90	2689	2463
			1800	6142	180 @ 10	60	20@90	2735	2504

RATINGS

Electric Resistance Steam Boilers

Model HSB Ratings 480V Supply

MODEL #	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	Steam lb./hr @ 212˚F	ELEMENTS Qty	ELEMENTS kW	# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES
HSB-423	300	200	1560	5460	117	13.3	39	7 @120, 9 @80	1879
			1600	5600	120	13.3	40	8 @120, 8 @80	1927
			1640	5740	123	13.3	41	9 @120, 7 @80	1975
			1680	5880	126	13.3	42	10 @120, 6 @80	2025
			1720	6020	129	13.3	43	11 @120, 5 @80	2072
			1760	6160	132	13.3	44	12 @120, 4 @80	2120
			1800	6300	135	13.3	45	13 @120, 3 @80	2168
			1840	6440	138	13.3	46	14 @120. 2 @80	2216
			1880	6580	141	13.3	47	15 @120, 1 @80	2264
			1920	6720	144	13.3	48	16 @ 120	2313
HSB-424	385	260	1960	6860	147	13.3	49	1 @160, 15 @120	2361
			2000	7000	150	13.3	50	2 @160. 14 @120	2409
			2040	7140	153	13.3	51	3 @160. 13 @120	2457
			2080	7280	156	13.3	52	4 @160, 12 @120	2505
			2120	7420	159	13.3	53	5 @160, 11 @120	2553
			2160	7560	162	13.3	54	6 @160. 10 @120	2602
			2200	7700	165	13.3	55	7 @160. 9 @120	2650
			2240	7840	168	13.3	56	8 @160, 8 @120	2698
			2280	7980	171	13.3	57	9 @160, 7 @120	2746
			2320	8120	174	13.3	58	10 @160, 6 @120	2794
			2360	8260	177	13.3	59	11 @160, 5 @120	2843
			2400	8400	180	13.3	60	12 @160, 4 @120	2891
HSB-425	470	320	2440	8540	183	13.3	61	13 @160, 3 @120	2939
			2480	8680	186	13.3	62	14 @160, 2 @120	2987
			2520	8820	189	13.3	63	15 @160, 1 @120	3035
			2560	8960	192	13.3	64	16 @ 160	3083
			2600	9100	195	13.3	65	11 @160, 7 @120	3132
			2640	9240	198	13.3	66	12 @160, 6 @120	3180
			2680	9380	201	13.3	67	13 @160, 5 @120	3228
			2720	9520	204	13.3	68	14 @160, 4 @120	3276
			2760	9660	207	13.3	69	15 @160, 3 @120	3324
			2800	9800	210	13.3	70	16 @160, 2 @120	3372
			2840	9940	213	13.3	71	17 @160, 1 @120	3421
			2880	10080	216	13.3	72	18 @ 160	3469

RATINGS

Electric Resistance Steam Boilers

Model HSB Ratings 600V Supply

MODEL #	Vessel Capacity (gallons)	Steam Space (gallons)	Rated kW	Steam lb./hr @ 212°F	ELEMENTS		# of CONTACTORS	No. of Steps @ kW	3-PHASE AMPERES
					Qty	kW			
HSB-423	300	200	1734	6070	111	15.6	37	17 @94, 3 @47	1671
			1781	6234	114	15.6	38	18 @94, 2 @47	1716
			1828	6398	117	15.6	39	19 @94, 1 @47	1762
			1875	6563	120	15.6	40	20 @ 94	1807
			1922	6727	123	15.6	41	9 @141, 7 @94	1852
			1969	6891	126	15.6	42	10 @141, 6 @94	1897
			2016	7055	129	15.6	43	11 @141, 5 @94	1943
			2063	7219	132	15.6	44	12 @141, 4 @94	1988
			2109	7383	135	15.6	45	13 @141, 3 @94	2032
			2156	7547	138	15.6	46	14 @141, 2 @94	2078
			2203	7711	141	15.6	47	15 @141, 1 @94	2123
			2250	7875	144	15.6	48	16 @ 141	2168
HSB-424	385	260	2297	8039	147	15.6	49	13 @141, 5 @94	2213
			2344	8203	150	15.6	50	14 @141, 4 @94	2259
			2391	8367	153	15.6	51	15 @141, 3 @94	2304
			2438	8531	156	15.6	52	16 @141, 2 @94	2349
			2484	8695	159	15.6	53	17 @141, 1 @94	2394
			2531	8859	162	15.6	54	18 @ 141	2439
			2578	9023	165	15.6	55	15 @141, 5 @94	2484
			2625	9188	168	15.6	56	16 @141, 4 @94	2529
			2672	9352	171	15.6	57	17 @141, 3 @94	2575
			2719	9516	174	15.6	58	18 @141, 2 @94	2620
			2766	9680	177	15.6	59	19 @141, 1 @94	2665
			2813	9844	180	15.6	60	20 @ 141	2710
HSB-425	470	320	2859	10008	183	15.6	61	17 @141, 5 @94	2755
			2906	10172	186	15.6	62	18 @141, 4 @94	2800
			2953	10336	189	15.6	63	19 @141, 3 @94	2845
			3000	10500	192	15.6	64	20 @141, 2 @94	2891
			3047	10664	195	15.6	65	21 @141, 1 @94	2936
			3094	10828	198	15.6	66	22 @ 141	2981
			3141	10992	201	15.6	67	19 @141, 5 @94	3027
			3188	11156	204	15.6	68	20 @141, 4 @94	3072
			3234	11320	207	15.6	69	21 @141, 3 @94	3116
			3281	11484	210	15.6	70	22 @141, 2 @94	3161
			3328	11648	213	15.6	71	23 @141, 1 @94	3207
			3375	11813	216	15.6	72	24 @ 141	3252

NOTES:

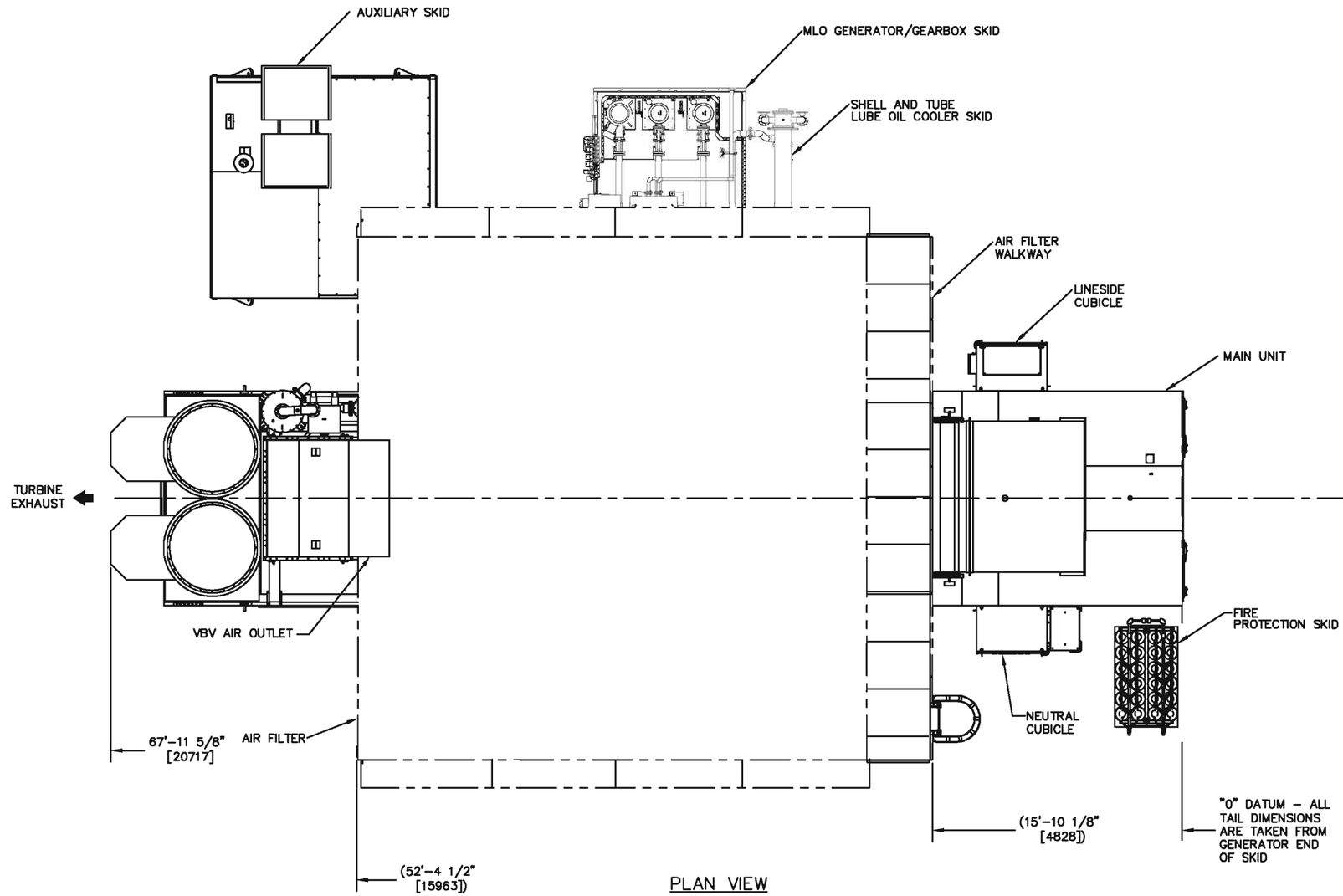
1. TOLERANCE ON FLANGE CONNECTIONS ±1/8" [3]
   TOLERANCE ON ELECTRICAL CONNECTIONS ±1/8" [3]
   TOLERANCE ON BOLT HOLES ±1/16" [2] TRUE POSITION
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. ADDITIONAL EXTERIOR LIGHTING TO BE SUPPLIED BY CUSTOMER.
4. MAXIMUM LOAD ON EACH ENGINE REMOVAL FOOT PAD IS 10,000 LBS [4536 kg], (20,000 LBS [9072 kg] TOTAL ENGINE REMOVAL LOAD). MAXIMUM LOAD ON EACH GEARBOX REMOVAL PAD IS 28,000 LBS [12700 kg].
5. AUXILIARY SKID, SPRINT SKID & FIRE PROTECTION SKID FOUNDATIONS MUST BE AT THE SAME ELEVATION AS THE MAIN SKID FOUNDATION. MLO SKID FOUNDATION MUST BE 1'-6 1/2" [471] LOWER.
6. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
7. TOLERANCES:
   LINEAR DIMENSION: ±1/8" [3]
   ANGULAR: ±0.5°

SAFETY NOTE: CAUTION

1. GEPPLP SHALL NOT BE LIABLE FOR DAMAGE CAUSED BY EXCESSIVE FLANGE LOADS OR INADEQUATE EXPANSION JOINT DESIGN. FAILURE TO PROVIDE FOR ADEQUATE THERMAL EXPANSION OR EXCEEDING ALLOWABLE FLANGE LOADS MAY RESULT IN DAMAGE TO OR DESTRUCTION OF FASTENERS AND ENGINE/EXHAUST SYSTEM RELATED HARDWARE RESULTING IN EXHAUST LEAKS AND ACCELERATED WEAR ON THE EXHAUST DIFFUSER ASSEMBLY. IT IS THE CUSTOMER'S RESPONSIBILITY TO ALLOW A CONSERVATIVE AMOUNT OF EXPANSION CAPABILITY TO ACCOMMODATE INSTALLATION ERRORS AND TOLERANCE STACK-UPS FOR THE COMPLETE EXHAUST SYSTEM.
2. IN THE REMOTE CHANCE OF A HP ROTOR FAILURE THE ENGINE CASING MAY NOT CONTAIN THE ENTIRE FAILURE. IT IS HIGHLY RECOMMENDED THAT NO PERMANENTLY MANNED SPACES BE LOCATED IN THE PLANE OF THE HP TURBINE. IT IS ALSO HIGHLY RECOMMENDED THAT ALL POTENTIALLY HAZARDOUS LINES (i.e. FUEL) OR EQUIPMENT (i.e. SHUTOFF VALVES, CONTROL VALVES) ALSO BE LOCATED OUTSIDE THE PLANE OF THE HP TURBINE.

REFERENCE DRAWINGS:

X-969204 GENERAL ARRANGEMENT, AIR FILTER
X-969218 GENERAL ARRANGEMENT, AUXILIARY SKID, RH
X-969221 GENERAL ARRANGEMENT, GENERATOR/GEARBOX MINERAL LUBE OIL SKID



PLAN VIEW

RESERVED

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000®

ADDL INFO

GE PACKAGED POWER, L.P.

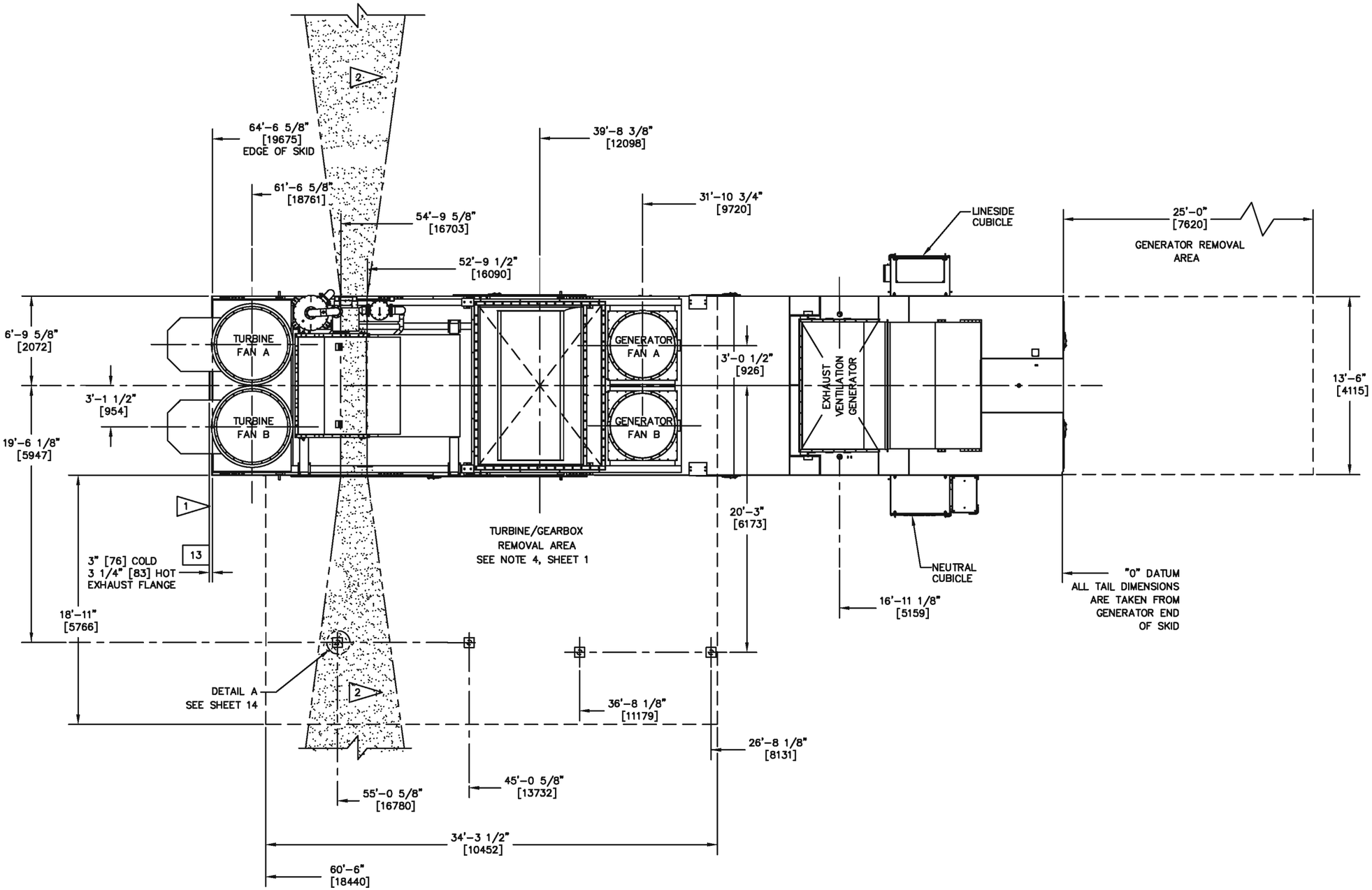
TITLE
GENERAL ARRANGEMENT
MAIN UNIT - RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 1/4" = 1'-0"

SHEET 1 OF 15



PLAN VIEW

AIR FILTER & SKIDS REMOVED FOR CLARITY

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

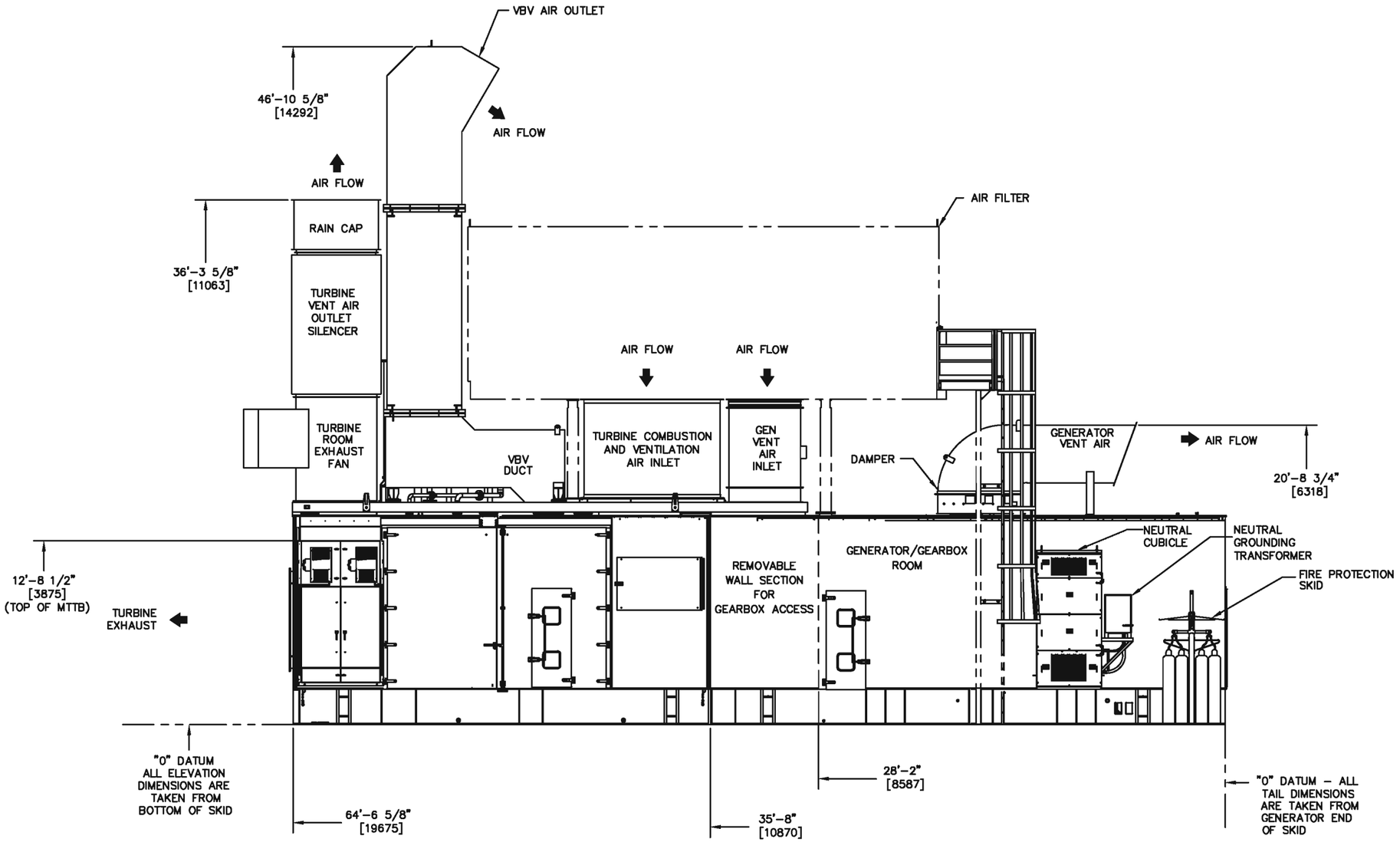
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO.: TYPICAL DRAWING 969200

REV.: H

SCALE 1/4" = 1'-0"

SHEET 2 OF 15



LEFT SIDE ELEVATION

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE

LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE

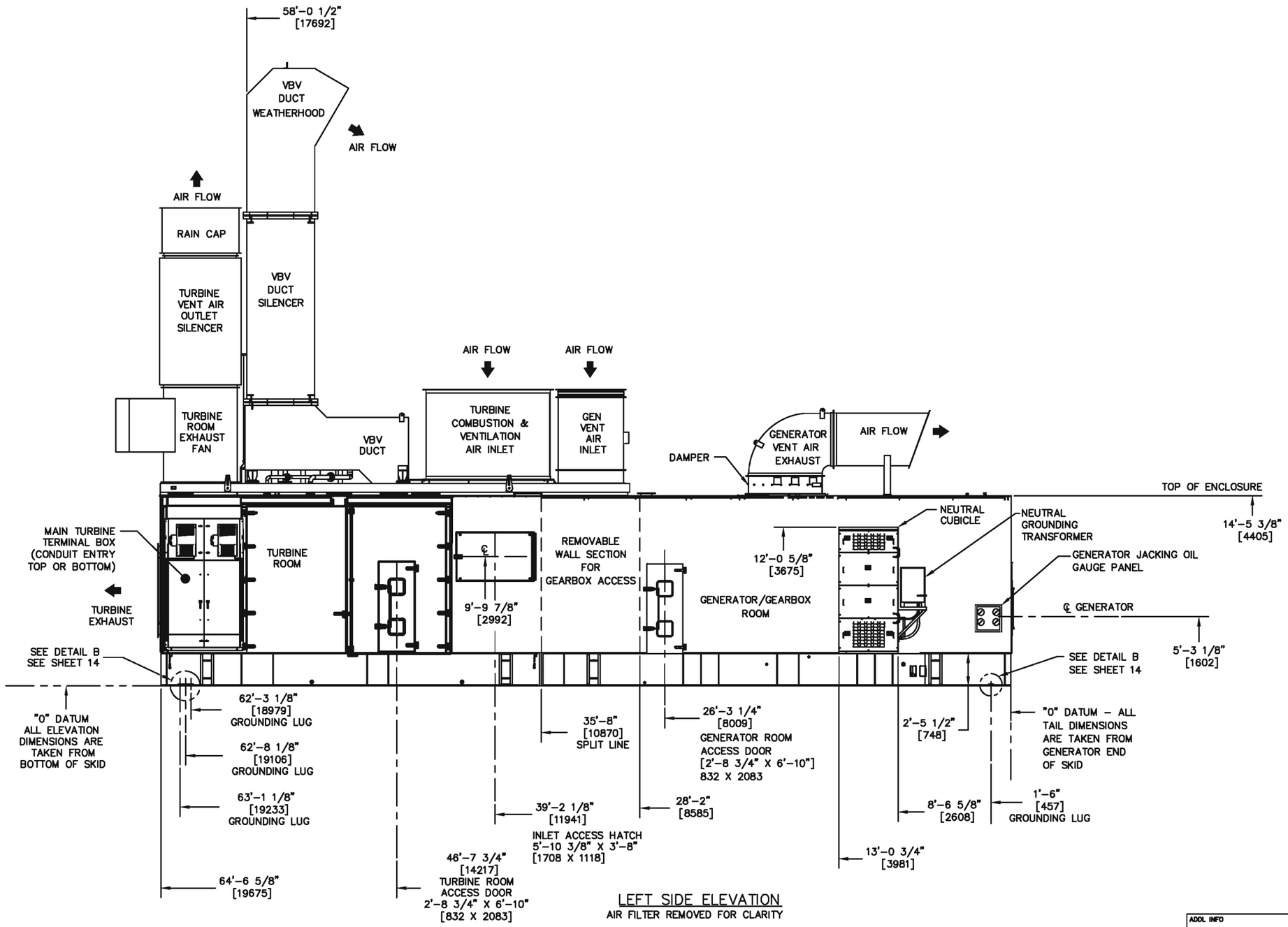
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 1/4" = 1'-0"

SHEET 3 OF 15



LEFT SIDE ELEVATION
AIR FILTER REMOVED FOR CLARITY

RESERVED

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

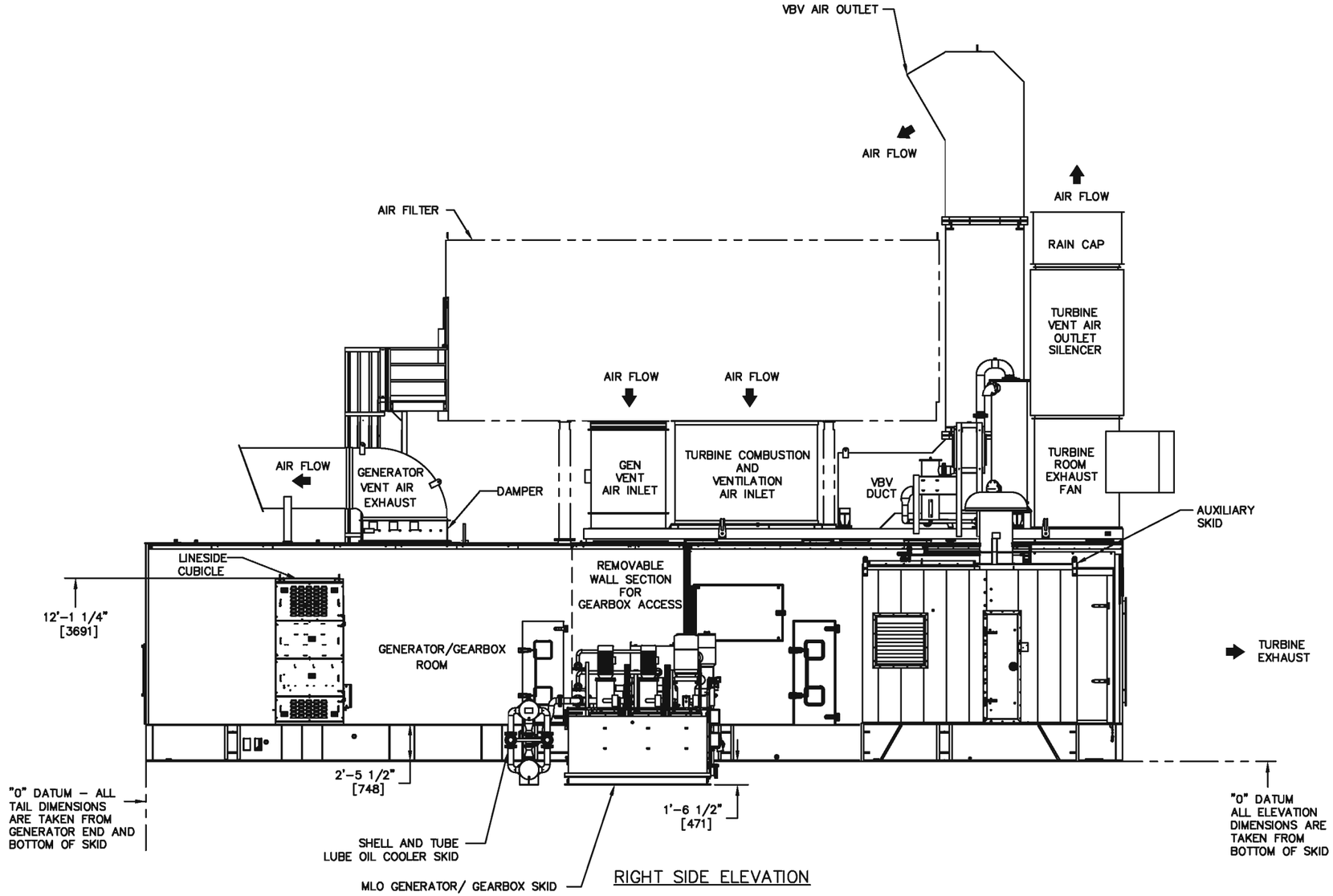
TITLE
GENERAL ARRANGEMENT
MAIN UNIT - RH

DWG NO.
TYPICAL DRAWING 969200

REV.
H

SCALE 1/4" = 1'-0"

SHEET 4 OF 15



RIGHT SIDE ELEVATION

RESERVED

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REVISIONS

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	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

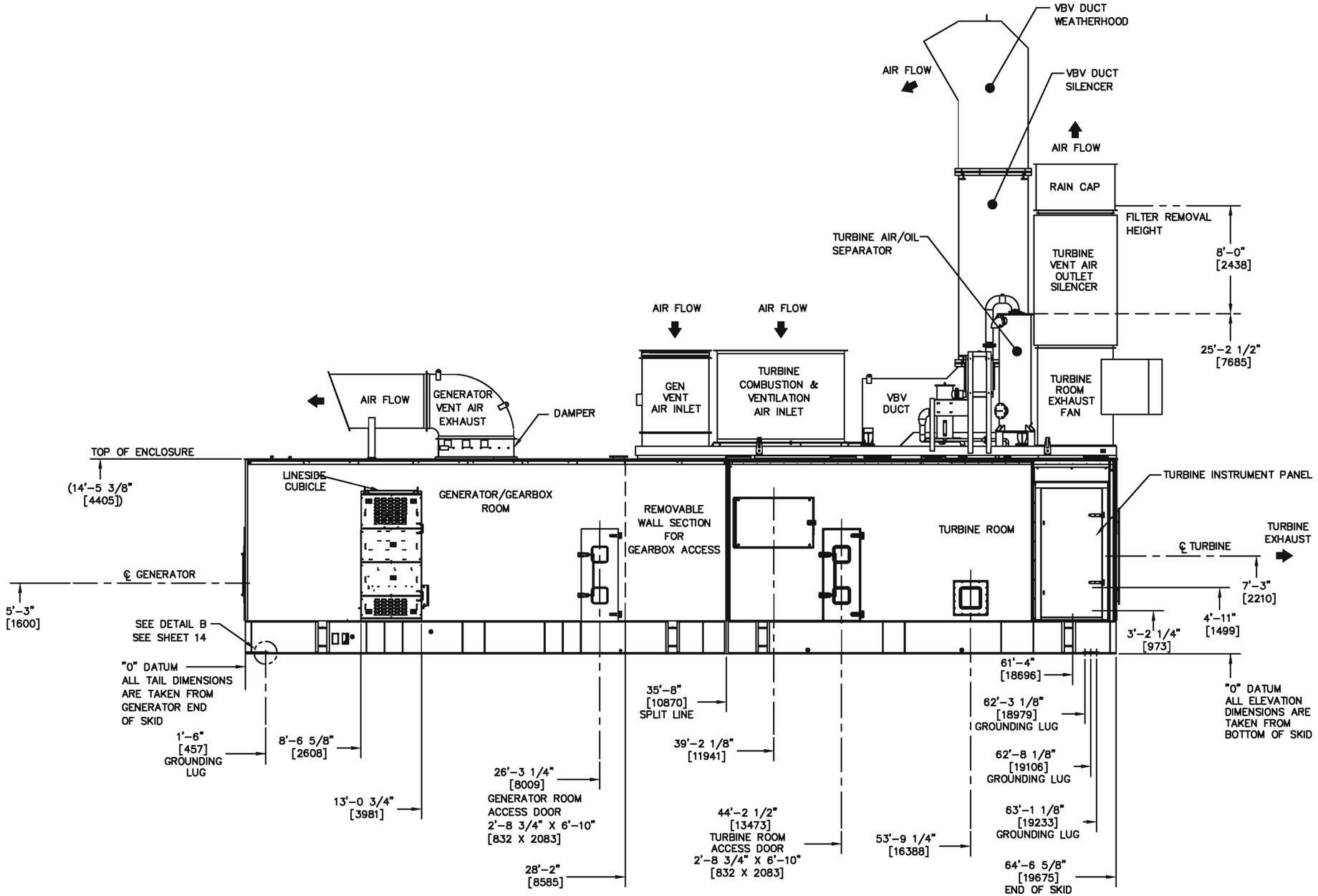
TITLE
GENERAL ARRANGEMENT
MAIN UNIT - RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 1/4" = 1'-0"

SHEET 5 OF 15



RIGHT SIDE ELEVATION
AIR FILTER & SKIDS REMOVED FOR CLARITY

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

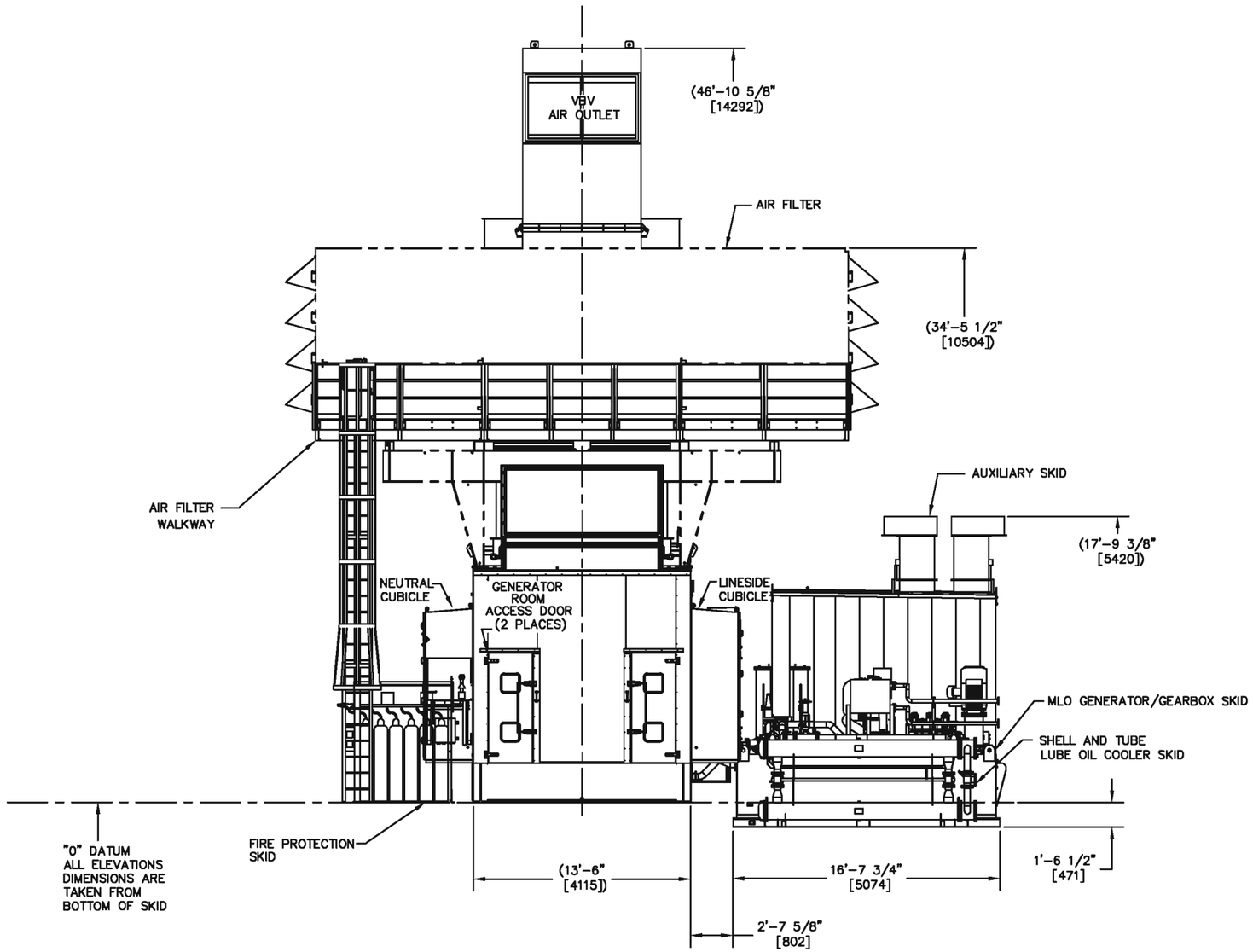
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200 | REV. H

SCALE 1/4" = 1'-0" | SHEET 6 OF 15



GENERATOR END VIEW

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

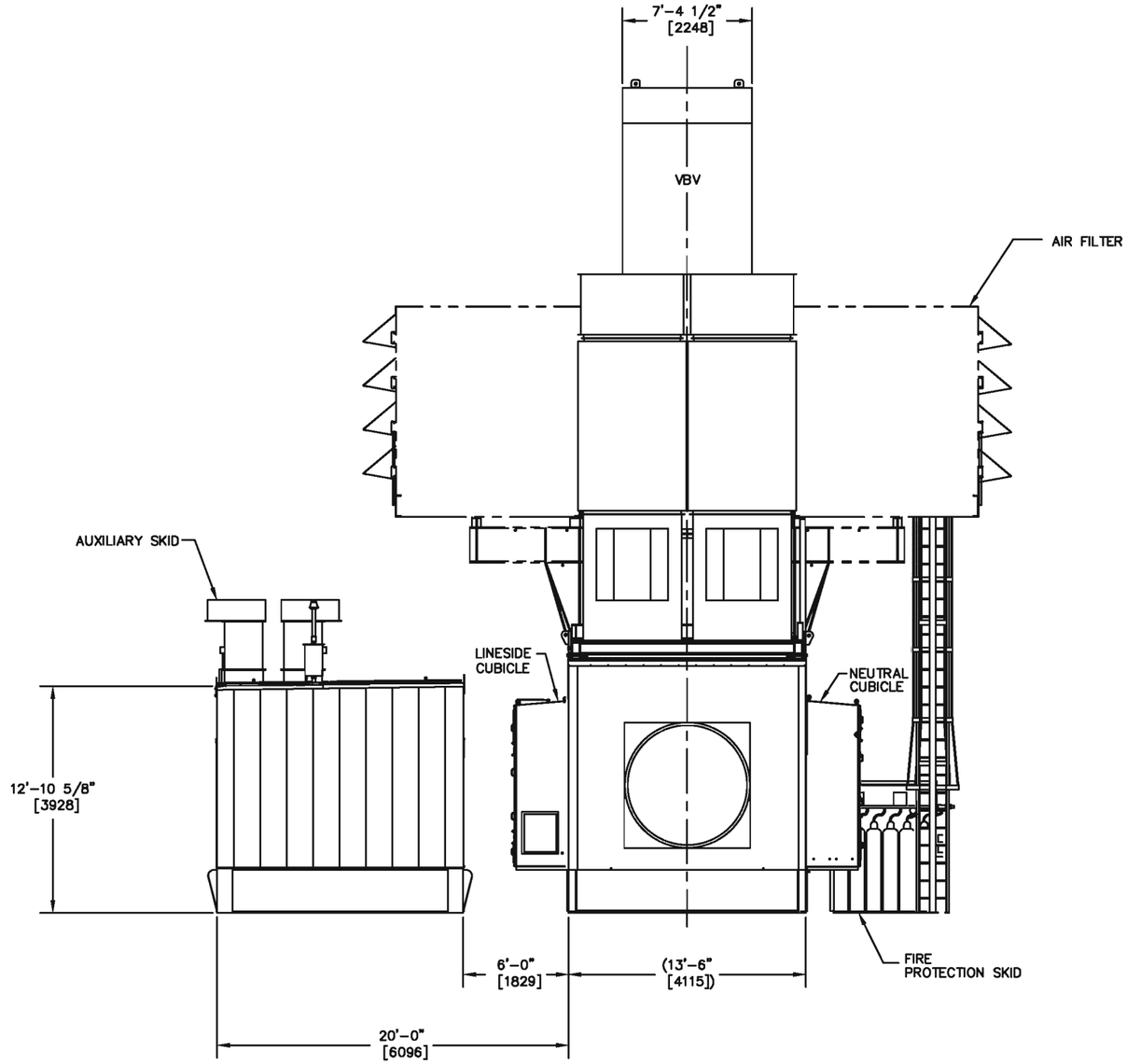
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200 REV. H

SCALE 1/4" = 1'-0" SHEET 7 OF 15



EXHAUST END VIEW

MLO SKID NOT SHOWN FOR CLARITY

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

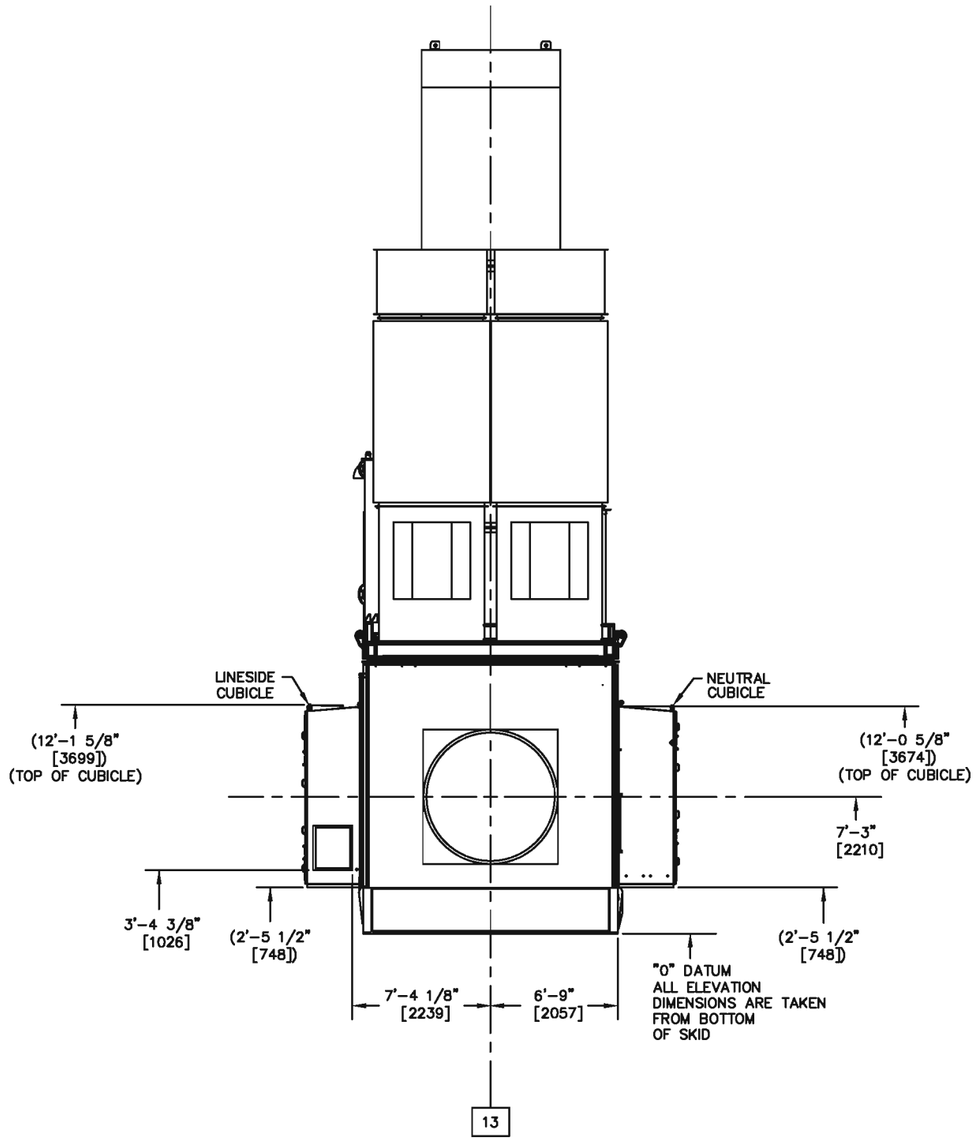
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO.
TYPICAL DRAWING 969200

REV.
H

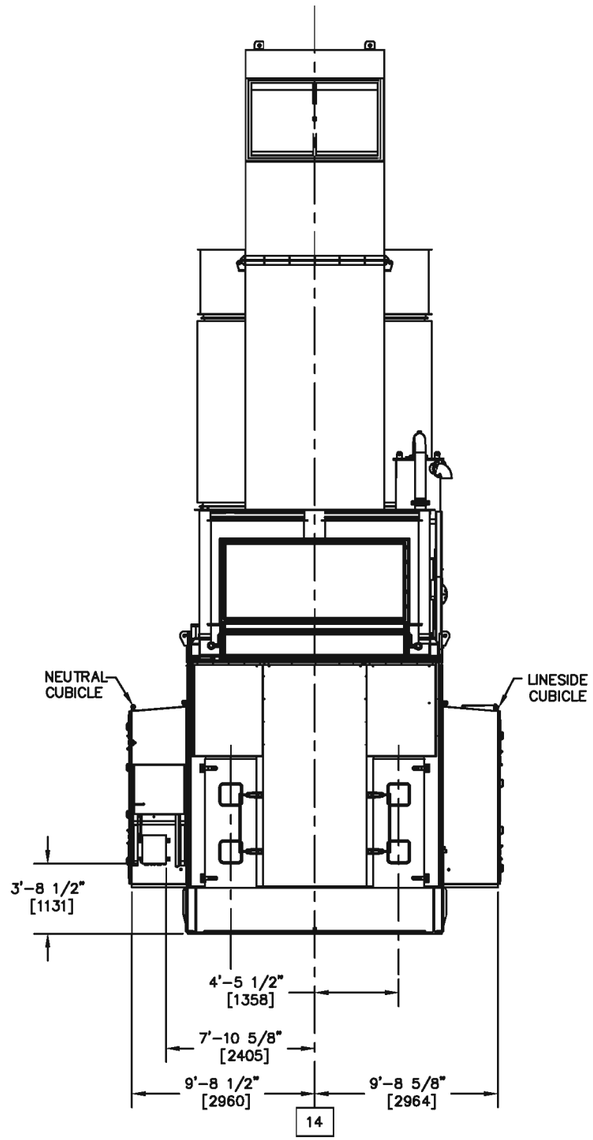
SCALE 1/4" = 1'-0"

SHEET 8 OF 15



VIEW FROM EXHAUST END

AIR FILTER & SKIDS REMOVED FOR CLARITY



VIEW FROM GENERATOR END

AIR FILTER & SKIDS REMOVED FOR CLARITY

RESERVED

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

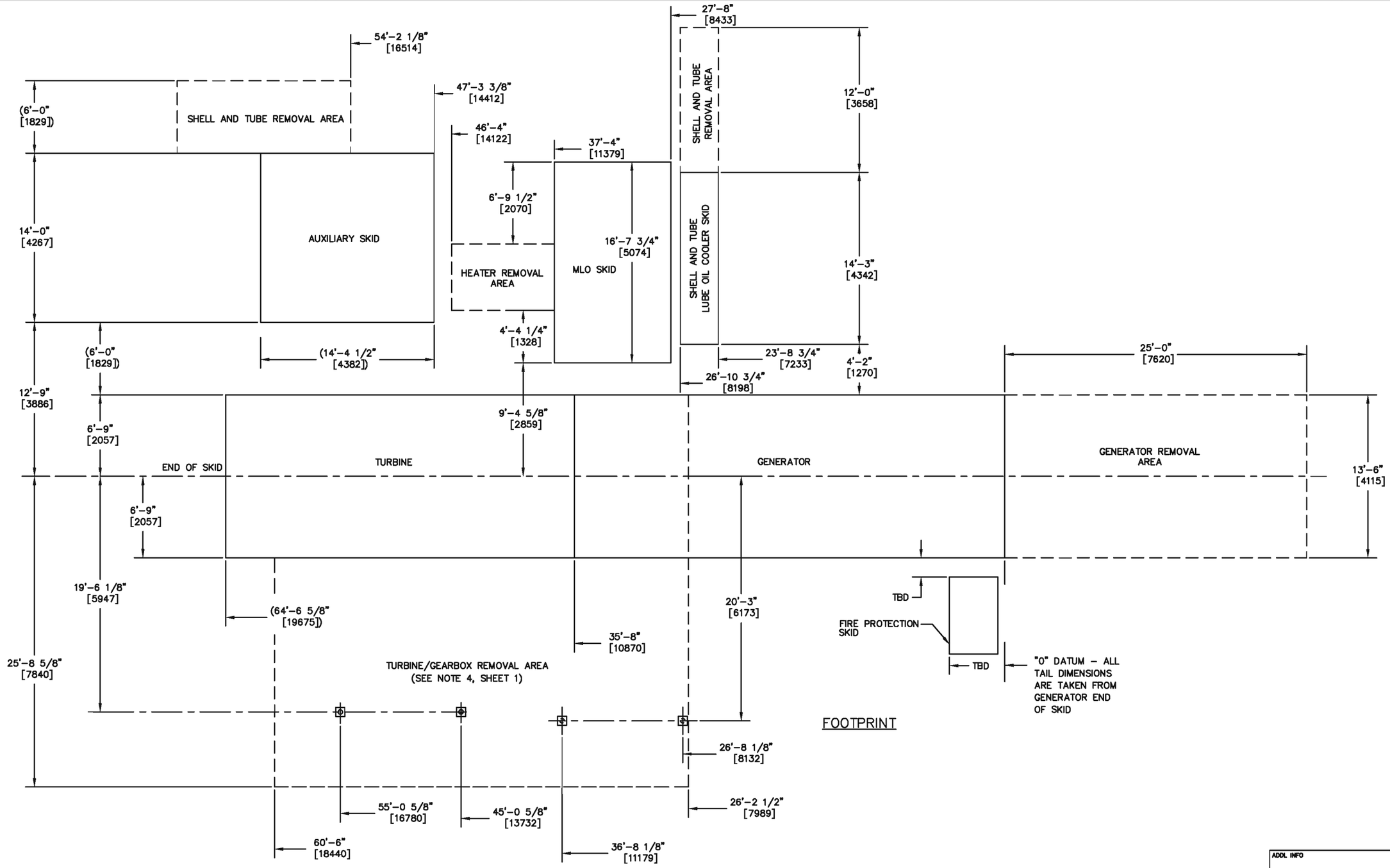
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO.: TYPICAL DRAWING 969200

REV.: H

SCALE 1/4" = 1'-0"

SHEET 9 OF 15



RESERVED

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

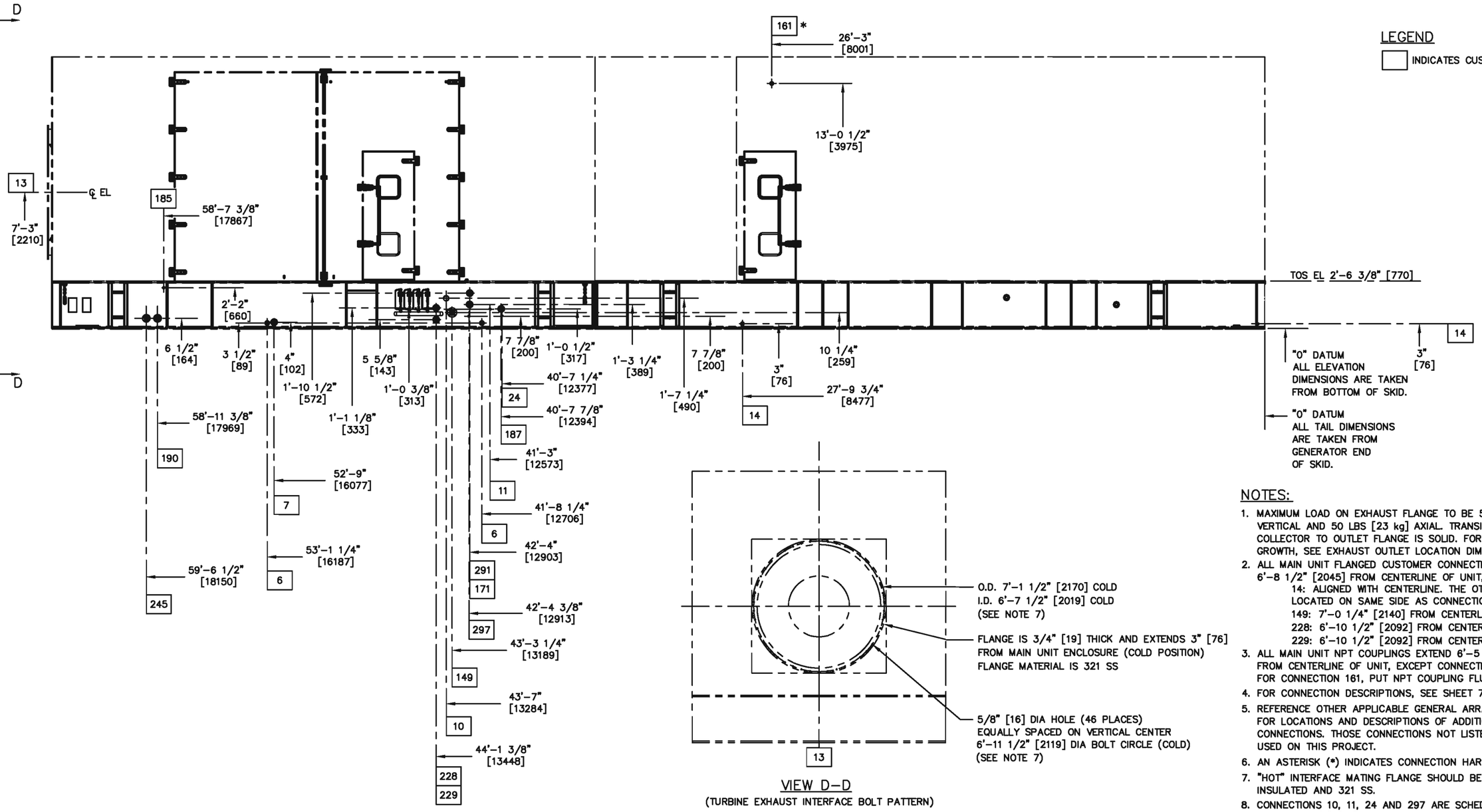
TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 1/4" = 1'-0"

SHEET 10 OF 15



LEFT SIDE ELEVATION

VIEW D-D

(TURBINE EXHAUST INTERFACE BOLT PATTERN)

LEGEND

INDICATES CUSTOMER CONNECTION.

NOTES:

1. MAXIMUM LOAD ON EXHAUST FLANGE TO BE 500 LBS [227 kg] VERTICAL AND 50 LBS [23 kg] AXIAL. TRANSITION FROM EXHAUST COLLECTOR TO OUTLET FLANGE IS SOLID. FOR EXPECTED THERMAL GROWTH, SEE EXHAUST OUTLET LOCATION DIMENSIONS.
2. ALL MAIN UNIT FLANGED CUSTOMER CONNECTIONS ARE LOCATED 6'-8 1/2" [2045] FROM CENTERLINE OF UNIT, EXCEPT:
   14: ALIGNED WITH CENTERLINE. THE OTHER TWO ARE LOCATED ON SAME SIDE AS CONNECTION 6.
   149: 7'-0 1/4" [2140] FROM CENTERLINE
   228: 6'-10 1/2" [2092] FROM CENTERLINE
   229: 6'-10 1/2" [2092] FROM CENTERLINE
3. ALL MAIN UNIT NPT COUPLINGS EXTEND 6'-5 1/8" [1959] FROM CENTERLINE OF UNIT, EXCEPT CONNECTION 14, 161, 183 AND 184. FOR CONNECTION 161, PUT NPT COUPLING FLUSH WITH PANEL.
4. FOR CONNECTION DESCRIPTIONS, SEE SHEET 7.
5. REFERENCE OTHER APPLICABLE GENERAL ARRANGEMENTS FOR LOCATIONS AND DESCRIPTIONS OF ADDITIONAL CONNECTIONS. THOSE CONNECTIONS NOT LISTED ARE NOT USED ON THIS PROJECT.
6. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
7. "HOT" INTERFACE MATING FLANGE SHOULD BE EXTERNALLY INSULATED AND 321 SS.
8. CONNECTIONS 10, 11, 24 AND 297 ARE SCHEDULE 40 304 SS PIPE RECESSED 1/2" [13] FROM EDGE OF SKID. CUSTOMER TO WELD PIPING AT INSTALLATION.
9. HARDWARE CONNECTION 13 IS SUPPLIED BY EXHAUST STACK / EXPANSION JOINT SUPPLIER.

RESERVED

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

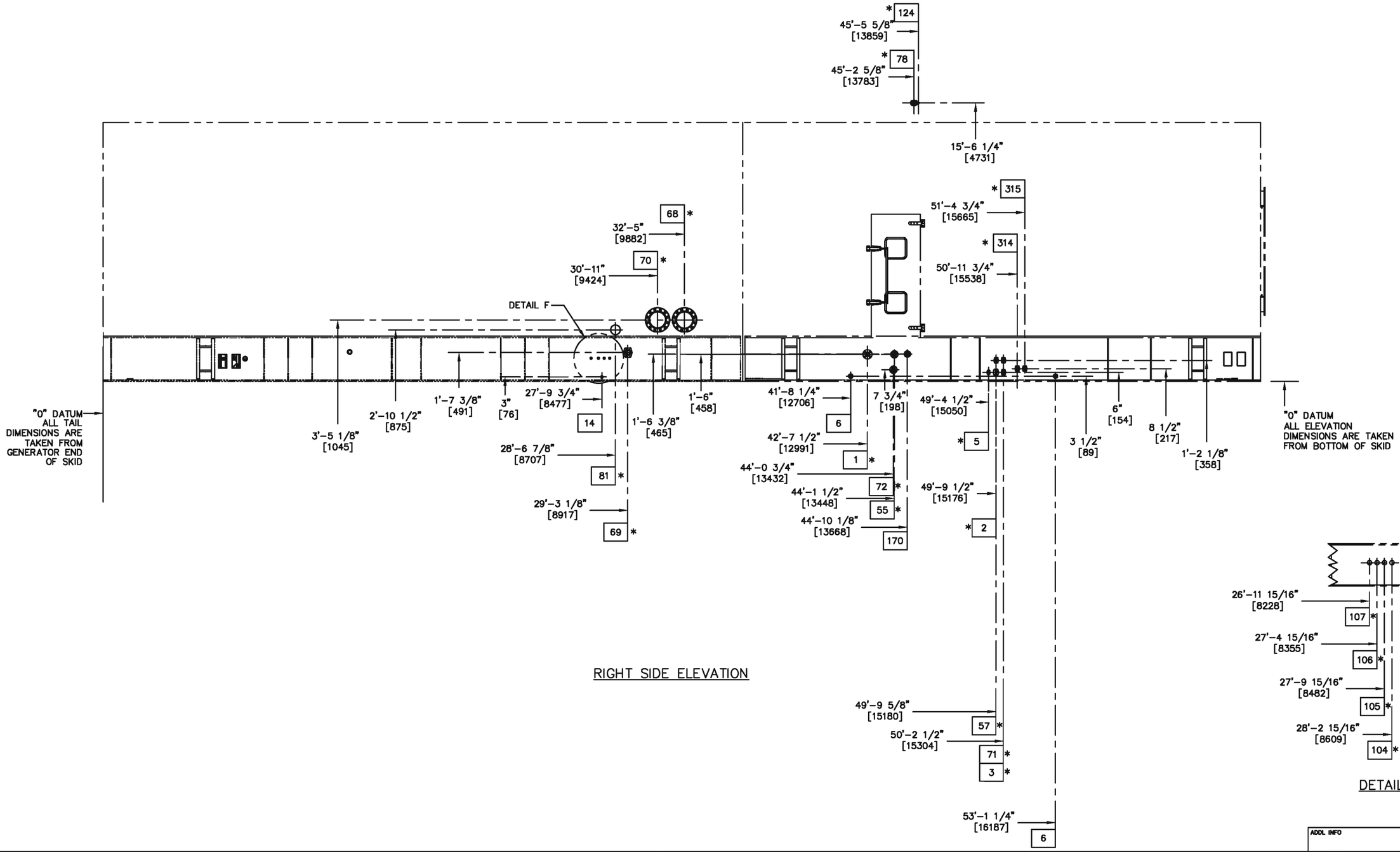
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 3/8" = 1'-0"

SHEET 11 OF 15



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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO.: TYPICAL DRAWING 969200 REV. H

SCALE 3/8" = 1'-0" SHEET 12 OF 15

CUSTOMER CONNECTION LEGEND:

*	1	DEMINERALIZED WATER SUPPLY – 1 1/2"–600# RF
*	2	HYDRAULIC STARTER SUPPLY – 1 1/2" SAE CODE 62
*	3	HYDRAULIC STARTER RETURN – 1 1/2" SAE CODE 61
*	5	HYDRAULIC STARTER CASE DRAIN – 1" SAE CODE 61
	6	TURBINE SUMP DRAIN – 2" NPT 3000# CPLG
	7	EXHAUST DRAIN – 1"–150# RF
	10	GAS FUEL INLET – 3" SCHEDULE 40 PIPING
	11	GAS FUEL VENT – 1" SCHEDULE 40 PIPING
	13	TURBINE EXHAUST DUCT CONNECTION – N/A
	14	GENERATOR/GEARBOX SUMP DRAIN – 1" NPT 3000# COUPLING
	24	GAS FUEL VENT – 1" SCHEDULE 40 PIPING
*	55	INSTRUMENT AIR SUPPLY – 1"–600# RF
*	57	SCAVENGE LUBE OIL FILTER/COOLER SUPPLY – 1 1/2" SAE CODE 61
*	68	GEARBOX LUBE OIL RETURN LINE – 10" SCHEDULE 10 PIPING
*	69	GENERATOR LUBE OIL SUPPLY – 4" SAE CODE 61
*	70	GEARBOX LUBE OIL RETURN LINE – 10" SCHEDULE 10 PIPING
*	71	TURBINE LUBE OIL PUMP SUPPLY – 1 1/2" SAE CODE 61
*	72	WATER WASH SUPPLY – 1"–600# RF
*	78	TURBINE LUBE OIL AIR/OIL PRE–SEPARATOR RETURN – 1 1/2" SAE CODE 61
*	81	GENERATOR LUBE OIL DRAIN LINE – 6" SCHEDULE 10 PIPING
*	104	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING
*	105	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING
*	106	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING
*	107	JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING
*	124	TURBINE LUBE OIL AIR/OIL SEPARATOR RETURN – 1/2" JIC
	149	INLET VOLUTE DRAIN – 2"–150# RF
*	161	CO2 – 1 1/4" NPT 3000# COUPLING
	170	SPRINT WATER SUPPLY – 1"–150# RF
	171	SPRINT DRAIN – 1"–150# RF
	185	INSTRUMENT AIR FOR DAMPER RESET – 1/4" NPT
	187	VBV DUCT DRAIN – 1"–150# RF
	190	WATER INJECTION BYPASS – 1" –600# RF
	228	TURBINE LUBE OIL OVERBOARD DRAIN VENT – 1"–150# RF
	229	TURBINE LUBE OIL OVERBOARD DRAIN – 1"–150# RF
	245	WATER INJECTION OVERBOARD DRAIN – 1"–150# RF
	291	STARTER CLUTCH SEAL TELL–TALE DRAIN – 1"–150# RF
	297	GAS FUEL VENT – 1" SCHEDULE 40 PIPING
*	314	TURBINE LUBE OIL DISCHARGE INTERCOOLER – 1 1/2" SAE CODE 61
*	315	TURBINE LUBE OIL SUPPLY INTERCOOLER – 1 1/2" SAE CODE 61

NOTES:

1. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200

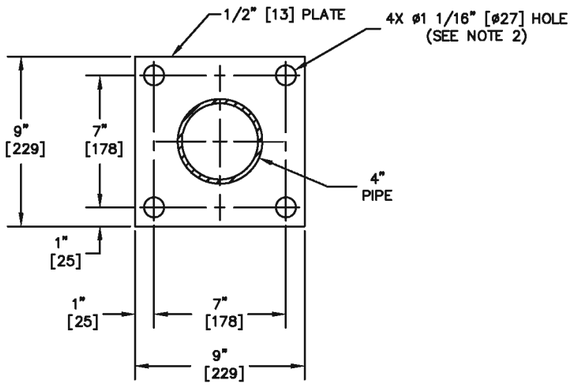
REV. H

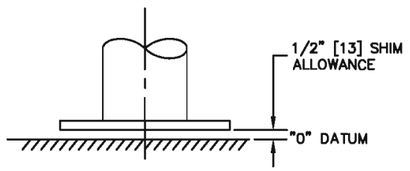
SCALE NONE

SHEET 13 OF 15

NOTES:

1. ALL ANCHORING HARDWARE TO BE SUPPLIED BY CUSTOMER.
2. BOLT HOLE TOLERANCE ± 1/8" [3], TRUE POSITION.



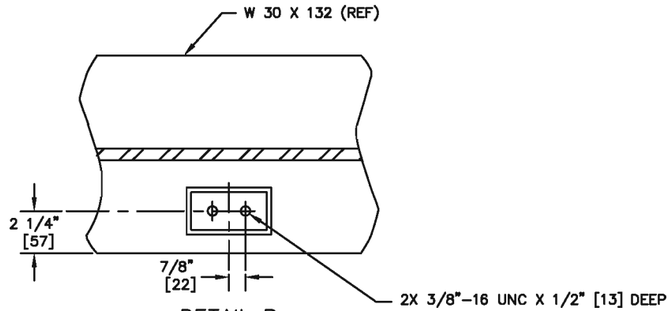


DETAIL A

ENGINE & GEARBOX REMOVAL FOOT PAD

SEE SHEET 2

(SEE NOTE 4, SHEET 1)



DETAIL B

GROUNDING LUG

SEE SHEET 4 & 6

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE

GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200

REV. H

SCALE 3" = 1'-0"

SHEET 14 OF 15

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000®

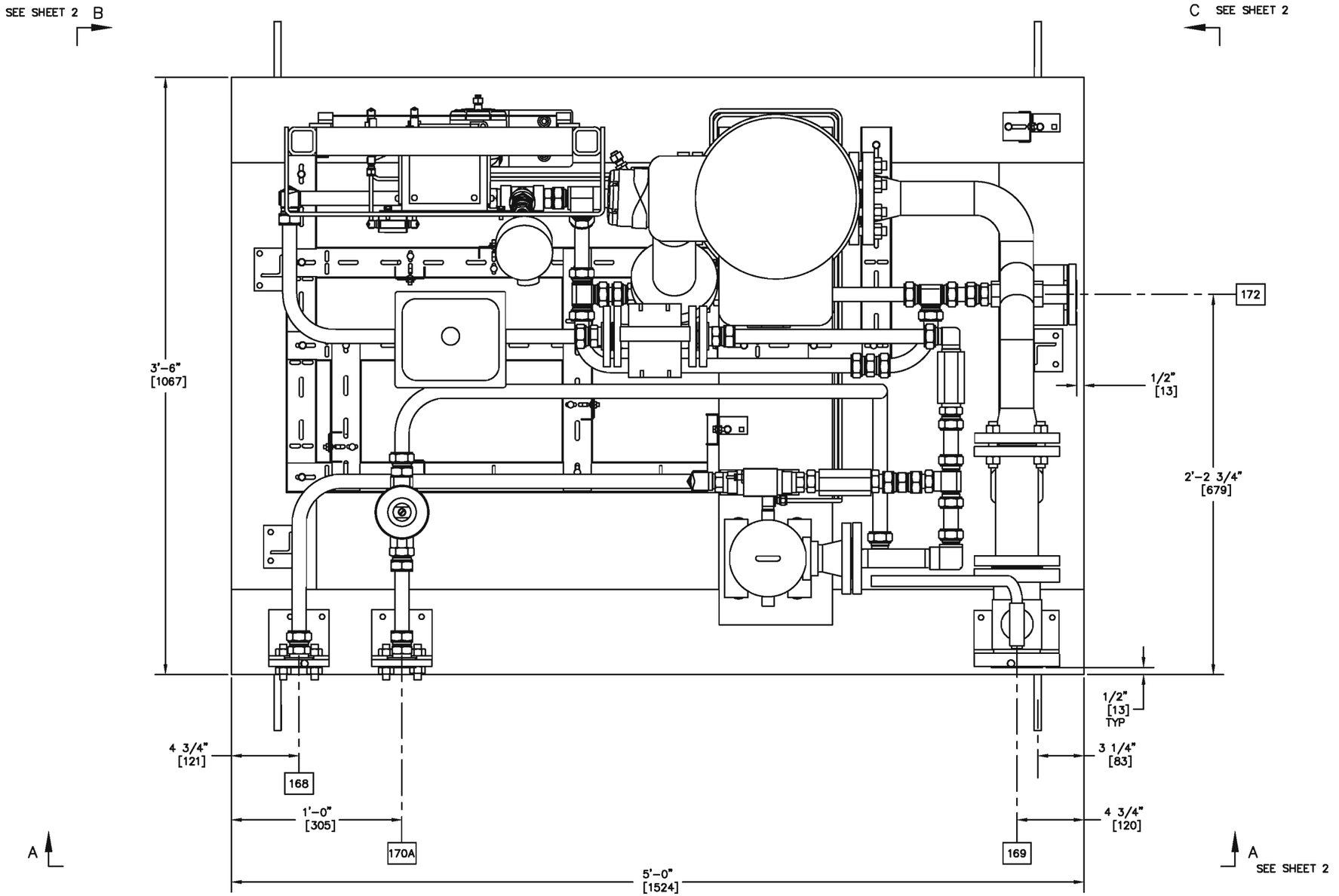
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. TYPICAL DRAWING 969200 REV. H

SCALE 3/4" = 1'-0" SHEET 15 OF 15



TOP VIEW

ENCLOSURE NOT SHOWN FOR CLARITY

LEGEND:

☐ INDICATES CUSTOMER CONNECTION

NOTES:

1. FLANGE CONNECTION TOLERANCE: ±1/8" [3]
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. ALL FLANGED CONNECTIONS ARE LOCATED 1/2" [13] INSIDE EDGE OF BASE UNLESS OTHERWISE NOTED.
4. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
5. APPLICABLE STANDARD/SPECIFICATION: ASME Y14.5M–1994, DIMENSIONING AND TOLERANCING.

CONNECTION LEGEND:

168	INSTRUMENT AIR, INLET FOR ENHANCED SPRINT SYSTEM – 1"–150# RF
169	SPRINT SYSTEM DEMINERALIZED WATER INLET – 2"–150# RF
170A	SPRINT SYSTEM DEMINERALIZED WATER LOW PRESSURE OUTLET – 1"–150# RF
172	SPRINT SYSTEM DEMINERALIZED WATER RETURN (BYPASS) – 1"–150# RF
173	SPRINT SKID DRAIN – 1" NPT 3000#

REFERENCE DRAWING:

X–969270 F&ID, SPRINT SYSTEM, SPRINT SKID

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REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

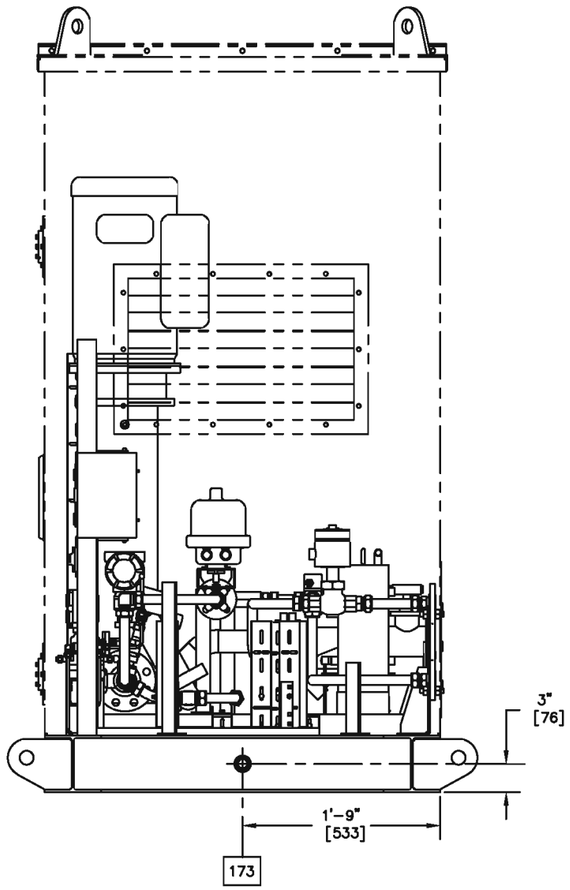
ADDL INFO

GE PACKAGED POWER, L.P.

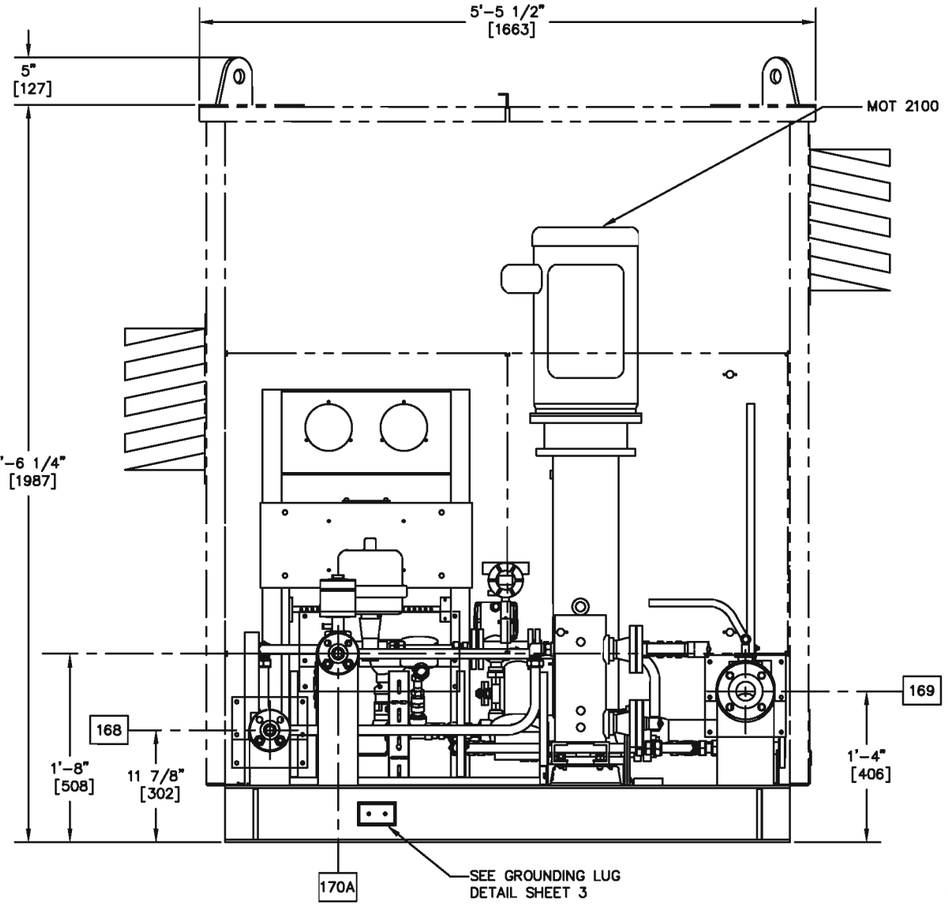
TITLE: GENERAL ARRANGEMENT SPRINT SKID

DWG NO.: TYPICAL DRAWING 969209 REV. D

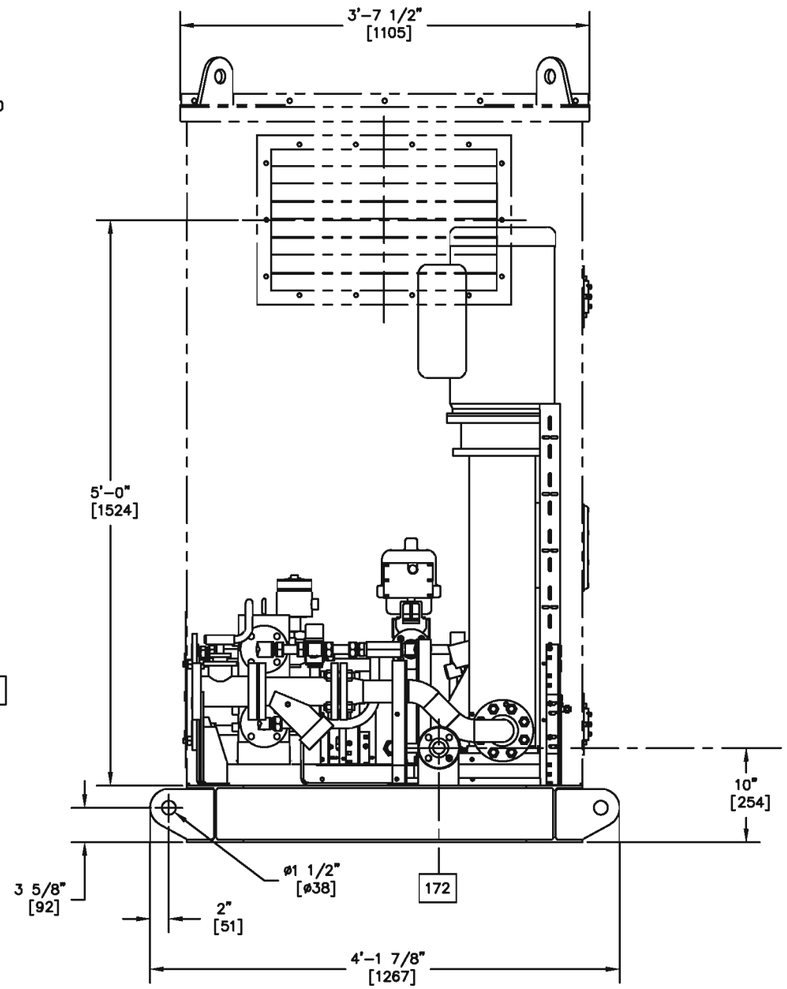
SCALE 3" = 1'-0" SHEET 1 OF 3



VIEW B–B
SEE SHEET 1



VIEW A–A
SEE SHEET 1



VIEW C–C
SEE SHEET 1

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
SPRINT SKID

DWG NO. TYPICAL DRAWING 969209

REV. D

SCALE 1 1/2" = 1'-0"

SHEET 2 OF 3

NOTES:

1. FOR VERTICAL P LOADS '+' IS A COMPRESSION AND '–' IS AN UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENTS A LOAD AT EACH ANCHOR LOCATION.
3. ROOF LIVE LOAD IS APPLIED AS PER IBC 2009, REPRESENTS A UNIFORM LOAD OF 60 PSF APPLIED AT EXPOSED SECTION ON THE ROOF OF SPRINT SKID.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE LONGITUDINAL AND TRANSVERSE DIRECTION AS PER EQUIVALENT LATERAL FORCE PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS.THESE LOADS ARE AS PER IBC 2009 CODE THAT REFERENCES ASCE 7–05.

SITE CLASS	D
OCCUPANCY CATEGORY, TABLE 1604.5	III
SEISMIC DESIGN CATEGORY – TABLE 1613.5.6	E
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7–05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7–05, TABLE 15.4–1	2.50
S_{DS} – SPECTRAL RESPONSE ACCEL. AT 0.2 SEC – G	1.20
S_{D1} – SPECTRAL RESPONSE ACCEL. AT 1 SEC – G	0.70
G – LEVELS FOR BASE ACCELERATIONS FOR DESIGN	0.60

SEISMIC LOAD MAY BE POSITIVE OR NEGATIVE.
CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT Ev=+/– 0.2SDS D IN THE FOUNDATION LOADS AS PER ASCE 7–05 SECTION 12.4.

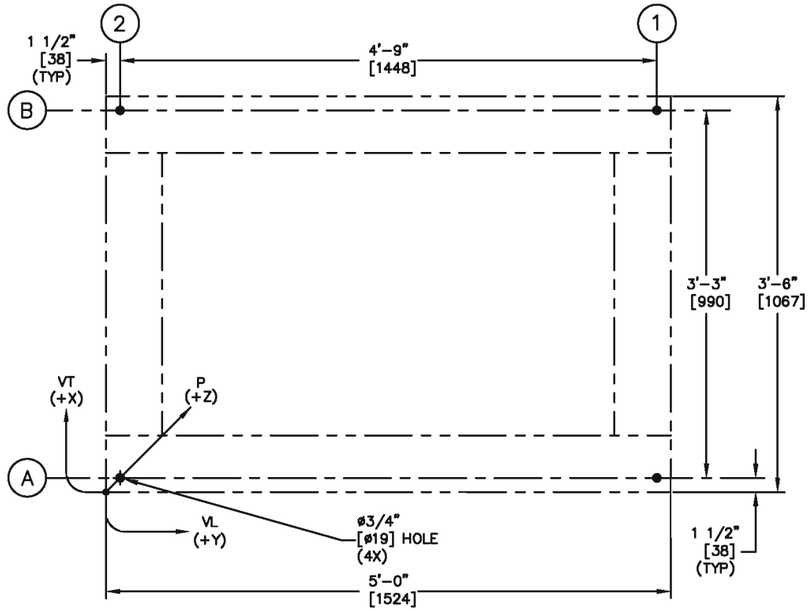
5. WIND LOADS ARE PER ASCE 7–05 CODE, 150 MPH FOR LOW RISE BUILDING, H < 60 FT

WIND PRESSURE (PSF), EQ 6–18	$p = q_h(GC_{pf} - GC_{pi})$	$75.53(GC_{pf} - GC_{pi})$
EXTERNAL PRESSURE COEF., FIGURE 6–10	GC_{pf}	
INTERNAL PRESSURE COEF., FIGURE 6–5	GC_{pi}	+/–0.18
VELOCITY PRESSURE (psf) , Eq 6–15	$q_h = 0.00256\ Kz\ Kzt\ Kd\ V^2\ I$	75.53
VELOCITY PRESSURE EXPOSURE COEF. – TABLE 6–3	Kz	0.98
TOPOGRAPHIC FACTOR, Eq. 6–3	$K_{zt} = (1 + K_1K_2K_3)^2$	1.37
FIGURE 6–4	K_1	0.17
FIGURE 6–4	K_2	1
FIGURE 6–4	K_3	1
WIND DIRECTIONALITY FACTOR, TABLE 6–4	K_d	0.85
WIND VELOCITY (MPH)	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15
EXPOSURE CATEGORY	C	C

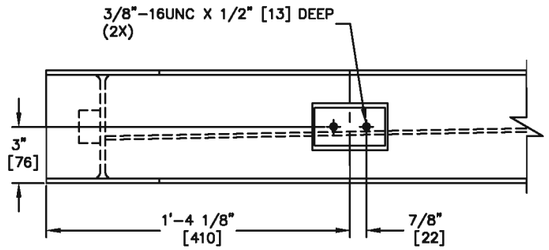
6. FOUNDATION DESIGNER MUST COMBINE LOAD CASES WITH PROPER SIGNS.
7. SIGNS CAN BE REVERSED ON ACCELERATION AND WIND LOADS.

LEGEND:

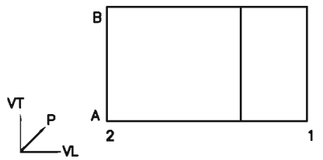
- ● ANCHOR BOLT
- P VERTICAL LOAD (+Z)
- VT TRANSVERSE SHEAR (+X)
- VL LONGITUDINAL SHEAR (+Y)



INSTALLATION FOOTPRINT
PLAN VIEW



GROUNDING LUG DETAIL
SEE SHEET 2
(SCALE: 2X)



STATIC FOUNDATION LOADS (KIPS)

ANCHOR POINTS	DEAD LOAD			SNOW LOAD (60 PSF)			SEISMIC (TRANSVERSE)			SEISMIC (LONGITUDINAL)			WIND (TRANSVERSE)			WIND (LONGITUDINAL)		
	VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ		VERT	HORIZ	
	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL	P	VT	VL
1–A	0.5	0.2	–0.2	0.3	0.1	–0.1	–0.5	–0.5	0.2	0.2	0.0	–0.3	–1.8	–0.8	0.4	0.3	0.1	–0.4
1–B	0.6	–0.2	–0.2	0.3	–0.1	–0.1	0.5	–0.2	–0.2	0.4	0.0	–0.4	1.1	–0.7	–0.2	0.3	–0.1	–0.4
2–A	0.4	0.2	0.2	0.3	0.1	0.1	–0.4	–0.5	–0.1	–0.2	0.0	–0.3	–1.7	–0.8	–0.4	–1.0	–0.2	–0.6
2–B	0.6	–0.2	0.2	0.3	–0.1	0.1	0.4	–0.1	0.1	–0.4	0.0	–0.3	1.1	–0.6	0.2	–1.0	0.2	–0.6
TOTAL	2.2	0.0	0.0	1.1	0.0	0.0	0.0	–1.3	0.0	0.0	0.0	–1.3	–1.3	–2.9	0.0	–1.3	0.0	–2.0

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

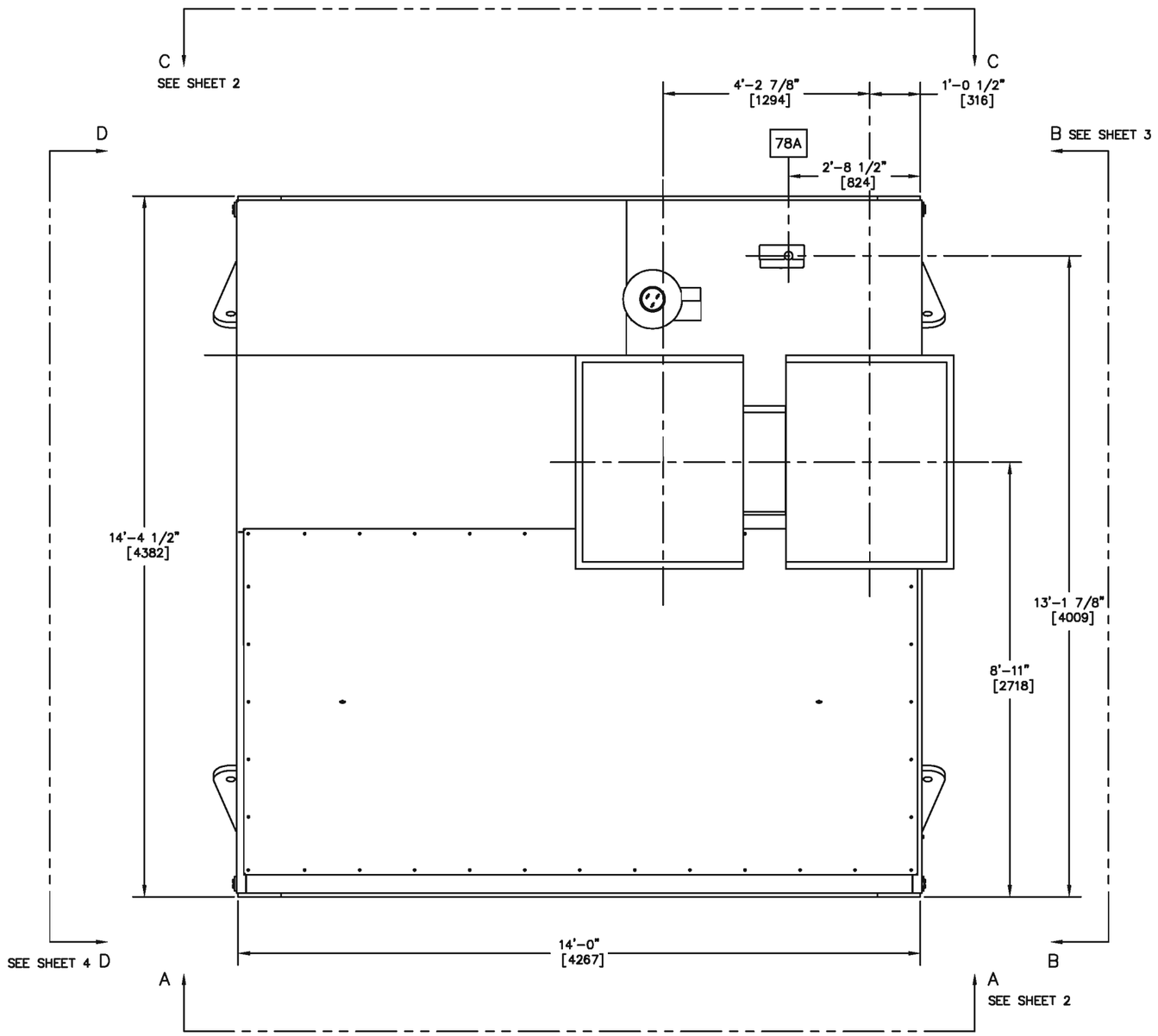
TITLE: GENERAL ARRANGEMENT SPRINT SKID

DWG NO.: TYPICAL DRAWING 969209

REV.: D

SCALE 6" = 1'–0"

SHEET 3 OF 3



TOP VIEW

LEGEND:

INDICATES CUSTOMER CONNECTION

NOTES:

1. APPLICABLE STANDARD/SPECIFICATION: ASME Y14.5M–1994, DIMENSIONING AND TOLERANCING.
2. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
3. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
4. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
5. ALL AUXILIARY SKID FLANGED CUSTOMER CONNECTIONS ARE LOCATED 1/2" [12.7] FROM EDGE OF SKID.

REFERENCE DRAWINGS:

X–969200	GENERAL ARRANGEMENT, PLANT LAYOUT–RH
X–969202	GENERAL ARRANGEMENT, MAIN UNIT–RH
X–969232	F & ID, HYDRAULIC START SYSTEM
X–969244	F & ID, TURBINE LUBE OIL SYSTEM
X–969260	F & ID, FUEL SYSTEM
X–969262	F & ID, WATER WASH SYSTEM
X–969269	F & ID, WATER INJECTION PUMP
X–969270	F & ID, SPRINT SYSTEM, SPRINT SKID

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES		
DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

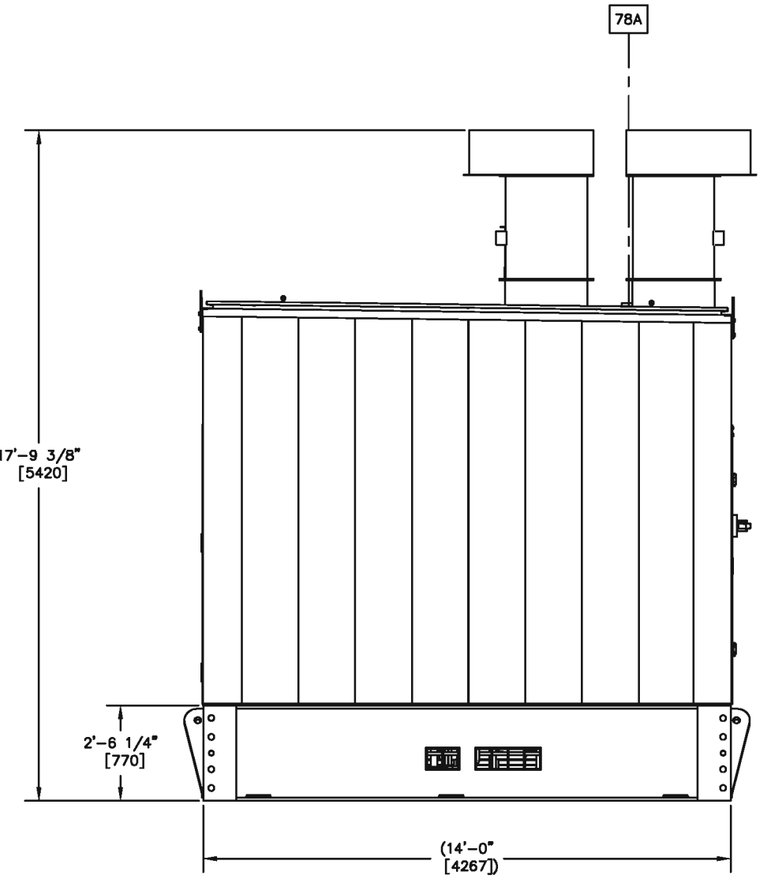
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO. TYPICAL DRAWING 969218

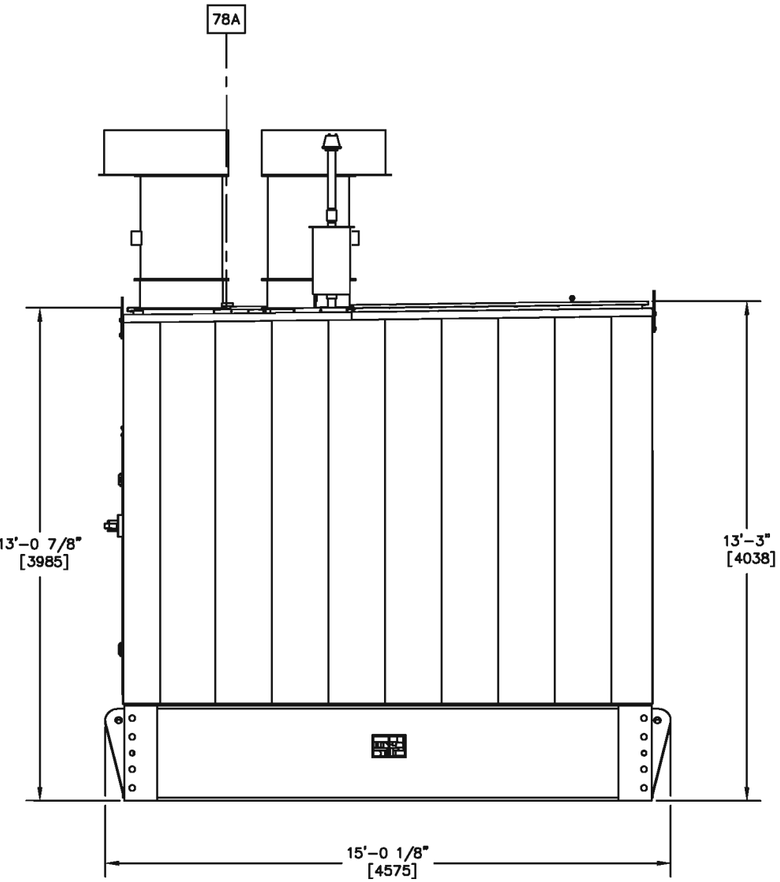
REV. H

SCALE 3/4" = 1'-0"

SHEET 1 OF 7



VIEW A-A
SEE SHEET 1



VIEW C-C
SEE SHEET 1

RESERVED

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THIRD ANGLE PROJECTION

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DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

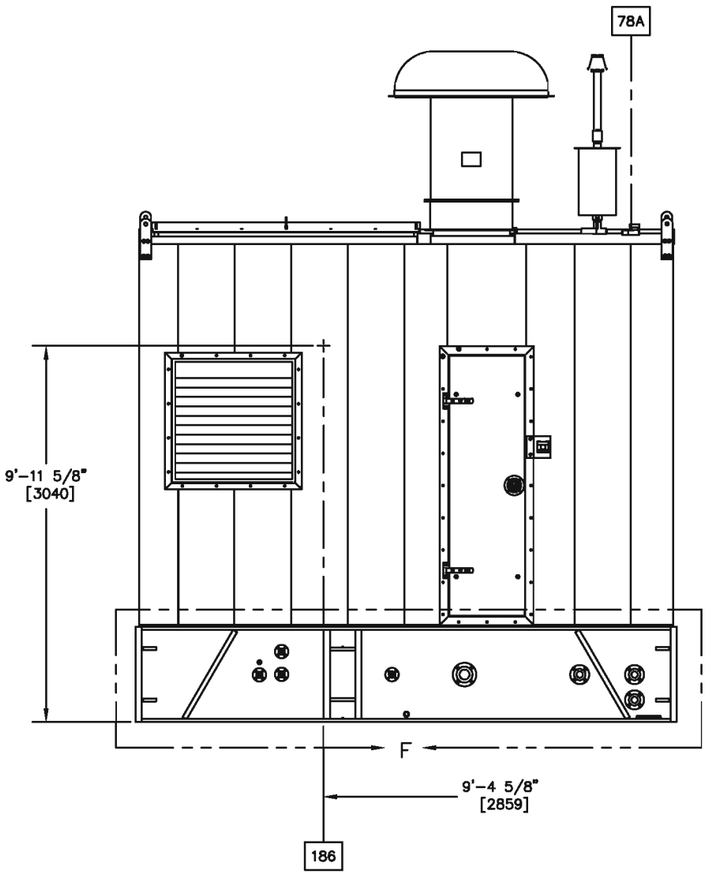
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO.
TYPICAL DRAWING 969218

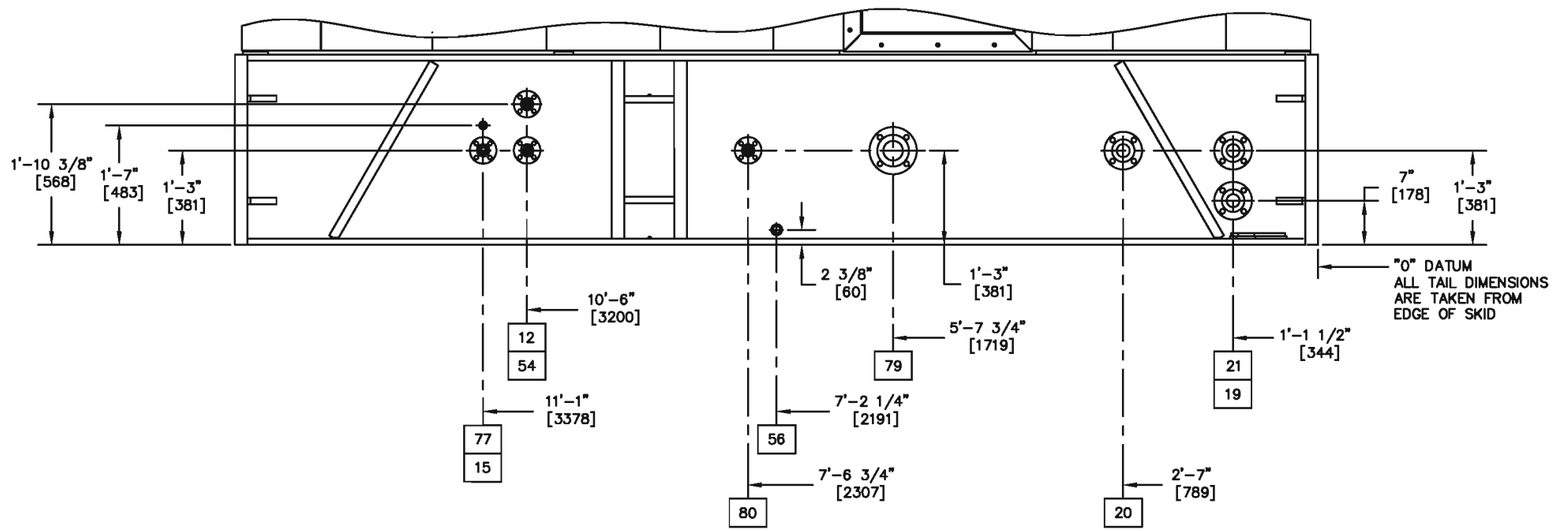
REV.
H

SCALE 1/2" = 1'-0"

SHEET 2 OF 7



VIEW B-B
SEE SHEET 1



DETAIL F

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REVISIONS

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THIRD ANGLE PROJECTION

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TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

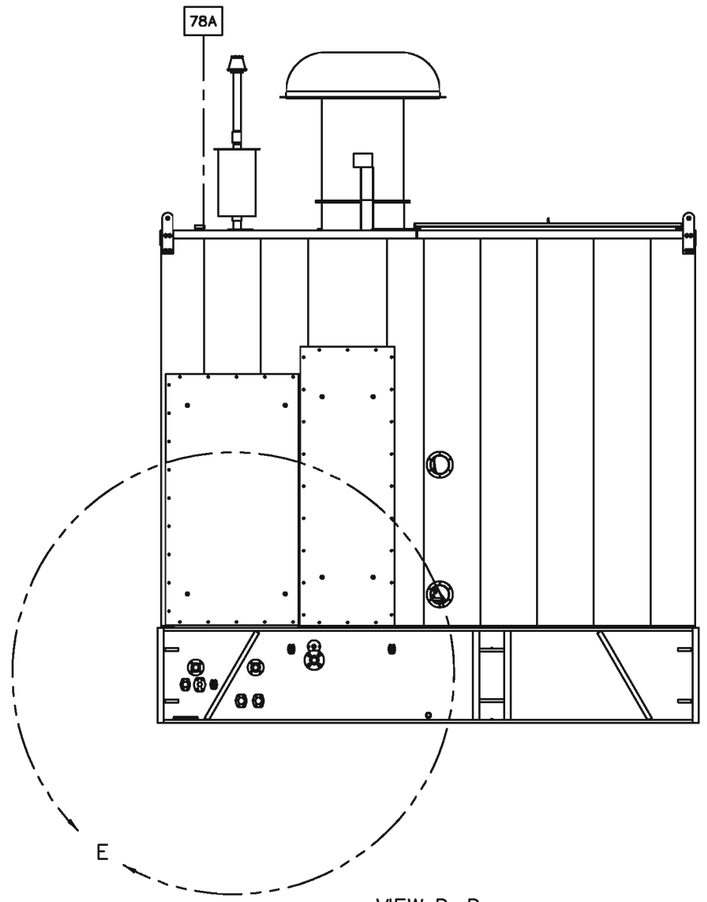
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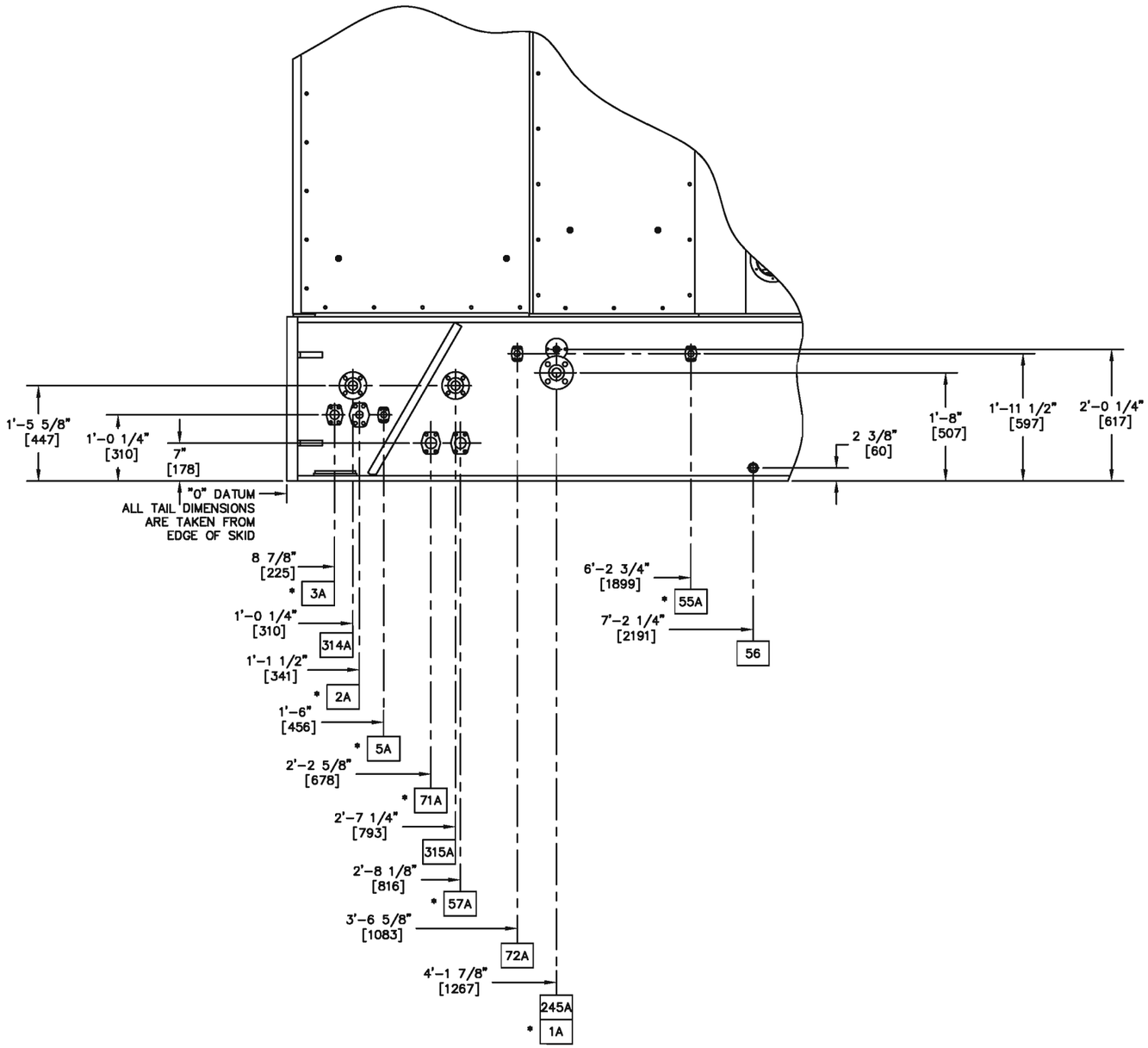
TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO. TYPICAL DRAWING 969218
REV. H

SCALE 1/2" = 1'-0"
SHEET 3 OF 7



VIEW D–D
SEE SHEET 1



DETAIL E

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04 WATER INJECTION 60 HZ

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO.
TYPICAL DRAWING 969218

REV.
H

SCALE 1/2" = 1'–0"

SHEET 4 OF 7

CUSTOMER CONNECTION LEGEND:

*	1A	WATER INJECTION SUPPLY – 1 1/2"–600# RF
*	2A	HYDRAULIC STARTER SUPPLY – 1 1/2" SAE CODE 62
*	3A	HYDRAULIC STARTER RETURN – 1 1/2" SAE CODE 61
*	5A	HYDRAULIC STARTER CASE DRAIN – 1" SAE CODE 61
	12	INSTRUMENT AIR SUPPLY – 1"–150# RF
	15	WASH WATER INLET – 1"–150# RF
	19	TURBINE LUBE OIL TANK DRAIN – 2"–150# RF
	20	TURBINE LUBE OIL SHELL & TUBE COOLING WATER SUPPLY – 2"–150# RF
	21	TURBINE LUBE OIL SHELL & TUBE COOLING WATER RETURN – 2"–150# RF
	54	WATER WASH TANK DRAIN–1"–150# RF
*	55A	INSTRUMENT AIR SUPPLY – 1" SAE CODE 61
	56	AUXILIARY SKID DRIP PAN DRAIN – 1" NPT 3000# CPLG
*	57A	SCAVENGE LUBE OIL FILTER/COOLER SUPPLY – 1 1/2" SAE CODE 61
*	71A	TURBINE LUBE OIL PUMP SUPPLY – 1 1/2" SAE CODE 61
	72A	WATER WASH SUPPLY – 1" SAE CODE 61
	77	ON LINE WATER WASH CHEMICAL INLET – 1/2" QUICK DISCONNECT
	78A	TURBINE LUBE OIL AIR/OIL PRE–SEPARATOR RETURN – 1 1/2" SAE CODE 61
	79	WATER INJECTION DEMINERALIZED WATER SUPPLY 3"–150# RF
	80	WATER INJECTION DRAIN 1"–150# RF
	186	INSTRUMENT AIR 1/4" MNPT 60 PSIA
	245A	WATER INJECTION DRAIN 3/4" MNPT
	314A	TURBINE LUBE OIL DISCHARGE TO COOLER 1 1/2" – 150# RF
	315A	TURBINE LUBE OIL RETURN FROM COOLER 1 1/2" – 150# RF

NOTE:

1. * CUSTOMER INTERFACE–MATING FLANGES FURNISHED BY GEPPLP ENERGY PRODUCTS.

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 | FRACTIONAL ±1/16" | ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE

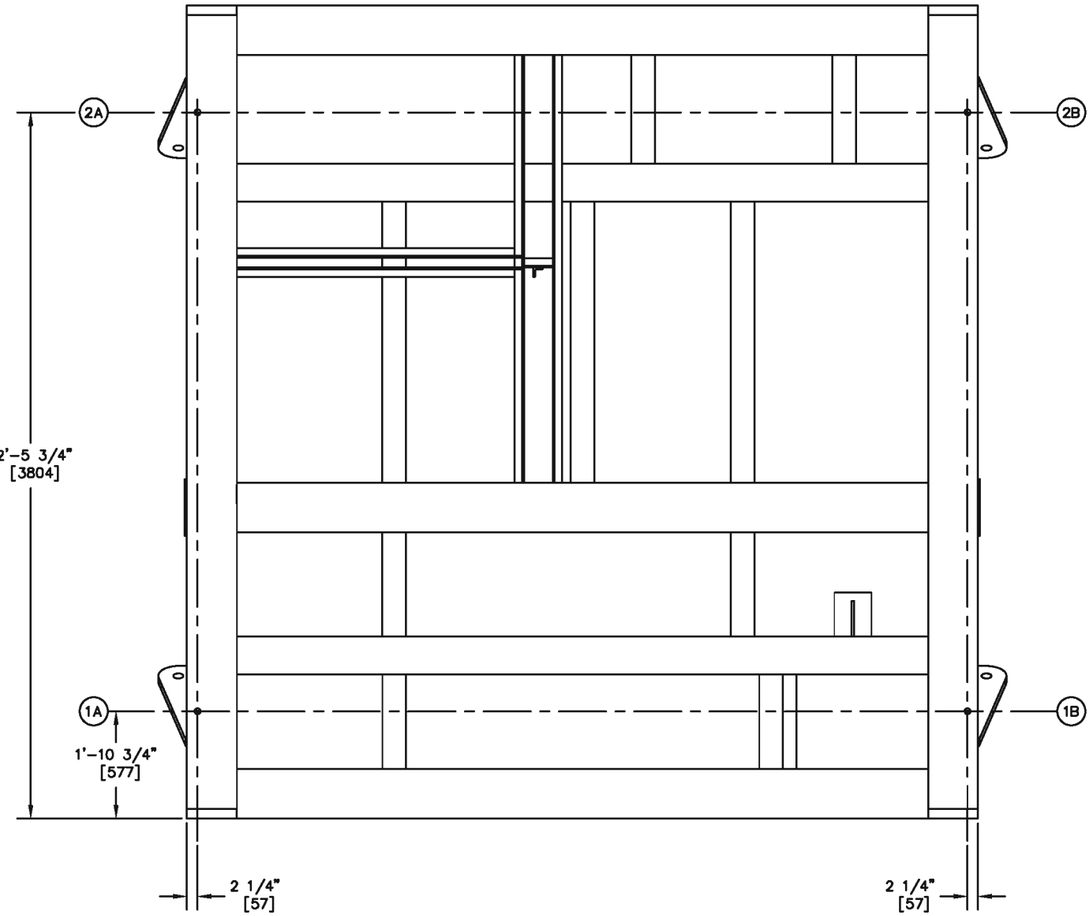
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO. TYPICAL DRAWING 969218

REV. H

SCALE NONE

SHEET 5 OF 7



BOTTOM VIEW

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO.
TYPICAL DRAWING 969218

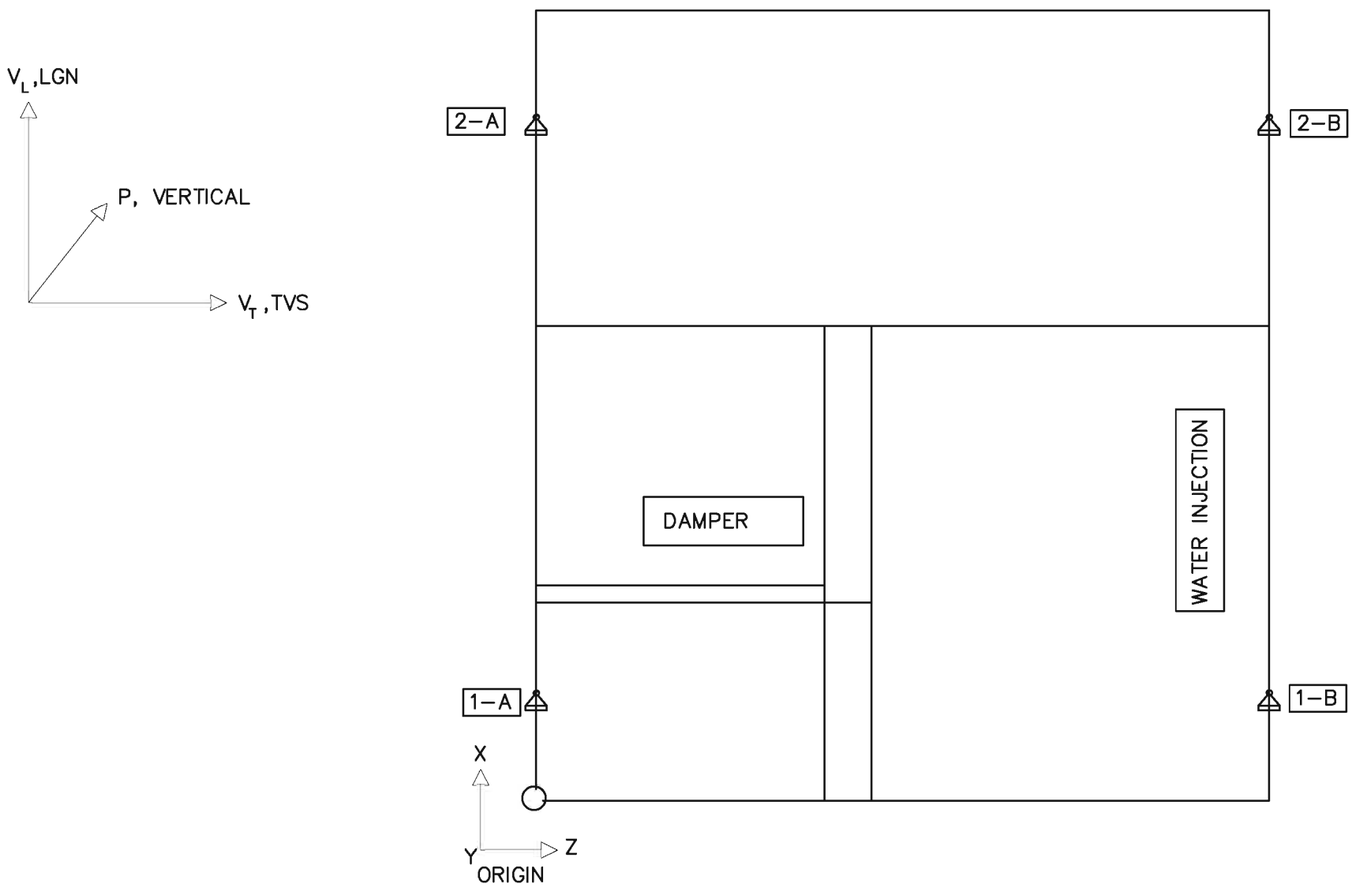
REV.
H

SCALE 3/4" = 1'-0"

SHEET 6 OF 7

GEPPLP LM6000 60Hz – AUXILIARY SKID (WITH ENCLOSURE)
STATIC FOUNDATION LOADS (KIPS)

ANCHOR POINT	DEAD LOAD			LIVE LOAD 60 PSF			SEISMIC LONGITUDINAL			SEISMIC TRANSVERSE			WIND LOAD LONGITUDINAL			WIND LOAD TRANSVERSE		
	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT
1–A	10.3	0.2	0.1	3.7	0.1	0.0	–6.9	–7.8	0.2	–6.6	0.0	–7.0	–12.6	–7.4	0.2	–10.3	1.4	–5.4
1–B	11.4	0.4	–0.2	2.8	0.0	0.0	–6.7	–7.5	–0.1	6.6	0.2	–7.1	–11.4	–5.2	0.2	2.2	–0.9	–5.4
2–A	12.7	–0.2	0.0	1.5	–0.2	0.0	6.9	–5.9	–0.1	–4.0	–0.8	–6.8	4.9	–3.7	–0.2	–9.6	–0.6	–4.6
2–B	12.2	–0.4	0.0	0.7	0.0	0.0	6.7	–6.9	–0.1	4.0	0.6	–7.1	5.4	–4.5	–0.2	3.9	0.1	–5.3
TOTAL	46.7	0.0	0.0	8.7	0.0	0.0	0.0	–28.0	0.0	0.0	0.0	–28.0	–13.8	–20.9	0.0	–13.8	0.0	–20.8



NOTES:

1. FOR P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENTS A LOAD AT EACH ANCHOR LOCATION.
3. ROOF LIVE LOAD IS APPLIED AS PER IBC 2009 TABLE 1607.1, REPRESENTS A UNIFORM LOAD OF 60 PSF APPLIED AT EXPOSED SECTION ON ROOF OF THE AUX SKID.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE LONGITUDINAL AND TRANSVERSE DIRECTION AS PER EQUIVALENT LATERAL FORCE PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER IBC 2009/CBC 2010 CODE SECTION 1613 THAT REFERENCES ASCE 7–05.

SITE CLASS	D
OCCUPANCY CATEGORY, TABLE 1604.5	III
SEISMIC DESIGN CATEGORY – TABLE 1613.5.6	E
IE – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7–05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7–05, TABLE 15.4–1	2.50
SDS – SPECTRAL RESPONSE ACCEL. AT 0.2 SEC – G	1.20
SD1 – SPECTRAL RESPONSE ACCEL. AT 1 SEC – G	0.70
G–LEVELS FOR BASE ACCELERATIONS FOR DESIGN	0.60

SEISMIC LOADS MAY BE POSITIVE OR NEGATIVE.

5. WIND LOAD ARE PER ASCE 7–05 CODE, 150 MPH 3 SEC GUST FOR LOW RISE BUILDING, H < 60 FT

WIND PRESSURE (PSF), EQ 6–18	$p = q_h\ (GC_{pf} - GC_{pi})$	$75.53(GC_{pf} - GC_{pi})$
EXTERNAL PRESSURE COEF., FIGURE 6–10	GC_{pf}	
INTERNAL PRESSURE COEF., FIGURE 6–5	GC_{pi}	+ or –0.18
VELOCITY PRESSURE (psf) , Eq 6–15	$q_h = 0.00256\ K_z K_{zt} K_d V^2 I$	75.53
VELOCITY PRESSURE EXPOSURE COEF. – TABLE 6–3	K_z	0.98
TOPOGRAPHIC FACTOR, Eq. 6–3	$Kzt = (1 + K_1 K_2 K_3)^2$	1.37
FIGURE 6–4	K_1	0.17
FIGURE 6–4	K_2	1.00
FIGURE 6–4	K_3	1.00
WIND DIRECTIONALITY FACTOR, TABLE 6–4	K_d	0.85
WIND VELOCITY (MPH)	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15
EXPOSURE CATEGORY	C	C

6. RECOMMENDED ANCHOR BOLT (PROVIDED BY OTHERS) IS ASTM F1554 GR 105 OF DIA 1 1/8 INCH.
7. SIGNS CAN BE REVERSED ON ACCELERATION AND WIND LOADS.

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THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE LM6000

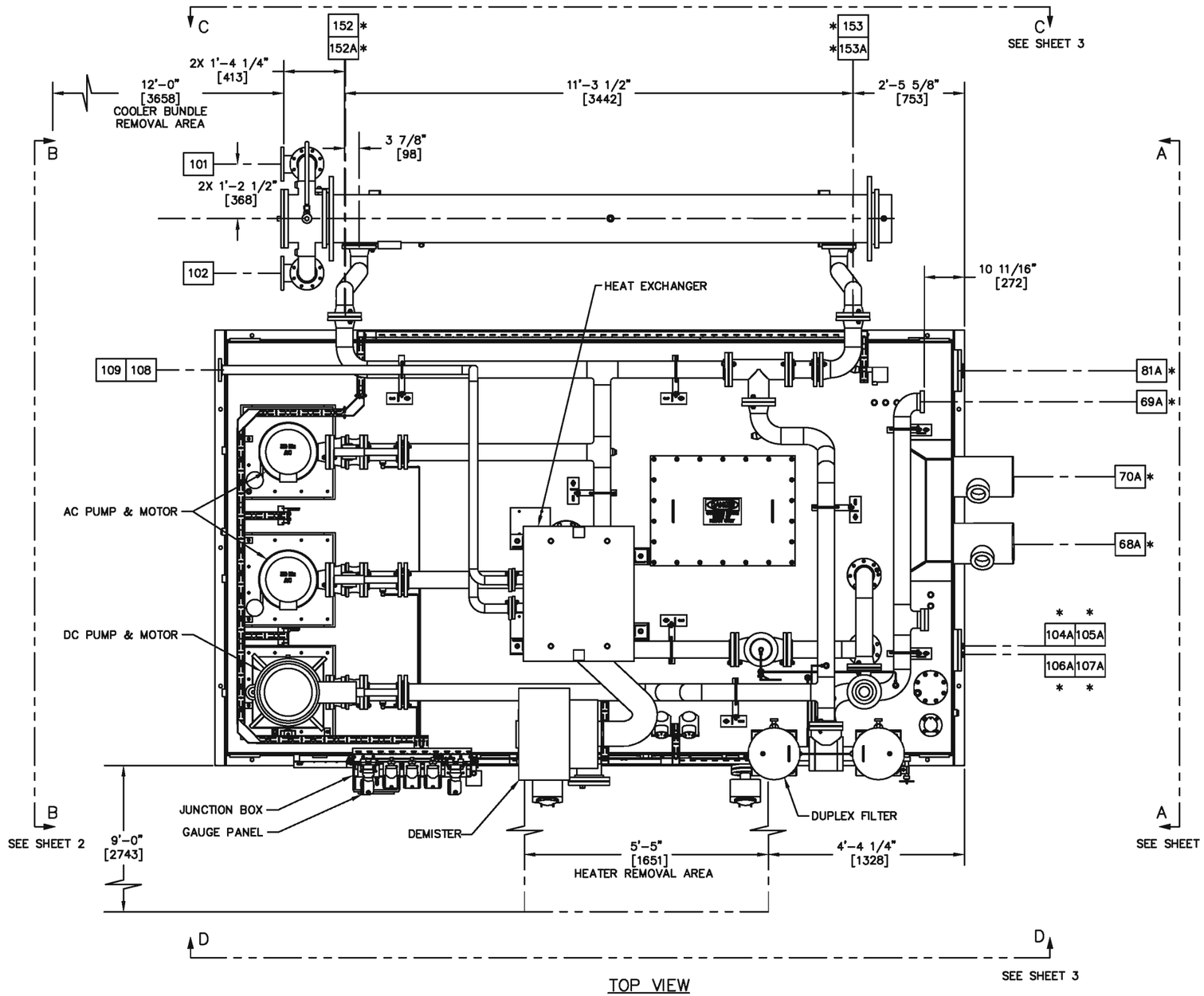
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
AUXILIARY SKID
RIGHT HAND

DWG NO. TYPICAL DRAWING 969218 REV. H

SCALE NONE SHEET 7 OF 7



TOP VIEW

LEGEND:

[ ] INDICATES CUSTOMER CONNECTION LOCATION

NOTES:

1. CUSTOMER PIPING CONNECTIONS ARE DEFINED AND DIMENSIONED ON THE MAIN UNIT GENERAL ARRANGEMENT DRAWING.
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)–(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X–(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
4. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.

REFERENCE DRAWINGS:

X–969200 GENERAL ARRANGEMENT, MAIN UNIT – RH

X–969248 FLOW & INSTRUMENT DIAGRAM, GENERATOR LUBE OIL SYSTEM

CUSTOMER CONNECTION LEGEND:

*	68A	GEARBOX LUBE OIL RETURN – 10" PIPE
*	69A	LUBE OIL SUPPLY – 4" SAE CODE 61
*	70A	GEARBOX LUBE OIL RETURN – 10" PIPE
*	81A	GENERATOR LUBE OIL DRAIN – 6" PIPE
	101	GENERATOR/GEARBOX LUBE OIL COOLING WATER SUPPLY – 4" – 150# RF
	102	GENERATOR/GEARBOX LUBE OIL COOLING WATER RETURN – 4" – 150# RF
*	104A	JACKING OIL RELIEF VALVE RETURN, PSV–6053A – 3/4" NPT 3000# CPLG
*	105A	JACKING OIL RELIEF VALVE RETURN, PSV–6053B – 3/4" NPT 3000# CPLG
*	106A	JACKING OIL RELIEF VALVE RETURN, PSV–6054A – 3/4" NPT 3000# CPLG
*	107A	JACKING OIL RELIEF VALVE RETURN, PSV–6054B – 3/4" NPT 3000# CPLG
	108	GENERATOR/GEARBOX LUBE OIL TANK DEMISTER COOLER WATER SUPPLY – 2" – 150# RF
	109	GENERATOR/GEARBOX LUBE OIL TANK DEMISTER COOLER WATER RETURN – 2" – 150# RF
*	152	GENERATOR LUBE OIL, COOLER SUPPLY – 4" 150# RF
*	152A	GEARBOX GENERATOR LUBE OIL SUPPLY TO COOLER – 4" 150# RF
*	153	GENERATOR LUBE OIL, COOLER RETURN – 4" 150# RF
*	153A	GEARBOX GENERATOR LUBE OIL RETURN FROM COOLER – 4" 150# RF
*	200	GENERATOR LUBE OIL DECK DRAIN – 3/4" FNPT
*	201	GENERATOR LUBE OIL RESERVOIR DRAIN – 2" FNPT

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REVISIONS

REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

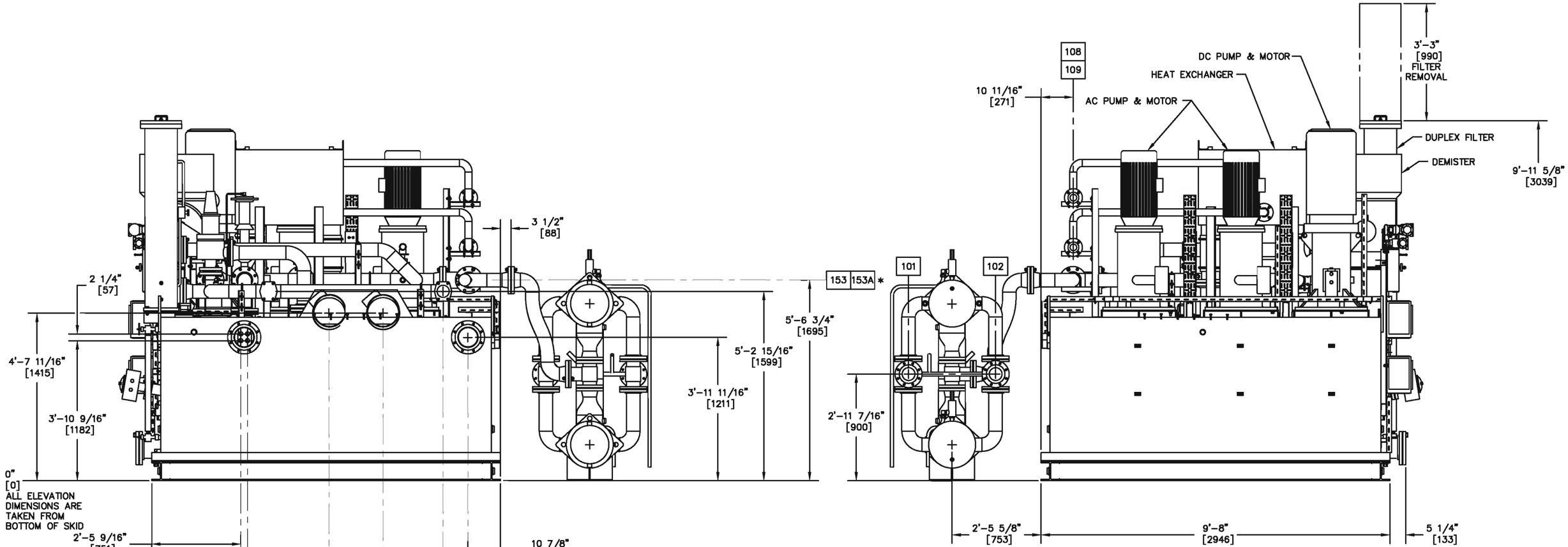
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE: GENERAL ARRANGEMENT GENERATOR/GEARBOX MINERAL LUBE OIL SKID

DWG NO.: TYPICAL DRAWING 969221 REV. F

SCALE 3/4" = 1'-0" SHEET 1 OF 6



VIEW A–A
SEE SHEET 1

VIEW B–B
SEE SHEET 1

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REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03	±1/16"	±1°
.XXX ± .010		

NEXT ASSY.

UNIT TYPE
LM6000

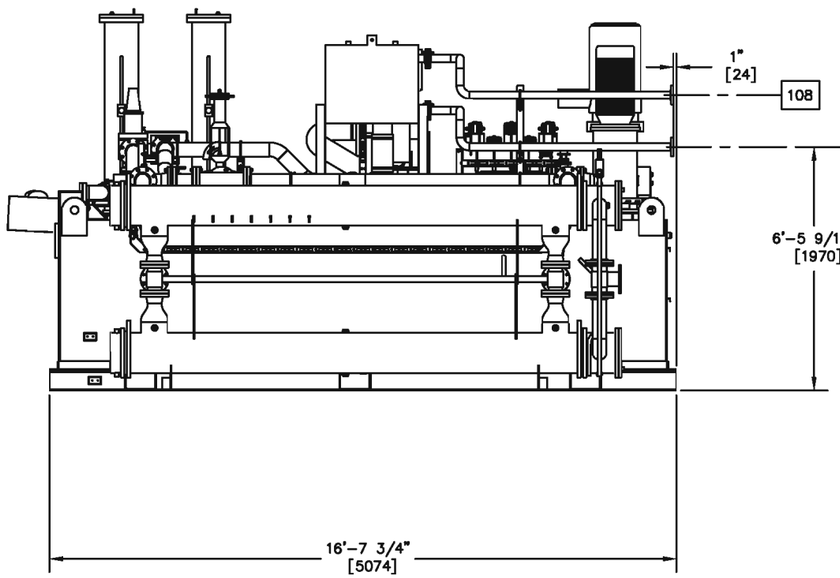
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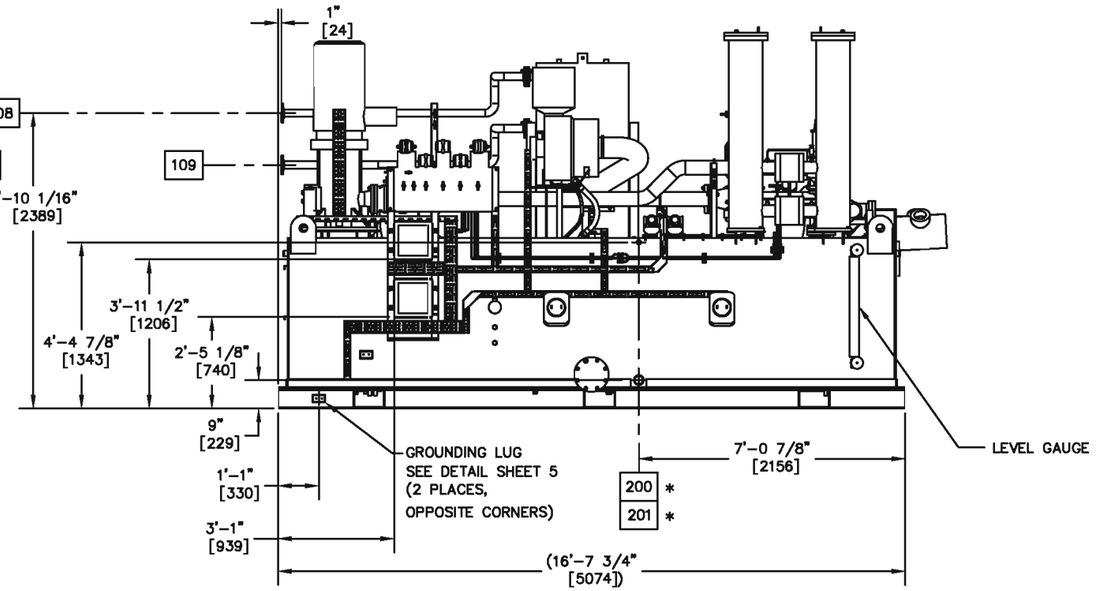
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GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. TYPICAL DRAWING 969221 REV. F

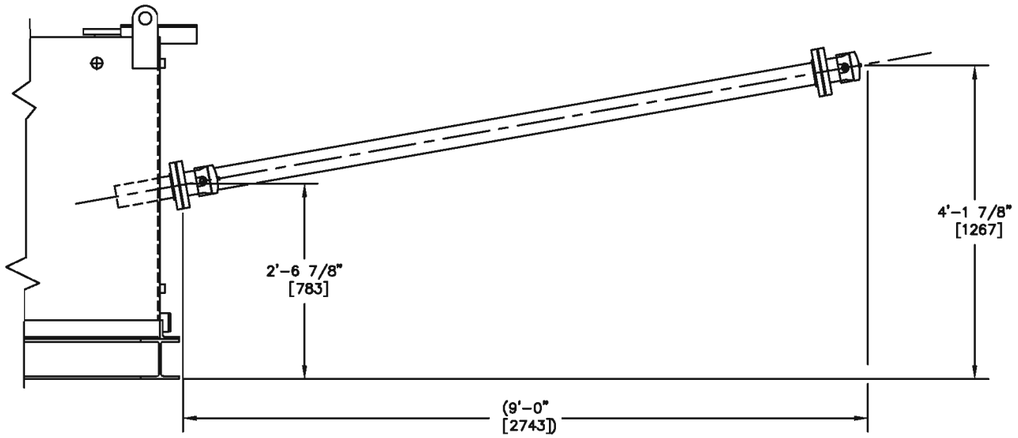
SCALE 3/4" = 1'-0" SHEET 2 OF 6



VIEW C-C
SEE SHEET 1



VIEW D-D
SEE SHEET 1



HEATER REMOVAL DETAIL

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THIRD ANGLE PROJECTION

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DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/16"
ANGULAR ±1°

NEXT ASSY.

UNIT TYPE
LM6000

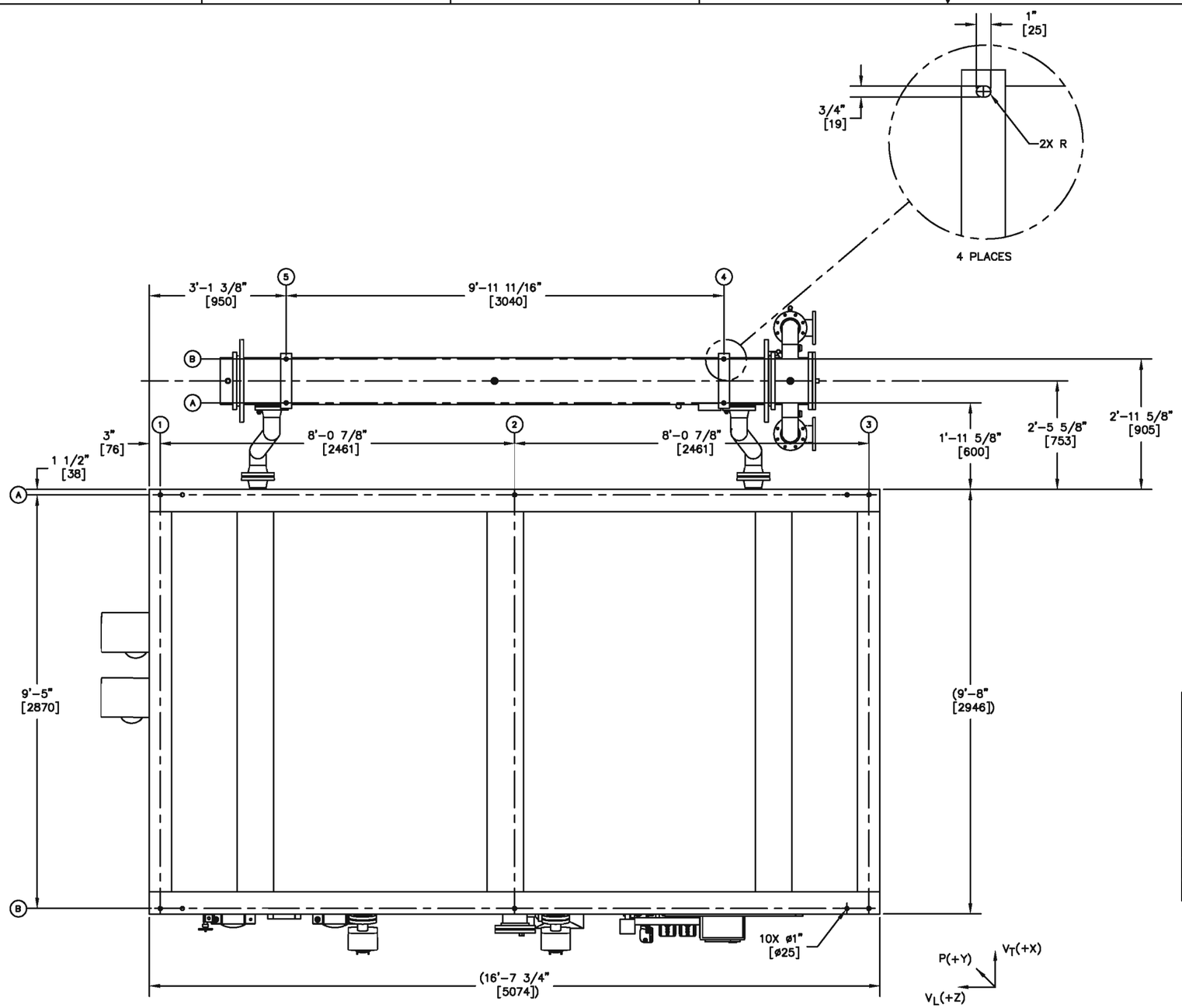
ADDL INFO

GE PACKAGED POWER, L.P.

TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. TYPICAL DRAWING 969221
REV. F

SCALE 1/2" = 1'-0"
SHEET 3 OF 6



INSTALLATION FOOTPRINT

LEGEND:

- ● ANCHOR BOLT

NOTES:

1. FOR VERTICAL P LOADS '+' IS A COMPRESSION AND '–' IS A UPLIFT. VT IS TRANSVERSE SHEAR AND VL IS LONGITUDINAL SHEAR.
2. EACH VALUE IN THE LOAD TABLE REPRESENTS A LOAD AT EACH ANCHOR LOCATION.
3. LIVE LOAD REPRESENTS A UNIFORM LOAD OF 60 PSF APPLIED AT EXPOSED SECTION ON THE ROOF OF GLO TANK.
4. SEISMIC LOADS ARE DUE TO 0.6g STATIC ACCELERATION APPLIED IN THE TRANSVERSE OR LONGITUDINAL DIRECTION AS PER EQUIVALENT LATERAL PROCEDURE FOR SEISMIC DESIGN OF BUILDINGS. THESE LOADS ARE AS PER IBC 2009/CBC 2010 CODE SECTION 1613 THAT REFERENCES ASCE 7-05.

SITE CLASS	D
OCCUPANCY CATEGORY	III
SEISMIC DESIGN CATEGORY – TABLE 1613.5.6	E
I_E – OCCUPANCY IMPORTANCE FACTOR, CATEGORY III, ASCE 7-05, TABLE 11.5.1	1.25
R – RESPONSE MODIFICATION FACTOR, ASCE 7-05, TABLE 15.4-2	3.00
S_{DS} – SPECTRAL RESPONSE ACCEL. AT 0.2 SEC – G	1.44
S_{D1} – SPECTRAL RESPONSE ACCEL. AT 1 SEC – G	0.75
G – LEVELS FOR BASE ACCELERATIONS FOR DESIGN	0.60

SEISMIC LOAD MAY BE POSITIVE OR NEGATIVE.

CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT $Ev=+/-\ 0.2S_{DS}D$ IN THE FOUNDATION LOADS AS PER ASCE 7-05 SECTION 12.4.

NOTES CONTINUED ON SHEET 6

LM6000-PG GENERATOR LUBE OIL TANK
FOUNDATION LOADING (KIPS)

ANCHOR	DEAD LOAD			ROOF LL (60 PSF)			SEISMIC (TRANSVERSE)			SEISMIC (LONGITUDINAL)			WIND (150 MPH) (TRANSVERSE)		
	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT	P	VL	VT
1–A	9.6	–4.5	–3.2	1.6	–0.8	–0.5	4.4	–1.9	–6.7	3.2	–5.5	–1.2	1.7	–0.7	–2.0
1–B	9.7	–4.5	2.5	1.4	–0.7	0.4	–4.1	1.8	–6.5	3.3	–5.8	1.2	–1.6	0.6	–1.9
2–A	5.3	–0.3	–1.7	0.8	0.0	–0.1	2.1	–0.3	–2.9	0.0	–6.2	–0.4	0.8	–0.1	–0.9
2–B	7.7	1.2	2.4	1.1	0.2	0.3	–2.7	0.3	–3.0	0.0	–6.8	0.3	–1.1	0.0	–0.8
3–A	11.1	4.4	–4.4	1.5	0.7	–0.5	4.7	1.3	–7.0	–3.2	–4.1	1.3	1.8	0.5	–2.1
3–B	11.2	3.7	4.1	1.4	0.6	0.5	–4.4	–1.2	–6.8	–3.3	–4.5	–1.1	–1.7	–0.4	–2.1
TOTAL	54.7	0.1	–0.3	7.8	0.0	–0.1	0.0	0.0	–32.8	0.0	–32.8	0.0	0.0	0.0	–9.8

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REV	DESCRIPTION	ECO	DRAWN	DATE	DESIGN
	FOR INFORMATION ONLY				

REVISIONS

THIRD ANGLE PROJECTION

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TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000

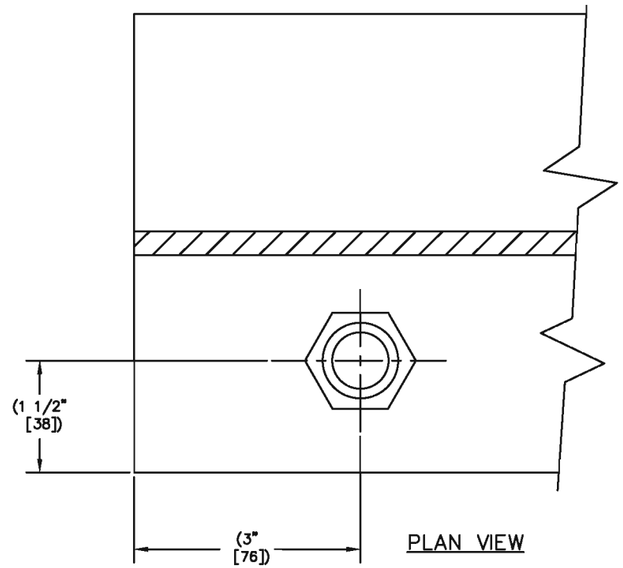
ADDL INFO

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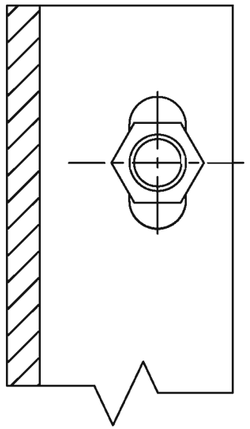
TITLE: GENERAL ARRANGEMENT GENERATOR/GEARBOX MINERAL LUBE OIL SKID

DWG NO. TYPICAL DRAWING 969221 REV. F

SCALE 3/4" = 1'-0" SHEET 4 OF 6



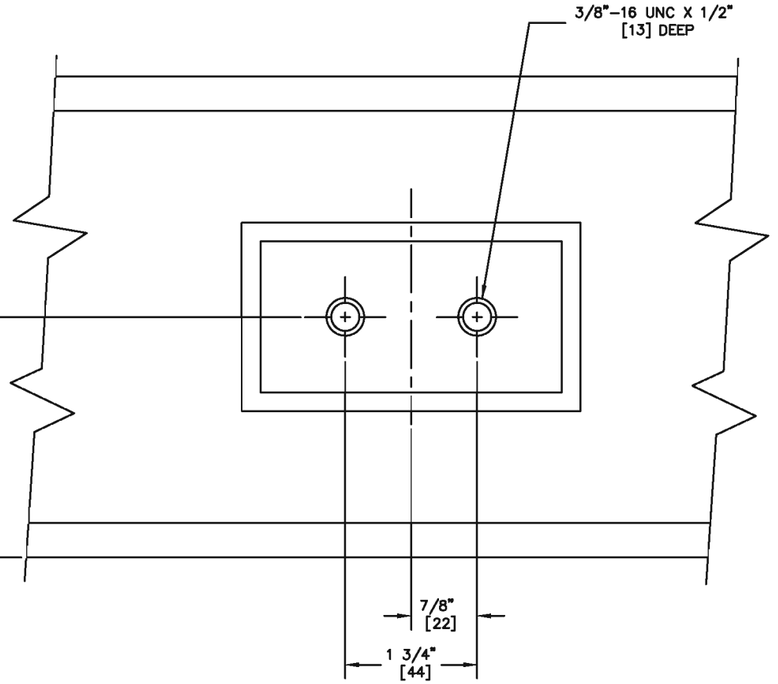
PLAN VIEW



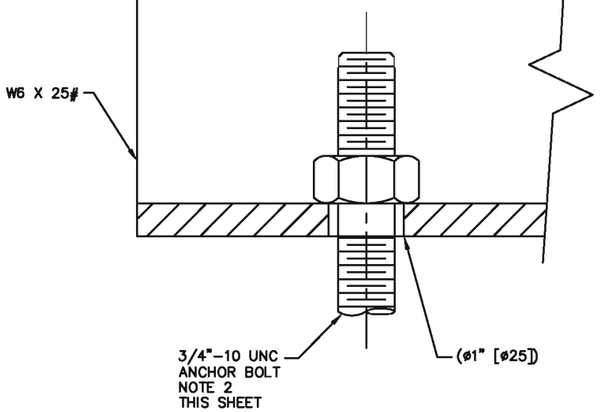
PLAN VIEW

NOTES:

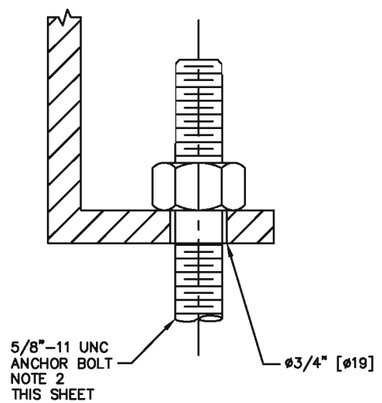
1. LEVELING AND GROUTING TO BE PERFORMED PER GUIDELINES OF INSTALLATION MANUAL.
2. ALL ANCHORING HARDWARE AND EMBEDDED STEEL TO BE SUPPLIED BY OTHERS.



GROUNDING LUG DETAIL
(SEE SHEET 3)



ANCHOR BOLT DETAIL MLO SKID



ANCHOR BOLT DETAIL SHELL & TUBE

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THIRD ANGLE PROJECTION

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TOLERANCES

DECIMALS	FRACTIONAL	ANGULAR
.XX ± .03 .XXX ± .010	±1/16"	±1°

NEXT ASSY.

UNIT TYPE
LM6000

ADDL INFO

GE PACKAGED POWER, L.P.

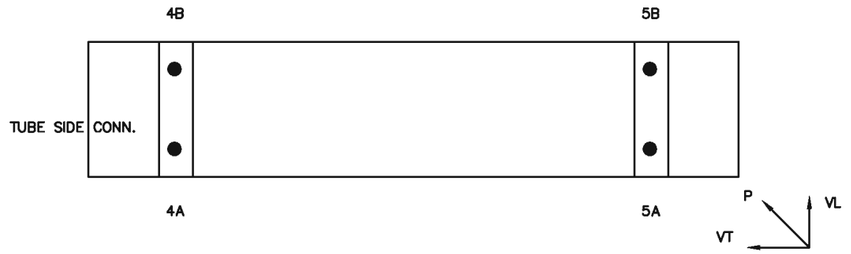
TITLE
GENERAL ARRANGEMENT
GENERATOR/GEARBOX
MINERAL LUBE OIL SKID

DWG NO. TYPICAL DRAWING 969221 REV. F

SCALE NONE SHEET 5 OF 6

HEAT EXCHANGER FOUNDATION LOADING (KIPS)

ANCHOR POINTS	DEAD LOAD			SEISMIC TRANSVERSE 0.6g			SEISMIC LONGITUDINAL 0.6g		
	P	VT	VL	P	VT	VL	P	VT	VL
4–A	1.2	0.0	0.0	5.9	−0.8	0.2	−0.6	0.0	−0.8
4–B	1.2	0.0	0.0	−5.9	−0.8	−0.2	−0.6	0.0	−0.8
5–A	1.6	0.0	0.0	7.3	−0.9	−0.2	0.6	0.0	−0.8
5–B	1.6	0.0	0.0	−7.3	−0.9	0.2	0.6	0.0	−0.8
TOTAL	5.6	0.0	0.0	0.0	−3.4	0.0	0.0	0.0	−3.4



NOTES: (CONT. FROM SHEET 4)

5. APPLIED WIND LOADS FOR DESIGN ARE PER ASCE 7–05 CODE, 150 MPH PER SECTION 6.5.15.

DESIGN WIND PRESSURE (PSF)	p=qz G Cf	96.30
FORCE COEFF, FIGURE 6–19	Cf	1.5
GUST FACTOR, SEC 6.5.8	G	0.85
VELOCITY PRESSURE (PSF) , EQ 6–15	q_z= 0.00256 K_z K_{zt} K_d V^2 I	75.53
VELOCITY PRESSURE EXPOSURE COEF., TABLE 6–3	K_z	0.98
TOPOGRAPHIC FACTOR, EQ 6–3	K_{zt} = $(1+K_1*K_2*K_3)^2$	1.37
WIND DIRECTIONALITY FACTOR, TABLE 6–4	K_d	0.85
K3, FIGURE 6–4	K_3	1
K2, FIGURE 6–4	K_2	1
K1, FIGURE 6–4	K_1	0.17
EXPOSURE CATEGORY	C	C
WIND VELOCITY (MPH) FOR DESIGN	V	150
IMPORTANCE FACTOR, TABLE 6–1	I	1.15

6. FOUNDATION DESIGNER MUST COMBINE LOAD CASES WITH PROPER SIGNS.
7. SIGNS CAN BE REVERSED ON ACCELERATION AND WIND LOADS.
8. RECOMMENDED ANCHOR BOLTS ARE ASTM F1554 GR 105 WITH A DIA OF 3/4 IN.

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NEXT ASSY.

UNIT TYPE LM6000

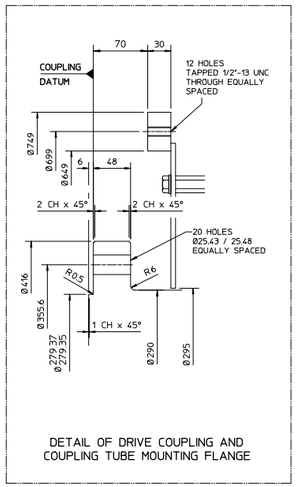
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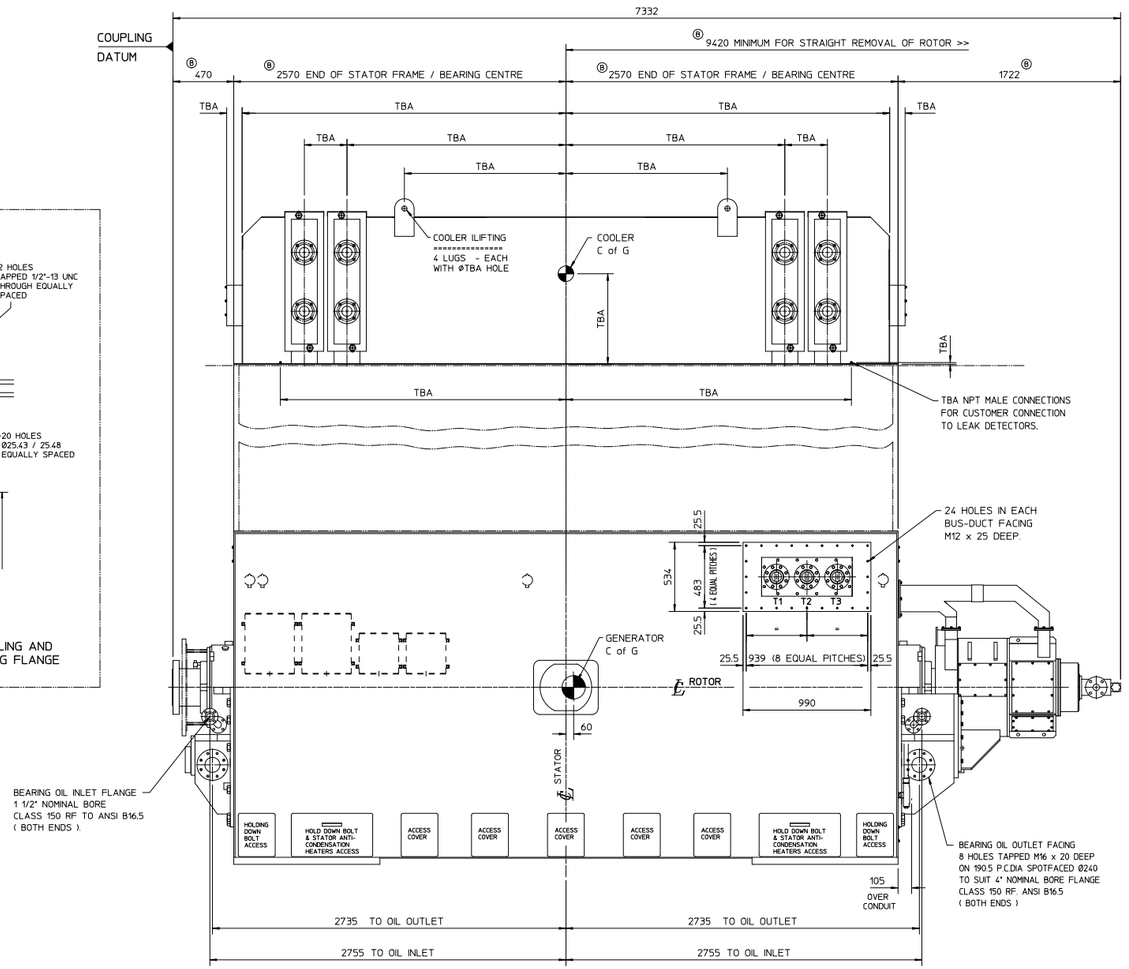
TITLE: GENERAL ARRANGEMENT GENERATOR/GEARBOX MINERAL LUBE OIL SKID

DWG NO. TYPICAL DRAWING 969221 | REV. F

SCALE NONE | SHEET 6 OF 6

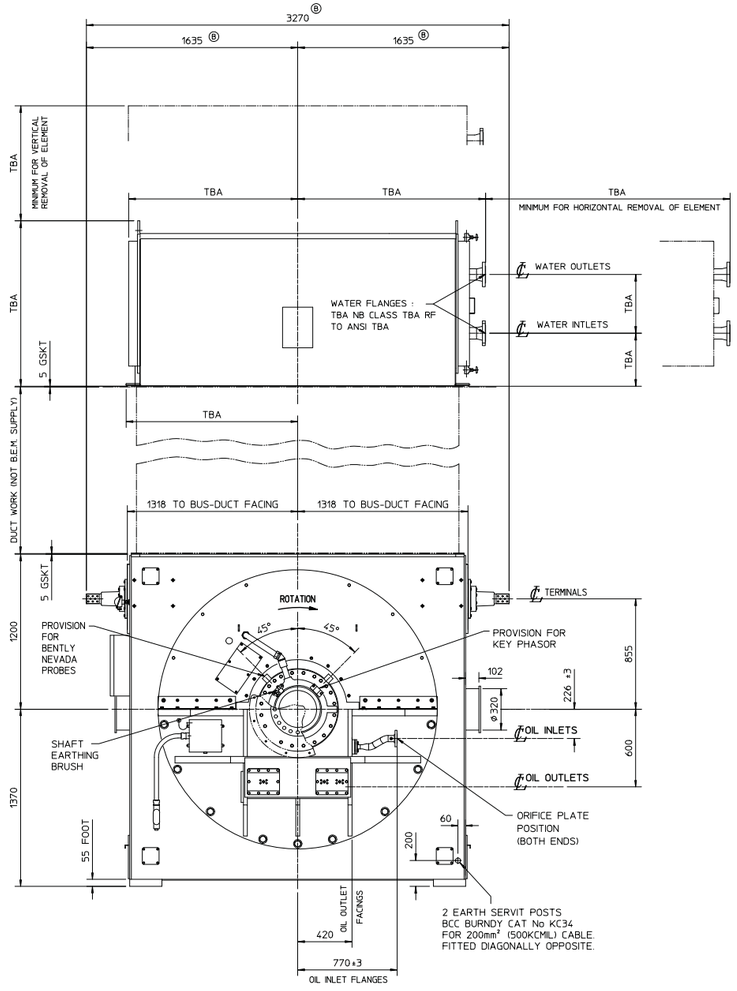


DETAIL OF DRIVE COUPLING AND COUPLING TUBE MOUNTING FLANGE



NON-EXCITER (DRIVE) END

EXCITER END



VIEW ON NON EXCITER (DRIVE) END

GENERAL NOTES :

PHASE SEQUENCE = T1-T3-T2
TERMINAL MARKINGS - AS SHOWN ON PLAN VIEW

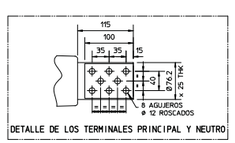
ASSOCIATED DRAWINGS :

321642500 - ROTOR GEOMETRY
321642400 - CONNECTION DIAGRAM

AUXILLIARY TERMINAL BOX DESIGNATIONS :

TB1 - CONTROL
TB2 - POWER
TB3 - INSTRUMENTATION
TB4 - STATOR WINDING RTD's

ALL BOXES ARE FITTED WITH EARTH LEAD TO STATOR FRAME (M10 STUD).



DETALLE DE LOS TERMINALES PRINCIPAL Y NEUTRO

MACHINE WEIGHTS :

WOUND STATOR = 53865 KG
ROTOR (INCLUDING EXC ARM) = 14342 KG

GENERATOR COMPLETE = 72900 KG

HEAT EXCHANGER = TBA KG (DRY) / TBA KG (WET) (B)

FOUNDATION LOADING

FAULTY SYNCHRONISING LOAD (120° OUT OF PHASE) = +/- 145230 KG

THIS ASSUMES INFINITE BUS-BAR (ZERO SYSTEM REACTANCE).

AIR CIRCUIT AND HEAT EXCHANGER DETAILS

THERMAL DETAILS	MACHINE AIR CIRCUIT	COOLANT CIRCUIT TREATED WATER (50% GLYCOL)
DISSIPATION AT RATING POINT	933 KW	933 KW
NORMAL INLET TEMPERATURE	TBA C	32.2 C
THERMAL OUTLET TEMPERATURE	38.5 C	TBA C
FLOW RATE (TOTAL)	21 m3/Sec	38.9 L/Sec
VELOCITY	-	TBA m/Sec
PRESSURE LOSS	730 Pa	<TBA KPa
WORKING PRESSURE	-	NOT KNOWN
DESIGN PRESSURE	-	10.34 bar g
TEST PRESSURE	-	13.44 bar g

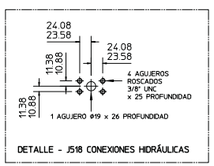
BEARING DETAILS

NON-EXCITER (DRIVE) END BEARING DETAILS									
OIL FLOW		POWER LOSS	SUPPLY PRESSURE (NOMINAL)	ORIFICE BORE	JOURNAL JACKING		THRUST JACKING		
					PRESSURE	FLOW	PRESSURE	FLOW	
2.1 L/S	33.3 US GPM	40.5 KW	2 BAR	Ø17	49 BAR	0.08 L/S 1.3 US GPM	185 BAR	0.19 L/S 3.0 US GPM	

EXCITER END BEARING DETAILS						
OIL FLOW		POWER LOSS	SUPPLY PRESSURE (NOMINAL)	ORIFICE BORE	JOURNAL JACKING	
					PRESSURE	FLOW
1.1 L/S	17.4 US GPM	25.2 KW	2 BAR	Ø12	49 BAR	0.08 L/S 1.3 US GPM

ABOVE DETAILS ASSUME OIL TO ISO VG 32 AT 55°C.
STATED PRESSURES ARE AT BEARING OIL INLETS

BOTH BEARINGS ARE INSULATED.
LOCATION BEARING FITTED AT NON-EXCITER END ONLY - MAXIMUM ALLOWABLE AXIAL THRUST = 33400N.
MAXIMUM OPERATING OIL LEVEL IS WITH THE OUTLET PIPES HALF FULL (ie 600mm FROM ROTOR C/LINE) - THIS ALLOWS FOR A BEARING AIR DRAIN OF 0.05m³/SEC (TOTAL).



DETALLE - J518 CONEXIONES HIDRÁULICAS

CUSTOMER :
G.E. PACKAGED POWER LP.

FRAME SIZE :
BDAX 7-290 ERHJT (60 Hz).

LM 6000 GAS TURBINE DRIVE WITH THRUST PAD & JOURNAL JACKING.

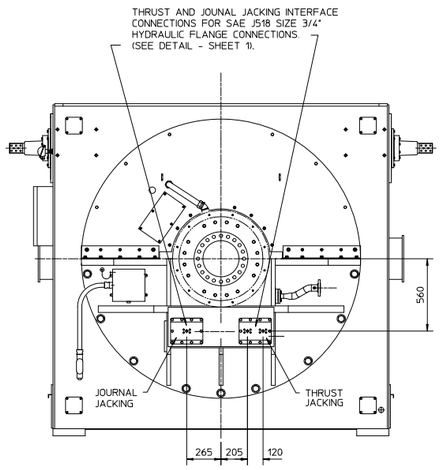
ISS	ZONE	MODIFICATION DETAILS	MOD BY	DATE
C		SPANISH TRANSLATION DRAWINGS ADDED	KJG3	17 JUL 2012
B		DIMENSIONS ADDED	KJG3	28 JUN 2012

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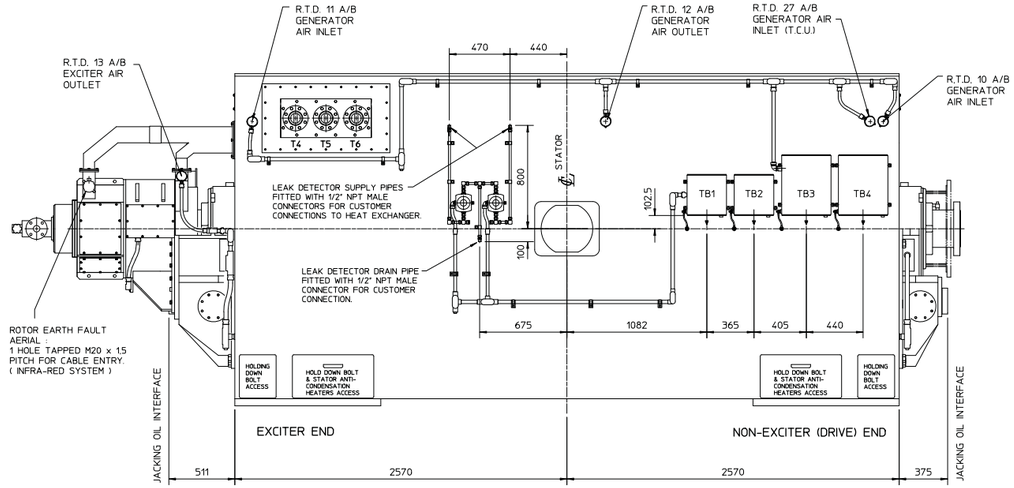
BRUSH
FALCON WORKS, NOTTINGHAM ROAD, LOUGHBOROUGH, LEICS LE11 1EX
WWW.BRUSH.EU

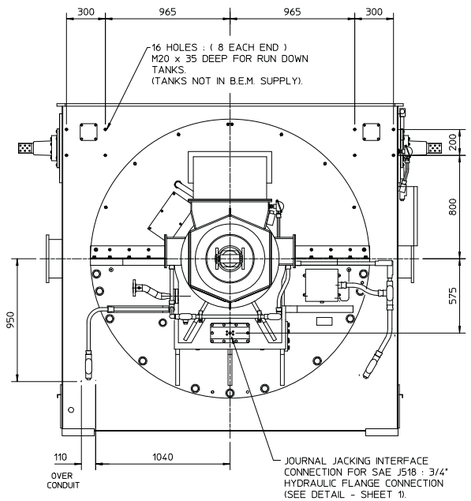
WELDING	WCP004	FIRST PROJ	22479	SCALE	1:15	ISS	DATE	18 Jun 2012	CH'D	KJG3	ISS CH'D KJG3
MANUFACTURING TOL	B.S.D.942 Ld5					A	DR'N	KJG3	APP	REH2	C APP REH2
SURFACE TEXTURE	B.S.D.986 Ls2	DRG REF	321280500								
FIRST ANGLE PROJECTION		GENERAL ARRANGEMENT - GENERATOR				A0 321638800					ISS C
		FRAME CODE	BDAX 7-290ERHJT			SHT 1 OF 4		DRAWING RANGE			

ME CAD REV 13

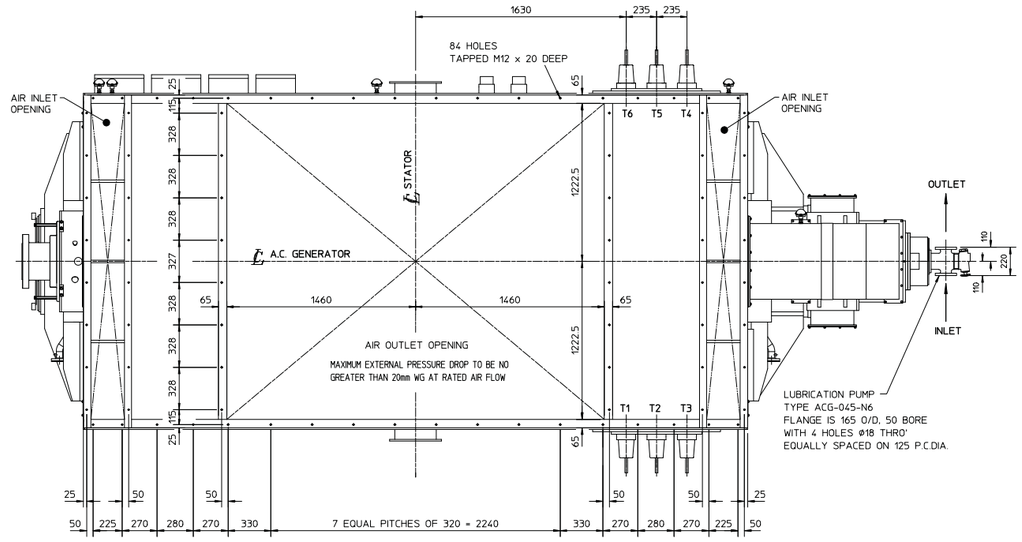


VIEW ON NON EXCITER (DRIVE) END

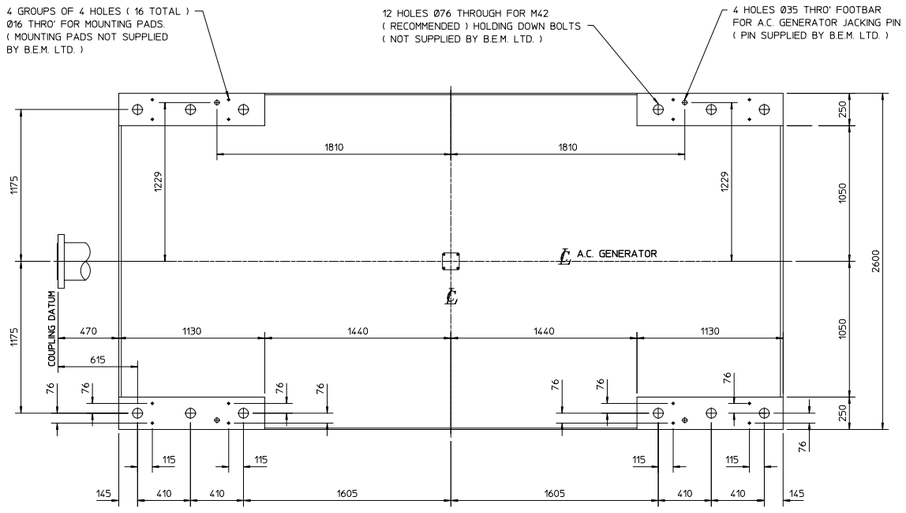




VIEW ON EXCITER END



PLAN VIEW ON GENERATOR TOP FLANGE



VIEW ON UNDERSIDE SHOWING DETAILS OF FOUNDATION PLAN

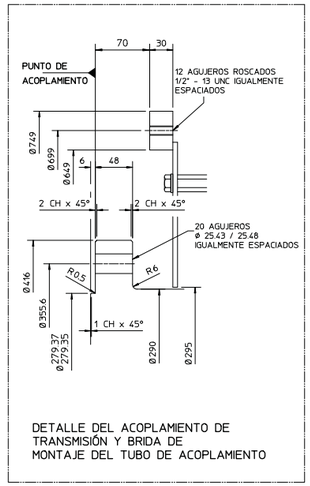
ISS	ZONE	MODIFICATION DETAILS	MOD BY	DATE
C		SPANISH TRANSLATION DRAWINGS ADDED	KJG3	17 JUL 2012
B		DIMENSIONS ADDED	KJG3	28 JUN 2012

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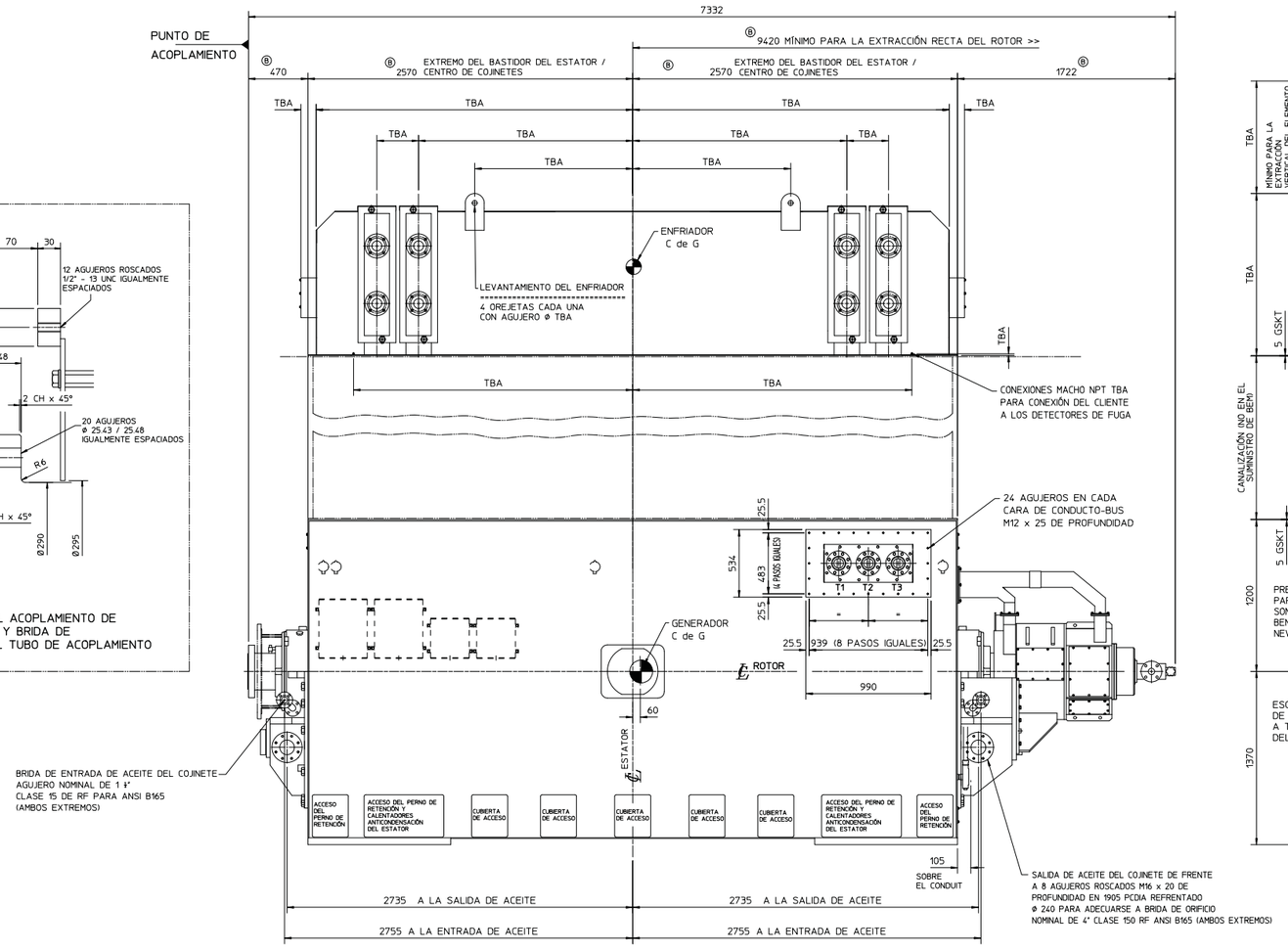
BRUSH
FALCON WORKS, NOTTINGHAM ROAD, LOUGHBOROUGH, LEICS LE11 1EX
WWW.BRUSH.EU

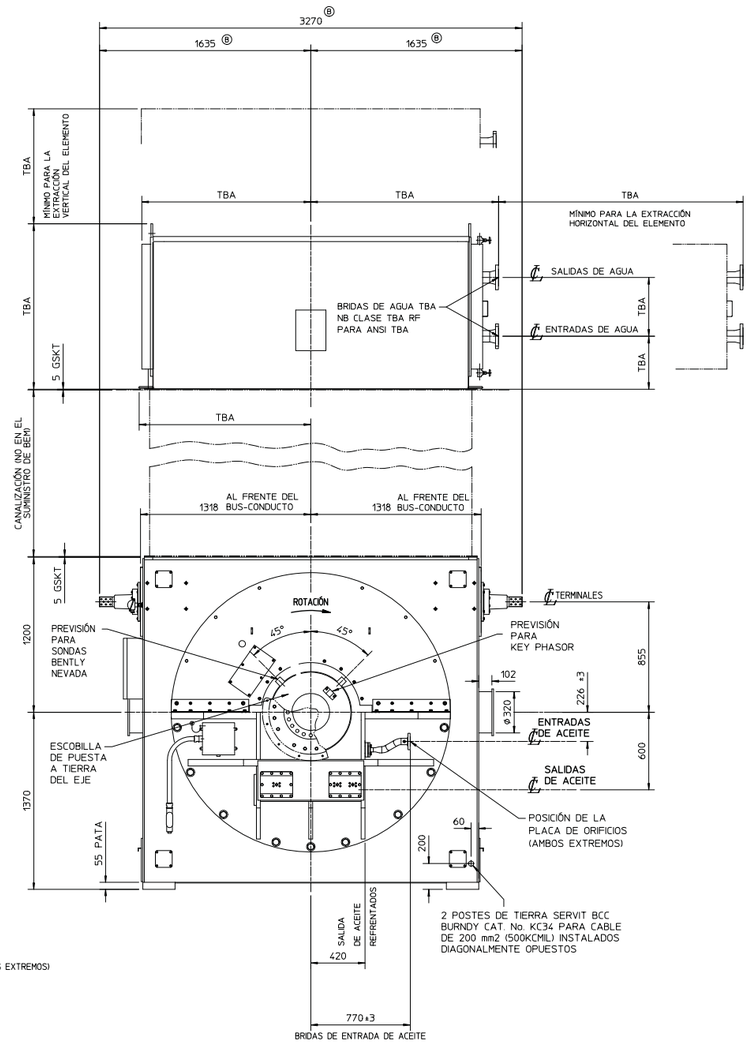
WELDING	WCP004	FIRST PROJ	22479	SCALE	1:15	ISS	DATE	18 Jun 2012	CH'D	KJG3	ISS	CH'D	KJG3
MANUFACTURING TOL	B.S.D.942 Ls5					A	DR'N	KJG3	APP	REH2	C	APP	REH2
SURFACE TEXTURE	B.S.D.986 Ls2	DRG REF	321280500										
FIRST ANGLE PROJECTION		GENERAL ARRANGEMENT - GENERATOR				A0 321638800							ISS C
		FRAME CODE	BDAX 7-290ERHJT			SHT 2 OF 4		DRAWING RANGE					

ME CAD REV 13



DETALLE DEL ACOPLAMIENTO DE TRANSMISIÓN Y BRIDA DE MONTAJE DEL TUBO DE ACOPLAMIENTO





VISTA DESDE EL EXTREMO (TRACCIÓN) NO DEL EXCITADOR

NOTAS GENERALES :

SECUENCIA DE FASES = T1 - T3 - T2
MARCAS DE TERMINALES - COMO SE MUESTRA EN LA VISTA DEL PLANO

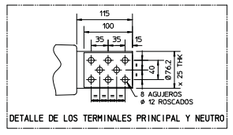
PLANOS ASOCIADOS :

321642500 - GEOMETRÍA DEL ROTOR
321642400 - DIAGRAMA DE CONEXIONES

DESIGNACIONES DE LA CAJA DE TERMINALES AUXILIAR :

TB1 - CONTROL
TB2 - POTENCIA
TB3 - INSTRUMENTACIÓN
TB4 - RTDs DEL DEVANADO DEL ESTATOR

TODAS LAS CAJAS CUENTAN CON LÍNEA DE TIERRA AL BASTIDOR DEL ESTATOR (ESPÁRRAGO M10)



DETALLE DE LOS TERMINALES PRINCIPAL Y NEUTRO

PESOS DE LA MÁQUINA :

ESTATOR DEVANADO	= 53865 KG
ROTOR (INCLUYENDO ARM. DE EXC.)	= 14342 KG
GENERADOR COMPLETO	= 72900 KG
INTERCAMBIADOR DE CALOR = TBA KG (SECO) / TBA KG (NETO)	

CARGA DE LA CIMENTACIÓN

CARGA DE SINCRONIZACIÓN DEFECTUOSA (120g FUERA DE FASE) = +/- 145230 KG

ESTO SUPONE BARRA COLECTORA INFINITA (REACTANCIA CERO DEL SISTEMA)

DETALLES DEL CIRCUITO DE AIRE Y EL INTERCAMBIADOR DE CALOR

DETALLES TÉRMICOS	CIRCUITO DE AIRE DE LA MÁQUINA	CIRCUITO DE REFRIGERANTE AGUA TRATADA (50% GLICOL)
DISIPACIÓN EN EL PUNTO DE FUNCIONAMIENTO NOMINAL	933 KW	933 KW
TEMPERATURA DE ENTRADA NORMAL	TBA C	32.2 C
TEMPERATURA DE SALIDA TÉRMICA	38.5 C	TBA C
CAUDAL (TOTAL)	21 m3/Seg	38.9 L/Seg
VELOCIDAD	-	TBA m/Seg
PÉRDIDA DE PRESIÓN	730 Pa	<TBA KPa
PRESIÓN DE TRABAJO	-	DESCONOCIDA
PRESIÓN DE DISEÑO	-	10.34 bar g
PRESIÓN DE PRUEBA	-	13.44 bar g

DETALLES DE COJINETES

DETALLES DEL COJINETE DE EXTREMO (TRACCIÓN) NO DEL EXCITADOR

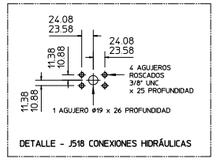
FLUJO DE ACEITE		PÉRDIDA DE POTENCIA	PRESIÓN DE ALIMENTACIÓN (NOMINAL)	ORIFICIO BORE	ELEVACIÓN DE MUÑÓN		ELEVACIÓN DE EMPUJE	
					PRESIÓN	FLUJO	PRESIÓN	FLUJO
2.1 L/S	33.3 GPM.EE.UU	40.5 KW	2 BAR	ø17	4.9 BAR	0.08 L/S | 1.3 US GPM	18.5 BAR	0.19 L/S | 3.0 GPM.EE.UU

DETALLES DEL COJINETE DEL EXTREMO DEL EXCITADOR

FLUJO DE ACEITE		PÉRDIDA DE POTENCIA	PRESIÓN DE ALIMENTACIÓN (NOMINAL)	ORIFICIO BORE	ELEVACIÓN DE MUÑÓN	
					PRESIÓN	FLUJO
1.1 L/S	17.4 GPM.EE.UU	25.2 KW	2 BAR	ø12	4.9 BAR	0.08 L/S | 1.3 GPM.EE.UU

LOS DETALLES ANTERIORES SUPONEN ACEITE A ISO VG 32 A 55 ºC
LAS PRESIONES ESTABLECIDAS SON EN LAS ENTRADAS DE ACEITE DE LOS COJINETES

AMBOS COJINETES ESTÁN AISLADOS
COJINETE DE LOCALIZACIÓN INSTALADO SÓLO EN EL EXTREMO NO DEL EXCITADOR - EMPUJE AXIAL MÁXIMO PERMITIDO = 33400 N
EL NIVEL MÁXIMO DE OPERACIÓN DEL ACEITE ES CON LOS TUBOS DE SALIDA ABIERTOS A LA MITAD (es decir, 600 mm DE LA LÍNEA/C DEL ROTOR)
- ESTO PERMITE UN DRENAJE DE AIRE DEL COJINETE DE 0.05 m3/seg (TOTAL)



DETALLE - J518 CONEXIONES HIDRÁULICAS

CLIENTE::
G.E. PACKAGED POWER LP.

TAMAÑO DEL BASTIDOR:
BDAX 7-290 ERHJT (60 Hz).

ACCIONAMIENTO DE TURBINA DE GAS LM 6000
CON ELEVACIÓN DE ALMOHADILLA DE EMPUJE Y MUÑÓN

DISPOSICIÓN GENERAL - GENERADOR

ISS	ZONE	MODIFICATION DETAILS	MOD BY	DATE
C		SPANISH TRANSLATION DRAWINGS ADDED	KJG3	17 JUL 2012
B		DIMENSIONS ADDED	KJG3	28 JUN 2012

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WELDING	WCP004	FIRST PROJ	22479	SCALE	1:15	ISS	DATE	18 Jun 2012	CH'D	KJG3	ISS CH'D KJG3
MANUFACTURING TOL	B.S.D.942 Lo5					A	DR'N	KJG3	APP	REH2	C APP REH2
SURFACE TEXTURE	B.S.D.986 Lo2	DRG REF	321280500								

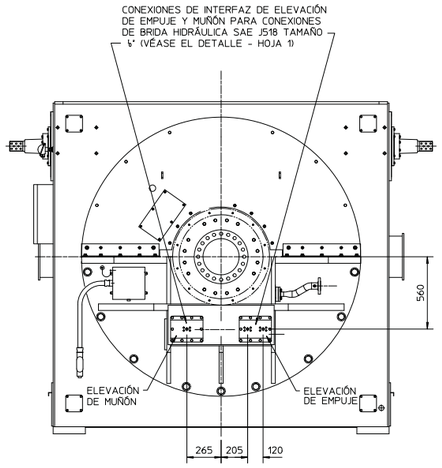
FIRST ANGLE PROJECTION

GENERAL ARRANGEMENT - GENERATOR

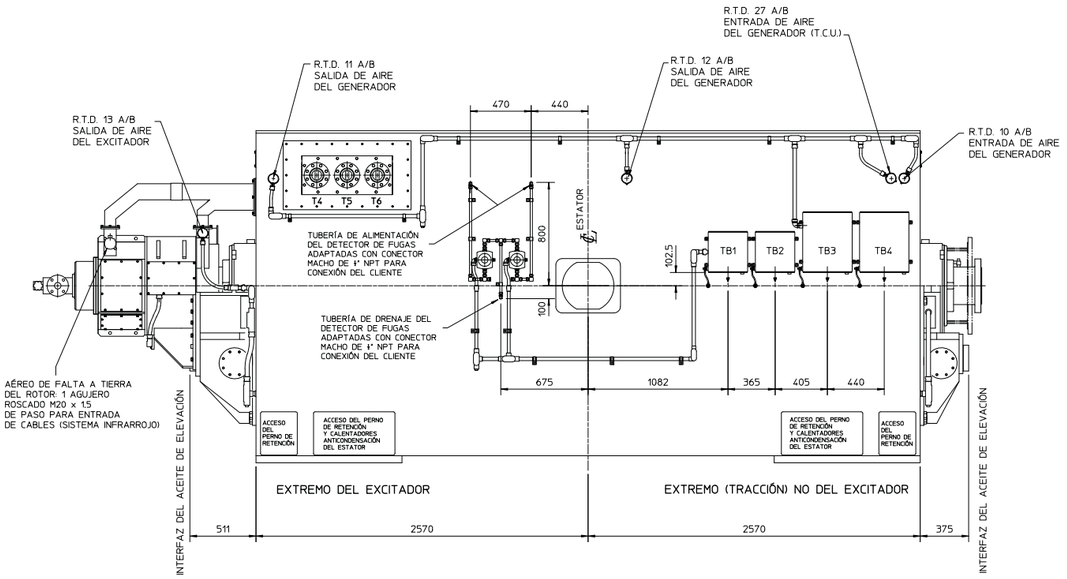
A0 321638800 ISS C

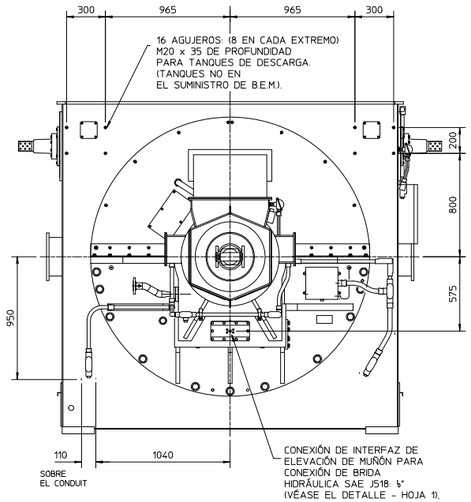
FRAME CODE | BDAX 7-290ERHJT | SHT 3 OF 4 | DRAWING RANGE

ME CAD REV 13

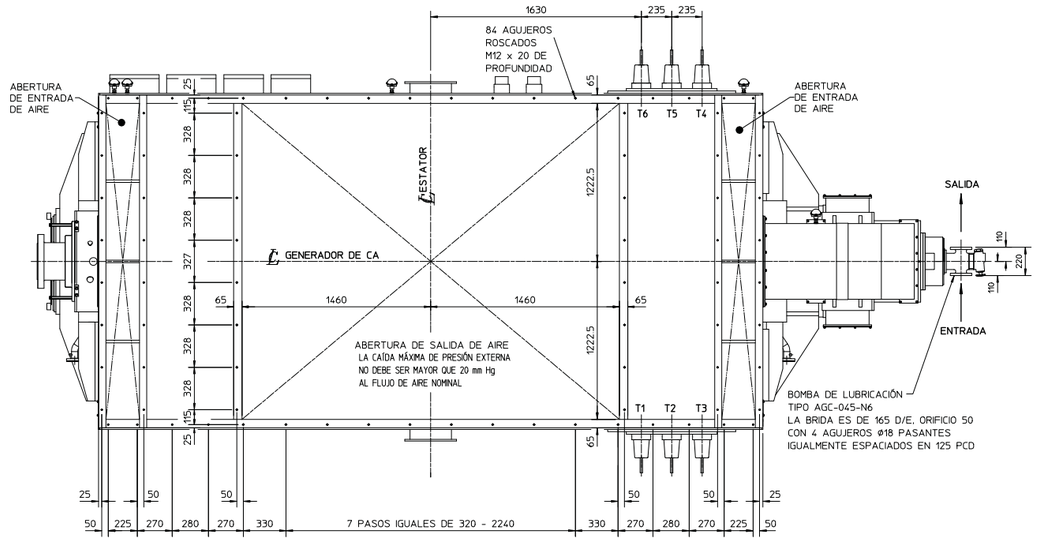


VISTA EN EL EXTREMO (TRACCIÓN) NO DEL EXCITADOR

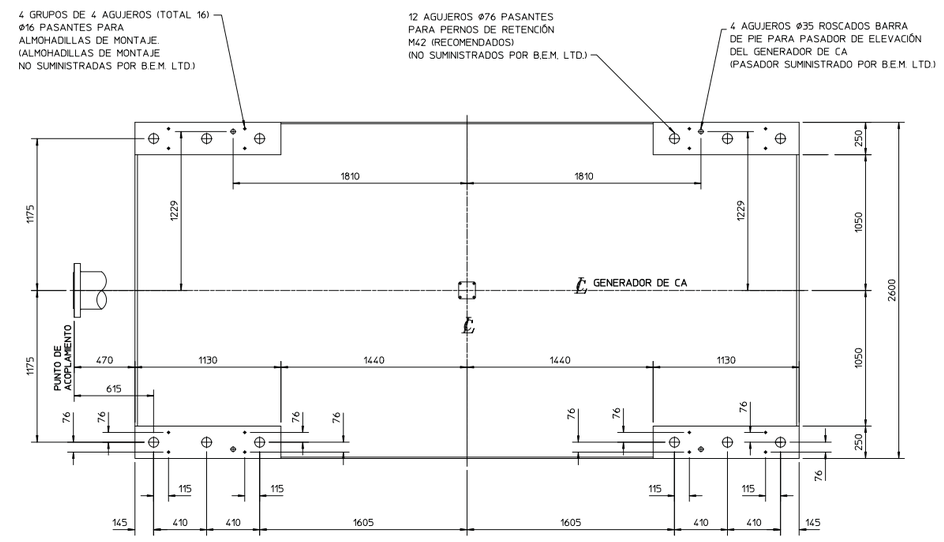




VISTA EN EL EXTREMO DEL EXCITADOR



VISTA DE PLANTA EN LA BRIDA SUPERIOR DEL GENERADOR



VISTA DESDE ABAJO QUE MUESTRA LOS DETALLES DEL PLANO DE CIMIENTOS

DISPOSICIÓN GENERAL - GENERADOR

ISS	ZONE	MODIFICATION DETAILS	MOD BY	DATE
C		SPANISH TRANSLATION DRAWINGS ADDED	KJG3	17 JUL 2012
B		DIMENSIONS ADDED	KJG3	28 JUN 2012

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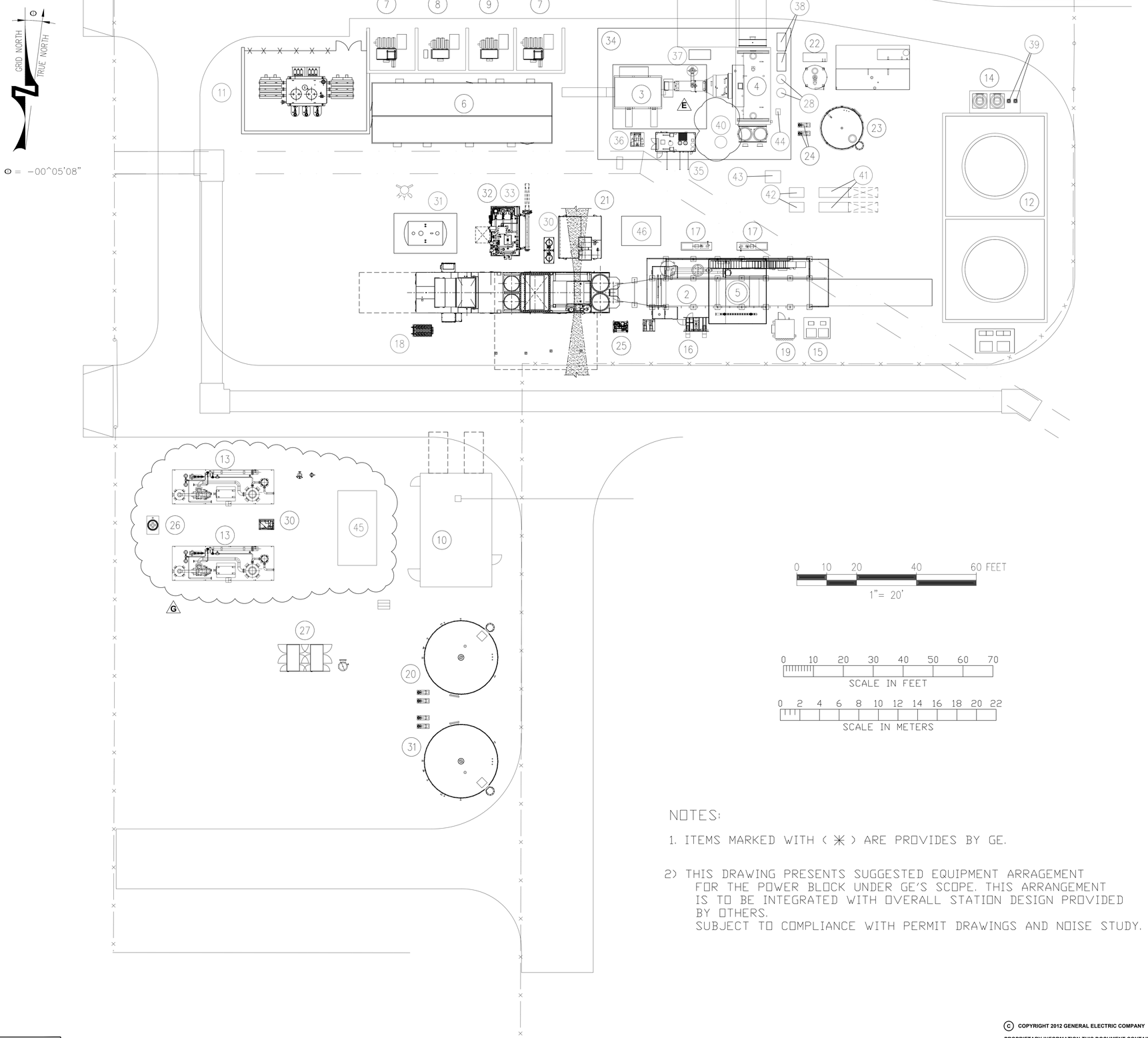
WELDING	WCP004	FIRST PROJ	22479	SCALE	1:15	ISS	DATE	18 Jun 2012	CH'D	KJG3	ISS	CH'D	KJG3
MANUFACTURING TOL	BS.D.942 Ls5					A	DR'N	KJG3	APP	REH2	C	APP	REH2
SURFACE TEXTURE	BS.D.986 Ls2	DRG REF	321280500										
FIRST ANGLE PROJECTION		GENERAL ARRANGEMENT - GENERATOR				A0 321638800							ISS C
		FRAME CODE	BDAX 7-290ERHJT			SHT 4 OF 4		DRAWING RANGE					

ME CAD REV 13

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\MECH\ M005_(RG)_120E4746.dwg DATE: SEP 12, 2013 TIME: 1:33 PM

SIZE	DWG NO	SH	REV
E	120E4746	1	G

REVISIONS				
	REV	DESCRIPTION	DATE	APPROVED
F		ITEMS 10 & 30 UPDATED, 45 ADDED	SEP/11/13	GF/AV
G		RELOCATED ITEMS 13, 26, 30 & 45	SEP/12/13	JM/EVN
	A	ITEMS 43, 44 & 45 ADDED	JUL/12/13	GF/AV
	B	ITEMS SIZE AND POSITION UPDATED	JUL/17/13	GF/AV
	C	ITEMS 32 & 33 UPDATED	AUG/08/13	GF/AV
	D	REMOVED ITEM 45 CHANGED GEOMETRY OF ITEM 10	AUG/14/13	JM/EVN
	E	ITEMS 11,25,29,40 & 46 UPDATED	AUG/23/13	GF/AV



LEGEND

1. GAS TURBINE GENERATOR (GTG)
2. ONCE THROUGH STEAM GENERATOR (OTSG)
3. STEAM TURBINE GENERATOR (STG)
4. SURFACE CONDENSER
5. OTSG STACK
6. POWER DISTRIBUTION CENTER (PDC)
7. 4.16KV AUX. TRANSFORMER
8. 480V AUX. TRANSFORMER
9. 480V AUX. TRANSFORMER
10. INLET AIR CHILLER
11. GSU TRANSFORMER
12. COOLING TOWER
13. FUEL GAS COMPRESSOR SKID
14. CIRCULATING WATER PUMPS
15. OTSG CHEMICAL FEED SKID
16. AMMONIA FLOW CONTROL UNIT
17. BOILER FEEDWATER PUMPS
18. GTG CO2 BOTTLES
19. CEMS SKID
20. DEMINERALIZED WATER TANK AND PUMPS
21. GTG AUXILIARY SKID (GTLO, FUEL, WATER WASH AND WATER INJECTION SYSTEMS)
22. CONDENSATE POLISHERS
23. CONDENSATE STORAGE TANK
24. CONDENSATE MAKE UP PUMPS
25. SPRINT SKID
26. FUEL GAS COMPRESSOR DRAINS TANK
27. AIR COMPRESSOR AND RECEIVER
28. CONDENSATE PUMPS
29. NOT USED
30. GTG FUEL GAS FINAL FILTER SKID
31. WATER WASH DRAINS TANK
32. GENERATOR/GEARBOX LUBE OIL SKID
33. LUBE OIL COOLER SKID
34. STEAM TURBINE ENCLOSURE
35. STEAM TURBINE LUBE OIL SKID
36. STEAM TURBINE HYDRAULIC OIL SKID
37. GLAND STEAM CONDENSER
38. VACUUM PUMP
39. AUXILIARY CIRCULATING WATER PUMP
40. ATMOSPHERICAL DRAINS VENT STACK
41. AUXILIARY COOLING HEAT EXCHANGERS
42. CLOSED COOLING WATER PUMP
43. ELECTRICAL AUXILIARY BOILER
44. AUXILIARY BOILER FEED PUMP
45. INLET HEAT EXCHANGE SKID
46. TEMPERING AIR FANS

NOTES:

1. ITEMS MARKED WITH (✳) ARE PROVIDES BY GE.

2) THIS DRAWING PRESENTS SUGGESTED EQUIPMENT ARRAGEMENT FOR THE POWER BLOCK UNDER GE'S SCOPE. THIS ARRANGEMENT IS TO BE INTEGRATED WITH OVERALL STATION DESIGN PROVIDED BY OTHERS.
SUBJECT TO COMPLIANCE WITH PERMIT DRAWINGS AND NOISE STUDY.

THIRD ANGLE PROJECTION

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PRELIMINARY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ±
ANGLES ±
FRACTIONS ±

	SIGNATURES	DATE
DRAWN	A VANSLYKE	12-10-18
CHECKED	N/A	YY-MM-DD
PROJ ENG	J. MESSINA	12-10-18
ISSUED	A VANSLYKE	13-02-07
CIVIL	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	12-10-18
CONTROLS		

PROJECT: GLENARM REPOWERING PROJECT
MADE FOR: PASADENA WATER & POWER

GE ENERGY
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION-POWER PLANT SYSTEMS

GENERAL ARRANGEMENT

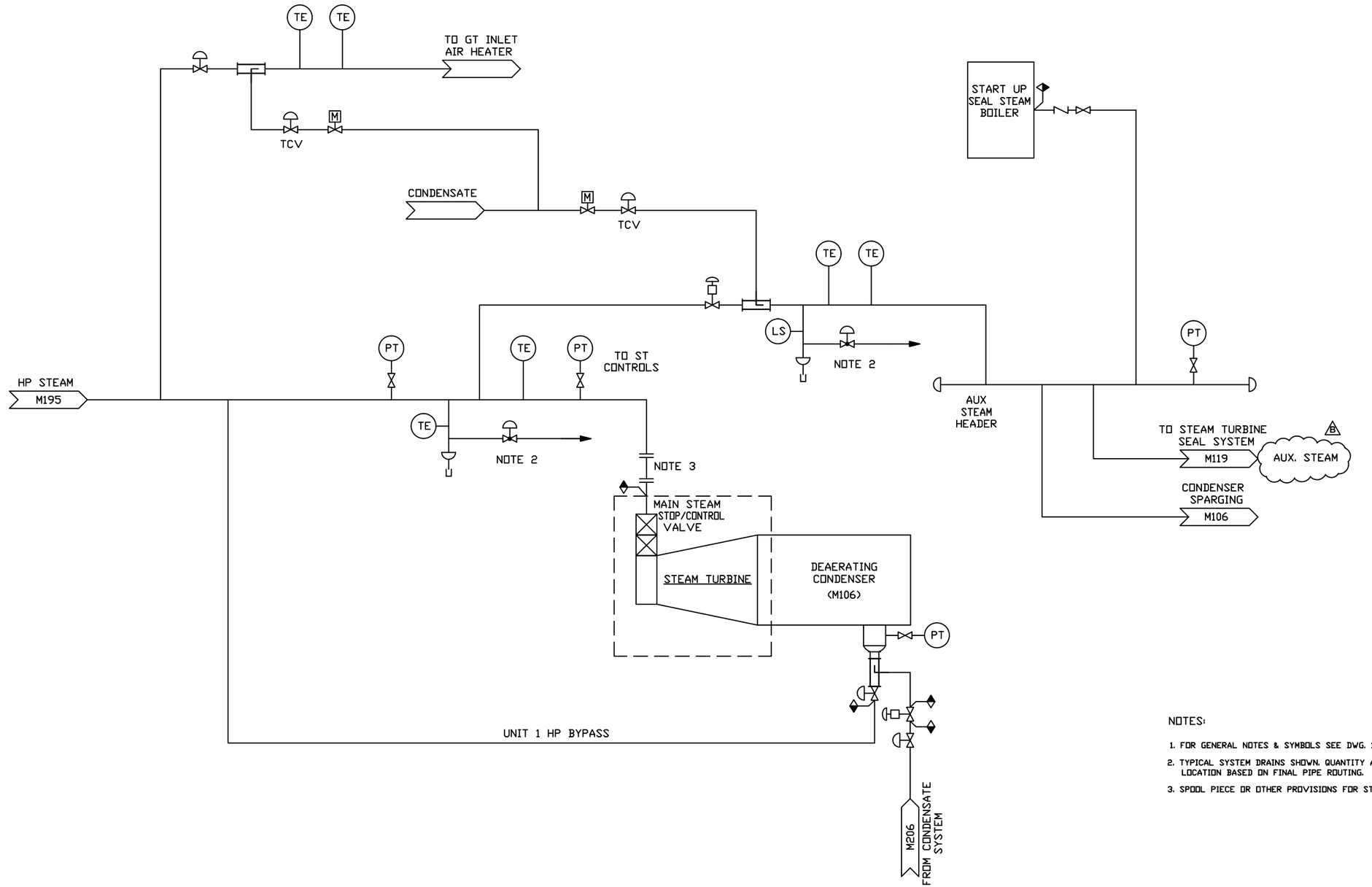
FIRST MADE FOR IPS-423049 M005

SIZE	CAGE CODE	DWG NO	REV
E		120E4746	G
SCALE NONE		SHEET 1	

SIZE	DWG NO	SH	REV
F	230F5536	1	B

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	TERMINAL POINT ADDED TO START UP SEAL STEAM BOILER	AUG/5/13	GF/AV
B	TEXT UPDATED AT (D-2)	AUG/23/13	GF/AV



NOTES:

1. FOR GENERAL NOTES & SYMBOLS SEE DWG. 100.
2. TYPICAL SYSTEM DRAINS SHOWN. QUANTITY AND LOCATION BASED ON FINAL PIPE ROUTING.
3. SPOOL PIECE OR OTHER PROVISIONS FOR STEAM BLOW.

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THIRD ANGLE PROJECTION

TYPICAL

UNLESS OTHERWISE SPECIFIED	SIGNATURES	DATE
DIMENSIONS ARE IN INCHES	DRAWN E NINNEMAN	13-01-28
TOLERANCES ON:	CHECKED N/A	YY-MM-DD
2 PL DECIMALS ±	PROJ ENG J MESSINA	13-01-28
3 PL DECIMALS ±	ISSUED A VANSLYKE	13-02-07
ANGLES ±	CIVIL N/A	YY-MM-DD
FRACTIONS ±	ELECTRICAL N/A	YY-MM-DD
PROJECT GLENARM REPOWERING PROJECT	MECHANICAL G FINNERTY	13-01-28
MADE FOR PASADENA WATER & POWER	CONTROLS N/A	YY-MM-DD

GE POWER SYSTEMS

GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

FLOW DIAGRAM
STEAM SYSTEM

FIRST MADE FOR IPS-423049 M101

SIZE	CAGE CODE	DWG NO	REV
F		230F5536	
SCALE NONE		SHEET 1	

8 DT-7N 7 6 5 4 3 2 1

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M101_230F5536.dwg DATE: AUG 23, 2013 TIME: 3:39 PM

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M105_230F5512.dwg DATE: FEB 07, 2013 TIME: 1:28 PM

SIZE	DWG NO	SH	REV
F	230F5512	1	-

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

FROM CONDENSATE SYSTEM M106

B

1x100% HP/LP FEED PUMP

M106 MIN FLOW RECIRC (TO CONDENSATE HOTWELL)

M195 TO UNIT 1 HP FEEDWATER

A

1x100% HP/LP FEED PUMP

M106 MIN FLOW RECIRC (TO CONDENSATE HOTWELL)

M195 TO UNIT 2 HP FEEDWATER

THIRD ANGLE PROJECTION

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TYPICAL

UNLESS OTHERWISE SPECIFIED	SIGNATURES		DATE
DIMENSIONS ARE IN INCHES	DRAWN	E NINNEMAN	12-11-07
TOLERANCES ON:	CHECKED	N/A	YY-MM-DD
2 PL DECIMALS ±	PROJ ENG	J MESSINA	12-11-07
3 PL DECIMALS ±	ISSUED	A VASLYKE	13-02-07
ANGLES ±	CIVIL	N/A	YY-MM-DD
FRACTIONS ±	ELECTRICAL	N/A	YY-MM-DD
	MECHANICAL	G FINNERTY	12-11-07
	CONTROLS	N/A	YY-MM-DD

PROJECT: GLENARM REPOWERING PROJECT

MADE FOR: PASADENA WATER & POWER

GE POWER SYSTEMS

GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

FEEDWATER SYSTEM

FIRST MADE FOR IPS-423049 M105

SIZE	CAGE CODE	DWG NO	REV
F		230F5512	

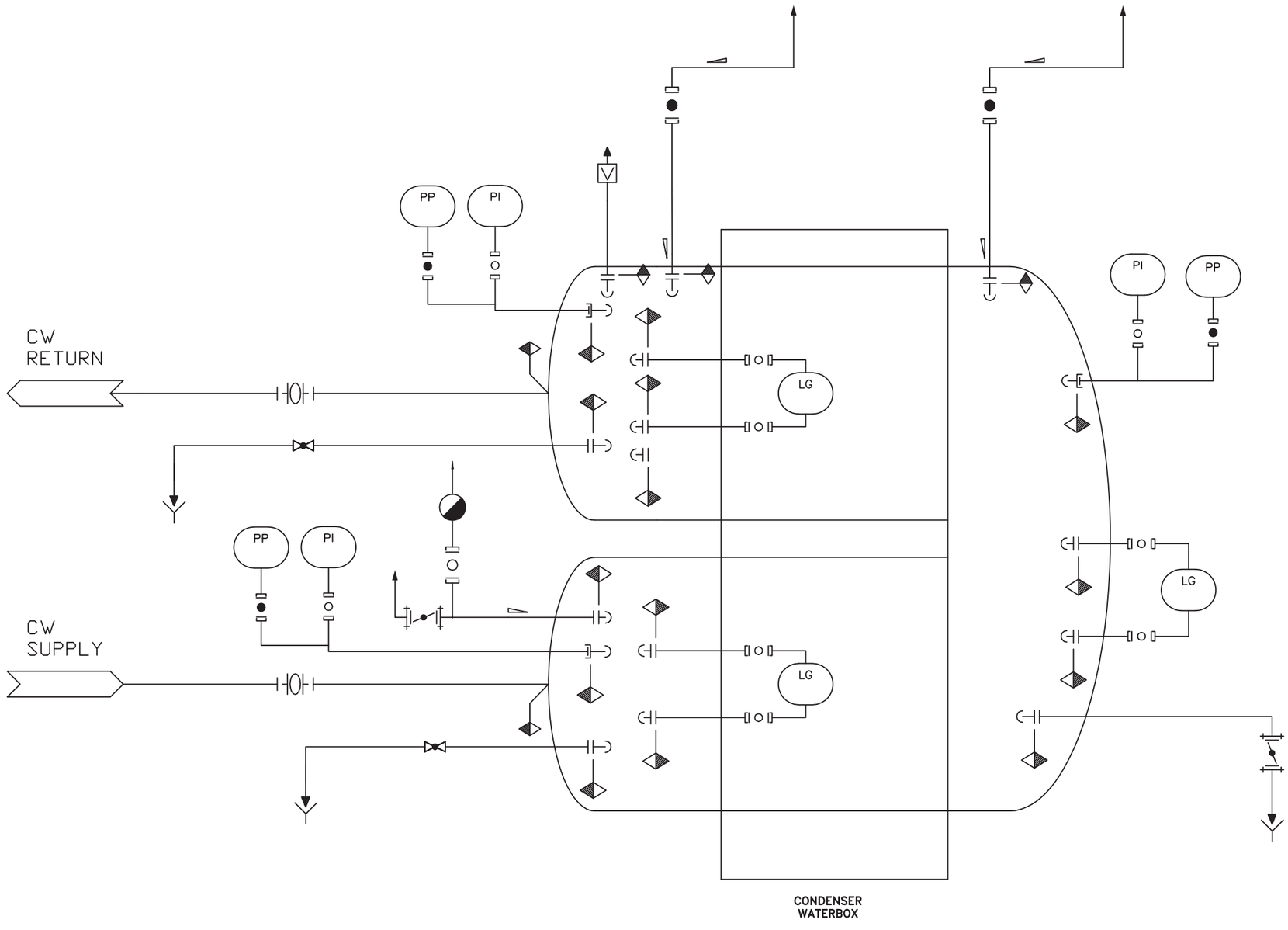
SCALE: NONE SHEET 1

DT-7N

SIZE	DWG NO	SH	REV
D	203D7522	2	-

REVISIONS

REV	DESCRIPTION	DATE	APPROVED



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GE POWER SYSTEMS SERVICE INC.	SIZE D	CAGE CODE	DWG NO 203D7522
DRAWN E NINNEMAN			
ISSUED E NINNEMAN	SCALE NONE		SHEET 2

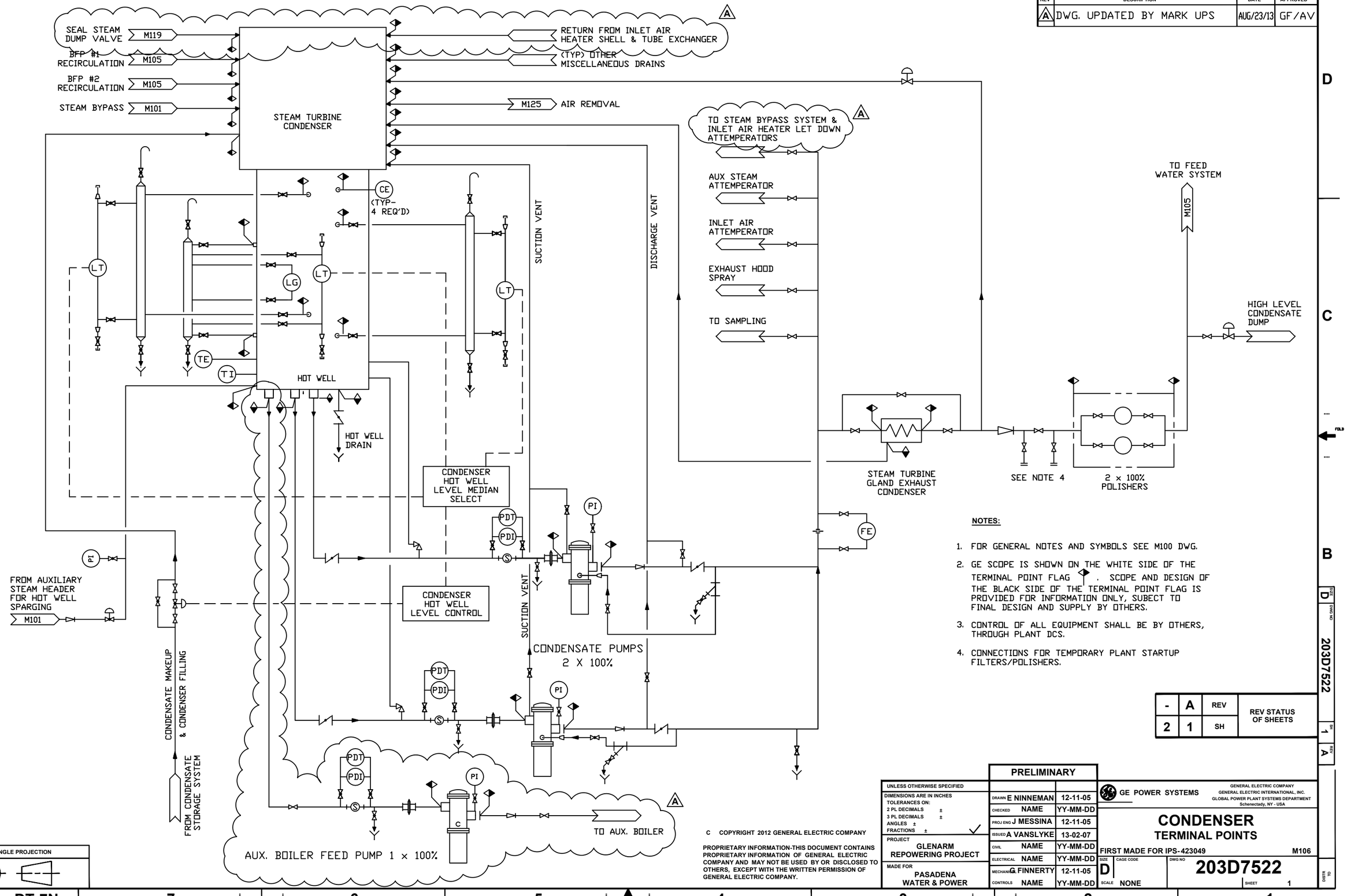
SIZE D | DWG NO 203D7522 | SH 2 | REV -

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M106_203D7522.dwg DATE: FEB 06, 2013 TIME: 8:52 AM

SIZE	DWG NO	SH	REV
D	203D7522	1	A

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	DWG. UPDATED BY MARK UPS	AUG/23/13	GF/AV



NOTES:

1. FOR GENERAL NOTES AND SYMBOLS SEE M100 DWG.
2. GE SCOPE IS SHOWN ON THE WHITE SIDE OF THE TERMINAL POINT FLAG ◆. SCOPE AND DESIGN OF THE BLACK SIDE OF THE TERMINAL POINT FLAG IS PROVIDED FOR INFORMATION ONLY, SUBECT TO FINAL DESIGN AND SUPPLY BY OTHERS.
3. CONTROL OF ALL EQUIPMENT SHALL BE BY OTHERS, THROUGH PLANT DCS.
4. CONNECTIONS FOR TEMPORARY PLANT STARTUP FILTERS/POLISHERS.

-	A	REV	REV STATUS OF SHEETS
2	1	SH	

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PRELIMINARY

UNLESS OTHERWISE SPECIFIED			
DIMENSIONS ARE IN INCHES			
TOLERANCES ON:			
2 PL DECIMALS ±			
3 PL DECIMALS ±			
ANGLES ±			
FRACTIONS ±			
PROJECT	GLENARM REPOWERING PROJECT		
MADE FOR	PASADENA WATER & POWER		
DRAWN	E NINNEMAN	12-11-05	
CHECKED	NAME	YY-MM-DD	
PROJ ENG	J MESSINA	12-11-05	
ISSUED	A VANSLYKE	13-02-07	
CIVIL	NAME	YY-MM-DD	
ELECTRICAL	NAME	YY-MM-DD	
MECHANICAL	G FINNERTY	12-11-05	
CONTROLS	NAME	YY-MM-DD	

GE POWER SYSTEMS

GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

CONDENSER
TERMINAL POINTS

FIRST MADE FOR IPS-423049 M106

SIZE	CAGE CODE	DWG NO	REV
D		203D7522	A
SCALE NONE		SHEET 1	

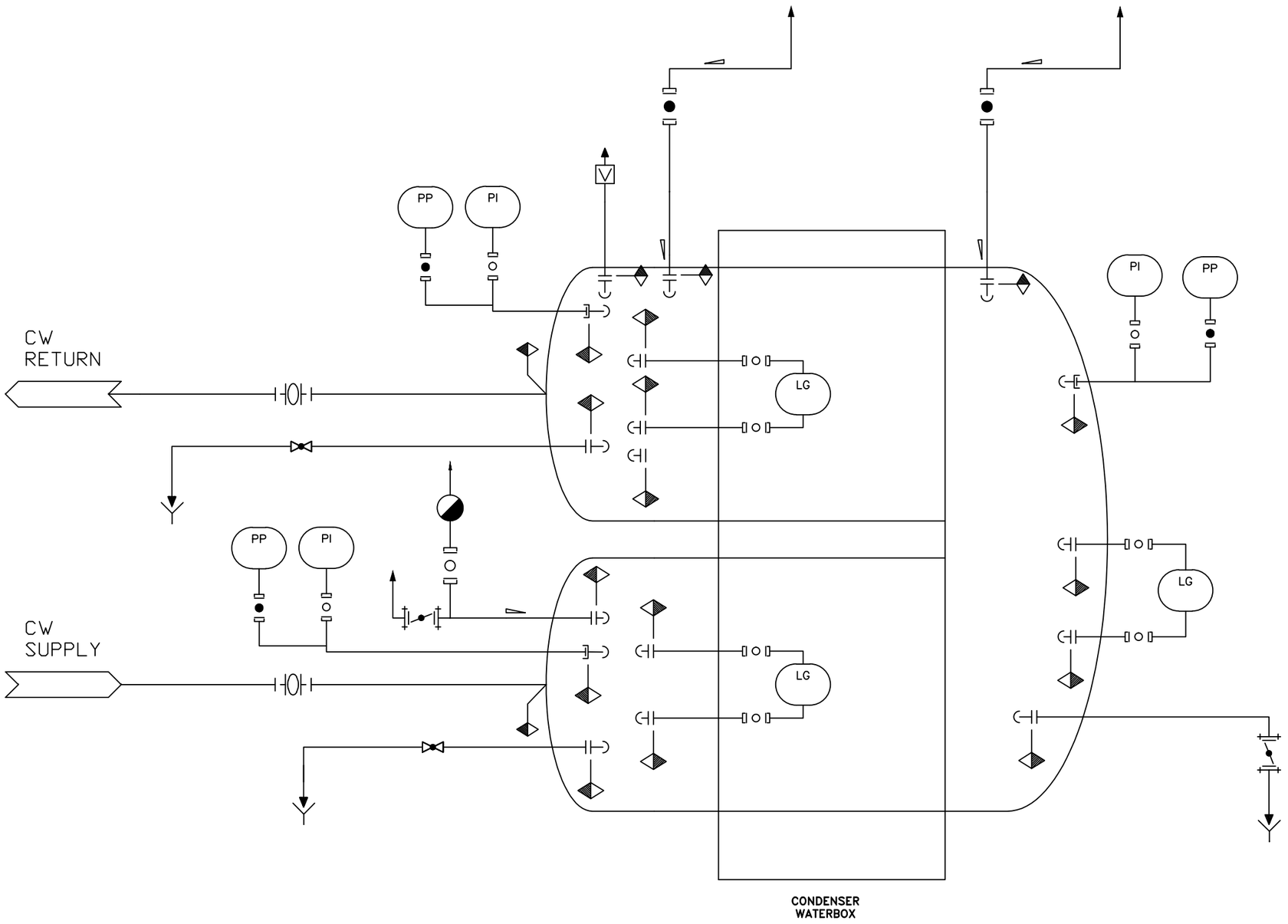
THIRD ANGLE PROJECTION

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M106_203D7522.dwg DATE: AUG 23, 2013 TIME: 3:40 PM

SIZE	DWG NO	SH	REV
D	203D7522	2	-

REVISIONS

REV	DESCRIPTION	DATE	APPROVED



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GE POWER SYSTEMS SERVICE INC.	SIZE D	CAGE CODE	DWG NO 203D7522
DRAWN E NINNEMAN			
ISSUED E NINNEMAN	SCALE NONE		SHEET 2

SIZE D | DWG NO 203D7522 | SH 2 | REV -

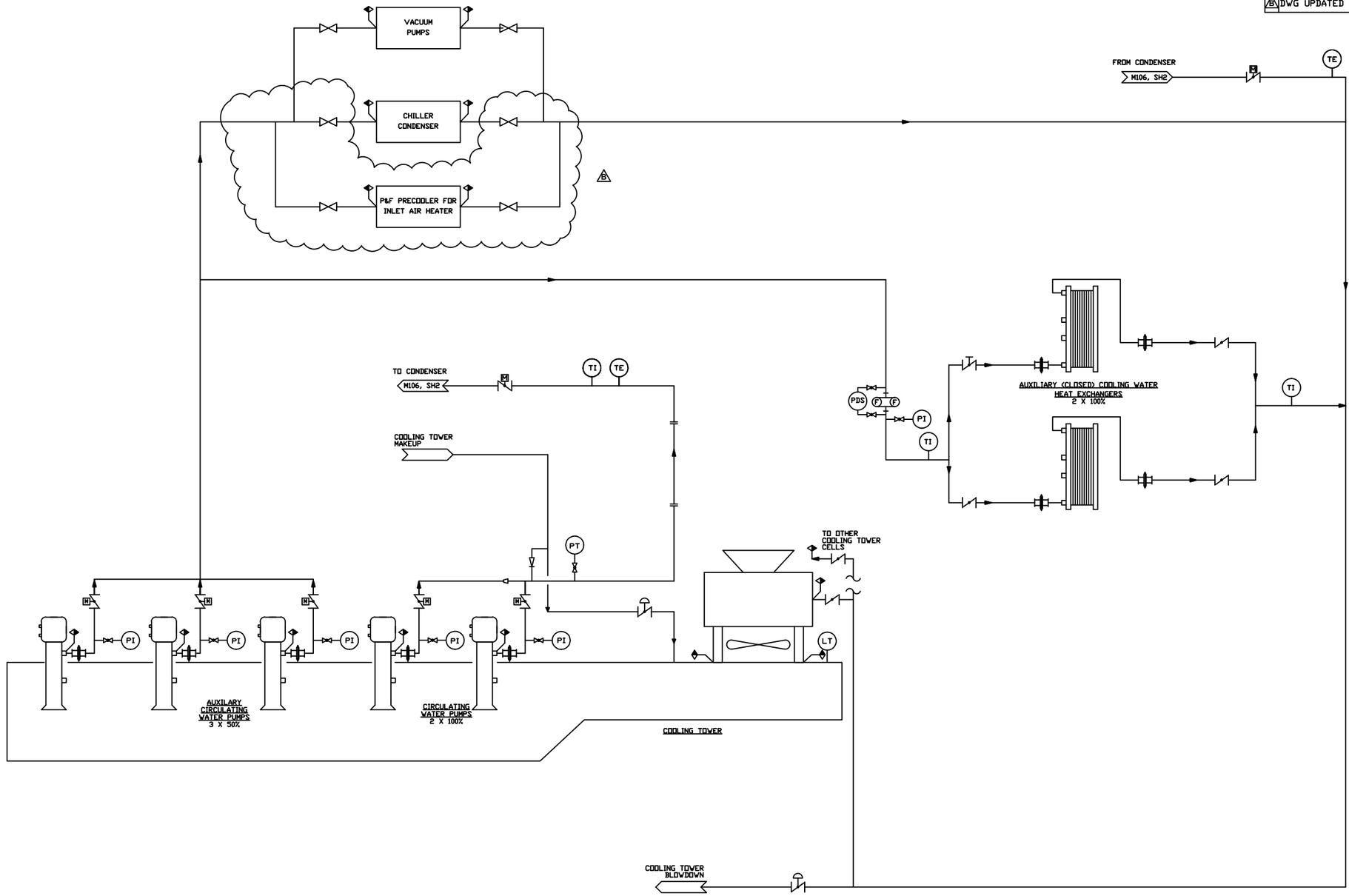
NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M106_203D7522.dwg DATE: FEB 06, 2013 TIME: 8:52 AM

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M107_120E4791.dwg DATE: AUG 23, 2013 TIME: 3:33 PM

SIZE	DWG NO	SH	REV
E	120E4791	1	B

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	WATER PUMP ADDED AT (D-8)	AUG/5/13	GF/AV
B	DWG UPDATED AT (G-6)	AUG/23/13	GF/AV



NOTES:
1. FOR GENERAL NOTES AND SYMBOLS SEE DWG M200.
2. NEED FOR COOLING TOWER BYPASS TO BE DETERMINED BY EVALUATION OF THE SITE SPECIFIC MINIMUM AMBIENT TEMPERATURE.

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PRELIMINARY

UNLESS OTHERWISE SPECIFIED	SIGNATURES	DATE
DRAWN	E NINNEMAN	13-01-28
CHECKED	N/A	YY-MM-DD
PROJ ENG	J MESSINA	13-01-28
ISSUED	A VANSLYKE	13-02-07
CIVIL	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	13-01-28
CONTROLS		

DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ±
ANGLES ±
FRACTIONS ±

PROJECT: GLENARM REPOWERING PROJECT
MADE FOR: PASADENA WATER & POWER

GE ENERGY
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION-POWER PLANT SYSTEMS

FLOW DIAGRAM
CIRCULATING WATER

FIRST MADE FOR IPS 423049 M107

SIZE E | CAGE CODE | DWG NO 120E4791

SCALE NONE | SHEET 1

THIRD ANGLE PROJECTION

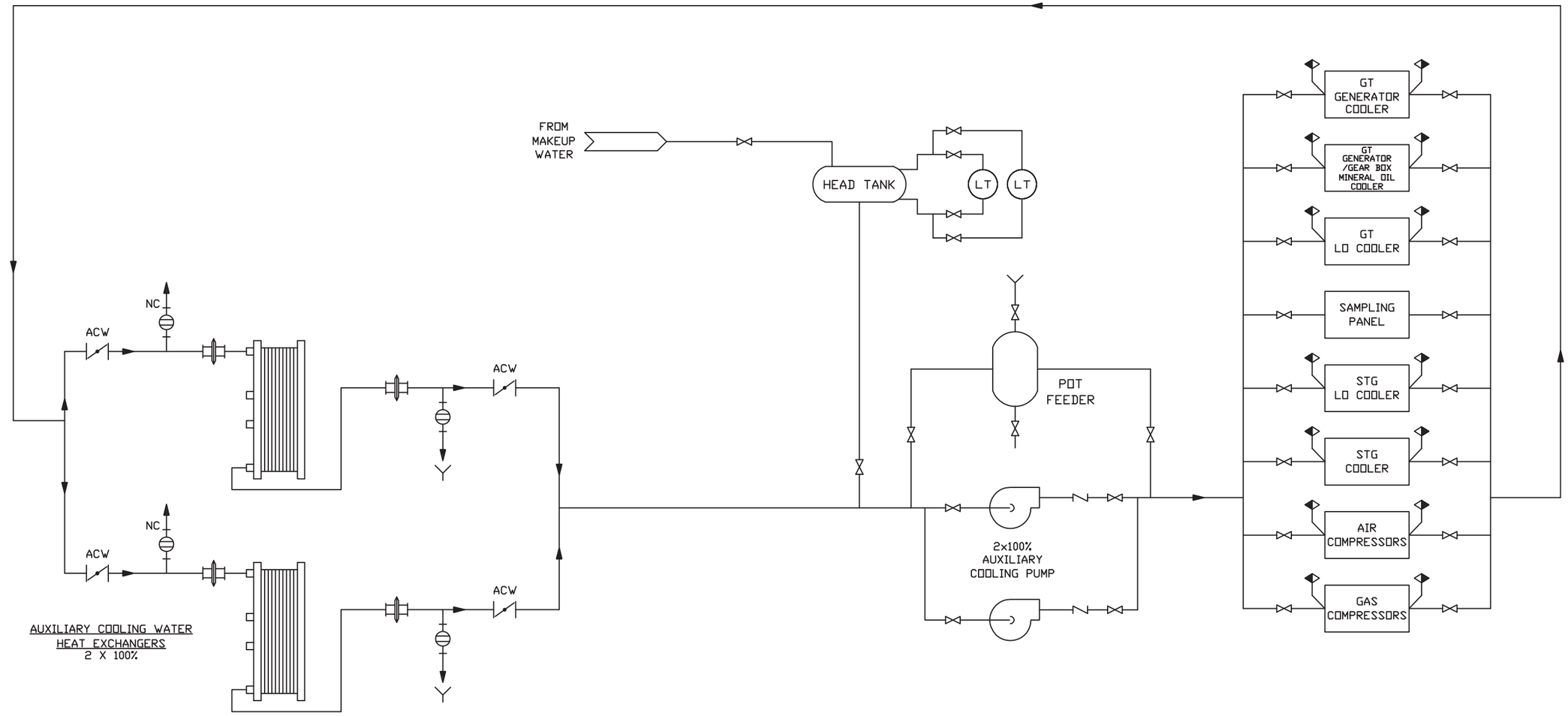
8 DT-7N 7 6 5 4 3 2 1

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M109_230F5537.dwg DATE: FEB 07, 2013 TIME: 10:49 AM

SIZE	DWG NO	SH	REV
F	230F5537	1	-

REVISIONS

REV	DESCRIPTION	DATE	APPROVED



NOTES:

1. THIS SYSTEM FOR BALANCE OF PLANT COOLING ONLY. GAS TURBINE COOLING PROVIDED BY DIFFERENT SYSTEM.

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THIRD ANGLE PROJECTION

TYPICAL

UNLESS OTHERWISE SPECIFIED	SIGNATURES		DATE
DIMENSIONS ARE IN INCHES	DRAWN	E NINNEMAN	13-01-28
TOLERANCES ON:	CHECKED	N/A	YY-MM-DD
2 PL DECIMALS ±	PROJ ENG	J MESSINA	13-01-28
3 PL DECIMALS ±	ISSUED	A VANSLYKE	13-02-07
ANGLES ±	CIVIL	N/A	YY-MM-DD
FRACTIONS ±	ELECTRICAL	N/A	YY-MM-DD
	MECHANICAL	G FINNERTY	13-01-28
	CONTROLS	N/A	YY-MM-DD

PROJECT: GLENARM REPOWERING PROJECT

MADE FOR: PASADENA WATER & POWER

GE POWER SYSTEMS

GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

AUXILIARY COOLING WATER SYSTEM

FIRST MADE FOR IPS-423049 M109

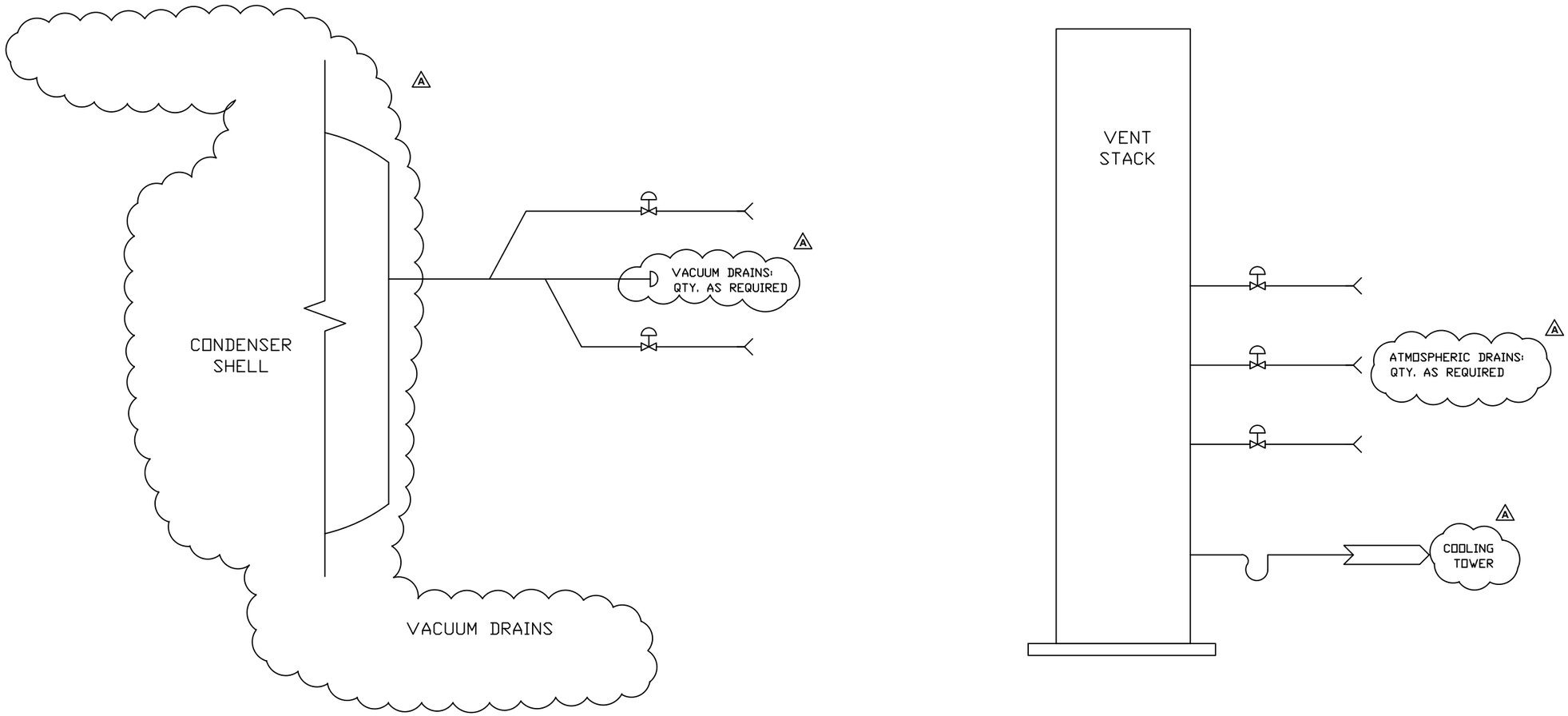
SIZE	CAGE CODE	DWG NO	REV
F		230F5537	-

SCALE NONE SHEET 1

DT-7N

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M112_(RA)_230F5538.dwg DATE: AUG 23, 2013 TIME: 3:38 PM

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	VACUUM DRAINS UPDATED	AUG/23/13	GF/AV



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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ±
ANGLES ±
FRACTIONS ±

PROJECT: GLENARM REPOWERING PROJECT
MADE FOR: PASADENA WATER & POWER

TYPICAL

SIGNATURES		DATE
DRAWN	E NINNEMAN	13-01-28
CHECKED	N/A	YY-MM-DD
PROJ ENG	J MESSINA	13-01-28
ISSUED	A VANSLYKE	13-02-07
CIVIL	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	13-01-28
CONTROLS	N/A	YY-MM-DD

GE POWER SYSTEMS
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

STEAM DRAINS SYSTEM

FIRST MADE FOR IPS-423049 M112

SIZE F | CAGE CODE | DWG NO 230F5538 | REV A
SCALE NONE | SHEET 1

DT-7N

PLOT NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M119_120E4734.dwg DATE: OCT 15, 2012 TIME: 10:32 AM

SIZE	DWG NO	SH	REV
E	120E4734	2	-

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

LUBE OIL SUPPLY HEADER

STEAM TURBINE

REDUCTION GEAR

GENERATOR

LO DRAIN HEADER

2×100% LO FILTERS

2×100% LO COOLERS

TO ATMOSPHERE

VENTILATOR

DEMISTER

2×100% AC LO PUMPS

1×100% DC LO EMERGENCY PUMP

LUBE OIL RESERVOIR

✳ LUBE OIL CONSOLE

ACCUMULATOR

HP CONTROL VALVE

HP STOP VALVE

COOLER

2×100% HYDRAULIC PUMPS

STEAM TURBINE HYDRAULIC RESERVOIR

✳ HYDRAULIC CONSOLE

CENTRIFUGAL CONDITIONING PURIFIER

✳ LUBE OIL CONDITIONER

LUBE OIL AND HYDRAULIC SYSTEMS

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GE OEG/GGT — GENERAL ELECTRIC COMPANY, GENERAL ELECTRIC INTERNATIONAL, INC., POWER GENERATION/POWER PLANT SYSTEMS

SIZE	CAGE CODE	DWG NO
E		120E4734

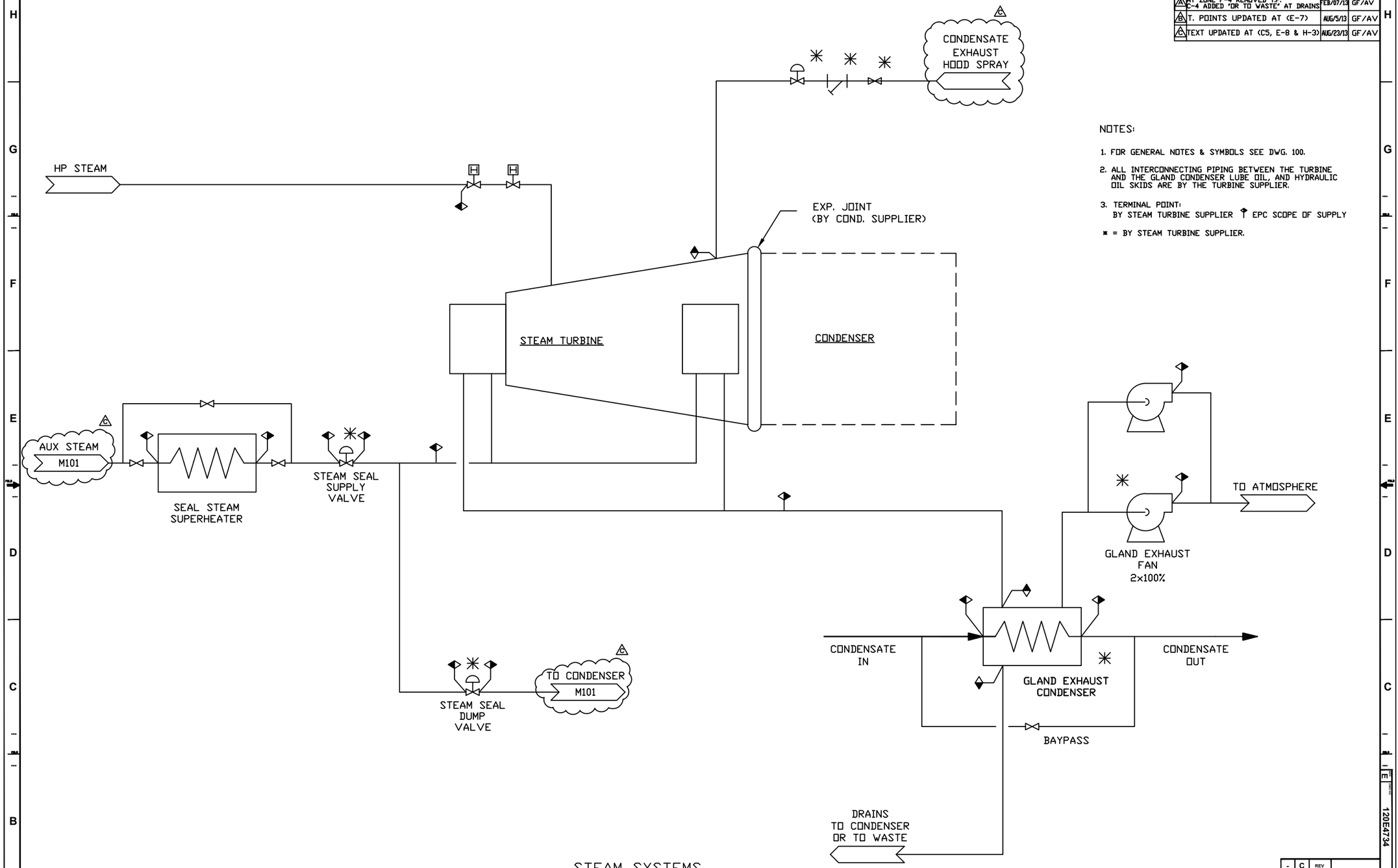
DRAWN	A. VANSLYKE
ISSUED	A. VANSLYKE
SCALE	NONE
SHEET	2

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M119_120E4734.dwg DATE: AUG 23, 2013 TIME: 3:42 PM

SIZE	DWG NO		REV
E	120E4734	SH 1	C

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	AT ZONE F-4 REMOVED T.P. C-4 ADDED "DR TO WASTE" AT DRAINS	FEB/07/13	GF/AV
B	T. POINTS UPDATED AT (E-7)	AUG/5/13	GF/AV
C	TEXT UPDATED AT (C5, E-8 & H-3)	AUG/23/13	GF/AV



NOTES:

1. FOR GENERAL NOTES & SYMBOLS SEE DWG. 100.
2. ALL INTERCONNECTING PIPING BETWEEN THE TURBINE AND THE GLAND CONDENSER LUBE OIL, AND HYDRAULIC OIL SKIDS ARE BY THE TURBINE SUPPLIER.
3. TERMINAL POINT:
   BY STEAM TURBINE SUPPLIER ↑ EPC SCOPE OF SUPPLY

* = BY STEAM TURBINE SUPPLIER.

STEAM SYSTEMS

-	C	REV
2	1	SH

REV STATUS OF SHEETS

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THIRD ANGLE PROJECTION

TYPICAL

UNLESS OTHERWISE SPECIFIED		SIGNATURES	DATE
DIMENSIONS ARE IN INCHES	DRAWN	A. VANSLYKE	12-09-11
TOLERANCES ON:	CHECKED	N/A	YY-MM-DD
2 PL DECIMALS ±	PROJ ENG	J. MESSINA	12-09-11
3 PL DECIMALS ±	ISSUED	A. VANSLYKE	12-10-15
ANGLES ±	CIVIL	N/A	YY-MM-DD
FRACTIONS ±	ELECTRICAL	N/A	YY-MM-DD
PROJECT: GLENARM REPOWERING PROJECT	MECHANICAL	G FINNERTY	12-09-11
MADE FOR: PASADENA WATER & POWER	CONTROLS		

GE ENERGY — GENERAL ELECTRIC COMPANY, GENERAL ELECTRIC INTERNATIONAL, INC., POWER GENERATION-POWER PLANT SYSTEMS

FLOW DIAGRAM
STEAM TURBINE
FIRST MADE FOR IPS- 423049 M119

SIZE	CAGE CODE	DWG NO	REV
E		120E4734	C
SCALE NONE		SHEET 1	

DT-7N

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M119_120E4734.dwg DATE: OCT 15, 2012 TIME: 10:32 AM

SIZE	DWG NO	REV
E	120E4734	2 -

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

LUBE OIL SUPPLY HEADER

STEAM TURBINE

REDUCTION GEAR

GENERATOR

LO DRAIN HEADER

2x100% LO FILTERS

2x100% LO COOLERS

TO ATMOSPHERE

VENTILATOR

DEMISTER

2x100% AC LO PUMPS

1x100% DC LO EMERGENCY PUMP

LUBE OIL RESERVOIR

✳ LUBE OIL CONSOLE

ACCUMULATOR

HP CONTROL VALVE ✳

HP STOP VALVE ✳

COOLER

2x100% HYDRAULIC PUMPS

STEAM TURBINE HYDRAULIC RESERVOIR

✳ HYDRAULIC CONSOLE

CENTRIFUGAL CONDITIONING PURIFIER

✳ LUBE OIL CONDITIONER

LUBE OIL AND HYDRAULIC SYSTEMS

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GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION-POWER PLANT SYSTEMS

DRAWN A. VANSLYKE
ISSUED A. VANSLYKE

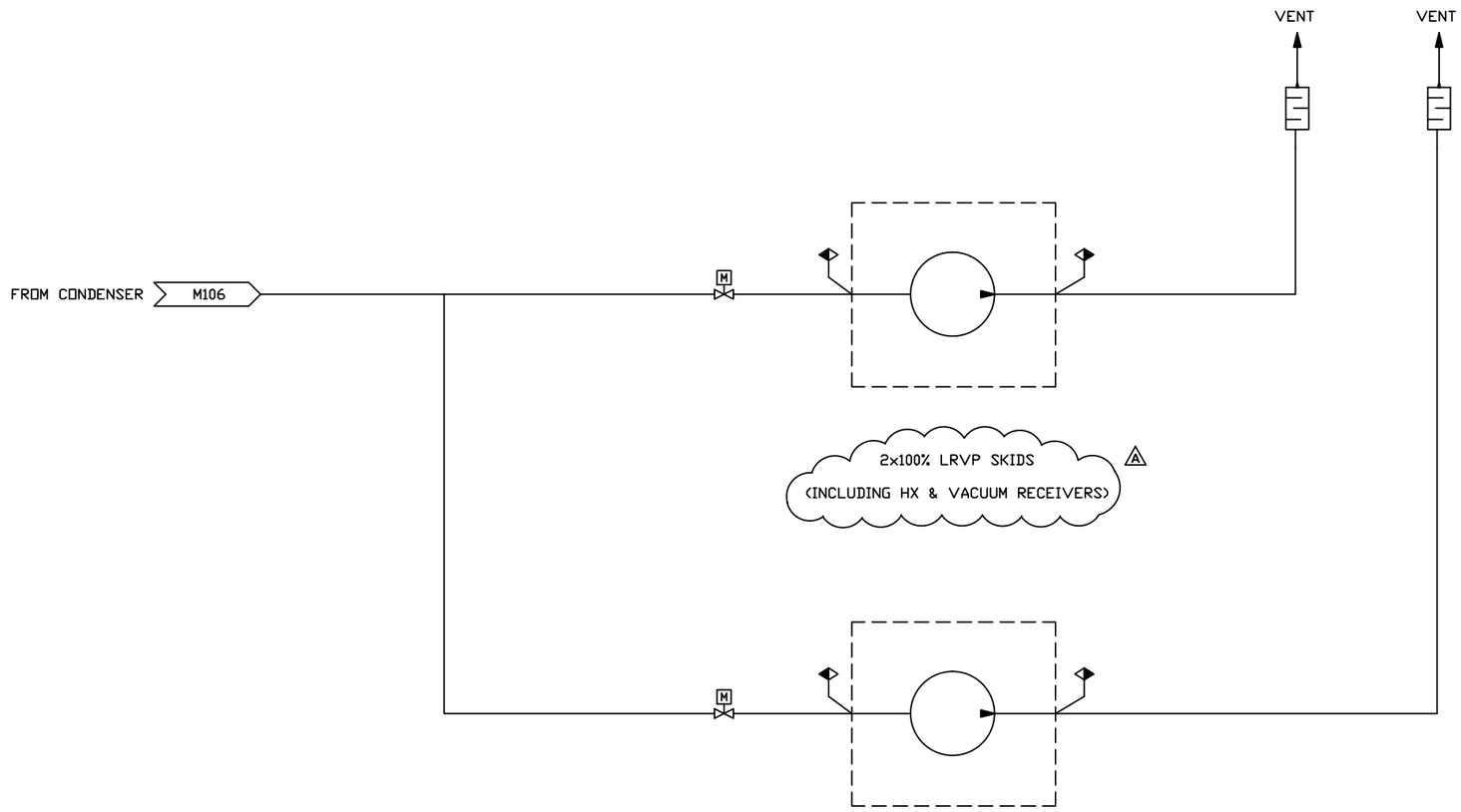
SIZE E | CAGE CODE | DWG NO 120E4734
SCALE NONE | SHEET 2

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M125_230F5539.dwg DATE: AUG 23, 2013 TIME: 3:35 PM

SIZE	DWG NO	SH	REV
F	230F5539	1	A

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	TEXT UPDATED AT (D-4)	AUG/23/13	GF/AV



THIRD ANGLE PROJECTION

DT-7N

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ±
ANGLES ±
FRACTIONS ±

PROJECT: GLENARM REPOWERING PROJECT

MADE FOR: PASADENA WATER & POWER

TYPICAL

SIGNATURES		DATE
DRAWN	E NINNEMAN	13-01-28
CHECKED	N/A	YY-MM-DD
PROJ ENG	J MESSINA	13-01-28
ISSUED	A VANSLYKE	13-02-07
CIVIL	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	13-01-28
CONTROLS	N/A	YY-MM-DD

GE POWER SYSTEMS

GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
GLOBAL POWER PLANT SYSTEMS DEPARTMENT
Schenectady, NY - USA

CONDENSER AIR REMOVAL SYSTEM

FIRST MADE FOR IPS-423049 M125

SIZE	CAGE CODE	DWG NO	REV
F		230F5539	A

SCALE NONE SHEET 1

F 230F5539 1 A

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M190_230F5504.dwg DATE: AUG 23, 2013 TIME: 3:44 PM

SIZE	DWG NO	SH	REV
F	230F5504	1	D

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	DRAWING UPDATED BY MARK UPS	FEB/07/13	GF/AV
B	ELECTRICAL AUXILIARY BOILER ADDED	JUN/17/13	GF/AV
C	VENT REMOVED, PIPE CONNECTION UPDATED PIT UPDATED TO PT AND TE ADDED	AUG/05/13	GF/AV
D	DRAWING UPDATED BY MARK UPS	AUG/23/13	GF/AV

LEGEND

- STEAM
- WATER
- AIR AND GAS (FLUE, AMMONIA ETC.)
- FUEL

H/X - HEAT EXCHANGER
FE - FLOW ELEMENT
IV - ISOLATION VALVE
SV - STOP VALVE
NRV - NON RETURN VALVE

NOTES

1. THIS DRAWING IS INTENDED TO SHOW THE TYPICAL S60LM OVERALL CUSTOMER CYCLE SYSTEM DESIGN AND IS NOT INDICATIVE OF GE SCOPE OF SUPPLY FOR THIS PROJECT.
2. THE ACTUAL NUMBER OF HRSG EXCHANGER SURFACES AND THEIR ARRANGEMENT WILL BE DETERMINED DURING DETAILED DESIGN ENGINEERING PHASE.
3. THIS DRAWING IS GENERALLY NOT INTENDED TO SHOW SMALL LINES (2 1/2") DRAINS NOR MULTIPLE LINES.
4. A MINIMUM OF 50 PIPE DIAMETERS OF STRAIGHT LENGTH ARE REQUIRED DOWNSTREAM OF BOTH THE HIGH PRESSURE TERMINAL ATTEMPERATORS.

VENT
ASME ANSI SEC.1 B31.1
B - 4
TO DRAIN TANK
RECIRCULATION
RECIRCULATION
HP FEEDWATER PUMPS 2 X 100%
SCR
CO CATALYST
AMMONIA INJECTION SKID
TCV
SILENCER (COMMON SILENCER)
NOTE #4
ASME ANSI SEC.1 B31.1
NOTE #3
HP STEAM
(NOTE 3)
CV1
SV1
TO INLET AIR HEAT EXCHANGER
HP BYPASS
TCV
LCV
HI LEVEL DUMP
POLISHER 2x100%
GLAND SEAL CONDENSER
VENT
DRAINS TANK
E - 6
HP FEEDWATER
GAS TURBINE EXHAUST GAS FLOW
GT (1 OF 2)
TEMPERING AIR FANS 2 x 100%
INLET AIR CONDITIONING
AIR
TO COOLING TOWER
VACUUM BREAKER
SEALS & MISCELLANEOUS
BFP1 RECIRCULATION
BFP2 RECIRCULATION
CONDENSER
2 X 100% VACUUM PUMPS
MAKE UP
SPARGING STEAM
MIN FLOW RECIRCULATION
ST EXHAUST HOOD SPRAY
TO INLET AIR HX LET DOWN ATTEMPERATOR
CONDENSATE PUMPS 2 X 100%
1 X 100% AUXILIARY FORWARDING PUMP
TO STEAM SEALS
ELECTRIC SUPERHEATER
FCV
TO CONDENSER SPARGING (IF SELECTED)
FROM AUXILIARY BOILER
AUXILIARY STEAM HEADER
ELECTRICAL AUXILIARY BOILER

THIRD ANGLE PROJECTION

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PRELIMINARY

UNLESS OTHERWISE SPECIFIED	SIGNATURES	DATE
DIMENSIONS ARE IN INCHES TOLERANCES ON:	DRAWN E NINNEMAN	12-10-16
2 PL DECIMALS ±	CHECKED N/A	YY-MM-DD
3 PL DECIMALS ±	PROJ ENG. J MESSINA	12-10-16
ANGLES ±	ISSUED E NINNEMAN	12-10-17
FRACTIONS ±	CIVIL N/A	YY-MM-DD
PROJECT GLENARM REPOWERING PROJECT	SYSTEMS B MARTINDALE	YY-MM-DD
MADE FOR PASADENA WATER & POWER	MECHANICAL N/A	12-10-16
	CONTROLS N/A	YY-MM-DD

GE ENERGY
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION - POWER PLANT SYSTEMS

COMBINED CYCLE SYSTEM
OVERVIEW DIAGRAM

FIRST MADE FOR IPS 423049 M190

SIZE F | CAGE CODE | DWG NO 230F5504 | REV D
SCALE NONE | SHEET 1

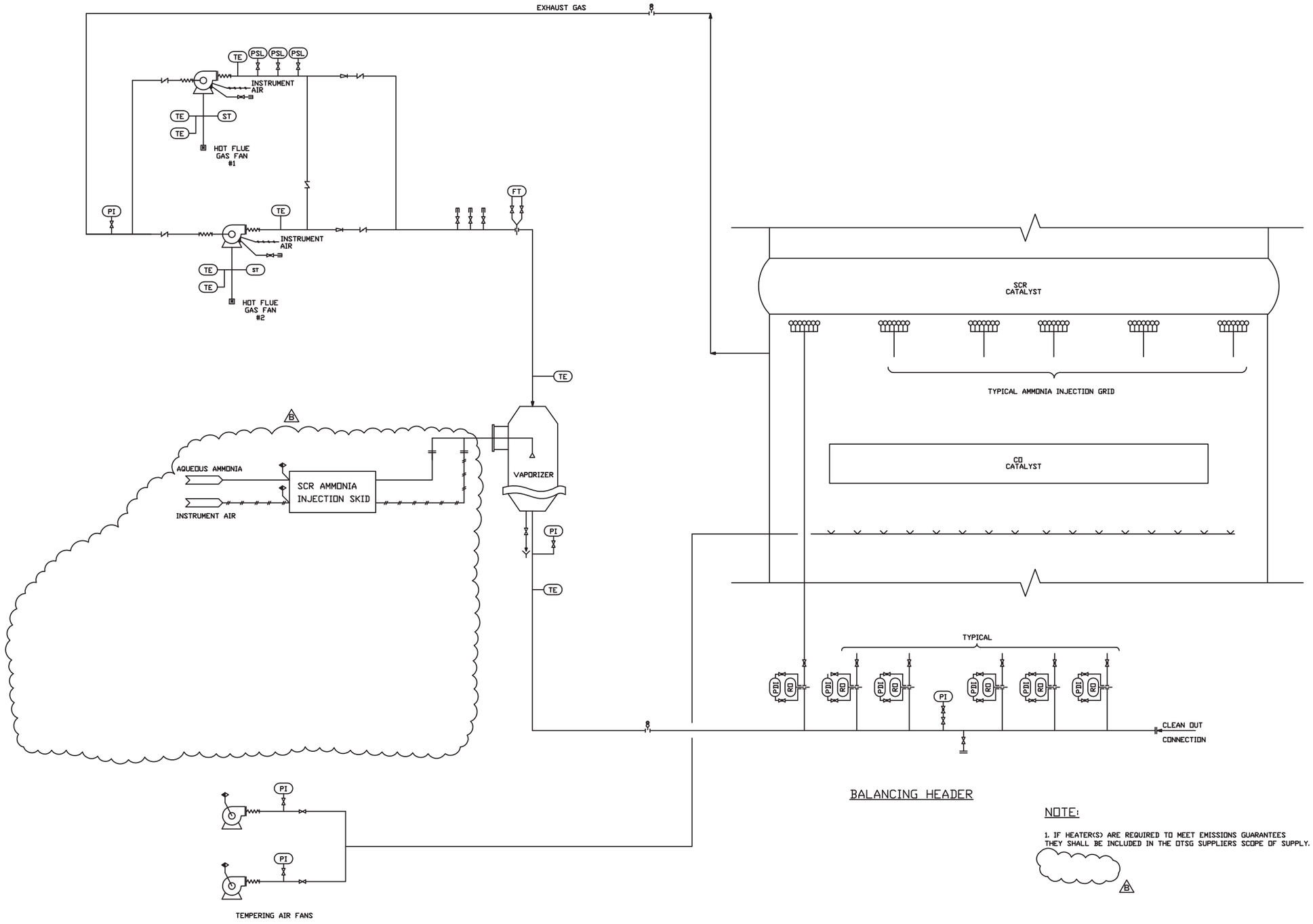
DT-7N

NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M195_230F5496.dwg DATE: FEB 07, 2013 TIME: 10:40 AM

SIZE	DWG NO	SH	REV
F	230F5496	2	B

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	TEMPERING AIR FANS ADDED.	OCT/17/12	GF/AV
B	DRAWING UPDATED BY MARKUPS	FEB/07/13	GF/AV



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GE POWER SYSTEMS — GENERAL ELECTRIC COMPANY (GENERAL ELECTRIC INTERNATIONAL INC. GLOBAL POWER PLANT SYSTEMS DEPARTMENT Schenectady, NY-USA)

DRAWN	A. VANSLYKE
ISSUED	A. VANSLYKE

SIZE	CAGE CODE	DWG NO
F		230F5496
SCALE	NONE	SHEET 2

DT-7N

FILE NAME: P:\1_Prop_IPS_420000\423049 PASADENA W&P\FLOWS\ M195_230F5496.dwg DATE: AUG 23, 2013 TIME: 3:45 PM

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PORTS, PLATFORMS, SILENCER & STACK CLOSURE ADDED, START UP VENT RELOCATED.	OCT/17/12	GF/AV
B	DRAWING UPDATED BY MARK UPS	FEB/07/13	GF/AV
C	VENT REMOVED, PIPE CONNECTION UPDATED PT UPDATED TO PI	AUG/05/13	GF/AV
D	TEXT UPDATED AT (A-3)	AUG/23/13	GF/AV

OPACITY PORTS
VELOCITY TEST PORTS
CEMS PLATFORM
EMISSIONS TEST PORTS
CEMS PORT
STACK
SILENCER
STACK CLOSURE
DAMPER PLATFORM
VENT
TSHH
TE
PI
PT
PSH
FC
FIT
ASME SEC.1 ANSI B31.1
B - 4
TO BLOWDOWN TANK
HP FEEDWATER
SEE SHEET 2
AMMONIA VAPORIZATION & INJECTION SKID
AMMONIA
SCR
CO
TUBE SHEET TEMPERATURE MEASUREMENT NO OF ELEMENTS BASED ON FINAL DESIGN
SLR01 SILENCER (COMMON SILENCER)
EXHAUST PATH
EXPANSION JOINT EXP01
GAS TURBINE EXHAUST GAS FLOW
TEMPERING AIR FANS
NOTE #3
TEMPERATURE CONTROL
TCV
TO SAMPLE SYSTEM
HP STEAM
DRAIN TANK
HP FEEDWATER E - 5
COOLING TOWER

NOTES:

1. FOR GENERAL NOTES AND SYMBOLS, SEE DWG. M100.
2. TYPICAL STEAM DRAINS SHOWN. QUANTITY AND LOCATION BASED ON FINAL PIPE ROUTING.
3. ✳ INDICATES SUPPLIED BY OTSG VENDOR
4. TERMINAL POINT:
   OTSG SUPPLIER ↑ EPC SCOPE OF SUPPLY

B	D	REV	REV STATUS OF SHEETS
2	1	SH	

THIRD ANGLE PROJECTION

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PL DECIMALS ±
3 PL DECIMALS ±
ANGLES ±
FRACTIONS ±

PROJECT: GLENARM REPOWERING PROJECT
MADE FOR: PASADENA WATER & POWER

TYPICAL

	SIGNATURES	DATE
DRAWN	A VANSLYKE	12-09-11
CHECKED	N/A	YY-MM-DD
PROJ ENG	J. MESSINA	12-09-11
ISSUED	A VANSLYKE	12-09-12
SYSTEM	N/A	YY-MM-DD
ELECTRICAL	N/A	YY-MM-DD
MECHANICAL	G FINNERTY	12-09-11
CONTROLS		

GE ENERGY
GENERAL ELECTRIC COMPANY
GENERAL ELECTRIC INTERNATIONAL, INC.
POWER GENERATION-POWER PLANT SYSTEMS

FLOW DIAGRAM
OTSG-1 PRESSURE

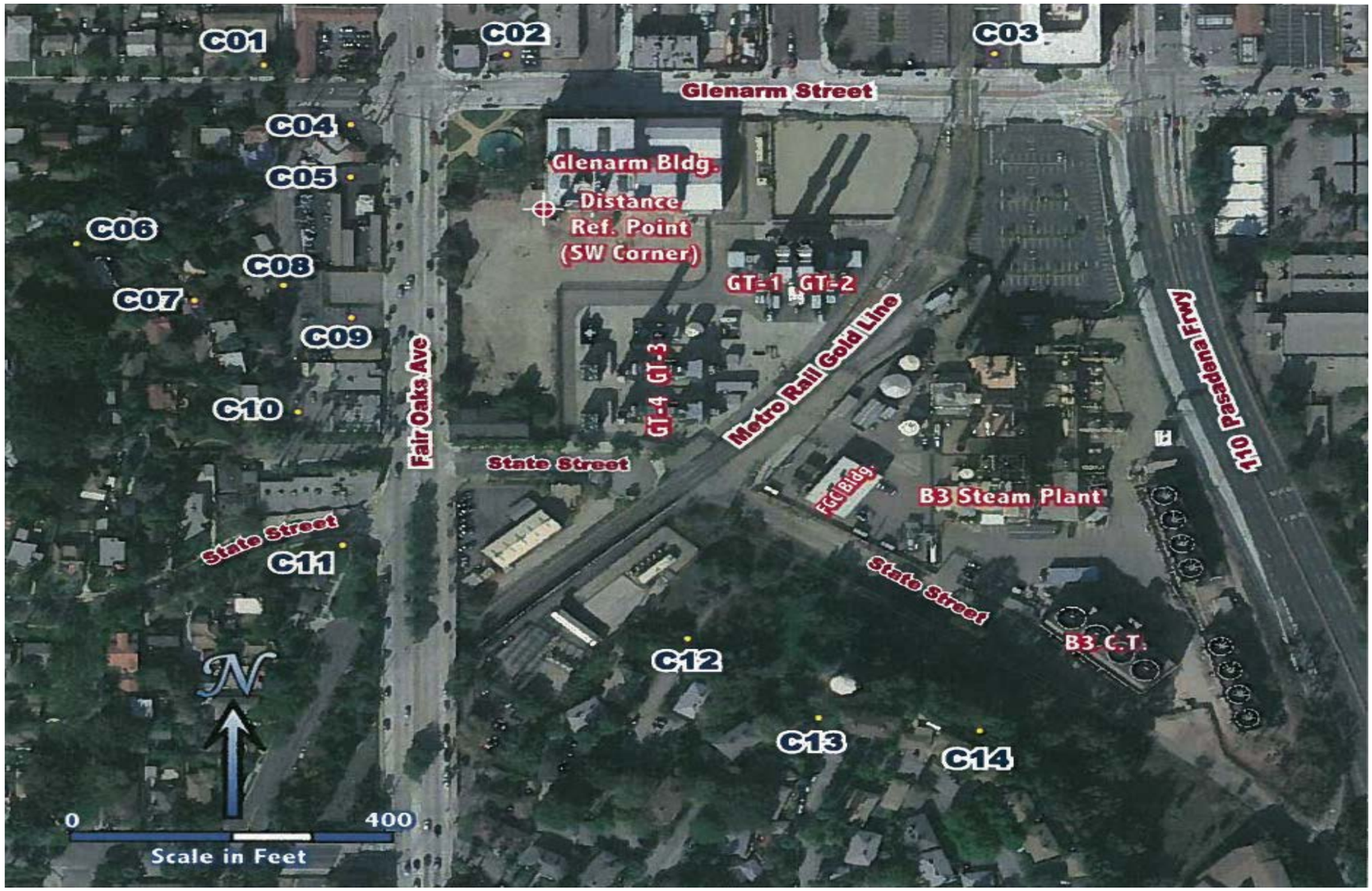
FIRST MADE FOR IPS- 423049 M195

SIZE F | CAGE CODE | DWG NO 230F5496 | REV D
SCALE NONE | SHEET 1

DT-7N

Glenarm Repowering Project
Pasadena Water & Power

TURBINE INLET AIR TEMPERATURE CONDITIONING SYSTEM

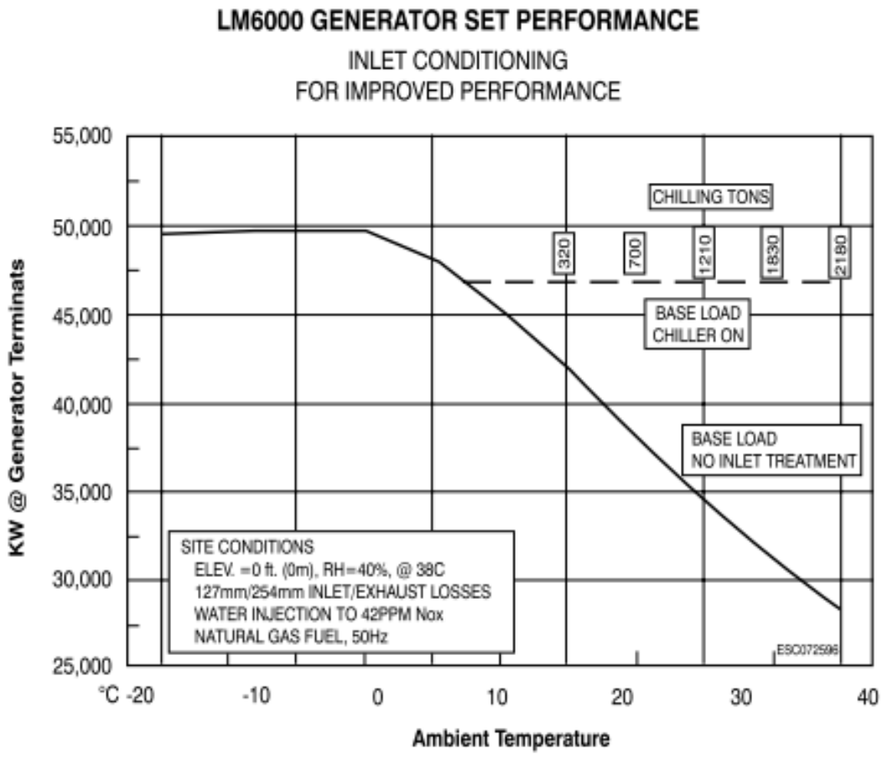


Project #20441
Part#BOP-177-20441

imagination at work

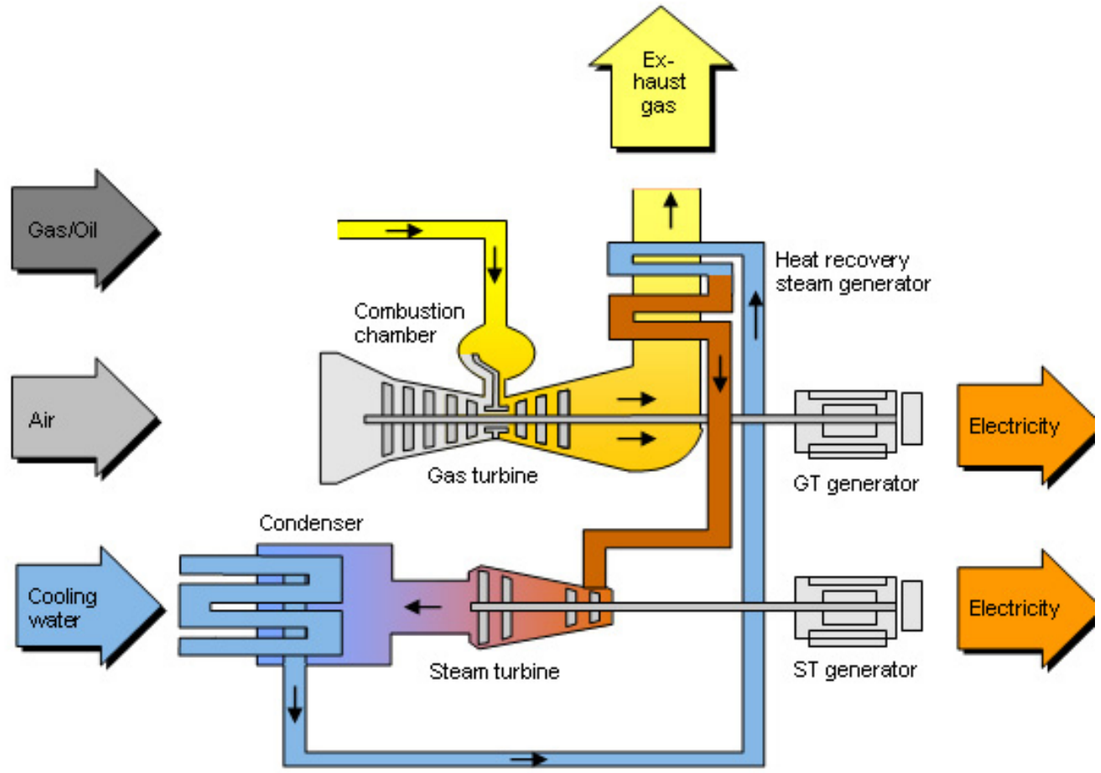
Inlet Air Chilling

The Gas turbine output power is directly related to the inlet air condition and especially air temperature.
This typical chart shows that increasing the inlet air temperature from 5.5 °C (42°F) to 38°C (100°F) will result to decrease the load about 50%, i.e. from 50 to 25 MW and vice versa.
Nowadays it is a common practice to use different kind of chilling system to chill the gas turbine inlet air and archive more power.



imagination at work

In combined cycle power plant, where the exhaust gas is used to produce steam, the condition will be different because the “cycle performance” is related to exhaust gas temperature and its mass flow rate as well. In combined cycle mode, the gas turbine best efficiency does not mean the best combined cycle efficiency necessarily. The following graphs show some optimum gas turbine inlet air temperature in different load and ambient conditions and we can see that especially in lower output, higher inlet air temperature results in higher efficiency.



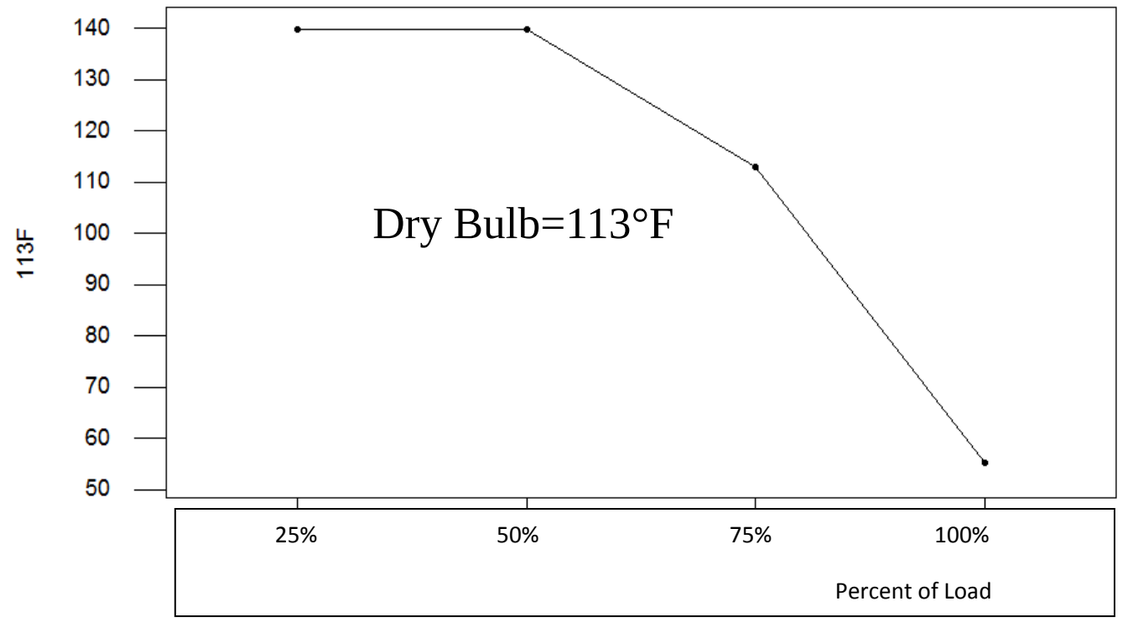
imagination at work

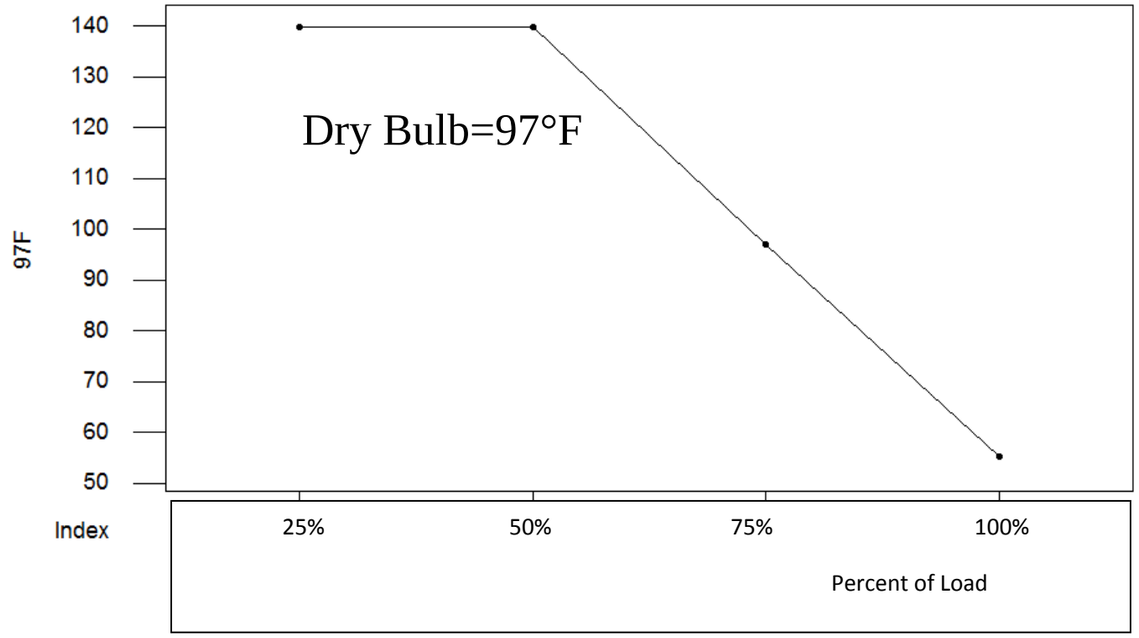
Optimum Air inlet Temperature (T2) for different Combined cycle load

P air(psi)	dry B Temp.	% hum	% load	T2	Mode	Net Output	GTG Output	STG Output	Remark
14.3	113.0	16.0	25	140	H	17290	11060	7850	
14.30	113.0 °	16.00	50	140	H	34790	25570	11150	
14.30	113.00	16.00	75	113.00	off	50900	39670	13480	
14.3	113.0	16.0	100	55	C	67310	55260	15690	71MW Gross
14.30	97.0	42.0	25	140	H	16990	11060	7540	
14.30	97.0	42.0	50	140	H	34880	25970	10840	
14.30	97.0	42.0	75	97	off	49500	38780	12940	
14.30	97.0	42.00	100	55	C	67020	55260	15600	71MW Gross
14.30	75.0	50.00	25	140	H	18060	11110	7500	
14.30	75.0	50.00	33MW	140	H	33010	24400	10510	
14.30	75.0	50.00	50	140	H	35380	25300	10630	
14.30	75.0	50.00	75	90.8	H	51070	40190	13120	
14.30	75.0	50.00	100	56	C	68050	55090	15900	71MW Gross
14.30	75.0	50.00	67MW	63	C	67050	54020	15820	
14.30	64.0	61.0	25	140	H	17820	11060	7310	
14.30	64.0	61.0	50	140	H	34060	25450	10530	
14.30	64.0	61.0	75	***89.5***	H	51200	40440	13010	
14.30	64.0	61.0	100	***57***	C	68160	54900	15990	71MW Gross

Note: All values are approximate and just for presentation.

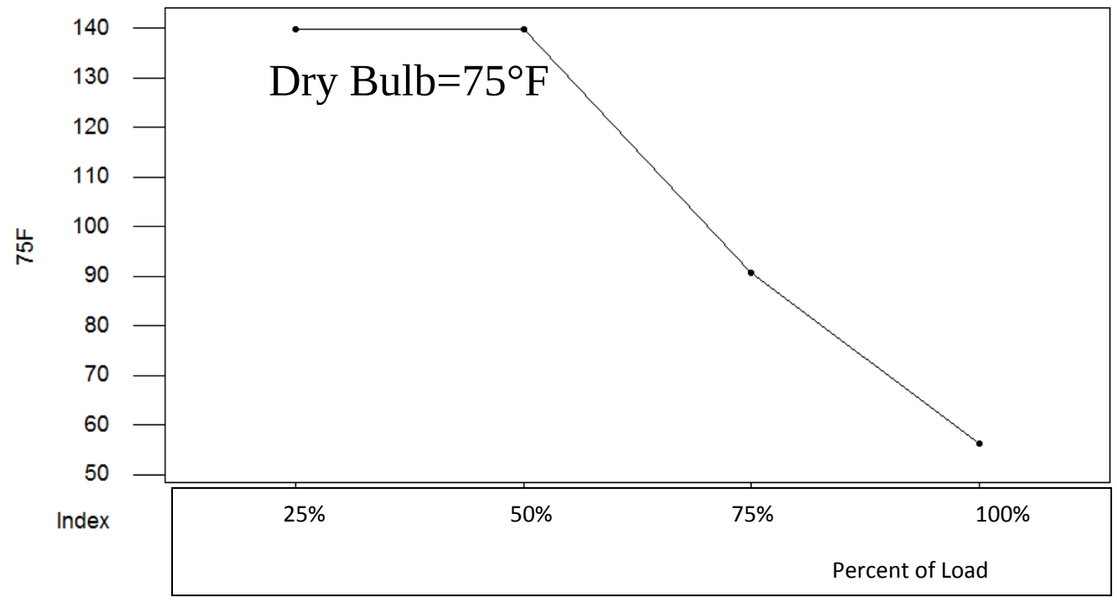
Optimum Inlet Air Temperature Vs. Combined Cycle Output

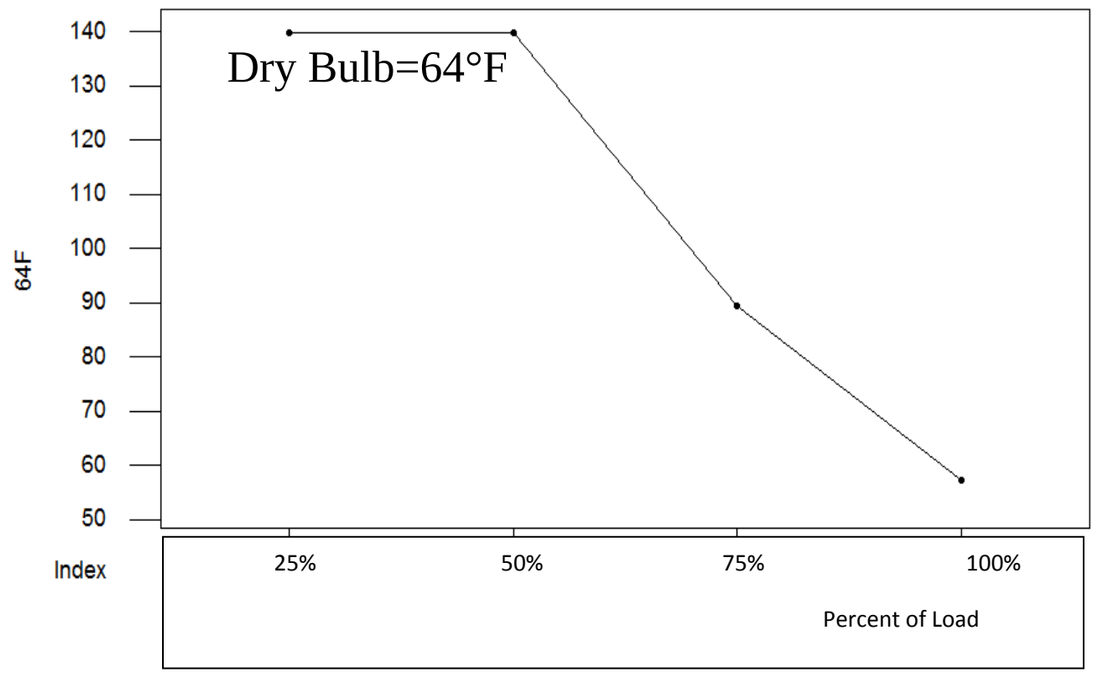




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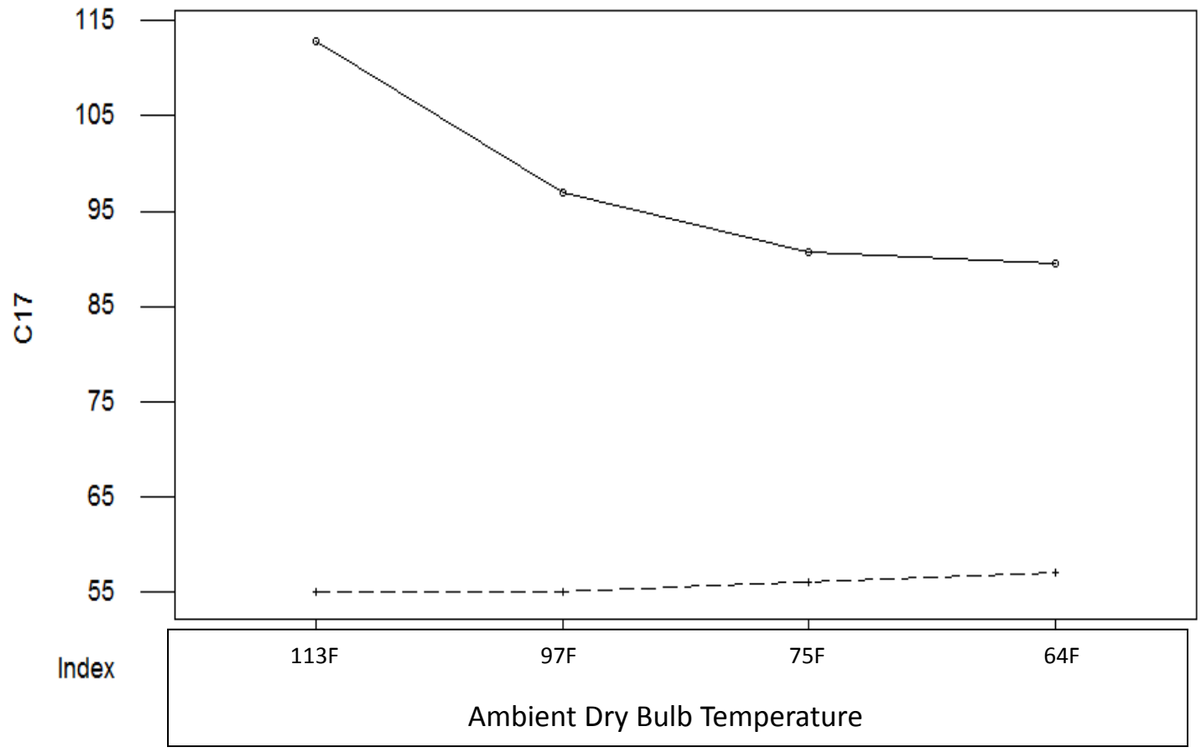
Optimum Inlet Air Temperature Vs. Combined Cycle Output

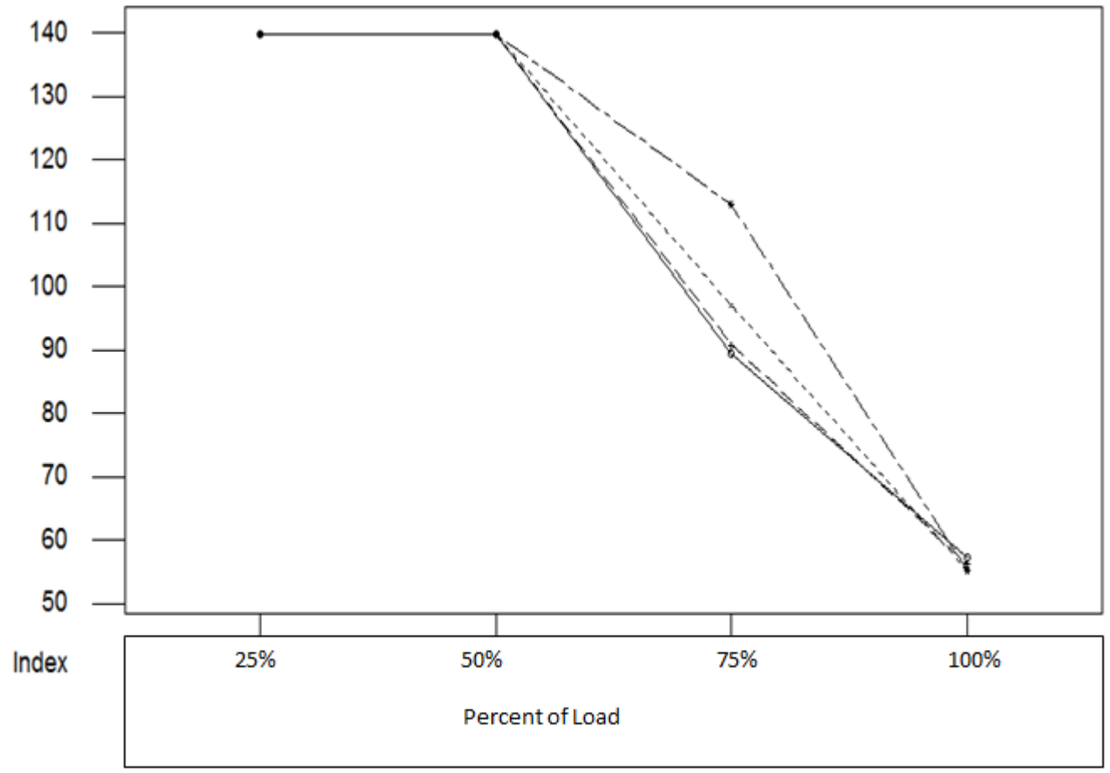




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Optimum Inlet Air Temperature Vs. Ambient Temperature





It is possible to conclude from the graphs that for having the best efficiency at 100% of cycle load, the inlet air to be chilled but if less output is necessary, then the optimum efficiency will be achieved by heating the inlet air .

What we mentioned previously is the result of having "**Air conditioning**" instead of "Air chilling" package for Pasadena combined cycle power plant.

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Scope of supply

To provide the optimum inlet air temperature, GE will provide a packaged modularized inlet air conditioning system that will allow for conditioning of the GT inlet air. The system is designed to operate in the following air conditioning modes:

GT Inlet Air Chilling
GT Inlet Air Heating

The chilling system will consist of:

- Two (2) 860 TR Nominal Water cooled Centrifugal Chillers (4160 V, 60 Hz Motors) on the structural steel skid with packaged piping, and valves,
- 3 x 50% Primary fixed speed Chilled Water Pumps
- Allen Bradley PLC Control System
- Factory Packaged Enclosure painted Ameron PSX700 GE Pearl Grey
- HVAC Unit for module climate control
- Exhaust Fans and Louvers
- Refrigerant Monitoring and ventilation per ASHRAE 15
- Lifting Lugs
- Low Voltage (LV) MCC
- Medium Voltage (MV) MCC
- Service Monorail for pumps
- Temperature Control Valves

Note: Cooling water(Condenser water) will be provided by plant Cooling Tower.

The heating system will consist of:

- One (1) Carbon Steel Shell & Tube Heat Exchanger designed and constructed to ASME Sec. 8 Div. 1. The heat exchanger will utilize extraction steam from the Once through Steam Generator (OTSG) to heat the fluid contained within the chilled water closed loop.
- One (1) Temperature Control Valve.
- One (1) Plate & Frame Heat Exchanger (Pre cooler)
- Expansion Tank
- Condensate Recovery system including tank, level control, with 2 x 100% condensate forwarding pumps.
- Miscellaneous valves and fittings
- Painted Carbon steel base frame.

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Site and Design Parameters

Site Design Data

Location	Pasadena,California
Elevation	751ft
Seismic Design Criteria	2010 CBC, Site Class D, Design Category D, Category III Facility with 1.25 Importance Factor
Wind Speed	85 MPH (3 Sec. gust wind speed)
Sound Pressure level@3ft from module	≤85 db(A)
Minimum Site Temperature	17 °F/71%RH
Maximum Site Temperature	113 °F/16%RH
Annual Average	64°F/61%RH
Design Condition	75 °F/50%
Summer Normal High (Design Point For chilling Mode)	97°F/ 42%RH
Winter Normal Low (Design Condition For Heater Mode)	32°F/ 70%RH

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Site and Design Parameters

Design Parameters:

1-Chilling Mode:

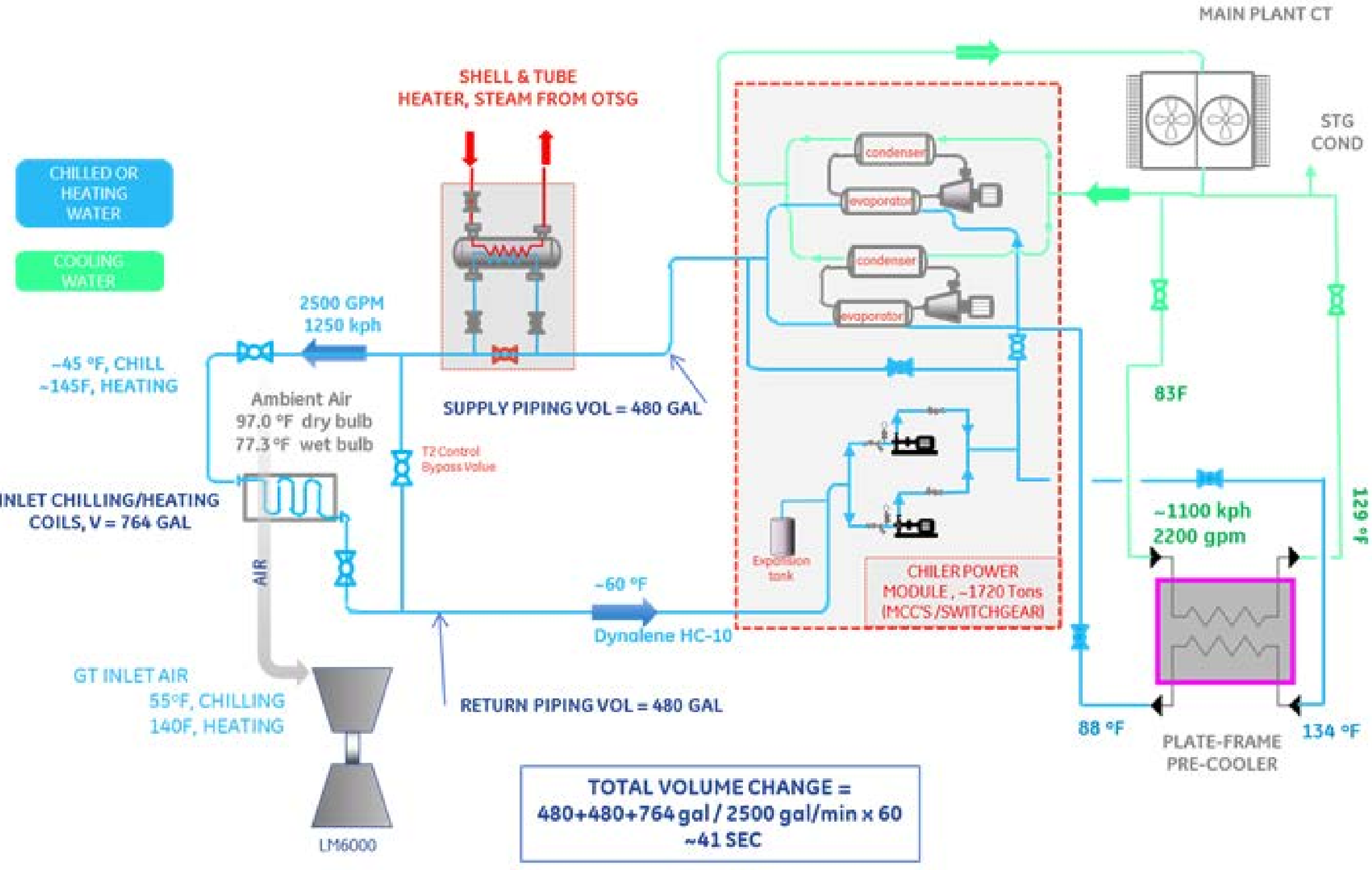
- Target T2 — 54 °F
- Coil Inlet temperature (HC-10) — 45 °F
- Coil Inlet temperature (25% PG) — 43 °F
- Circulating Water — 2500GPM
- Max. Power Consumption (HC-10/25% PG) — 1212/1264 KW
- Condenser Water Flow/ Supply Temperature — 2717GPM/85F

2-Heating Mode:

- Target T2 — 140 °F
- Coil Inlet temperature — 145 °F
- Coil Outlet Temperature(HC-10/25%PG) — 128.3/128.7
- Supply steam to Heat Exchanger
  - pressure — 167.7Psia
  - Temperature — 570 °F
  - Mass Flow Rate — 17.37 KPPH

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Pasadena Glenarm CC
Inlet Air Chilling/Heating Conceptual Design



Simplified Conceptual System

System Description

The role of air conditioning system control is regulating the T2 and therefore the plant output by inlet air chilling or heating whatever whenever necessary.
Plant control system, DCS(not in GE scope) will continually send a measured net plant MW signal, measured at the high side of the GSUs, to the chiller system PLC. To change plant output, DCS will send to chiller PLC a desired net plant MW value.
The chiller system PLC will compare current net plant MW to target and reduce or increase GT inlet air temperature until target MW is reached.
The plant needs to swing over a wide power range; numerous times a day. Therefore frequent change over from Chilling to Heating mode and vice versa will be necessary as well for adjusting the T2.

System Description

Regulating T2 will take sometimes based on the amount of water in the circuit and the required temperature difference. According the rough calculation, this time will be less than 5 minutes even in worst case. (circulating water temp=ambient=32°F to 140 °F).
In the other word, the rate for temperature change will be about 0.4 °F/sec

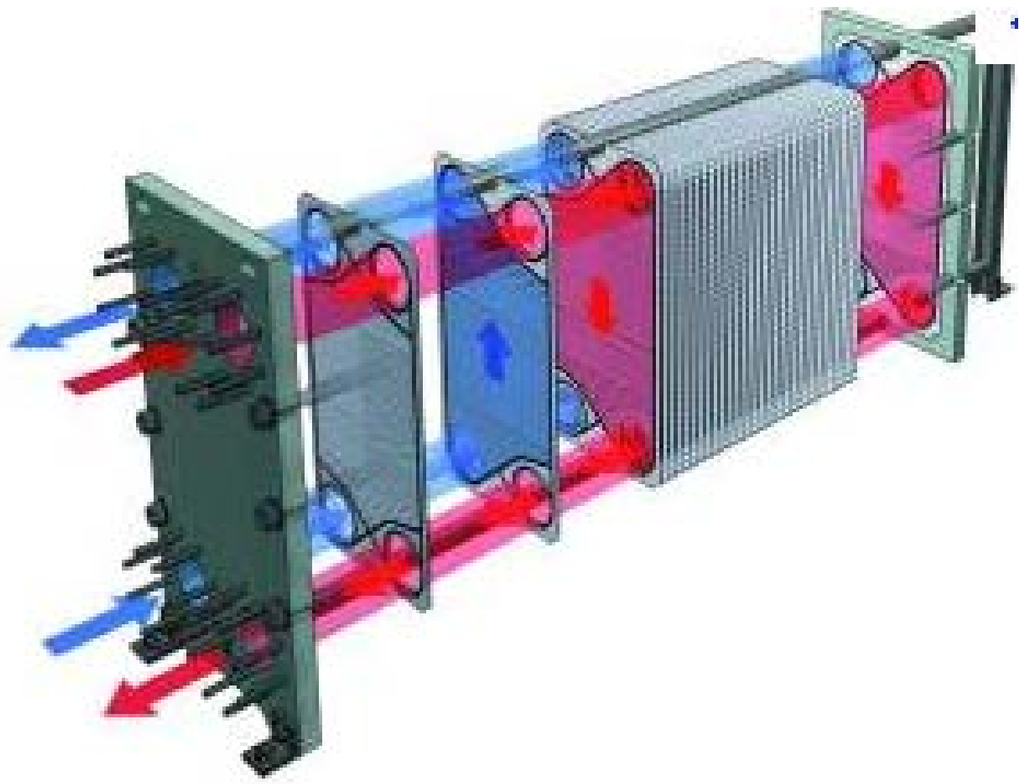
Or 23 °F/min.)

Assumed pipe length(ft)	300
assumed pipe size ,in	12
volume of system (ft^3)	235.5
Mass of water(lb)	14,702
Max Temp. diff from 145 °F to 32 °F	112
Q(cooling Load) BTU	1,646,600
Chiller capacity(TR)	1720
Chiller Capacity(BTU/hr.)	20,640,000
required time(t=Q/P),min	4.79(4' 48")

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Role of Pre Cooler

When system is changed from heating to cooling, the closed loop water temperature should be reduced from 145 to 45 but there is a max water temperature for chiller start up. The mentioned heat exchanger will act as a pre cooler, using plant cooling water to cool down the circulating water. After loop is cooled enough, then chiller will be started and cooling water will be used for its main purpose of chiller condenser cooling.



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Out Of Scope

The followings are excluded from GE scope of work/supply:

- Installation, pre commissioning and commissioning activities.
- MV and LV electrical feeds to the module electrical room.
- Cooling Water interconnect piping for chiller condenser heat rejection from plant cooling tower.
- Chilled water Interconnect piping between Chiller Package, Shell & Tube Heat exchanger, and GTG inlet Air Coils.
- Extraction Steam interconnect piping between Inlet heating Shell & Tube heat exchanger skid and OTSG extraction steam header (or designated tie-in point)
- Extraction Steam pressure control valve to condition supply steam from OTSG to the heat exchanger design conditions.
- Condensate return piping from Condensate recovery package to plant condensate line
- External electrical and controls wiring
- First fill of Chilled Water Fluid



Drawing & Package Delivery Dates

CKOM Date (Please Refer To General Note #1 Below):	Nov 13-Nov 15	Chiller Deliverables Schedule	LD's Assigned [Y/N]	For Review / For Information [R/I]
CHILLER SKID Deliverable Description		**Initial Issue Time In Weeks After The Date Of The Last Day Of The CKOM**		
P&ID	March 23, 2014	14	N	I
GENERAL ARRANGEMENT	March 23, 2014	14	Y	R
FOUNDATION LOADING (NOT TO EXCEED) DWG	March 23, 2014	14	Y	R
ELECTRICAL SINGLE LINE DWG	March 23, 2014	14	N	I
ELECTRICAL LOAD LIST	March 23, 2014	14	Y	R
ELECTRICAL CABLE SCHEDULES & FIELD INSTALL PLAN	Apr 20, 2014	18	N	I
I/O LIST	Apr 20, 2014	18	N	I
FUNCTIONAL DESCRIPTION	May 18, 2014	22	N	I
MODULE SHIPPING/RIGGING DIAGRAMS	May 04, 2014	20	N	I

Package delivery date:

Scheduled RTS date: Dec 17,2014

Guarantee Delivery Date: Jan 28, 2015

Delivery Term and Point: DDP to City of Pasadena Glenarm site

City of Pasadena

Glenarm Repowering Project

LM6000
GE Aeroderivative Package

Juan Montoya/Kevin Motley
Controls Engineer



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Agenda

- Control System Documentation
- Control System Overview
- Network Architecture
- Time Synchronization
- Software Architecture
- Start Sequencing
- Human Machine Interface Overview
- HMI Control Screens
- Alarm Logging and Data Trending
- Questions

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Control System Documentation

Cause and Effect Drawing (969149)

CUSTOMER NAME:

SITE:

LM6000 MICRONET CONTROL

CAUSE AND EFFECT MATRIX
HYDRAULIC STARTER SYSTEM

LINE	REV	TAG NO.	PROCESS DESCRIPTION	RANGE LOW (English)	RANGE HIGH (English)	LIMIT DECR (English)	LIMIT INCR (English)	ENGLISH UNIT	RANGE LOW (Metric)	RANGE HIGH (Metric)	LIMIT DECR (Metric)	LIMIT INCR (Metric)	METRIC UNIT	ACTION	NOTE	ALARM	ALM DLY (S)	SHUT DOWN	ABORT START	START PERM.	CRANK PERM.	MOTORS	HEATERS	VALVES
1		PDSHH-1600	START SKID HYDRAULIC PUMP VACUUM HIGH HIGH DIFF PRESS				6.5	IN.HG				165.0	mm.Hg	PDAHH	2			ESN						
2																								
3		LSLL-1601	START SKID HYDRAULIC OIL TANK LOW LOW LEVEL			6.0		IN			152.0		mm	LALL	2			ESN					HE 1610 PERM	
4																								
5		TSH-1602	START SKID HYDRAULIC CASE DRAIN HIGH TEMP				180.0	DEG F				82.2	DEG C	TAH		X								
6																								
7		TSL-1603	START SKID HYDRAULIC OIL TANK LOW TEMP			70.0		DEG F			21.1		DEG C	TAL		X					X			
8																								
9		PSLL-1605	START SKID HYDRAULIC PUMP SUPPLY LOW LOW PRESS			250.0		PSIG			1724.0		KPaG	PALL	2			ESN						
10																								
11		TE-1663A1	TURB HYDRAULIC STARTER CLUTCH OIL DRAIN PAN TEMP (A1)	-65.0	1200.0	-45.0	390.0	DEG F	-53.9	648.9	-42.7	198.9	DEG C	SF		X								
12		TE-1663A2	TURB HYDRAULIC STARTER CLUTCH OIL DRAIN PAN TEMP (A2)	-65.0	1200.0	-45.0	390.0	DEG F	-53.9	648.9	-42.7	198.9	DEG C	SF		X								
13		TE-1663A1/A2	TURB HYD STARTER CLUTCH OIL DRAIN PAN	-65.0	1200.0	-45.0	390.0	DEG F	-53.9	648.9	-42.7	198.9	DEG C	SF		X								
14		TE-1663A1/A2	TURB HYD STARTER CLUTCH OIL DRAIN PAN				10.0	DEG F				5.6	DEG C	HD		X	1							
15		TE-1663SEL	TURB HYD STARTER CLUTCH OIL DRAIN PAN				230.0	DEG F				110.0	DEG C	TAHH	2		1	DM						
16		TE-1663SEL	TURB HYD STARTER CLUTCH OIL DRAIN PAN				200.0	DEG F				93.3	DEG C	TAH		X	1							
17																								
18		SOV-1619	SOLENOID OPERATED VALVE-PUMP CONTROL PISTON	0.0	100.0			%	0.0	100.0			%											
19																								
20		MOT-1615	HYDRAULIC STARTER PUMP																					
21		MOT-1615FB	HYDRAULIC STARTER PUMP MOTOR STARTER AUX CONTACT																					
22																								
23		HE-1610	START SKID HYDRAULIC OIL TANK HEATER																					
24																								
25																								

NOTES
1. INTENTIONALLY LEFT BLANK
2. SHUTDOWN START SYSTEM BY ALLOWIN ITION FOR 10 SEC. AND THEN TURN OFF MOT-1615.

LEGEND
1. SEE LEGEND TAB

REVISION LIST
A ORIGINAL ISSUE
B NO CHANGES THIS SHEET

====== EN

Device Description

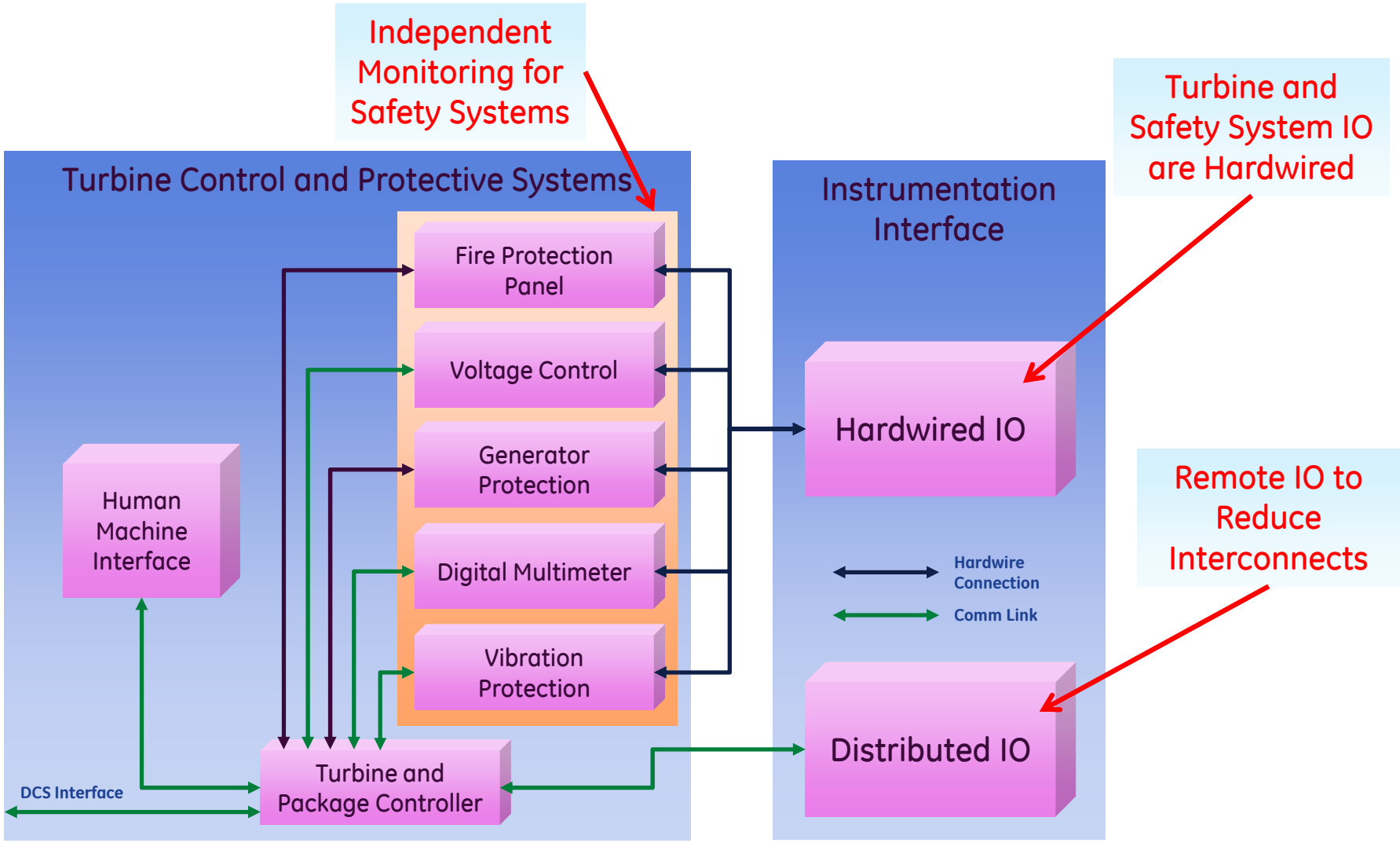
-Sensor Scaling
-Fault Limits

Control Actions

Tag Number (TE-1663)

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LM6000 Control System Overview



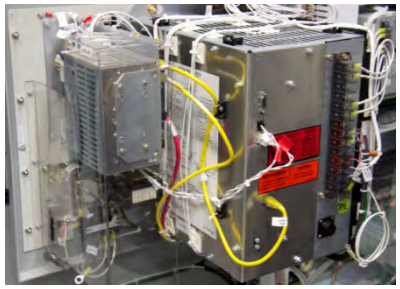
GTG Controller

- Package sequencing and GT controlled by the MicroNet™ Plus Controller
  - Chassis contains power supply, CPUs, and I/O cards
    - Includes CAN/LON/Serial interface
  - Dual-Redundant CPU Architecture
  - 24 VDC Redundant Power Supply
  - Communicates with HMIs and other devices via OPC/EGD/Modbus



Other Control System Devices

- **Automatic Voltage Regulator (AVR)**
  - Model: GE EX2100e
  - Purpose: Provides excitation and voltage monitoring
  - Communication w/ Micronet: EGD



- **Bently Nevada Vibration System**
  - Model: 3500 series
  - Purpose: Monitors generator/gearbox/turbine vibration
  - Communication w/ Micronet: Hard-wired and Serial Modbus



- **Integrated Generator Protection System (iGPS)**
  - Model: Beckwith M-3425A
  - Purpose: Provides generator protection against short-circuits, excitation problems, etc.
  - Communication w/ Micronet : Hard-wired



Other Control System Devices (cont'd)

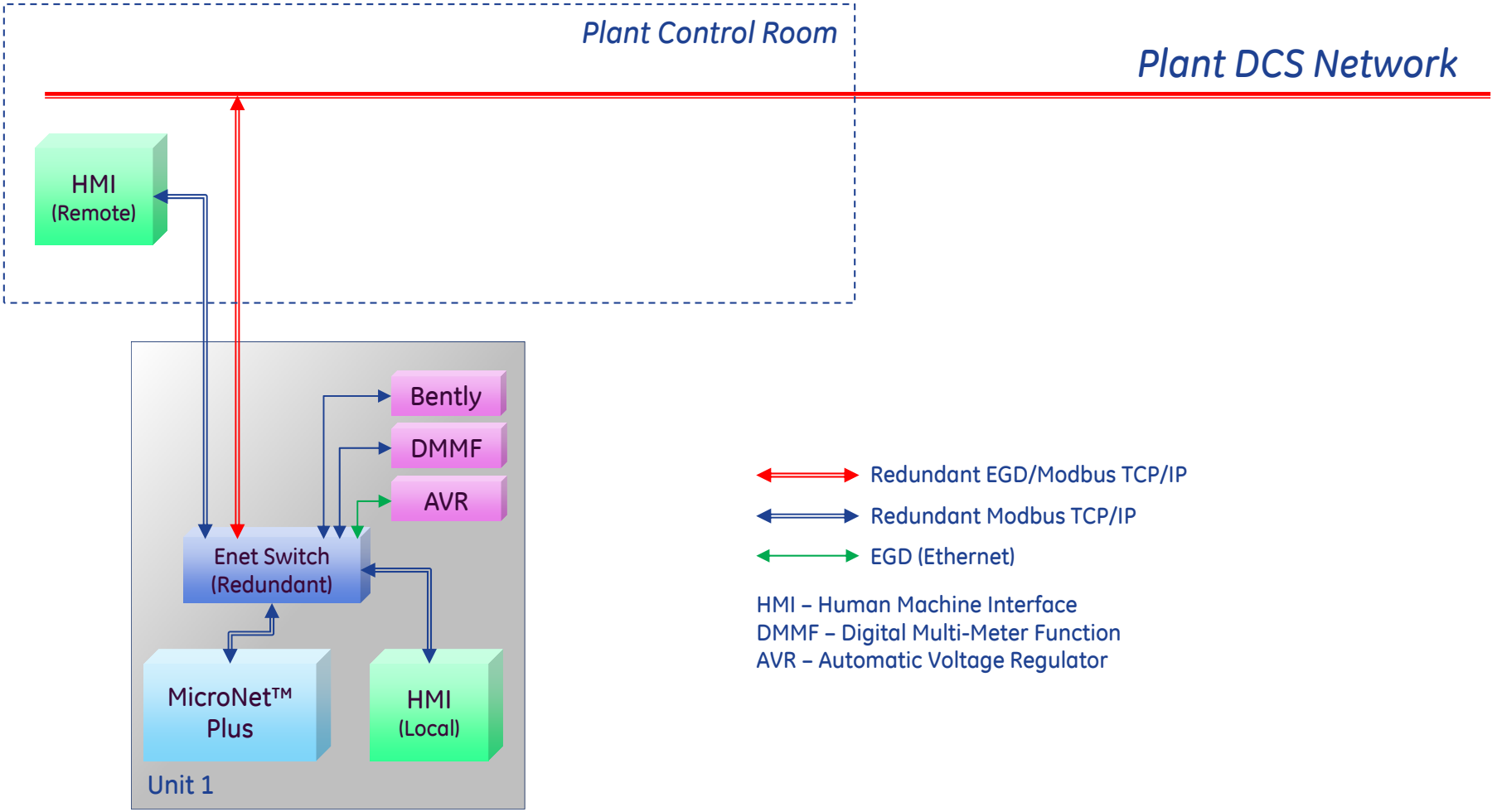
- **Digital Meter Multifunction (DMMF)**
  - Model: SATEC PM174
  - Purpose: Displays generator parameters
  - Communication w/ Micronet : Modbus



- **Fire and Gas Protection Panel (FPP)**
  - Model: Allestec 800 series
  - Purpose: Provides GTG protection based on detection of smoke, fire, and unburned fuel
  - Communication w/ Micronet : Hard-wired



Network Architecture



Redundant EGD/Modbus TCP/IP

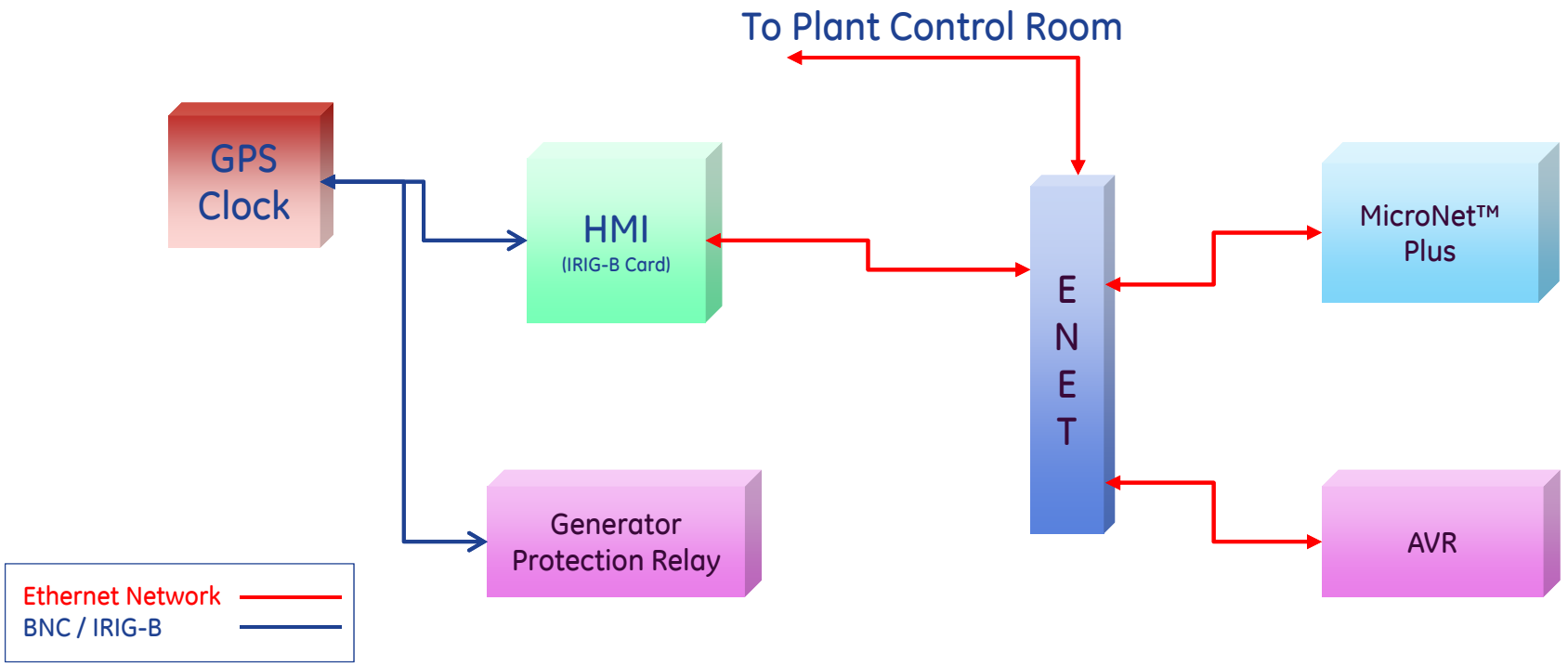
Redundant Modbus TCP/IP

EGD (Ethernet)

HMI – Human Machine Interface
DMMF – Digital Multi-Meter Function
AVR – Automatic Voltage Regulator

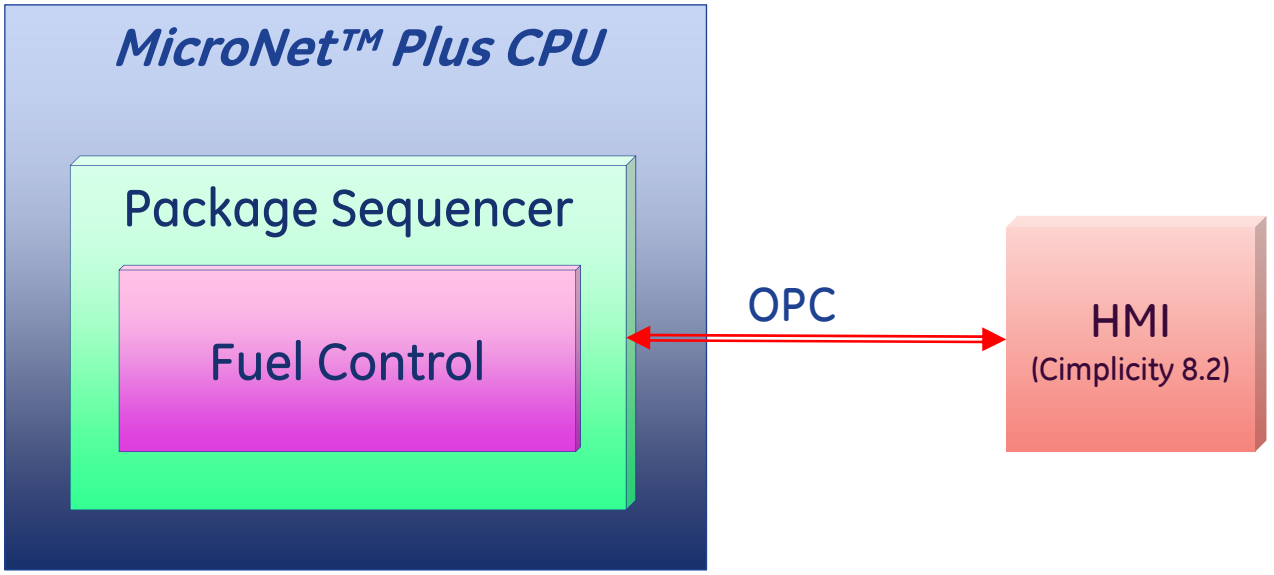
Time Synchronization

Time synchronization via GPS clock or DCS time signal through NTP over the Ethernet network

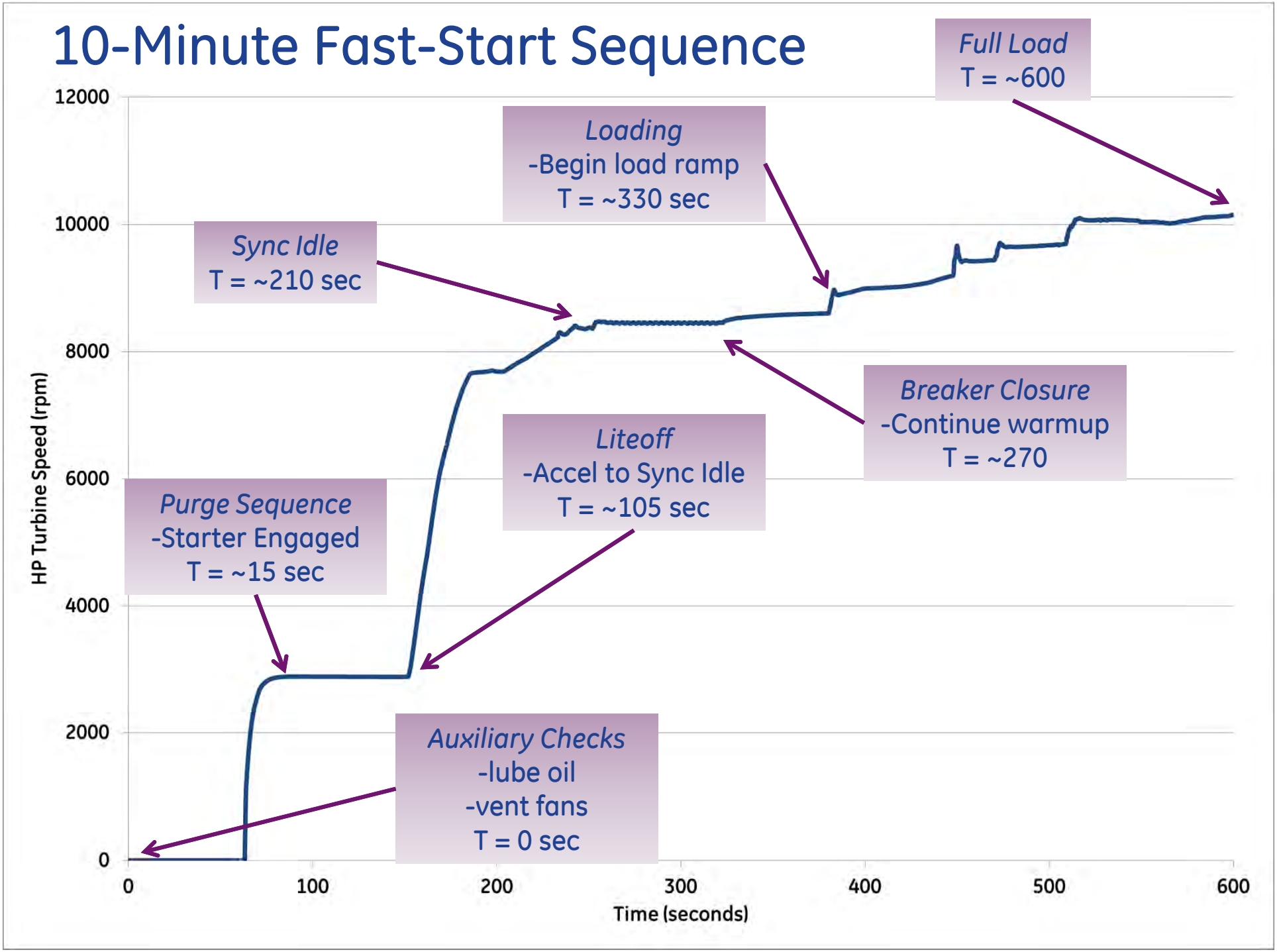


Control Software Architecture

- All control software is written using GAP (Graphical Application Programmer)
  - Core qualified with GE Aviation by Woodward
  - Sequencer code for package written by GE Aero
- Final CPU software and device communication is validated through computer simulation and static testing in Houston



10-Minute Fast-Start Sequence

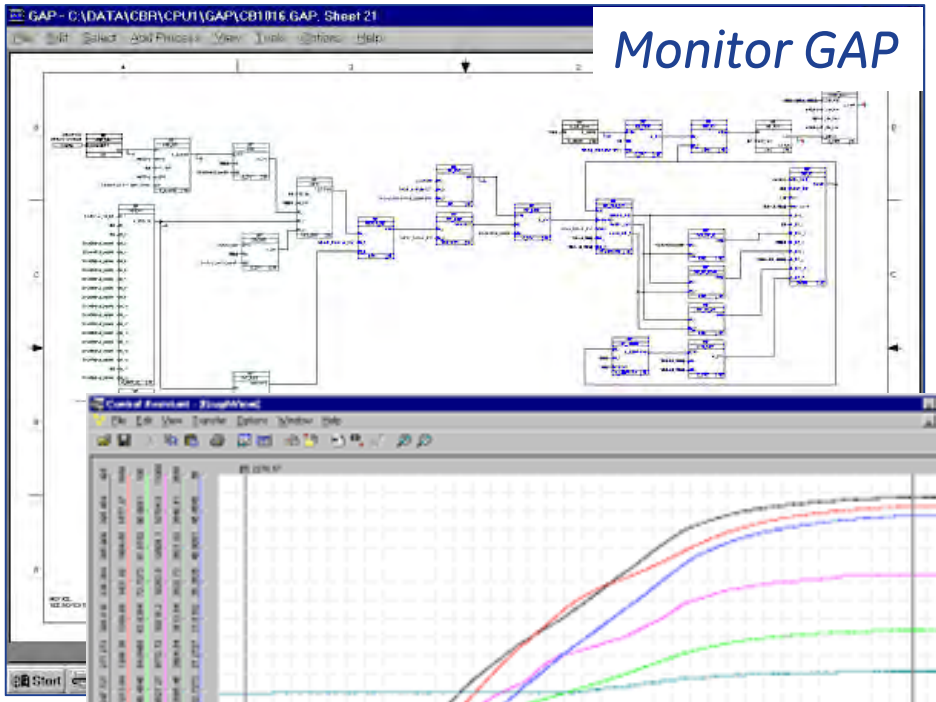


Human Machine Interface (HMI) Utilities



HP Z420 (Local Panel-Mount)

HMI/SCADA - CIMPLICITY



Monitor GAP

Windows 7



HP Z420 (Remote)

Control Assistant

imagination at work

HMI – Turbine Overview Screen

Critical Parameters

Sequence Timers

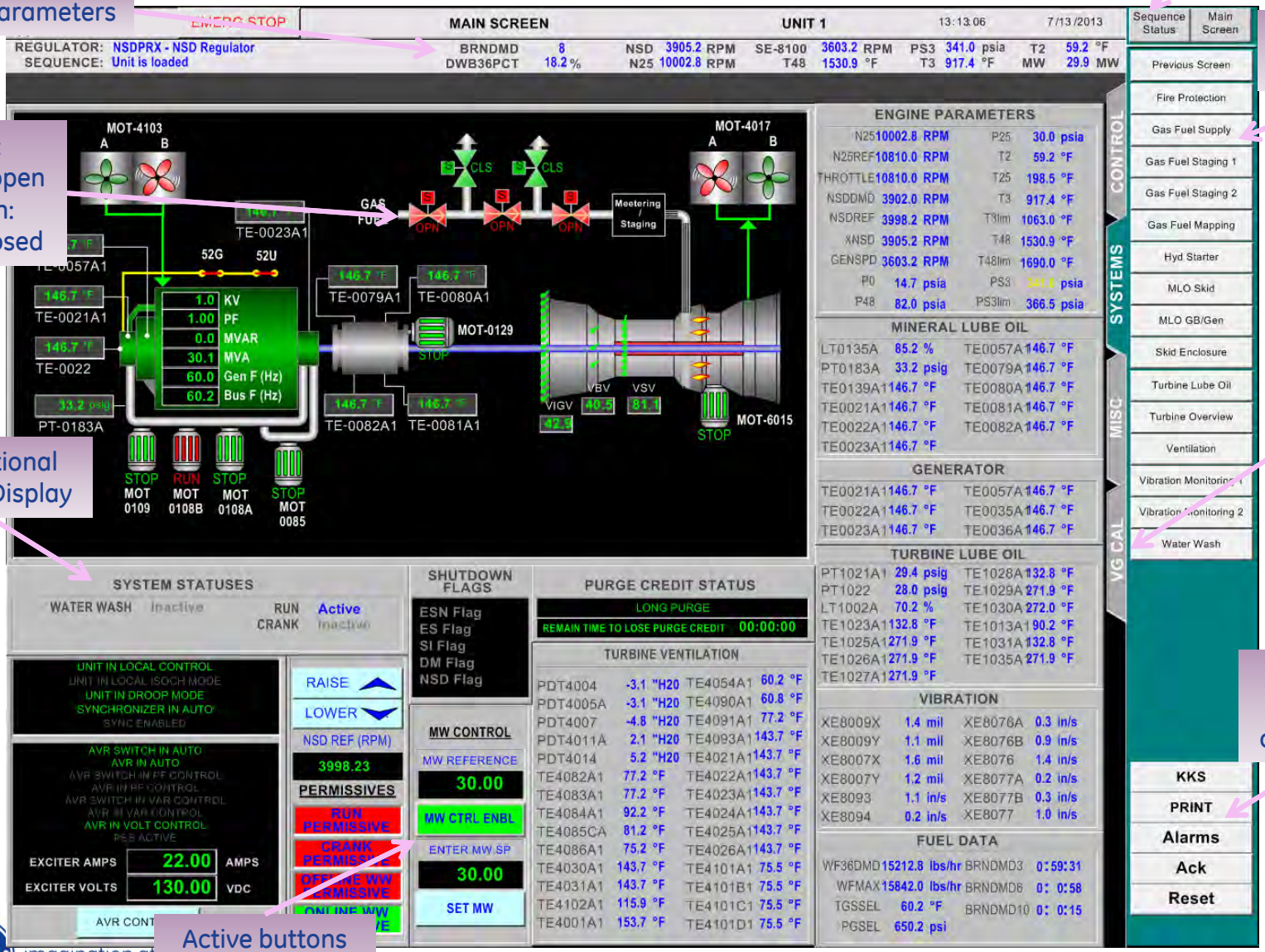
Package System Access

Red: active/open Green: Safe/closed

VG Calibration

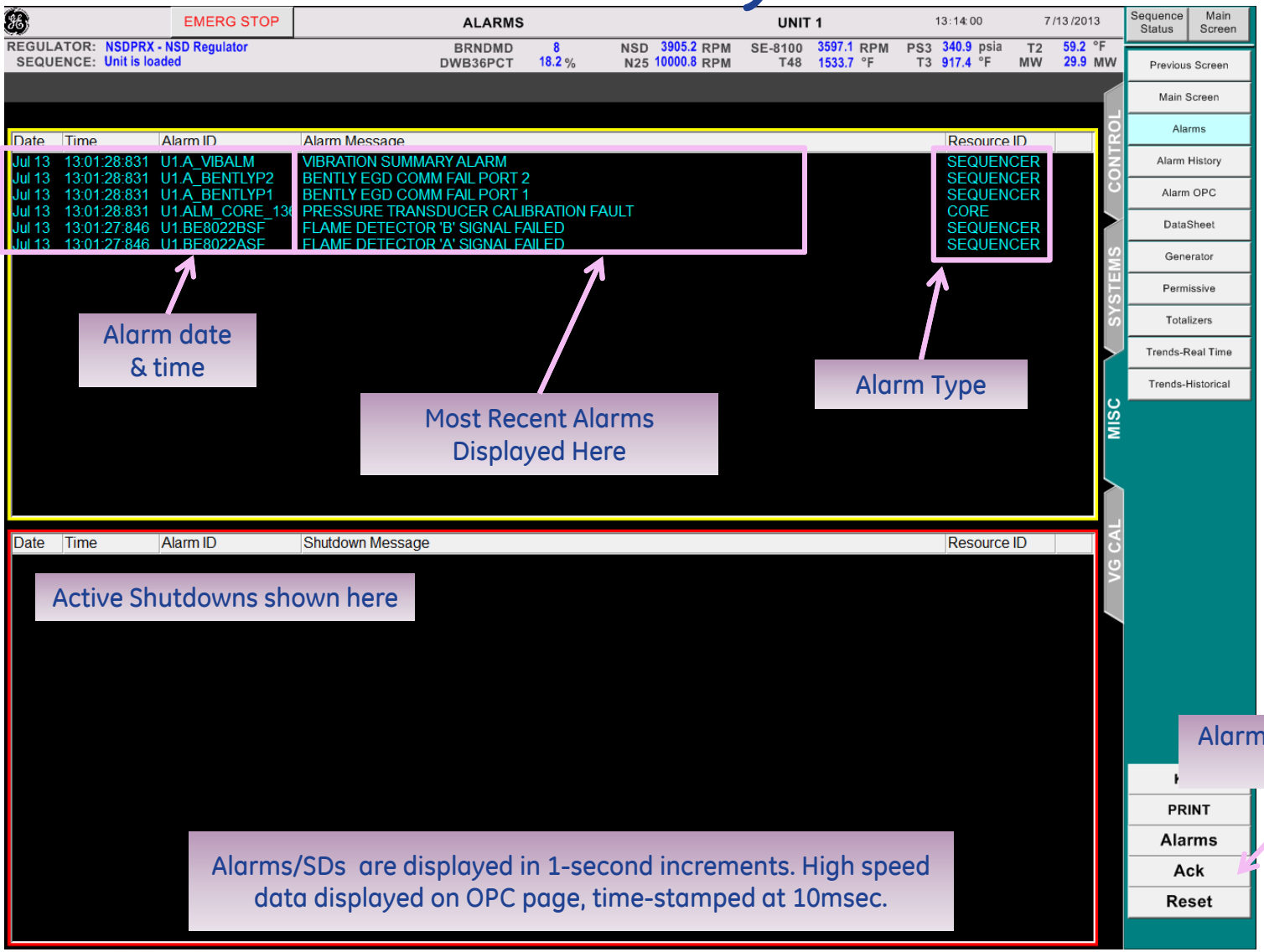
Operational Modes Display

Print Screen capability



Active buttons Submenus for Turbine Control

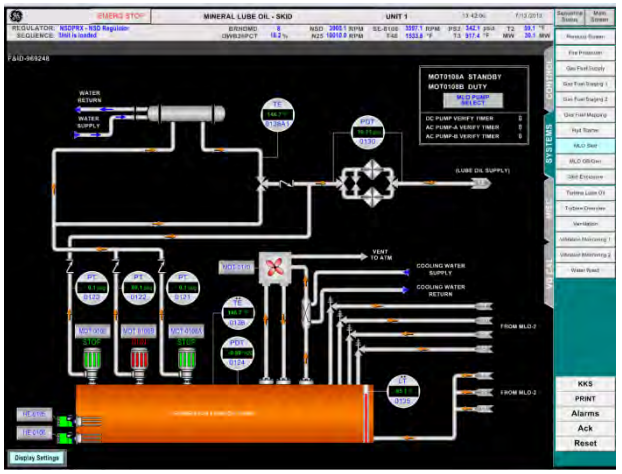
HMI – Alarm Summary

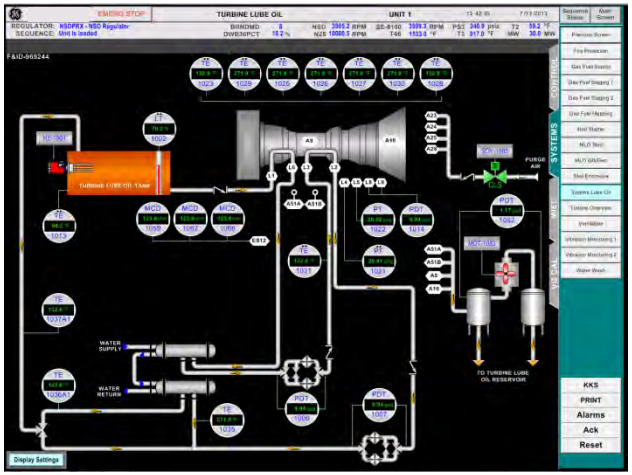


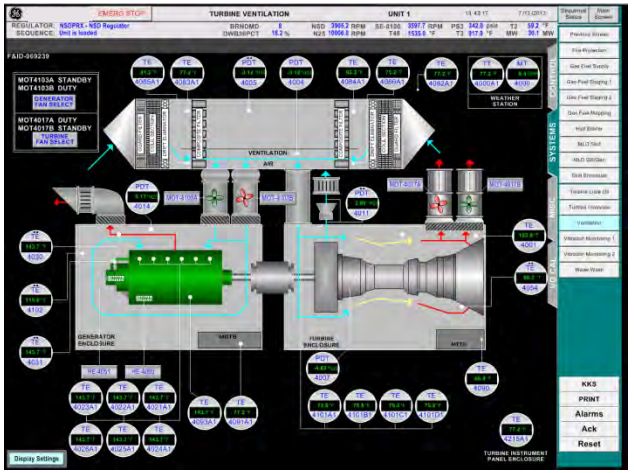
HMI – Data Recording

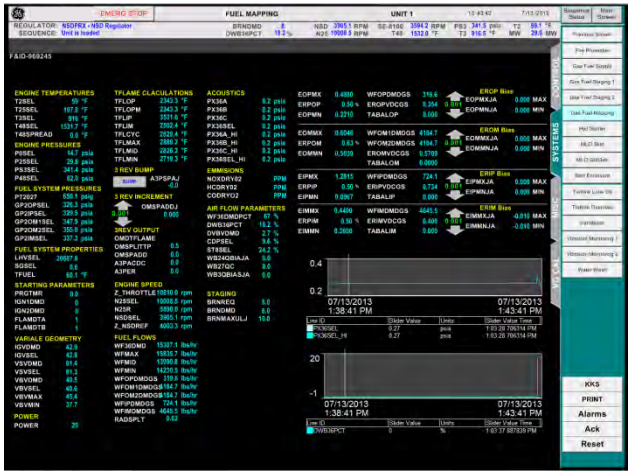
- Alarms
  - Logged daily in .ALM files and stored for 30 days by default
  - High speed alarm data is available on the OPC page of the HMI with a resolution up to 10msec
- Data Logs
  - Once/second data available through historical trending on HMI
    - Amount of data storage limited only by hard drive size
    - Data accessible through HMI, ODBC, and Excel
  - High-speed data logs (10msec) can be run from the HMI manually, and are also automatically collected upon a unit trip
    - Data points are pre-programed and mostly include turbine parameters

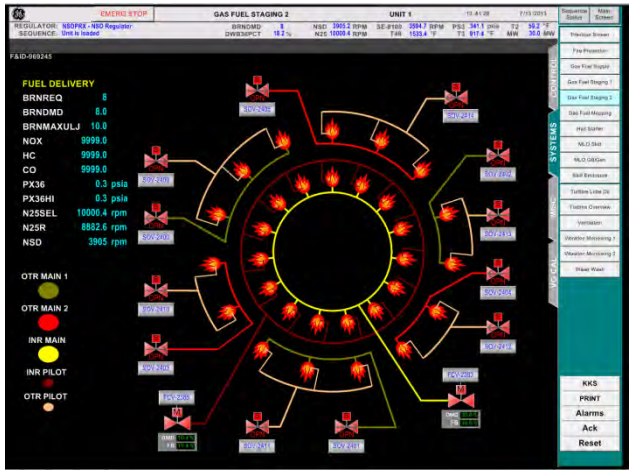
Sample HMI Screens

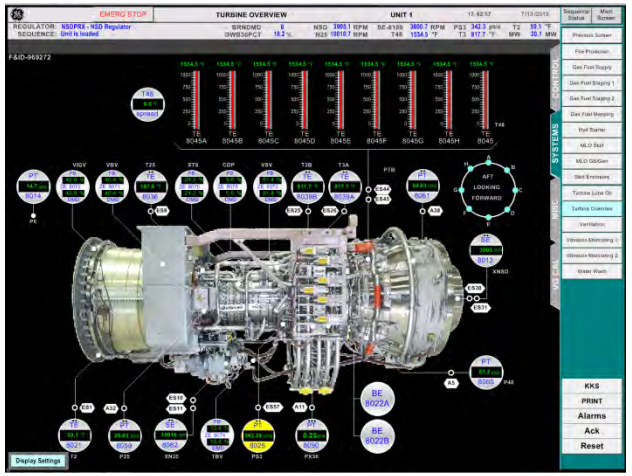













Questions?

	Equipment	Description	Estimated Weight	
			LBS	Tons
1	OTSG	Shipping weight of heaviest module	301,000	151
2	GSU Transformer	Shipping weight w/o oil	189,840	95
3	Cooling Tower	Assembled dry weight	97,200	49
4	Condenser	Assembled empty weight	52,000	26
5	Steam Turbine	ST & gear box skid weight	93,000	46
6	Gas Turbine	GT Generator in shipping container	177,000	89
7	Gas Turbine	GT Air Filter Assembly	193,000	97

ITEM	DESCRIPTION/MATERIAL
1	STEAM OUTLET – 3.0" FLG 150#
2	SAFETY VALVE – 125 PSI (1–1/2" Outlet)
3	LOW WATER CUTOFF WATER COLUMN – McD&M 157
4	SIGHT GAUGE GLASS BLOWDOWN – 0.25 NPS
5	FEEDWATER – GLOBE VALVE 0.75 NPS
6	FEEDWATER – CHECK VALVE 0.75 NPS
7	SLOW BLOWDOWN DRAIN VALVE – 1.0 NPS
8	QUICK BLOWDOWN DRAIN VALVE – 1.0 NPS
9	AUX. LOW WATER CUTOFF – WARRICK PROBE
10	PRESSURE CONTROL – OPERATING
11	WATER COLUMN BLOWDOWN – 0.75 NPS
12	(7) STEPS @ 80kW, (2) STEP @ 40 kW, (1) STEP @ 60 kW
13	ELEMENT ACCESS PANEL
14	PILOT SWITCH/ POWER LIGHT/ HIGH PRESS LIGHT/LOW WATER LIGHT
15	CONTROL PANEL DOORS
16	PRESSURE GAUGE
17	SURFACE BLOWOFF SYSTEM (STRAINER, STOP, & METERING VALVE)
18	PRESSURE CONTROL – MODULATING
19	PRESSURE CONTROL – HIGH LIMIT
20	ALARM – 4" BELL WITH SILENCING SWITCH
21	--
22	--

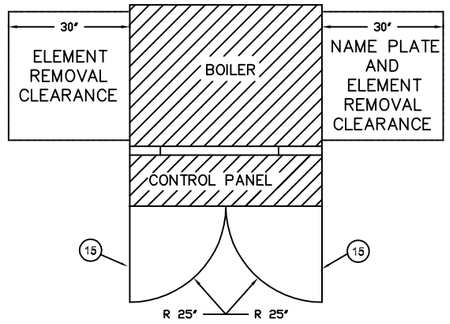
NOTES:

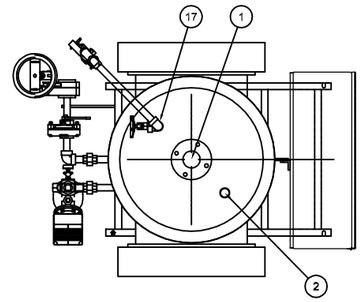
1) Boiler to be constructed per ASME Boiler and Pressure Vessel Code, Section I, "S" stamped and National Board registered.
2) Boiler will have a UL labeled panel
3) (a) Vessel is to be wrapped with 2" insulation with sheet metal lagging
   (b) One layer of standard 2" insulation is to be on control panel back plate and rear wall of the boiler casing
4) All valves to be mounted, hydro tested, & listed on applicable forms.
5) Boiler meets CSD–1 requirements

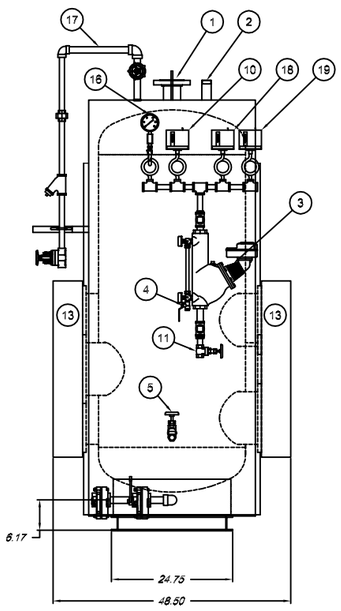
CAUTION

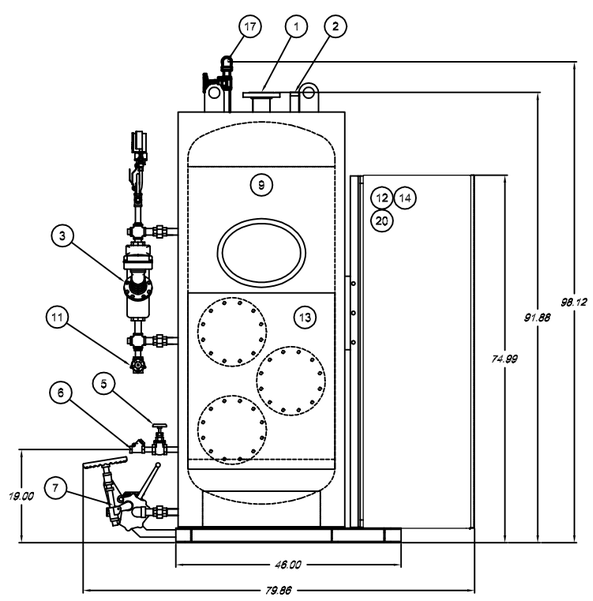
DIMENSIONS SHOWN ARE APPROXIMATE AND SHOULD NOT BE USED IN RESTRICTIVE LAYOUTS OR TO PREFABRICATE ASSEMBLIES UNLESS CLEAVER-BROOKS HAS BEEN CONSULTED. IT IS STRONGLY RECOMMENDED THAT THE CUSTOMER REQUEST AS-BUILT CERTIFIED DRAWINGS FOR THESE CASES.

BOILER MAY BE SHOWN WITH OPTIONAL EQUIPMENT IN LUEI OF STANDARD COMPONENTS.









SPECIFICATIONS

PRESSURE: DESIGN 150PSI
KW 704 AT 480 / 3 / 60
105 ELEMENTS AT 6.7 KW 67 WSI INCOLOY
SAFETY VALVE SET PRESSURE 125 PSI

REVISIONS

SAMPLE

DIMENSIONAL DRAWING

SHT 01 OF 01

SCALE N.T.S.

DATE 6/8/10

DRAWN

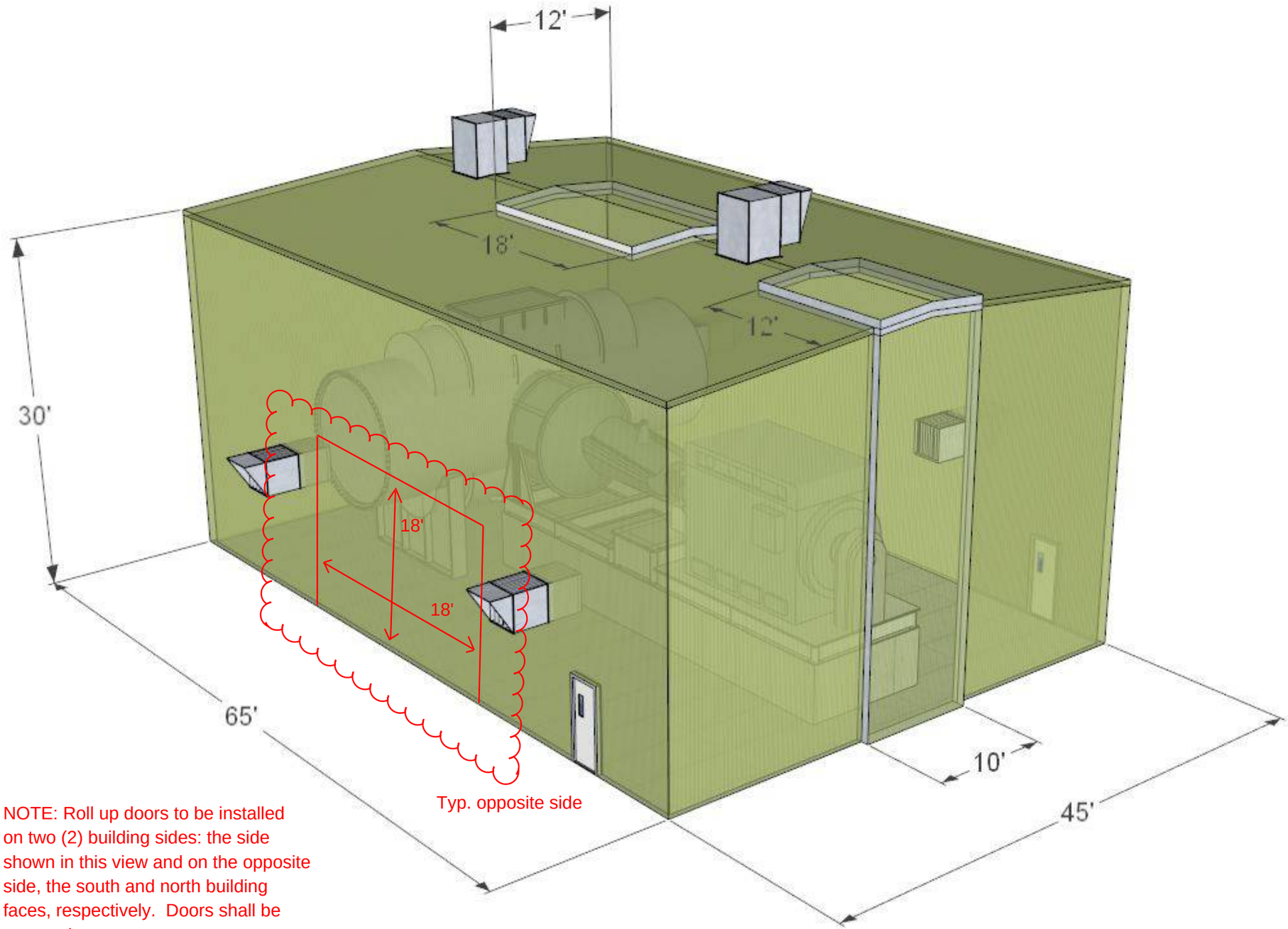
SIZE

CleaverBrooks®

TYPE	SIZE	KW	PRESSURE	GALLONS
S	302	700	150ST	
VOLTS	PHASE	HERTZ	WIRE	INSURANCE
480	3	60	3	N/A

DRWG. NO. SAMPLE 00

THIS DRAWING IS PROPERTY OF CLEAVER-BROOKS, INC.
IT IS SUBJECT TO CHANGE WITHOUT NOTICE, AND IS NOT TO BE COPIED OR USED IN ANY WAY DETRIMENTAL TO THE COMPANY.
SUGGESTIONS AND INFORMATION CONTAINED ON THIS DRAWING ARE NOT INTENDED TO SUPPLANT LOCAL CODES.



NOTE: Roll up doors to be installed on two (2) building sides: the side shown in this view and on the opposite side, the south and north building faces, respectively. Doors shall be automatic

ATCO Emissions Management

DRAWN BY TWFR
ISSUE 11.15.2012

PROJECT NO. Q3658-12

Glenarm Repowering Project
Acoustic STG Enclosure

sk

01

Attachment 12

Mechanical Completion Certificate

(a) "Mechanical Completion Certificate" means that the Equipment has been erected and installed in accordance with Contractor's Installation and Commissioning Manuals, including: (i) the setting of all equipment on foundations; (ii) the connection of all such equipment to other applicable equipment as required by way of piping, wiring, controls, and safety systems; and (iii) ensuring that:

(A) all such equipment and such related operating systems are individually cleaned, leak checked, lubricated,
(B) all initial fills have been completed,
(C) all instruments are calibrated and field verified,
(D) all relays are set with their initial setting(s),
(E) all equipment is checked out,
(F) all ground checks are made,
(G) all piping that is required to be pressure tested and/or flushed has been tested and/or flushed and certified clean,
(H) all motor rotation and alignment checks are complete,
(I) the generator panels have been energized,
(J) the electrical interconnection is complete and ready to backfeed,
(K) the gas interconnection is complete and ready to flow gas,
(L) demineralized water interconnection to the skid is complete,
(M) the GTG's fire system is operational,
(N) all electrical circuits have been point-to-point checked to verify that such equipment and operating systems have been correctly installed and verified to respond to simulated test signals equivalent to actual signals received during operation, , all loop checks have been completed and plant control system is fully operational,
(O) all equipment is ready for initial operation, and may be so operated, without damage thereto or to any other property and without injury to any person,
(P) the GTG has been first fired;

(b) all City and Contractor supplied equipment required for the operation of the Equipment has been installed, checked-out, and is ready for commissioning; and

(c) City and Contractor have certified the completion of the "Precommissioning Procedure Checklist" from Contractor's "Installation and Commissioning Manual."

Rev	Date	Description	Author	Checked
0	13 Sept 2013	Issued for Construction	JT	

Customer: **City of Pasadena**

Project: **Glenarm Repowering Project**

Contract: **P12079**

Innovative Steam Technologies
549 Conestoga Boulevard
Cambridge, Ontario
Canada N1R 7P4
An AECON Company

Title:

ONCE THROUGH STEAM GENERATOR ERECTION & INSTALLATION INSTRUCTIONS

No. of Boilers:	Author:	Date:	IST Document Number:
One (1)	J Tong	Nov 20, 2013	**C12079-EI**

REVISION SUMMARY

Revision Number	Description of Revision	Prepared By	Approved By	Approval Date
P	Preconstruction Issue - Erection instructions reflect a typical OTSG installation and are subject to change during design phase. - Figures from different projects are provided as reference only. Weights and dimensions are subject to change.	JT		Nov 20,2013

TABLE OF CONTENTS

1 ERECTION PACKAGE DRAWING LIST 7

2 RECOMMENDED CONSTRUCTION PRACTICES 8

2.1 LIFTING OF EQUIPMENT 8
2.2 ACCESSING CONNECTION POINTS 8
2.3 CHECKING THE OTSG COMPONENTS FOR LEVEL 9

3 PRE-CONSTRUCTION ACTIVITIES 9

3.1 SHIPPING DAMAGE 9
3.2 OFFLOADING AND SHIPPING BEAMS 9
3.3 OTSG MODULE SHIPPING BEAMS 10
3.4 DUCTING COMPONENT SHIPPING BEAMS 10

4 BASE PLATES 10

5 ERECTION PLATES 11

5.1 ERECTION PLATE BOLT TIGHTENING PROCEDURE 12

6 LIFTING INSTRUCTIONS 13

7 DUCTING & MODULE INSTALLATION 13

7.1 ERECTION OF INLET PLENUM – GENERAL PROCEDURE 13
7.2 ERECTION OF LOWER OTSG MODULE – GENERAL PROCEDURE 15
7.3 ERECTION OF SCR MODULE – GENERAL PROCEDURE 17
7.4 ERECTION OF UPPER OTSG MODULE – GENERAL PROCEDURE 18
7.5 ERECTION OF LOWER EXHAUST HOOD – GENERAL PROCEDURE 19
7.6 ERECTION OF UPPER EXHAUST HOOD – GENERAL PROCEDURE 21
7.7 ERECTION OF STACK ADAPTER – GENERAL PROCEDURE 22
7.8 ERECTION OF EXHAUST STACK – GENERAL PROCEDURE 22
7.9 ERECTION OF DILUTION AIR DUCT – GENERAL PROCEDURE 24
7.10 ERECTION OF INLET TRANSITION DUCT – GENERAL PROCEDURE 25
7.11 ERECTION PLATE WELDING 27
7.12 INTERNAL SEAL WELDING 27

8 SUPPORTS AND RESTRAINTS 28

8.1 TUBESHEET TOP SUPPORT BEAMS 28
8.2 PRESSURE PART RESTRAINT 28
8.3 FEEDWATER BOX SHIPPING RESTRAINT 29

9 JOINT ASSEMBLY KIT (JAK) INSTALLATION 29

10 PLATFORMS 31

11 EXTERIOR SURFACE 32

12 ACCESS DOORS 32

13 PIPING AND VALVES 32

14 "JUMPER" TUBE INSTALLATION 34

15 VENDOR SUPPLIED ITEMS 35

15.1 FABRIC EXPANSION JOINT (GAS TURBINE DISCHARGE) 35

15.2 SAFETY VALVE SILENCER 35
15.3 SELECTIVE CATALYST REDUCTION (SCR) SYSTEM 37
15.4 CARBON MONOXIDE (CO) CATALYST SYSTEM 39
15.5 DILUTION AIR SYSTEM 42
15.6 STACK DAMPER 43

16 INTERNAL COMPONENTS INSTALLATION 43

16.1 END SEALS 43
16.2 LOWER OTSG MODULE TUBESHEET THERMOCOUPLE INSTALLATION 43
16.3 SCR MODULE THERMOCOUPLE INSTALLATION 44
16.4 INSPECTION OF TUBES & SIDE SEAL GAS BAFFLES (V SEALS) 44
16.5 PIPING INSULATION AND LAGGING 44

17 PRE-SERVICE INSPECTION AND CHECK LIST 46

18 CUSTOMER / CONTRACTOR BACKCHARGE PROCEDURE 51

19 SYSTEM CLEANING 51

19.1 DRY RUN OPERATION 51
19.2 FEEDWATER SYSTEM CLEANING 52

Appendix A - Reference Figures for Erection and Installation Instructions
Appendix B - Extra Work Order Form
Appendix C - Customer Backcharge Procedure and Authorization Form
Appendix D - Painting – IST Specification 11303-0450
Appendix E - Hydrostatic Testing – IST Specification ES-020
Appendix F - Pipe Cleaning – IST Specification ES-021
Appendix G - Outdoor Storage and Shipping Protection – IST specification ES-023
Appendix H - Module Shipping and Lifting Instructions – IST Specification ES-024
Appendix I - Soluble Fiber Insulating Materials – IST Specification ES-026
Appendix J - Feedwater Quality – IST Specification ES-1000

INTRODUCTION

The following document contains installation and erection instructions for the Once Through Steam Generator (OTSG). It must be understood that an OTSG can be supplied in multiple configurations and incorporate various associated equipment. This document will specifically address the OTSGs supplied for the Southcentral Power Project and also outline installation instructions for the associated equipment supplied.

This procedure for erecting a conventional Once-Through Steam Generator (OTSG) and auxiliary equipment was prepared as an overview of the basic steps that should be followed to achieve a successful installation. This procedure is not intended to be a substitute for proper and thorough planning on the part of the erecting agency. However, it will attempt to familiarize the Erectors with the basic procedure for assembling this system in the manner in which it was designed to be assembled.

Contact Innovative Steam Technologies if further information is required:

Main Line: (519) 740-0757 Direct: (519) 740-0757 Fax: (519) 740-2051

Peter Hecimovic – Project Manager Ext. 222

James Tong – Project Engineering Ext. 283

Peter Finlin - Customer Service Supervisor Ext. 270

The Erector should be familiar with these instructions so as to understand the system, and the manner by which it was designed to be assembled.

IMPORTANT

Please be aware that the procedures outlined in this document are not intended to be a substitute for proper and thorough planning. The safe handling and correct placement of the equipment outlined herein is ultimately the responsibility of the customer and their Erector.

All Figures can be found in Appendix A

FIGURE NUMBER	TITLE
1	OTSG Module Shipping Beam Detail
2	Lower OTSG Module Shipping Beam Location
3	Cross Section Through Lower OTSG Module
4	Upper OTSG Module Shipping Beam Location
5	Cross Section Through Upper OTSG Module
6	Inlet Transition Duct #1 Lifting Layout for Shipping
7	Inlet Transition Duct #1 Lifting Layout for Positioning
8	Inlet Transition Duct #2 Lifting Layout for Shipping
9	Inlet Transition Duct #2 Lifting Layout for Positioning
10	Dilution Air Duct Lifting Layout for Shipping
11	Dilution Air Duct Lifting Layout for Positioning
12	Lower Inlet Plenum Lifting Layout for Shipping and Positioning
13	Upper Inlet Plenum Lifting Layout for Shipping and Positioning
14	Lower OTSG Module Lifting Layout for Shipping and Positioning
15	SCR Module Lifting Layout for Shipping and Positioning
16	Upper OTSG Module Lifting Layout for Shipping and Positioning
17	Lower Exhaust Hood Lifting Layout for Shipping and Positioning
18	Upper Exhaust Hood Lifting Layout for Shipping and Positioning
19	Stack Adaptor Lifting Layout for Shipping and Positioning
20	Exhaust Stack Lifting Layout for Shipping
21	Exhaust Stack Lifting Layout for Positioning
22	OTSG Module Top Support Beam Detail
23	Lower OTSG Module Front Restraint Rod / Endseal Detail
24	Lower OTSG Module Rear Restraint Rod / Endseal Detail
25	Upper OTSG Module Front Restraint Rod / Endseal Detail
26	Upper OTSG Module Rear Restraint Rod / Endseal Detail
27	Duct Joint Insulation Sketch

1 ERECTION PACKAGE DRAWING LIST

The following list identifies the complete set of drawings associated with this project that will be required to successfully complete the OTSG installation. Review the list and ensure that hard copies are available at the construction site. Please contact IST if any of the following drawings are required.

Drawing Number	Description
11303-0001	General Arrangement
11303-0002	Foundation Loading Diagram
11303-0003	Baseplate Layout Assembly
11303-0004	Feedwater Steam and Exhaust Flow Sheet
11303-0012	Inlet Transition Duct #1 Assembly
11303-0013	Inlet Transition Duct #2 Assembly
11303-0014	Dilution Air Duct Assembly
11303-0015	Lower Inlet Plenum Assembly
11303-0016	Upper Inlet Plenum Assembly
11303-0017	Lower Exhaust Hood Assembly
11303-0018	Upper Exhaust Hood Assembly
11303-0019	Exhaust Transition Duct Assembly
11303-0020	Exhaust Stack Assembly
11303-0021	Platform Erection Plan and Details
11303-0022	HP Feedwater Inlet Piping Assembly
11303-0024	HP Steam Outlet Piping Assembly
11303-0026	HP Vent Stack Piping Assembly
11303-0027	Erection Diagram and Details
11303-0100	Instrument List
11303-0200	Valve List
11303-0300	Equipment List
11303-0503	JAK Inlet Transition Duct #1 to Inlet Transition Duct #2
11303-0504	JAK Inlet Transition Duct #2 to Dilution Air Duct
11303-0505	JAK Dilution Air Duct Inlet Plenum
11303-0506	JAK Lower Inlet Plenum to Upper Inlet Plenum
11303-0507	JAK Upper Inlet Plenum to Lower OTSG Module
11303-0508	JAK Lower OTSG Module to SCR Module
11303-0509	JAK SCR Module to Upper OTSG Module
11303-0510	JAK Upper OTSG Module to Lower Exhaust Hood
11303-0511	JAK Lower Exhaust Hood to Upper Exhaust Hood
11303-0512	JAK Upper Exhaust Hood to Stack Adaptor
11303-0513	JAK Stack Adaptor to Exhaust Stack

Drawing Number	Description
11303-0601	Lower Module Closure Kit Arrangement
11303-0602	Lower/AIG/CO Module Thermocouple Arrangement
11303-0650	Field Jumper Arrangement
11303-0658	Field Jumper Tube Assembly
11303-0661	Field Jumper Tube Assembly
11303-0664	Field Jumper Tube Assembly
11303-0716	AIG Piping Field Arrangement
11303-0717	Header Shield Kit Arrangement
11303-0728	SCR Module Thermocouple Arrangement
11303-0734	SCR Catalyst Loading Arrangement
11303-0735	CO Catalyst Installation Kit
11303-0736	Cart Rail Extension Frame Assembly

2 RECOMMENDED CONSTRUCTION PRACTICES

2.1 LIFTING OF EQUIPMENT

It is recommended that the lifting procedure of all components utilize conventional hoisting methods. Recommended lifting arrangements are illustrated in Figure 6 to 21.

The final decision as to what lifting method is used remains the full responsibility of the Erector. IST recommends that the lifting arrangements shown in the attached figures be followed. General construction equipment such as spreader beams, choker cables, and shackles are not considered specialized and therefore are the responsibility of the contractor to provide.

2.2 ACCESSING CONNECTION POINTS

There are various methods that can be utilized to provide high elevation access for installing modules, erection plates and welding. Some of which is a man basket, mobile man lift (Genie Boom) or scaffolding (built from the ground up). The most commonly used method is the mobile man lift. Another option is to install temporary tank brackets to the component walls prior to the lift. Tank brackets can be temporarily installed on the vertical structural members and in turn support scaffolding planks and handrails. Brackets are to be installed approximately 3 ft (1 m) below the upper horizontal joint on each of the major components. These include the OTSG module, inlet plenum, and exhaust hood. These brackets will allow construction personnel fast and easy access to erection plates at all field joints, for both bolting and welding. The downside is that it takes time to install these in advance of the lift, and then all need to be

removed once equipment installation is complete and any grinding removal will require touch-up painting.

2.3 CHECKING THE OTSG COMPONENTS FOR LEVEL

To ensure proper fit, and to eliminate excessive gap on the horizontal joints, it is very important to measure the interface points of the each component (all OTSG modules, inlet plenums and exhaust hoods) for level. The number of measuring points should be at least four (4) for small units and six (6) for larger ones. A maximum difference of ¼" (6mm) between measured points on each component is acceptable. For that reason, the measuring method should provide at least 1/8" (3mm) accuracy. The use of water gauges or measuring tapes, measuring from ground elevations, would not provide an accurate measurement, especially for higher elevations. Acceptable measuring practices include utilizing laser type measuring instruments or positioning optical instruments on top of the measured component.
The plenum shall be leveled prior to placing any of the modules in position. The deviation from straightness of the top and bottom surface of the component sidewalls should be checked by running a line from endwall to endwall. Deviation of more than ¼" (6mm) must be reported prior to placing the next component as the modules are very rigid and will not flex to fill the gap.

3 PRE-CONSTRUCTION ACTIVITIES

3.1 SHIPPING DAMAGE

All components should be inspected for shipping damage prior to installation. Ducting components should be inspected for casing, liner, or structural damage. The OTSG modules should have a more thorough inspection that should also include tubing, end restraints and top support beams. Any damage should be reported to IST prior to lifting the component into place.

3.2 OFFLOADING AND SHIPPING BEAMS

In order to protect the OTSG components during shipment, and to facilitate transport, temporary shipping beams have been installed. When an OTSG component is off-loaded from the transport vehicle and placed to rest on the ground, it is necessary that the sidewalls be supported at the jacking points (as a minimum). The jacking points are clearly identified on the module sidewalls and cribbing should be used to spread the load to the vertical wall columns.

Consideration must be given to the placement of the cribbing / blocking so as to not interfere with the removal of the shipping beams. Block points are to be level to ensure no torsion forces are generated in the component.

To remove a shipping beam, unfasten the bolts holding the beam in position to the sidewalls (refer to Figure 1). Once the beam is removed, re-install the bolts in the holes (with the bolt heads on the outside) and seal weld them in position, this will create a gas tight seal.

All temporary structural components and shipping beams are painted yellow prior to shipment. IST must be contacted immediately if there are any doubts as to what items are to be removed.

3.3 OTSG MODULE SHIPPING BEAMS

All shipping beams in the bottom of OTSG lower module are to remain in position throughout the transporting of the module and offloading at site. Before the module is lifted into its final position, the Erector may elect to remove some of the module shipping beams (refer to Figures 2 and 4). A number of shipping beams must remain in place and are only to be removed after the module is in its final position, outer erection plates are installed and the internal seal welding is underway.

3.4 DUCTING COMPONENT SHIPPING BEAMS

Ducting components which include the inlet transition ducts, burner ducts, inlet plenum, SCR module, exhaust hoods, and stack, may also come equipped with shipping beams. All shipping beams within these components are to remain during any transportation of the component to site. Typically, ducting components are large in nature and are not designed with any permanent internal stiffening members. Unless otherwise instructed, IST recommends that all shipping beams remain installed during any placement or lifting of these components. The contractor may find it necessary to remove the odd shipping beam to assist with minor alignment adjustments. This is acceptable to IST but should be first reviewed with the IST site representative. Shipping beams can be removed after the component is in its final position and seal welding is under way.

4 BASE PLATES

Although the OTSG outside casing is a “cold casing” (i.e. insulated inside), provisions have been made to allow expansion of the OTSG unit in both the side-to-side and fore-and-aft directions. The instructions on the Base Plate Layout drawing 11303-0003 should be carefully followed.

The principle of the base plate design is to hold one corner of the OTSG fixed (usually the steam outlet piping corner). The corner base plate on the side opposite the “fixed” corner will allow expansion from side-to-side only and prevent any fore-and-aft movement. Base plates on the same side as the “fixed” base plate, which are parallel to the side of the OTSG, are installed in a manner that allows only fore-and-aft movement and not any side-to-side movement.

In order to allow thermal movements, all base plates, except the “fixed” base plates are to be installed with a Fabreeka pad. The Teflon side of this pad should face up and interface with the

stainless plate welded to the bottom of the base plate. In order to prevent any dust or contamination from damaging the Teflon surface, the slotted hole in the base plate is to be covered with an oversized washer.

At all locations where base plates are designed to move, anchor bolts are to be installed and secured with nuts. Nuts are to be installed "snug" tight then loosened ¼ turn and fixed in position with a tack weld or locked in position with a second nut (jam nut).

Anchor bolts at the "fixed" base plate location are to be installed with nuts. These nuts are to be installed "snug" tight then tightened an additional ¼ turn. The base plate is then required to be welded to the adjacent soleplate, per the Base Plate Layout drawing. All base plate and sole plate components shown on the Base Plate Layout drawing are designed and supplied by IST. All anchor bolts, foundation design, and grouting are designed and supplied by Erector.

The base plate layout drawing indicates all anchor bolt sizes used in the design of the base plate hole and slot sizes. If actual anchor bolts sizes are different than that shown, notify IST immediately.

During the final placement of the soleplates and base plates, survey personnel should ensure that elevations and centrelines are located per design. Centrelines should be scribed on the base plates to act as reference datum lines for the placement of the inlet plenum columns.

After installation of anchor bolts and welding of the inlet plenum columns to the base plates, the Erector is to perform touch-up painting over the welded areas in accordance with Appendix D. The Erector is responsible for the supply of all primer for touch-up required throughout the construction process.

5 ERECTION PLATES

During erection, ducting components are stacked on top of each other and bolted together with erection plates. The erection plates are subsequently welded to the ducting structural beams and internal seal welding is completed in accordance with IST Erection Diagram 11303-0027. At assembly, it is not necessary to perform all welding, however if time permitting, erection plate welding should be completed as the duct components are installed. The exception to this procedure being the lower inlet plenum to upper inlet plenum joint where all erection plate welding and structural welding must be completed prior to any further lifts.

Where ducting erection is completed without immediately welding out the joints, the erection plates and internal seal welding must be completed after the placement of the lower exhaust hood. Erection plate welding and internal seal welding should commence with the lowest joint – upper inlet plenum to lower OTSG module – and progressing upward.

Due to the potential for high winds that can occur during erection, it is necessary to erect the platform steel after the installation of the lower exhaust hood. The platform steel will provide bracing to the overall structure. The platform columns at locations [A1 through A7] on IST Platform Erection Plan and Details 11303-0021, cross beams, and ties will be erected with bolting only to the OTSG ducting prior to installing the upper exhaust hood and exhaust stack assemblies. The following requirements are to be met:

1) The lower inlet plenum and upper inlet plenum must first be aligned and levelled on their respective base plates. The columns must be securely welded to base plates and all erection plates joining the two assemblies must be securely welded before the balance of ducting and OTSG modules can be stacked on top.

2) The lower OTSG module, SCR module, upper OTSG module, and lower exhaust hood can be stacked on top and secured with erection plates by bolting properly tightened to AISC requirements (see Section 5.1). Due to the exhaust stack height, erection plate welding and some internal seal welding must be complete before the upper exhaust hood and exhaust stack can be installed. Refer to Section 7.5 for complete stack erection prerequisites.

3) The connection of the upper exhaust hood to exhaust stack shall be bolted together and immediately welded into position at the corners while the crane is supporting the stack adapter and exhaust hood respectively. Follow the welding instructions given on IST Erection Diagram 11303-0027.

The erection contractor should note that all erection plates are not always the same size, thickness, and the attachment hardware and welding may vary for each location. Please pay strict attention to the Erection Diagram 261027 for the location of applicable erection plates and securing specifics. If you are unsure please contact the on-site IST supervisor or IST head office.

5.1 ERECTION PLATE BOLT TIGHTENING PROCEDURE

Hex bolts are to be installed with the heads on the exterior of the erection plates in accordance with AISC requirements. Bolts shall be installed in all holes of the connection, and brought to a "snug" tight condition. "Snug" tight is defined as the tightness that exists when the plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or from the full effort of a man using an ordinary spud wrench. The tightening process shall progress systematically from the most rigid part of the connection to the free edges, and then the bolts of the connection shall be re-tightened in a similar systematic manner until all bolts are simultaneously "snug" tight and the connection is fully compacted. Following this initial operation, all bolts in the connection shall be tightened further by 1/3 turn. During the tightening operation, there shall be no rotation of the part not turned by the wrench.

6 LIFTING INSTRUCTIONS

Refer to the attached Figures 6 to 21 for recommended lifting arrangements. Ensure proper spreader beams, rigging cables and shackles (supplied by others) are used at all times.

Lifts should be smooth and any form of load shock should be avoided. Take precaution to avoid weak axis lug bending.

7 DUCTING & MODULE INSTALLATION

7.1 ERECTION OF INLET PLENUM – General Procedure

a. The inlet plenum comprises of two (2) major components – a Lower Inlet Plenum, an Upper Inlet Plenum, four (4) loose columns, and a cross brace.

b. Installation of the Lower Inlet Plenum and four (4) loose columns should not be initiated until base plate installation is complete and grouting has taken place and given time to cure before imposing loads.

c. Remove tarps from the top framing of the Lower Inlet Plenum and Upper Inlet Plenum.

d. The Lower Inlet Plenum assembly is to be lifted and positioned such that each column rests centrally on its respective base plate, which were previously positioned and scribed during the initial layout (See "Base Plates" in Section 4). For the recommended lifting arrangement of the lower inlet plenum refer to Figure 12. Upon setting the lower inlet plenum assembly, ensure that the main columns are vertical and centered on the centerline of the base plates. At this time, check that the inlet opening centerline is aligned with the centerline of the gas turbine discharge. The most critical position is the "fixed" column, having this correctly located will ensure proper tie-in points to piping and ducting. The elevation height from the top of the lower inlet plenum to the base plate should be measured and confirmed with IST drawings. With a transit, check the top four (4) corners of the plenum for level before proceeding to weld columns to base plates.

e. Weld the column beams to the relevant base plates per IST Base Plate Layout Assembly drawing 11303-0003.

f. Stand in position and temporarily brace the four (4) loose vertical columns at grid lines 1 and 2. Loosely install the erection splice plates with the hardware provided. Ensure the columns are centered on their respective base plates.

g. The upper inlet plenum assembly is then lifted and placed on top of the lower inlet plenum assembly. Guide plates are installed on the perimeter horizontal beams to assist while lowering it into position. For the recommended lifting arrangement of the upper inlet plenum refer to Figure 13. Keep the upper inlet plenum on the crane hook as the four (4) columns at grid lines 1 and 2 are aligned and mechanically connected with erection splice plates and hardware provided. Once alignment of the columns with the upper inlet plenum is complete, weld the four (4) column beams to the relevant base plates per IST Base Plate Layout Assembly drawing 11303-0003.

h. Once the overall inlet plenum assembly is properly aligned and mechanically secured, weld all of the erection plates per IST Erection Diagram 11303-0027 and use full penetration welds at all required locations along the plenum joint. Closely follow the welding instructions on the IST Erection Diagram as various types and sizes of weld are required at different locations.

i. Weld the splice plates that attach the upper inlet plenum to the loose columns per IST Erection Diagram. Weld the column beams together where they meet and finally weld the columns to their respective base plate per IST Base Plate Layout Assembly drawing 11303-0003.

j. Once the erection plate welding is complete, internal seal welding at the casing interface can commence. Refer to IST Erection Diagram 11303-0027 for welding instructions.

k. Ensure that all upper inlet plenum to lower inlet plenum internal seal welding is complete. All temporary shipping beams can now be removed. Shipping beam bolts should be reinserted back into the open holes and seal welded around the bolt shoulder.

l. The Joint Assembly Kit (JAK) 11303-0506 between upper and lower inlet plenums can be installed immediately after internal seal welding is complete or at a later time at the discretion of the Erector.

m. Scaffolding should now be installed inside the upper inlet plenum to access the joint between the upper inlet plenum and lower OTSG module. A working platform should be created at an elevation that will accommodate internal seal welding and joint assembly kit installation.

n. If required, scaffolding external to the boiler can also be constructed to reach the joint assembly kit elevation. Alternatively, tank brackets can now be installed to the exterior columns as detailed Section 2.2.

o. Welding of all inlet plenum structural components must be complete before the OTSG module is installed to the Inlet Plenum assembly.

7.2 ERECTION OF LOWER OTSG MODULE – General Procedure

NOTE

The arrival of the IST site representative is coordinated with this point of the installation process. IST recommends that our representative be on site prior to continuing forward with the installation procedure.

a. Installation of the Lower OTSG Module should commence only after the inlet plenum is installed and all the required welding is complete. This will ensure proper structural integrity exists as the load on the inlet plenum is increased. Prior to lifting the module, ensure that all required scaffolding inside the inlet plenum is complete.

b. Ensure that only the identified shipping beams as specified in Figure 2 are removed. Once the beams are removed, re-install the bolts in the holes (with the bolt heads on the outside) and seal weld them in position to create a gas tight seal. A cross-section of the Lower OTSG Module is found in Figure 3.

c. Remove tarps from top of the module framing. Plywood is to be placed on the top surface of the fin tubes between the top support beams to prevent damage to finned tubes from falling debris and by distributing any weight placed on top of the tubes. Plywood is also to be placed on the top surface of the installed Ammonia Injection Grid (AIG) lances to prevent debris from plugging the injection holes and to distribute weight placed on top of the lances. Any weight placed on the AIG must be distributed over a minimum of four lances.

d. The joint assembly kit (JAK) 11303-0506 and lower module closure kit 11303-01601 may be placed on top of the CO catalyst frame prior to the lift or immediately after the lift. These components must be stored in the Lower OTSG Module prior to placing the SCR Module.

e. Scaffolding should now be installed inside the Lower OTSG Module to access the joint with the SCR Module. A working platform should be created at an elevation that will accommodate internal seal welding and joint assembly kit installation.

f. If required, scaffolding external to the boiler can also be constructed to reach the Lower OTSG Module and SCR Module joint elevation. Alternatively, tank brackets can now be installed to the exterior columns as detailed Section 2.2.

g. Lift the Lower OTSG Module vertically using spreader beams as per the lifting arrangement shown in Figure 14.

h. Carefully place the Lower OTSG Module on top of the Upper Inlet Plenum. Guide plates have been installed during fabrication to assist in the alignment during this installation process. Ensure that columns and stiffeners are aligned properly and that the top of the module is level. Mechanically secure erection plates at all connections using the supplied bolting hardware. Refer to Section 5.0 and IST Erection Diagram 11303-0027 for details.

i. It is recommended that erection plate welding and seam welding between the Upper Inlet Plenum and Lower OTSG Module be completed at this point. Only after all erection plates have been welded and seam welding between the Upper Inlet Plenum and Lower OTSG Module are complete can the remaining shipping beams at the base of the Lower OTSG Module and at the top of the Upper Inlet Plenum be removed. Shipping beams at the top of the Lower OTSG Module can be removed only after seal welding with the SCR Module has been completed. Remove the remaining shipping beams by unfastening the bolts holding the beam in position to the sidewalls. Once the beam is removed, re-install the bolts in the holes and seal weld them in position to create a gas tight seal. All temporary structural components and shipping beams are painted yellow prior to shipment. IST must be contacted immediately if there are any doubts as to what items are to be removed and/or when they are to be removed.

j. Top support beam end clip angles and studs should not be removed until the SCR Module is in position and the majority of the internal seal welding between the Lower OTSG Module and SCR Module is completed in order to prevent any sidewall deflection.

k. Due to the proximity with the main lifting points on the Lower OTSG Module, two (2) Ammonia Injection Grid (AIG) lance assemblies are shipped loose for assembly at site. The two AIG lances should be placed on the CO catalyst frame once the Lower OTSG Module is mechanically secured in place. The Erector has the option of continuing with the placement of the SCR module at this point or completing the AIG lance installation.

l. The 2" NPS Sch. 40 inlet nozzle of the lance assemblies are located directly behind the module lifting lugs on the non-platform side of the module. The lance assembly with an internal manifold from which four HSS 2" x 2" lances project towards the opposite wall. The four lances will be inserted into receptacles in the sidewalls while the inlet nozzle will protrude outside beyond the Lower OTSG Module casing. A stainless steel patch ring will be welded over the sidewall opening and be used to level and center the AIG lance assembly.

m. Internal insulation and the lower module closure kit 11303-0601 may be installed upon completion of the AIG lance assemblies. Internal insulation and the Upper Inlet Plenum to Lower OTSG Module JAK 261508 may also be installed at this time.

n.

NOTE

Prior to working on top of OTSG module, tubes and AIG lance assemblies shall be covered with plywood and fire blankets. Failure to do so will result in possible warranty invalidation. Extreme care must always be exercised to prevent any possible damage to the pressure tubes and AIG lances. Do not support heavy equipment or liner panels (greater than 200 lb [90 kg]) on the tubes and AIG lances and ensure that loads are spread over multiple tube surfaces.

7.3 ERECTION OF SCR MODULE – General Procedure

a. Installation of the SCR Module should commence only after installation of the Lower OTSG Module is complete. This will ensure proper structural integrity exists as the load on the inlet plenum is increased. Prior to lifting the module, ensure that all required scaffolding inside Lower OTSG Module is complete and that the Lower OTSG Module to SCR Module joint assembly kit 11303-0508 is placed inside. Ensure erection plates and hardware are placed in the lower sidewall beam gutters for easy access.

b. Remove tarp from top of the SCR Module framing

c. Ensure that all temporary shipping beams and bracing remain in the assembly until the SCR Module is mechanically secured.

d. The JAK 11303-0509 may be placed on top of SCR frame in the module prior to the lift or immediately after the lift. These components must be stored in the SCR Module prior to placing the Upper OTSG Module.

e. Lift the SCR Module vertically using spreader beams as per the lifting arrangement shown in Figure 15.

f. Carefully place the SCR Module on top of the Lower OTSG Module. Guide plates have been installed during fabrication to assist in the alignment during this installation process. Ensure that columns and stiffeners are aligned properly and that the top of the module is level. Mechanically secure erection plates at all connections using the supplied bolting hardware. Refer to Section 5.0 and IST Erection Diagram 11303-0027 for details.

g. It is recommended that erection plate welding and seam welding between the Lower OTSG Module and SCR Module be completed at this point. Only after all erection plates have been welded and seam welding between the Lower OTSG Module and SCR Module are complete can the remaining shipping beams and braces at the top of the Lower OTSG Module and at the base of the SCR Module be removed. Shipping beams at the top of the SCR Module can be removed once seal welding between the SCR Module and Upper OTSG Module have been completed. Remove the remaining shipping beams by

unfastening the bolts holding the beam in position to the sidewalls. Once the beam is removed, re-install the bolts in the holes and seal weld them in position to create a gas tight seal. All temporary structural components and shipping beams are painted yellow prior to shipment. IST must be contacted immediately if there are any doubts as to what items are to be removed and/or when they are to be removed.

h. SCR support beam end clip angles and studs should not be removed until the Upper OTSG Module is in position and the majority of the internal seal welding between the SCR Module and Upper OTSG Module is completed in order to prevent any sidewall deflection.

i. The support beam clip angles are temporary shipping restraints that are removed during the erection process. All support beam clip angles that are painted yellow must be removed. Once the angles are removed, the bolts are to be reinserted into their respective holes in the sidewall, their heads cut off with a grinder, and seal welded. Care must be taken to ensure that the remaining bolt body be either ground flush with the beam flange or be left in a position that allows sufficient clearance to the side of the support beam. Minimum clearance from the end of the support beam to any bolting inserted into the wall is 1" [25 mm]. For the support beam located closest to the head end, the beam is allowed to grow axially but prevented from moving laterally in the unit. The restraint angles are therefore not to be removed (hence they are not painted yellow). Only the stud restraining the support beam to the restraint angles is to be removed at both ends (refer to Figure 22).

j. Internal insulation and the Lower OTSG Module to SCR Module JAK 11303-0508 can be installed upon completion of the internal seal welding of the two assemblies.

7.4 ERECTION OF UPPER OTSG MODULE – General Procedure

a. Installation of the Upper OTSG Module should commence only after installation of the SCR Module is complete. This will ensure proper structural integrity exists as the load on the SCR Module is increased. Prior to lifting the module, ensure that all required scaffolding inside the SCR Module is complete.

b. Ensure that only the identified shipping beams as specified in Figure 4 are removed. Once the beams are removed, re-install the bolts in the holes (with the bolt heads on the outside) and seal weld them in position to create a gas tight seal. A cross section of the Upper OTSG Module is found in Figure 5.

c. Remove tarp from top of the module framing. Plywood is to be placed on the top surface of the fin tubes between the top support beams to prevent damage to finned tubes from falling debris and by distributing any weight placed on top of the tubes.

d. The JAK 11303-0510 may be placed on top of Upper OTSG Module prior to the lift or immediately after the lift. These components must be stored on top of the Upper OTSG Module prior to placing the Lower Exhaust Hood.

e. If required, scaffolding external to the boiler can also be constructed to reach the Upper OTSG Module and Lower Exhaust Hood joint elevation. Alternatively, tank brackets can now be installed to the exterior columns as detailed Section 2.2.

f. Lift the Upper OTSG Module vertically using spreader beams as per the lifting arrangement shown in Figure 16.

g. Carefully place the Upper OTSG Module on top of the SCR Module. Guide plates have been installed during fabrication to assist in the alignment during this installation process. Ensure that columns and stiffeners are aligned properly and that the top of the module is level. Mechanically secure erection plates at all connections using the supplied bolting hardware. Refer to Section 5.0 and IST Erection Diagram 11303-0027 for details.

h. It is recommended that erection plate welding and seam welding between the SCR Module and Upper OTSG Module be completed at this point. Only after all erection plates have been welded and seam welding between the SCR Module and Upper OTSG Module are complete can the remaining shipping beams and braces of the Upper OTSG Module and at the top of the SCR Module be removed. Remove the remaining shipping beams by unfastening the bolts holding the beam in position to the sidewalls. Once the beam is removed, re-install the bolts in the holes and seal weld them in position to create a gas tight seal. All temporary structural components and shipping beams are painted yellow prior to shipment. IST must be contacted immediately if there are any doubts as to what items are to be removed and/or when they are to be removed.

i. Upon completion of internal seal welding, internal insulation and installation of the Upper OTSG Module to SCR Module JAK 11303-0509 can be installed.

j. Top support beam end clip angles and studs should not be removed until the Lower Exhaust Hood is in position and the majority of the internal seal welding between the Upper OTSG Module and Lower Exhaust Hood is completed in order to prevent any sidewall deflection.

7.5 ERECTION OF LOWER EXHAUST HOOD – General Procedure

a. Installation of the Lower Exhaust Hood should commence only after installation of the Upper OTSG Module is complete. This will ensure proper structural integrity exists as the load on the Upper OTSG Module is increased.

b. Remove tarp from top of the Lower Exhaust Hood framing. Plywood is to be placed on the top surface of the silencer baffles to prevent damage to internal structure from falling debris and by distributing any weight placed on top of the baffle assembly.

c. Place the Lower Exhaust Hood to Upper Exhaust Hood JAK 11303-0511, the Upper Exhaust Hood to Stack Adaptor JAK 11303-0512, and the Stack Adaptor to Exhaust Stack JAK 11303-0513 on top of the silencer baffles prior to lifting the Lower Exhaust Hood. Otherwise, place these JAKs on the silencer baffles prior to placing the Upper Exhaust Hood assembly.

d. Temporary shipping beams are to be removed only after the internal seal welding is underway and erection plates are securely bolted and welded. They are only to be removed prior to the lift if there is interference with the top support beams. After removal of temporary shipping beams, the bolts are to be placed back into the holes and seal welded into position.

e. The Lower Exhaust Hood assembly is to be lifted vertically using spreader beams as designated in Figure 17. Guide plates have been installed during the fabrication to assist with alignment during erection. Ensure that columns and stiffeners are aligned properly and that the top of the Lower Exhaust Hood is level. Mechanically secure erection plates at all connections using the supplied bolting hardware. Refer to Section 5.0 and IST Erection Diagram 11303-0027 for details.

f. If gaps are evident at end joints between the Lower Exhaust Hood and the Upper OTSG Module as a result of the fit up, the outer most erection plates may be required to be left off until internal welding is complete. Some pressure jacking may be required to force gaps closed and minimize closure welds.

g. It is recommended that erection plate welding and seam welding between the Upper OTSG Module and Lower Exhaust Hood be completed at this point. Only after all erection plates have been welded and seam welding between the Upper OTSG Module and Lower Exhaust Hood are complete can the remaining shipping beams and braces at the bottom of the Lower Exhaust Hood be removed. Remove the remaining shipping beams by unfastening the bolts holding the beam in position to the sidewalls. Once the beam is removed, re-install the bolts in the holes and seal weld them in position to create a gas tight seal. All temporary structural components and shipping beams are painted yellow prior to shipment. IST must be contacted immediately if there are any doubts as to what items are to be removed and/or when they are to be removed.

h. Internal insulation and installation of the Upper OTSG Module to Lower Exhaust Hood JAK may commence after completion of the internal seal weld between the two assemblies.

i. Due to the potential for high winds that can occur during erection, it is necessary to erect the platform steel after the installation of the lower exhaust hood. The platform steel will provide bracing to the overall structure. See Section 10 for complete installation procedures for the platform steel.

7.6 ERECTION OF UPPER EXHAUST HOOD – General Procedure

a. Installation of the Upper Exhaust Hood should commence only after installation of the Lower OTSG Module and all platform steel is complete. This will ensure proper structural integrity exists as the load on the Lower Exhaust Hood is increased.

b. Remove tarps from top of the Upper Exhaust Hood framing.

c. Ensure erection plates and hardware are placed in the lower sidewall beam gutters for easy access. Safety handrailing should also be placed at the upper ends of exhaust hood for the benefit of the welders who will eventually be working in that region making the final bolting and welding of the stack adapter.

d. Temporary shipping beams are to be removed only after the internal seal welding is underway and erection plates are securely bolted and welded. After removal of temporary shipping beams, the bolts are to be placed back into the holes and seal welded into position.

e. The Upper Exhaust Hood assembly is to be lifted vertically using spreader beams as designated in Figure 18. Guide plates have been installed during the fabrication to assist with alignment during erection. Ensure that columns and stiffeners are aligned properly and that the top of the Upper Exhaust Hood is level. Mechanically secure erection plates at all connections using the supplied bolting hardware. Refer to Section 5.0 and IST Erection Diagram 11303-0027 for details.

f. A closure plate is installed to cover the gap in the front and rear wall casing between the Lower Exhaust Hood and Upper Exhaust Hood. The closure plate will be seal welded to the duct casing on the exterior and stitch welded on the inside. Refer to IST Erection Diagram 11303-0027 for details.

g. Internal insulation and installation of the Upper Lower Exhaust Hood to Upper Exhaust Hood JAK 11303-0512 may commence after completion of the internal seal weld between the two assemblies.

7.7 ERECTION OF STACK ADAPTER – General Procedure

a. Installation of the Stack Adapter should commence only after installation of the Upper Exhaust Hood is complete. This will ensure proper structural integrity exists as the load on the Upper Exhaust Hood is increased.

b. Remove tarps from top of the Stack Adapter assembly.

c. The adapter assembly should be shored up on the ground in the vertical position. Any temporary bracing inside the adapter assembly can be removed at this time.

d. Ensure erection plates and hardware are placed in the lower sidewall beam gutters for easy access. Safety handrailing should also be placed at the top of the stack adapter for the benefit of the welders who will eventually be working in that region making the final bolting and welding of the exhaust stack.

e. Once the overall adapter assembly has been made ready, it should be taken directly to the top of the upper exhaust hood for placement. The Stack Adapter assembly is to be lifted vertically using spreader beams as designated in Figure 19. **Note orientation of the adapter.**

f. The adapter assembly section will rest on the upper exhaust hood channel frame and holes on the mating faces must be aligned and secured with erection hardware provided. Ensure that the top of the stack adapter is level. Once secured atop the exhaust hood, welding of the internal and external seam at the upper exhaust hood to stack adapter joint will begin. It is recommended that a minimum of 12" (300 mm) of internal/external casing seam weld be completed at each corner before removing rigging from the top of the adapter. Refer to IST Erection Diagram 11303-0027 for details.

g. Full penetration continuous seal welding must be performed on the inside and outside perimeter of the exhaust hood to adapter joint as soon as possible.

h. Internal insulation and installation of the Upper Exhaust Hood to Stack Adapter JAK 11303-0513 may commence after completion of the internal seal weld between the two assemblies.

7.8 ERECTION OF EXHAUST STACK – General Procedure

a. Erection of the exhaust stack can only proceed after the following steps have been completed:

- All inlet plenum columns to base plate welds are complete and all base plates are secured to the anchor bolts.
- Inlet plenum diagonal bracing is installed and completely welded.
- All erection plates are completely welded at all ducting assembly joints.
- External and internal seal welding is complete for a length of at least 12" (305 mm) on either side of every column and at least 25% of the entire lengths of all seal welds are complete at all ducting assembly joints.
- Platform columns are erected and welded to their base plates which are secured to the anchor bolts.
- Beams between all platform columns and between the platform and the OTSG are installed and completely fastened.
- Cross bracing between the platform columns and the OTSG are installed and completely welded.

b. The Exhaust Stack assembly is designed to be lifted in a single section, although it may have its respective platform assembly installed on the ground prior to the lift. This requires that the stack section be offloaded on the ground in a horizontal position on solid temporary cribbing. Refer to horizontal and vertical rigging sketches Figures 20 and 21. Once the platform sections are attached, assembly can be lifted vertically into position.

c. Care should be taken when assembling the platforms to the stack. The Exhaust Stack should be shored up on the ground using temporary cribbing and having the orientation such that the top lifting lugs are on the strong axis for the subsequent vertical lift. Certain sections of the stack platform may have to be left off and installed once the stack is erected.

d. As soon as the platform assembly to the Exhaust Stack is completed, it can be simultaneously rotated and lifted. This can be accomplished using 2 lifting cranes – a main lift crane with rolling sheave blocks at the top of the stack to distribute loading equally to the lifting lugs and a tailing crane near the bottom of the stack to lift the end off the ground and prevent stack damage. Comprehensive planning is necessary on the part of the Erector to negotiate this complex lift from the horizontal to vertical position.

e. Once the stack / platform assembly is in the vertical position, it should be taken directly to the top of the exhaust hood for installation. Do not set the stack assembly back on the ground once it is lifted. This will avoid damaging the bottom casing of the Exhaust Stack.

f. The interface of the Exhaust Stack casing into the Stack Adapter has been designed as a clearance fit. If required, additional slitting of the stack casing lower corners will give additional flexibility to fit into the Stack Adapter opening.

g. The Exhaust Stack casing will insert into the Stack Adapter opening by approximately 2" (50 mm). Note the orientation of the stack before carefully lowering the Exhaust Stack

onto the Stack Adapter. The four Stack Adapter to Exhaust Stack erection plates are installed and secured with the erection hardware provided, leaving a 3/8" (10 mm) gap at the four vertical columns. Refer to the IST Erection Diagram 11303-0027 for details. The load is not to be released from the crane hook until the stitch and external seal welds between the Exhaust Stack and Upper Exhaust Hood are completed.

h. The stack shall be true and plumb to within 2" (50 mm) in 100 ft (30 m) based on ASME STS-1-2000 Steel Stacks.

i. Internal insulation and installation of the Stack Adapter to Exhaust Stack JAK 11303-0513 can commence once internal seam welding at the joint is completed.

j. The obstruction lights should be installed and made operational as soon as possible the exhaust stack assembly is erected.

7.9 ERECTION OF DILUTION AIR DUCT – General Procedure

a. The dilution air duct section is located upstream of the inlet plenum. The dilution air duct is designed to slip fit into the inlet plenum ductwork opening. It is up to the Erector to decide whether to build the ducting towards the gas turbine or upwards to the exhaust stack following the completion of the Inlet Plenum installation. This decision typically rests on the most effective use of available crane time on site.

b. Prior to obstructing all sizeable openings, ensure that the dilution air duct JAK 11303-0505 is inside the ducting. Otherwise some components will not fit through the access doors.

c. The Dilution Air Duct assembly is to be lifted vertically utilizing spreader beams and rigging as shown in Figure 13. This ductwork is to be lowered directly in front of the inlet plenum opening. Keeping the ductwork on the hook, pull the duct section into the frame of the Inlet Plenum. Ensure the alignment of the burner duct centerline with the gas turbine discharge centerline. The height from the top of the burner duct to top of concrete should be measured and confirmed with IST drawings. With a transit, check the top four (4) corners of the burner duct for level.

d. Once alignment of the duct is confirmed, the columns will be welded to the base plates in accordance with the instructions shown on Base Plate Layout Assembly drawing 11303-0003. Tack weld the dilution air duct to the inlet plenum before removing the lifting equipment.

e. Seal welding of the casing perimeter between Dilution Air Duct and Inlet Plenums can commence. Two gusset plates will be welded to the underside of Dilution Air Duct at

columns B7 and E7 as shown on the IST Erection Diagram 11303-0027 once seal welding of the casing perimeter is complete.

f. Any temporary bracing installed in the interior of the duct can be removed after all casing welds are complete. Internal insulation and JAK installation can commence after the completion of internal casing welds.

7.10 ERECTION OF INLET TRANSITION DUCT – General Procedure

a. The Inlet Transition Duct comprises of two (2) major assemblies – Inlet Transition Duct #1 and Inlet Transition Duct #2. Installation of Inlet Transition Duct #2 commences only after installation of the Dilution Air Duct is complete. Prior to obstructing all sizeable openings, ensure that all the appropriate joint assembly kits 11303-0503 and 11303-0504 are inside the ducting, otherwise some components will not fit through the access doors.

b. Inlet Transition Duct #2 is to be lifted vertically with a rigging arrangement as shown in Figure 9. This ductwork section is to be lowered directly in front of the dilution air duct opening. Keeping the duct on the hook, pull the duct section inside the opening of the burner duct. Ensure the alignment of the burner duct centerline with the gas turbine discharge centerline. The elevation height from the top of the inlet transition duct to the top of concrete should be measured and confirmed with IST drawings.

c. As Inlet Transition Duct #2 is not self-supported by columns, cribbing must be placed under the duct to support its weight until the installation of Inlet Transition Duct #2. Tack weld the duct to the dilution air duct before removing the lifting equipment.

d. Seal welding of the casing perimeter between Inlet Transition Duct #2 and Dilution Air Duct can commence.

e. Any temporary bracing installed in the interior of the duct can be removed after all casing welds are complete. Internal insulation and JAK installation can commence after the completion of internal casing welds.

f. Installation of Inlet Transition Duct #1 should commence only after the complete installation of Inlet Transition Duct #2. The duct assembly is to be lifted vertically utilizing spreader beams and rigging as shown in Figure 7. This ductwork is to be lowered directly in front of the Inlet Transition Duct #2 opening. Keeping the ductwork on the hook, pull the duct section such that the outlet frame fits over the Burner Duct #2 inlet opening. Center the columns of Burner Duct #1 over their respective base plates and rest the duct securely on the base plates. Ensure the alignment of the burner duct centerline with the gas turbine discharge centerline. The height from the top of the burner duct to top of concrete should be measured and confirmed with IST drawings.

g. Ensure the inlet flange is aligned with the gas turbine discharge centerline. The dimensional position of the Inlet Transition Duct should be checked and that it is centered accordingly and that a 20" [510 mm] gap from the Inlet Transition Duct flange to the GT flange is maintained for insertion of the expansion joint.

h. Weld columns to base plates as specified on IST Base Plate Layout Assembly drawing 11303-0003.

i. Seal welding of the casing perimeter between Inlet Transition Duct #2 and Inlet Transition Duct #1 can commence.

j. Any temporary bracing installed in the interior of the duct can be removed after completion of column to base plate welding.

k. The next piece to be installed to this group is the expansion joint. Break the tack welds on the inlet transition duct flange and adjust it back (if required). This will provide a larger opening for insertion of the expansion joint if needed and also allow for adjustment during the final fit up. Prior to lowering the expansion joint into position, gasket tape must first be applied to the inlet and outlet flange faces of the expansion joint assembly. The expansion joint is to be installed in its preset compressed condition by first attaching to the Inlet Transition Duct flange with the hardware provided.

l. Loosen designated bolts on the expansion joint preset bars as illustrated on the expansion joint drawing and expand the joint to its required cold operational setting. Bolt upstream expansion joint flange securely to gas turbine exhaust flange.

m. Once the expansion joint is installed and positioned properly, the angle flange on the inlet transition duct can be seal welded around the entire casing perimeter. Refer to IST Erection Diagram 11303-0027.

n. After the expansion joint is installed, internal installation of the joint assembly kit can commence.

7.11 ERECTION PLATE WELDING

NOTE

If any gaps exist at the interface of two components, it is recommended that the internal seal welding be performed prior to any erection plate welding. See Section 8.7 *Internal Seal Welding* for instructions. Slight adjustment to the erection plate holes may be necessary at site. It is at this time of the OTSG installation process that erection plates are welded to the structural beams that they are bolted to. Depending on which construction option was chosen in Section 8.0 *Ducting & Module Installation*, most erection plates may already be welded at this point. If not, continue erection plate welding until complete. Welding requirements are outlined on the IST Erection drawing.

During the OTSG installation process, erection plates are welded to the structural beams that they are bolted to. Depending on which construction option is chosen, erection plates may be welded while individual assemblies are erected or may be completed immediately after the installation of the Lower Exhaust Hood. Welding requirements are outlined on the IST Erection Diagram.

Erection plate welding shall be commenced as quickly as possible after the components have been assembled. The Erector shall minimize the amount of time the structure stands without full structural welding completed.

7.12 INTERNAL SEAL WELDING

After the installation of a component and once the associated erection plates are welded, internal seam welding should commence. Specific requirements for these welds are outlined on the IST Erection drawings. Seal welding is required at each interface of two components to form a gas tight enclosure.

During the fabrication of the large OTSG module and ductwork components, it is possible that any variance in straightness will result in gaps at either end. This is noticeable when two components are stacked upon each other. In order to compensate for these gaps it is best, during seal welding, to have two (2) welders inside the unit. Both welders should start welding at the middle point of the unit, one on the left wall and one on the right wall. They should weld simultaneously towards the end with the gap. The continuous welding in the one direction will effectively reduce a large portion of the existing gap. This will help to eliminate multiple closure weld passes at the end wall. The Erector may find that the erection plates on the end walls may need to be left off until this internal seal welding is complete. Hydraulic jacks may also be used to force gaps closed and minimize the closure welds.

Inspect all seal welds for adequate size and completeness. Once seal welding is complete, all temporary shipping beams and/or braces can be removed. Ensure that any bolt holes from these beams are covered by having the bolt re-installed and seal welded in place.

8 SUPPORTS AND RESTRAINTS

8.1 TUBESHEET TOP SUPPORT BEAMS

The tube bundles in the OTSG Modules are supported from tubesheets hung vertically from top support beams (refer to Figure 3 and 5) tubesheet support beams are end-supported on expansion pads that allow axial growth towards the sidewalls and to the rear (refer to Figure 22). In addition, all tubesheet support beams, except for the one farthest from the header end, are interconnected along the length of the unit via the use of "push" pipes. To accommodate thermal expansion, the ends of the support beams must not be restrained. During shipping, the ends of the beams are restrained with shipping angles. These angles, which are painted yellow, must be removed (refer to Figure 22). Once the shipping angles are removed, the bolts are to be reinserted into their respective holes in the sidewall, their heads cut off with a grinder, and seal welded. Care must be taken to ensure that the remaining bolt body be either ground flush with the beam flange or be left in a position that allows sufficient clearance to the side of the top support beam. Minimum clearance from the end of the top support beam to any bolting inserted into the wall is 1" [25 mm].

The shipping angles shall be removed only after the majority of the peripheral internal seal weld has been completed between all support beams. Once the angles are moved, the remaining seal welding can be completed.

For the top support beam located farthest from the header end, the beam is allowed to grow laterally (side to side) but prevented from moving longitudinally (fore and aft) within the module. The restraint angles are therefore not to be removed (hence they are not painted yellow). Only the studs restraining the support beam to the restraint angles is to be removed at both ends (refer to Figure 22).

When all required top support beam shipping angles have been removed and the inside periphery of the lower module to SCR module joint and the upper module to lower exhaust hood joint have been welded, the joint assembly kit may be installed. Refer to Section 9.0. Ensure that the joint assembly kit liner panels are installed such that tubesheet top support beam growth is not hindered.

8.2 PRESSURE PART RESTRAINT

The tube bundle is restrained in position with rods that extend from the end casing to the return bend restraint assemblies (refer to Figures 23 to 26). To prevent damage during shipping, rubber strips have been inserted between the return bend inner restraints and the inside surface of the return bends. All rubber strips must be removed prior to operation.

The return bend end pattern design of the internal pressure boundary matrix is a hybrid arrangement containing a zigzag arrangement in the economizer and evaporator sections and an

inline arrangement in the superheater section. The zigzag return bend restraints use a 'double bar' restraint located at the inside of the return bends. The inline return bend restraints use a "pipe" restraint located at the inside of the return bends. These restraints will be used to hold the tube bundle in position during operation.

Please note that throughout this document, reference will be made to the 'front' end. This end of the module will be at the feedwater box or header end.

At all restraint levels, the gap between the inside of the return bend and the double bar restraint is to be adjusted to have a gap of 0" to 1/16" [0 to 2 mm] maximum after the protective rubber is removed. Care must be taken not to damage the return bends. Note that it may be possible to remove the shipping rubber without having to readjust the restraints, provided the clearance after the rubber is removed is 0" to 1/16" [0 to 2 mm]. It is allowable to have minimal clearance between restraints at some of the return bends, but the majority should just touch.

For restraint positions 1, 3, 5, and 6 as shown on Figures 23 and 25, a gap of no more than ¼" [6 mm] must be maintained between the outside of the return bend and the push pipe restraint.

Once installed, all restraints at all levels must be checked at the wall bracket location to ensure that each is securely fastened.

CAUTION

The proper adjustment of the return bend restraints is critical to the reliable operation of the OTSG. Improperly adjusted restraints can lead to pressure part and restraint failure. It is highly recommended that an IST Service Representative be on site during this stage of the construction.

8.3 FEEDWATER BOX SHIPPING RESTRAINT

Temporary restraints consisting of lumber and zip ties are installed inside the feedwater box for shipping purposes. Completely remove these restraints prior to commissioning the OTSG.

9 JOINT ASSEMBLY KIT (JAK) INSTALLATION

Once the internal seam welding is completed, shipping beams removed, and all bolt holes plugged, the joint assembly kits can be installed. These kits comprise of insulation, stainless steel liner panels, retaining channels, washers, and nuts.

Proper planning by the Erector will ensure that all required joint assembly kit components are placed in their proper location, inside the unit, during installation of each OTSG assembly.

Concentrated loading of joint assembly kit components directly onto finned tubes is strictly prohibited. JAK liner panels should straddle top support beams or be distributed over the tube surface in several areas. Insulation bundles can be set directly on tubes between top support beams.

JAK installation is required at the following component interfaces:

1. Expansion Joint to Inlet Transition Duct #1
2. Inlet Transition Duct #1 to Inlet Transition Duct #2
3. Inlet Transition Duct #2 to Dilution Air Duct
4. Dilution Air Duct to Upper/Lower Inlet Plenum
5. Lower Inlet Plenum to Upper Inlet Plenum
6. Upper Inlet Plenum to Lower OTSG Module
7. Lower OTSG Module to SCR Module
8. SCR Module to Upper OTSG Module
9. Upper OTSG Module to Lower Exhaust Hood
10. Lower Exhaust Hood to Upper Exhaust Hood
11. Upper Exhaust Hood to Stack Adapter
12. Stack Adapter to Exhaust Stack

Prior to joint assembly kit installation, inspect all liner plates. They should be flat or have distortion less than a ½" [12 mm].

The installed insulation should be tight fitting and joints should be staggered to prevent hot spots, refer to the individual JAK drawings for details. All insulation being installed in JAK locations is clearly indicated in the JAK drawing. In the case of insulated joints with liners to achieve the required 6" [150 mm] thickness, insulation is to be installed in layers. The insulation is then compressed to 5½" [140 mm] when the liner panels are secured in place. The insulation density is provided in the individual joint assembly kit drawings.

Ensure that liner panels are installed in the correct, overlapping sequence. Once the joint assembly kit liner panels are placed in position, retaining channels, washers and then nuts can be installed.

The liner sections immediately adjacent to the top support beams are floating, as they must allow the beams to expand along the length of the unit, as well as side-to-side. These floating panels are to be installed directly after the placement of insulation and are to be placed local to the ends of the top support beam.

IMPORTANT

The nuts installed on the studs, at all JAK locations, should be "snug" tight, then backed off ¼ turn and then tack welded. This will ensure that the liner panel is not secured too tightly as to prohibit liner plate movement during thermal expansion.

10 PLATFORMS

Check that platforms are in conformance with IST supplied drawings and that the platforms and other OTSG attachments do not place any restraint on the OTSG thermal growth. The platform is an integral part of the OTSG structure and will have to be erected in sequence with the boiler. Due to the potential for high winds during construction, the platform steel must be installed prior to the placement of the Upper Exhaust Hood assembly. See Section 7.0. Refer to the IST Platform Arrangement drawing 11303-0021, installation detail drawings [TBD], and fabrication detail drawings [TBD] for all erection details.

At the start of platform installation, the major columns along gridline A are to be centred over their respective base plates and welded into place. Gusset plates for cross bracing along the base of gridline B must be welded to the duct columns and base plates at four locations prior to erecting the balance of the platform steel. The platform steel is designed to be bolted together during the erection phase. Bolt holes are drilled into the duct columns and platform columns for quick assembly of connecting beams in the field.

The connecting beams at column lines B1, B3, B5, and B7 have gusset plates that require field welding to the duct columns. It is permissible to bypass these field welds during the erection of the platforms as these bolted joints are designed to withstand wind loading on the OTSG during the construction phase. The connecting beam field welds must be completed immediately after the installation of the Exhaust Stack.

The platform steel is shipped with a coating of Carbozinc 11 primer. Coating removal and preparation for welding is the responsibility of the Erector. The Erector is responsible for cleaning and coating of welded joints and other surface imperfections. The Erector is responsible for the supply and application of all primer touch-up required throughout the construction process.

Grating penetration holes, for piping and conduit, are to be cut in the field by the Erector. The Erector will fabricate and install collars at all grating penetrations.

11 EXTERIOR SURFACE

Once the OTSG installation is complete, inspect all field welds made between the major components. Check the welds for adequate size, quality and completeness. Check all bolts for tightness, including all erection plate bolts and header restraint bolts. All ducting flange bolts (e.g. at expansion joint location) should be checked for tightness and seal welded if required.

External surfaces, where temporary shipping components have been removed, and any areas of grinding and welding, should be touched up with paint equivalent to that on the supplied equipment. All external joint seam welding and other surface imperfections are to be cleaned and coated following the instructions outlined in IST Paint Specification 11303-0450 attached in Appendix D for reference. The Erector is responsible for the supply and application of all primer touch-up required throughout the construction process.

12 ACCESS DOORS

OTSG access doors have a standard opening dimension of 18" x 18" [450 mm x 450 mm]. Install any access doors that may have been shipped loose. Verify that structural steel does not interfere with the door hardware when it is opened. Since the doors have considerable thickness, obstructions must not exist beside the hinge points, otherwise the insulation plug on the inside of the door will not open far enough to allow access into the OTSG.

Inspect all rope gaskets in the door to ensure that a continuous loop exists around the door perimeter. Close the door to check that the rope gasket seals around the entire perimeter of the door frame.

Ensure that the eyebolt has been coated with anti-seize compound.

After all internal inspections have been completed, close the doors and tighten the handle firmly.

13 PIPING AND VALVES

During OTSG installation, do not remove protective end caps from headers or piping until necessary. Install steam and feedwater external piping spools as detailed in the IST Piping drawings. Ensure all necessary post weld heat treatment and non-destructive examination has been completed. Refer to Appendix E for Hydrostatic testing requirements.

Check that the safety valves have been installed correctly, all seals are in tact and have the proper rating. Ensure that plugs and gags have been removed, if the hydrostatic test is complete, and confirm that operational disks have been installed. Check that the drain connections have been properly routed to ensure operator safety.

Safety valve vent stack pipes should be installed firmly supported and restrained. Sufficient clearance should exist between the safety valve discharge elbow and the vent pipe to allow for steam pipe thermal expansion. Refer to the IST Vent Stack Piping drawing for details. Refer to Section 14.2 for installation instructions.

Install all valves that were shipped loose. Take note of the correct flow direction. Motorized and pneumatic valves should be checked for proper operation. Operate the valves to ensure the linkages do not bind. Refer to the IST Flowsheet drawing 11303-0004 for tag number references.

Ensure that the flow nozzle meter run is installed in the direction of flow.

Check that all drains and vents are free of obstructions and that the lines have been properly and safely, routed and supported.

Check all pipe supports to ensure that guides act only as guides and that piping is restrained only at the points indicated on the Customer Engineering drawings. Steam pipe hanger supports are to be installed such that there are no external forces imposed on the OTSG header connection. All spring hanger supports are to be adjusted so that the load indicator is positioned at the desired "cold" setting. If travel stops are installed, have these removed prior to OTSG operation.

NOTE

Due to rapid temperature changes of the external piping during startup and shut down, welding of pipe supports to the steam piping should be avoided whenever possible.

Check that all bolts on flanged connections are tight and that proper gaskets have been installed.

All sampling ports off the OTSG casing and drain connection at the bottom of the inlet plenum should be capped or plugged.

All temporary pipe supports and bracing installed for erection and cleaning purposes must be removed before OTSG operation.

All blanking plates and hydro test plugs used for hydrostatic testing shall be removed once the hydro has passed test.

Ensure that all required feedwater strainers are installed. Their purpose is to safeguard control valves and to prevent damage and/or plugging of downstream flow orifices. They should be installed prior to water flushing and OTSG start up.

14 "JUMPER" TUBE INSTALLATION

As the OTSG pressure part assembly is distributed over three (3) modules – Lower OTSG Module, SCR Module, and Upper OTSG Module – the internal tube circuits have to be connected once all modules have been erected in place. Before the interconnecting tube welding can take place, the internal seam welding and JAK (joint assembly kit) between Lower, SCR and Upper Modules must first be completed. There are forty-one (41) 1"∅ jumper tube sets at the front end, each made up of two (2) sections of field installed tubing. This field installed tubing will require one hundred twenty three (123) field welds to be performed by an automated orbital TIG welding process.

For specific arrangement refer to IST drawing *Field Jumper Tube Arrangement* 11303-0650. The services to perform this activity are available to the customer at IST standard per diem rates. These rates and a tentative schedule are submitted separately to the customer for review. The Erector will be responsible for certain functions related to this activity and are outlined as follows:

- 480 Volt 60 Amp junction uninterrupted power source and hook-up service for IST orbital welding transformer, plus 110 / 220 Volt 100 Amp for tool crib container to provide lighting and use of power tools.
- Designated lay down area local to steam generator unit (preferably) for IST tool crib container.
- Provision of dry compressed air and designated area for air compressor local to steam generator unit.
- Twelve (12) 2,300 psig bottle manifold pack of argon with two (2) manifold connections for backing gas for orbital welding, plus six (6) loose bottles for welding machine shielding gas.
- Internal scaffold inside the ducting for the completion of orbital welds as required.
- Provision of salamander heaters, hoses of which to be fed into the inlet plenum access door. This is a requirement only if work is performed during winter months. These will also be required during the hydrostatic test in order to raise the temperature of the tube material.
- Tarpaulin over access doors in the event of inclement weather.
- Site safety induction lecture of IST personnel prior to commencement of site activities.
- Provision by customer for one (1) site personnel for safety watch while IST welding technicians work inside the ducting and one (1) other support personnel to assist with cutting, prepping and purging of tubes. In the event of two (2) shifts, a set of support personnel will be required for each shift.
- Designated lunch, smoking area, and washroom facilities.
- Provision and arrangement of any onsite permit requirements.
- Supply of ample demineralized water and pressurizing equipment to perform a hydrostatic test of each steam generator unit once jumper tube welding is complete and piping tie-ins are made.

- Coordinate activities with local authorities for approvals and witnessing of hydrostatic tests. All associated costs are the responsibility of the customer.

All associated costs to conduct the hydrotest, which may include the supply of pressurizing equipment, obtaining suitable water and the service fees of the local authorized inspector, are not covered by IST.

15 VENDOR SUPPLIED ITEMS

15.1 FABRIC EXPANSION JOINT (Gas Turbine Discharge)

Please reference the expansion joint manufacturers drawing & installation instructions *B25744-1* for additional details.

Before installing the expansion joint, the gas turbine exhaust diffuser must be located in its final, fixed position.

The fabric expansion joint should be preset compressed for installation into position and must be bolted directly to the gas turbine exhaust flange. The expansion joint preset bars should be intact at this time. The face-to-face distance between the gas turbine exhaust flange and the spool duct flange should be checked to ensure proper installation clearance.

Prior to lifting, identify the "TOP" position on the expansion joint. Be sure to apply the self adhesive, woven fibreglass gasket material to both the inlet and outlet flange faces of the expansion joint. Lift and place the expansion joint within the opening. Once the expansion joint is in position, securely fasten it to the gas turbine exhaust flange. Allow the joint to expand to the end of the slot. (Confirm the joint overall operational flange to flange distance is in accordance with specifications). The inlet transition duct flange (shipped tack welded) can now be repositioned if necessary to properly mate up to the expansion joint flange. The flange can now be seal welded in its final position to the inlet transition duct. Securely bolt the expansion joint outlet flange to the now fixed inlet flange of the inlet transition duct with the hardware provided.

Install insulation in the internal cavity between the inlet transition duct and the expansion joint as shown in the IST Erection Diagram 261027. Lap liner plates will be installed to cover the insulation between the expansion joint and inlet transition duct.

15.2 SAFETY VALVE SILENCER

Please refer to the following installation information for the safety valve silencer provided for this project. Refer to the silencer arrangement drawing *1170016-1* for detailed dimensional information.

IST is providing one (1) steam vent silencer on each OTSG that will facilitate two (2) HP safety relief vent lines, and one (1) HP start-up vent line with 30% capacity,

Upon receipt of the silencer at site, a thorough inspection should be performed. Look for any signs of shipping damage both internally and externally. If damage is found immediately contact IST. Any damaged surfaces on the silencer should be repaired according to IST Paint Specification attached in Appendix D. A zinc-rich primer coat of Carbozinc 11 is applied to the external casing. All touch up coatings to be supplied by the Erector.

The vent silencer will be shipped to site on its side. Use the lifting lugs supplied on the equipment for rotating and lifting. Lifting slings if used shall be properly located so that weight distribution is approximately equal on both slings. Spreader beams should be utilized to reduce minor axis bending of lifting lugs, where appropriate

The Erector must ensure all connecting piping are properly supported prior to connecting with the silencer flanges. Failure to comply can lead to excessive forces and moments applied to the nozzles causing damage to the silencer body.

The vent silencer is to be mounted onto support steel which is outlined on the Platform Arrangement drawing 11303-0021. The securing hardware to fasten the silencers to the support steel is called up on the erection diagram. Align the bolt holes and securely connect the four (4) base plates with the hardware provided.

Do not remove any protective end caps from the inlet and outlet nozzles until necessary during installation. Verify that all vent piping has been installed and supported per the design assembly drawings. The vent silencer is to be positioned with the orientation of the weather hood outlet facing towards the Gas Turbine.

Ensure that no interference exists between the silencer and any surrounding structures or piping. Flanged connections on the bottom of the silencer are designed to connect with the safety valve vent stack piping described Section 13.0. The flanged connections on the side of the silencer are designed to connect with the start-up vent piping provided by others. The Erector must ensure piping is properly supported prior to installation at the silencer connection flanges. Loading the connection flanges beyond the allowable loads and moments provided in silencer arrangement drawing *1170016-1* will cause damage to the silencer.

The vent silencer is constructed with connecting flanges with bolt holes straddling plan view centrelines. Install proper gaskets between the inlet flanges of the silencer and vent stack pipes. Bolt the pipe flanges in place with the hardware provided. Hardware and gaskets provided by IST are listed on the Vent Stack piping Assembly drawing 11303-0026 and will be shipped in a hardware kit associated with this equipment. Vent stack pipe flange connections may require re-tightening of the bolts after the unit reaches operating temperature.

A low point drain, off the silencer main body, is provided for removal of condensation or precipitation. Check that the silencer drain is free of obstructions and that the drain line has been properly routed to a safe location and supported.

Drain lines are to be supplied and installed by the Erector. Under no circumstances should liquids be allowed to accumulate in the upstream vent piping or the silencer prior to operation of the silencer as the resulting forces could result in mechanical failure of the silencer.

15.3 SELECTIVE CATALYST REDUCTION (SCR) SYSTEM

The following provides an overview of installation information for the Selective Catalyst Reduction (SCR) System. Detailed installation instructions for the SCR system can be found in the vendor drawings and manuals and SCR Catalyst Loading Arrangement drawing 11303-0734. A complete SCR system consists of the following components:

- Ammonia storage tanks (by Others)
- Ammonia forwarding pumps, interconnecting piping, and instrumentation (by Others)
- Ammonia Flow Control Unit (by IST)
- Ammonia Distribution Manifold (by IST)
- Aqueous and vaporized ammonia interconnecting piping (by Others)
- Ammonia Inject Grid (by IST)
- SCR catalyst support frame internal to the SCR Module (by IST)
- SCR catalyst blocks (by IST)
- SCR catalyst loading cart (by IST)

The Ammonia Flow Control Unit (AFCU) consists of a vaporizer vessel with immersion heater, dual dilution air blowers, and associated instruments and valves mounted on a steel skid. The equipment will be anchored to the concrete foundation. Anchoring hardware and grounding equipment will be supplied and installed by the Erector. Wiring to the control cabinet terminal points will be supplied and installed by the Erector. The Erector will be responsible for connecting electrical supply, ammonia supply, and instrument air supply to the unit. The AFCU will be controlled by the plant DCS using control logic supplied by Peerless Manufacturing Company.

The Ammonia Distribution Manifold (ADM) is located downstream of the AFCU skid and is mounted at grade close to the OTSG. The manifold branches off into thirteen branches leading to individual Ammonia Injection Grid assemblies. The ADM is to be placed on a concrete pad with anchor bolts supplied and installed by the Erector. Due to the temperature of the vaporized ammonia, the ADM is designed to grow thermally away from the manifold inlet. The Erector must ensure the anchoring hardware will accommodate the thermal growth of the ADM.

The fifteen (15) Ammonia Inject Grid (AIG) assemblies are installed inside the OTSG Lower Module. With the exception of two locations at the module lifting lugs, the AIG assemblies are

shop-installed by IST. For field instructions on the installation of the two remaining AIG assemblies, see Section 7.2.

Prior to loading the SCR catalysts into the OTSG, the OTSG internals must be heated by the gas turbine exhaust in order to remove any residual paint, oil, debris, and other chemicals that can contaminate the catalyst. The temperature during this burn-out process should reach the dry running design temperature of the OTSG which will cycle the SCR support frame through the full design thermal growth. An inspection of the frame prior to SCR catalyst installation will confirm the perimeter seals are able to accommodate the frame expansion. The following bur-out procedure shall be followed:

1. Run the gas turbine at synch-idle and hold for a minimum of two (2) hours. At no time should the gas turbine exhaust temperature be lower than 550°F (290°C) during the burn-out process. The gas turbine power level should be set accordingly.

2. After the previous step is completed, increase the gas turbine load such that the exhaust temperature is equal to the design dry running temperature +0/-50°F (+0/-28°C). It is preferred that the exhaust temperature reaches the dry running temperature at this stage. Hold for two (2) hours minimum at this steady state condition. The gas turbine will likely be close to 100% load at this time.

3. Reduce the gas turbine load back to synch-idle with an exhaust temperature not less than 550°F (290°C) and hold for a minimum of 10 hours. The burn-out process may be interrupted during the 10 hour burn-out period provided an additional 30 minutes is added to the heat soak time per restart. If the interim shut down is less than two hours, additional run time is not required.

4. As an alternative to the above burn-out procedure, the gas turbine can be brought up to full load with temperature equal to the design dry running temperature +0/-50°F (+0/-28°C) and maintained for a minimum of 14 hours.

It is required that an SCR vendor representative and an IST representative be present for the installation of the SCR catalyst.

To access the SCR catalyst loading area, three removable casing panels at the rear of the SCR Module must be unbolted and removed. The internal liner channels and seals behind the door will be removed from inside the ducting by entering through the closest access door. Next, the SCR cart rail assemblies will be placed and securely fastened to the support beams inside the ducting. A SCR cart rail extension assembly will be securely fastened to the SCR loading platform. Install scaffolding and planking to permit personnel to walk to the length of the unit between the SCR cart rails. Strips of plywood will be placed on top of the tube bundle in the Lower OTSG Module and on top of the AIG lances to prevent falling debris from damaging the finned tubes, AIG lances, and CO catalyst blocks.

IST has supplied a hydraulic SCR loading cart for the purpose of installing the SCR catalyst blocks. The hydraulic cart will be placed on the SCR loading platform to accept catalyst blocks. The catalyst blocks may be transported by truck, forklift, or hoist using a suitable lifting device. Precautions should be taken during transportation and hoisting to avoid shocks and jolts to the catalyst blocks.

Catalyst module assembly packaging should be removed just before installation into the SCR Module. Precautions must be taken to protect the catalyst from damage caused by tools, sharp objects, welding sparks, and other dangers caused by local work activities. Damaged catalyst blocks should not be placed into the SCR Module. Any damage shall be reported immediately to an IST representative.

Prior to installing the catalyst module assemblies, measure their length and compare it against the distance between the stop bars on the catalyst support frame to ensure there is sufficient room for thermal growth.

Woven fiberglass gasket material shall be applied to the catalyst support frame assembly. This will ensure a gas-tight seal between consecutive catalyst module assemblies.

A catalyst module assembly will be placed on the SCR loading cart with the lip at the bottom of blocks facing the rear of the OTSG. The operator will raise the hydraulic actuator to ensure the catalyst clears the catalyst support frame. Slowly push the catalyst module assembly towards the front of the OTSG. Ensure consecutive catalyst module assemblies fit tightly to ensure all catalyst blocks will fit on the support frame. Gently lower the hydraulic actuator and move the loading cart back once the catalyst module assembly is secured.

After all catalyst blocks are loaded, stitch weld the retaining bracket to the support framework at the rear end. The SCR cart rail assemblies and extensions are removed and the SCR loading door sections replaced. Ensure that gasket material is installed around the entire perimeter and that the door panels are installed in the correct sequence. Replace all internal flexible seals and liner channels. Tighten the bolting around the door panel flanges. If gas leaks are found to exist during gas turbine operation, seal welding door flanges may be required.

15.4 CARBON MONOXIDE (CO) CATALYST SYSTEM

The following provides an overview of installation information for the Carbon Monoxide (CO) Catalyst System. Detailed installation instructions for the SCR system can be found in the vendor drawings and manuals and CO Catalyst Installation drawing 11303-0735.

A complete CO catalyst system consists of the following components:

- CO catalyst support frame internal to the Lower OTSG Module (by IST)
- CO catalyst blocks (by IST)

NOTE

The following contaminants are known catalyst deactivators and contribute to shortened catalyst life – heavy and base metals such as lead, mercury, arsenic, antimony, sodium, potassium, lithium, zinc, copper, tin, iron, nickel, chrome, sulfur, silicon, phosphorous, fluorine, chlorine, bromine, and iodine. Hence the contents of these contaminants in the catalyst are recommended not to singularly or collectively accumulate to levels exceeding 10 mg/ft^3 (350 mg/m^3) of catalyst as determined by ICP-OES (Inductive Couple Plasma-Optical Emissions Spectroscopy) or glow discharge spectrophotometry. The presence of levels of the listed contaminants exceeding the stated limits will void the catalyst warranty unless otherwise expressly agreed in writing by EmeraChem.

Prior to loading the CO catalysts into the OTSG, the OTSG internals must be heated by the gas turbine exhaust in order to remove any residual paint, oil, debris, and other chemicals that can contaminate the catalyst. The temperature during this burn-out process should reach the dry running design temperature of the OTSG which will cycle the CO support frame through the full design thermal growth. An inspection of the frame prior to CO catalyst installation will confirm the perimeter seals are able to accommodate the frame expansion. The following burn-out procedure shall be followed:

1. Run the gas turbine at synch-idle and hold for a minimum of two (2) hours. At no time should the gas turbine exhaust temperature be lower than 550°F (290°C) during the burn-out process. The gas turbine power level should be set accordingly.

2. After the previous step is completed, increase the gas turbine load such that the exhaust temperature is equal to the design dry running temperature +0/-50°F (+0/-28°C). It is preferred that the exhaust temperature reaches the dry running temperature at this stage. Hold for two (2) hours minimum at this steady state condition. The gas turbine will likely be close to 100% load at this time.

3. Reduce the gas turbine load back to synch-idle with an exhaust temperature not less than 550°F (290°C) and hold for a minimum of 10 hours. The burn-out process may be interrupted during the 10 hour burn-out period provided an additional 30 minutes is added to the heat soak time per restart. If the interim shut down is less than two hours, additional run time is not required.

4. As an alternative to the above burn-out procedure, the gas turbine can be brought up to full load with temperature equal to the design dry running temperature +0/-50°F (+0/-28°C) and maintained for a minimum of 14 hours.

It is required that a CO vendor representative and an IST representative be present for the installation of the CO catalyst. It is advisable to complete SCR catalyst installation prior to CO catalyst installation to prevent debris from falling onto the CO catalyst blocks. In the event that

both catalysts are installed together, ensure there is sufficient planking above the CO catalyst installation to prevent debris from falling onto the catalyst blocks.
The CO catalyst blocks are fragile – both physically and chemically – and expensive. It is requested that the individual blocks be handled with extreme care.

A crane or other suitable lifting device will be used to deliver the CO catalyst blocks to the appropriate platform elevation. A removable CO catalyst door is located in the SCR Module above the AIG lances from which the CO catalyst blocks will be brought into the ducting. Plywood must be placed over the AIG lances to protect the lance nozzles and to prevent damage to the lances by distributing weight. The weight of workers and CO catalyst blocks must be distributed over a minimum of four AIG lances.

Gas seal panels at the rear of the ducting between the AIG lances and CO catalyst support frame will be removed to grant personnel access for the installation or removal of the CO catalyst blocks.

Individual CO catalyst blocks will be passed through the AIG lances to the installer positioned on the CO catalyst support frame. A fiberglass gasket is applied between the frame support and the catalyst block. Set the catalyst block onto the frame. Ensure the catalyst sits squarely in the frame and check from the sides, top, and bottom to ensure the gasket remains in place. Any gaps in the gasketing between the frame and catalyst will result exhaust gas bypassing the system and reducing CO catalyst performance.

CAUTION
Do not walk on CO catalyst surface.

After all the CO catalyst blocks have been installed in the support frame, install retaining washers and retaining nuts over the threaded studs as indicated in CO Catalyst Installation drawing 11303-0735. Apply a high temperature anti-seize compound (by IST) sparingly on the studs. Install the retaining washer followed by the first nut ensuring it is tightened to the proper torque. Install the second nut and ensure the first nut does not turn, thus changing its initial torque.

Once all the catalyst blocks have been loaded and the installation is considered adequate, the gas seal panels at the rear of the ducting between the AIG lances and CO catalyst frame will be reinstalled to its original state. Remove all plywood planking used during the installation. Reinstall the CO catalyst loading door ensuring that gaskets are used and bolts tightened to prevent gas leakage. If persistent gas leakage is found after the bolts are tightened, it may be necessary to seal weld the door joint.

15.5 DILUTION AIR SYSTEM

The following provides an overview of installation information for the Fossil Power Systems duct burner. Detailed installation instructions for the duct burner can be found in the Fossil Power Systems drawings and manuals.

A complete duct burner system consists of the following components:

- Six (6) dilution air elements and assembly (by IST)
- One (1) blower skid with inlet silencer (by IST)
- One (1) set of interconnecting ducting between blower skid and injection lances (by Others)
- Noise abatement barriers and ducting insulation (by Others as required)

The dilution air system has six (6) horizontal burner elements that are shipped loose and inserted widthwise into the Diluition Air Duct by the Erector. Each dilution air element is supplied with an end support that is welded to the platform side external casing of the duct during the dilution air element installation. The end support should be tack welded at four corners during initial installation. Prior to installing the dilution air elements, the end support will be lined with 6 lb/ft^3 (96 kg/m^3) soluble fiber insulation to minimize heat transfer to the duct exterior.

The dilution air elements are inserted through the duct casing openings on the non-platform side and supported on the opposite wall by the end supports. The burner elements are to be checked for position, level, elevation, and angular alignment upon installation. Once the correct installation of the individual dilution air elements is verified, the faceplates and end supports can be seal welded to the duct casing. 6 lb/ft^3 (96 kg/m^3) soluble fiber insulation will be installed in all casing cavities prior to the installation of the supplied closure liner plates and bolting hardware. Tack weld nuts on the inner securing studs once closure panels are secured in place.

The faceplates will act as the fixed point of the dilution air elements and thermal growth will be towards the expansion end supports. Ensure the installed elements are free to expand towards the end supports.

The dilution air blower skid is to be located and installed in an appropriate location designated by the Erector. The equipment will be anchored to the concrete foundation. Anchoring hardware and grounding equipment will be supplied and installed by the Erector. Wiring to the control cabinet terminal points will be supplied and installed by the Erector. The Erector will be responsible for connecting electrical supply, and instrument air supply to the skid.

15.6 STACK DAMPER

The following provides an overview of installation information for the stack damper. Detailed installation instructions for the stack damper can be found in the vendor drawing CF-2245-01-01 and manuals.

The stack damper actuator and rain skirts may be may be shipped loose to prevent damage to the components. Assembly of the actuator should be completed prior to installation of the stack damper on the exhaust stack.

The stack damper is not to be installed on the exhaust stack until it is mechanically secured and all internal and external seal welding is complete. A crane will be employed to lift the stack damper using the lifting lugs provided. The damper will be secured onto the exhaust stack lifting plates using the supplied hardware. The load is not to be released from the crane hook until the proper installation of the stack damper hardware is confirmed.

Any rain skirt panels that are shipped loose will be bolted into position after the stack damper is secured in place.

Wiring and power supply to the stack damper terminal points will be supplied and installed by the Erector.

16 INTERNAL COMPONENTS INSTALLATION

16.1 END SEALS

The end restraint adjustment procedure, outlined in Section 8.2, may require the removal of end seal panels (floor panels) to allow access. Once the restraint rod adjustment process is complete, the end seal panels should be replaced and inspected. No significant leakage paths between end seal panels should exist; otherwise adjustments should be made to eliminate any gaps.

The end seal panels have been designed with oversized holes to allow for thermal expansion. To ensure these panels slide freely during operation, all bolts should be installed “snug” tight and backed off ¼ turn.

16.2 LOWER OTSG MODULE TUBESHEET THERMOCOUPLE INSTALLATION

Gas side thermocouples are required to be field installed on the tubesheet reinforcing pipes at three (3) locations across the width of the duct at eight (8) tubesheet locations. All thermocouple leads will be secured firmly to the tubesheet reinforcing pipes as they traverse to the Thermocouple Head Assembly. The junction head is to be installed on site into a pipe nipple provided on the external casing of the Lower OTSG Module on the platform side.

Each set of three (3) gas side thermocouples are to be field installed on the tubesheet reinforcing pipes. All three thermocouple wire leads will extend through the side casing by a pipe nipple provided to a single thermocouple junction head. Thermocouple instrumentation conduit cables (by others) are to be run from the junction head on the side casing back to the DCS in the control room. For detailed installation of the tubesheet thermocouples, refer to the IST Lower/AIG/CO Module Thermocouple Arrangement drawing 11303-0602. Ensure that the installation conforms to all notes shown in the drawing.

16.3 SCR MODULE THERMOCOUPLE INSTALLATION

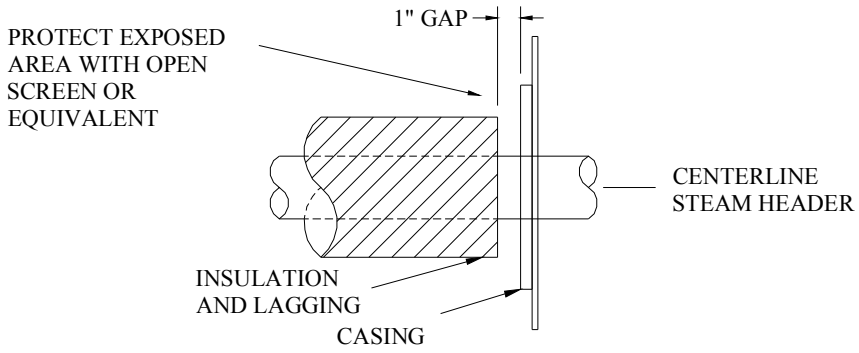
Gas side thermocouples are required to be field installed on the underside of the catalyst block support pipes at three (3) locations across the width of the unit and at two (2) catalyst support pipe locations. All thermocouple leads will also in turn be secured firmly to the underside of the support pipes as they traverse to the Thermocouple Head Assembly. The junction head is to be installed on site into a pipe nipple provided on the external casing of the SCR Module on the platform side. Thermocouple instrumentation conduit cables (by others) are to be run from junction head on Exhaust Hood back to DCS in the control room. For detailed installation of SCR module thermocouples refer to the IST SCR Module Thermocouple Arrangement drawing 11303-0728. Ensure that the installation conforms to all notes shown in the drawing.

16.4 INSPECTION OF TUBES & SIDE SEAL GAS BAFFLES (V SEALS)

Except for the end restraint assemblies and connection to headers, the tubes should be free to expand. All debris must be removed from the top of the module so that no tubes are prevented from moving through the tubesheets. On either side of the tube bundle, the side seal gas baffles or "V-Seals" (refer to Figure 3 and 5) allow the bundle to thermally grow side-to-side while the outside casing remains a fixed size. Any debris that has fallen onto the top of the "V-Seals" must be removed prior to operation. Damage to the "V-Seals" will result during operation if all debris is not removed. Inspect all visible tubes for straightness and immediately report to IST any tubes that show any signs of bowing. Tube finning should be relatively undamaged. If there appears to be major areas of fin damage, the fins can be "combed" out. Leave the fins bent in areas of minor damage.

16.5 PIPING INSULATION AND LAGGING

All required external insulation and lagging for feedwater piping and their branches are to be supplied and installed by the Erector. Any areas requiring insulation or other materials for personnel protection shall be addressed. In general, this should cover all feedwater piping downstream of the heat exchanger including vents, drains, and transmitter connections. All steam piping insulation is the responsibility of the customer and their selected contractor. To prevent casing overheating, the steam pipe insulation shall not be insulated tight against the boiler casing. The insulation shall be stopped short of the casing by a minimum of 1" [25 mm] as shown in the Figure below.


1" GAP
PROTECT EXPOSED AREA WITH OPEN SCREEN OR EQUIVALENT
CENTERLINE STEAM HEADER
INSULATION AND LAGGING
CASING

17 PRE-SERVICE INSPECTION AND CHECK LIST

During construction and when the installation is complete, the unit should be completely inspected by an IST representative. This is required prior to the unit being exposed to gas turbine exhaust. If the unit is found not to be in conformance with the supplied drawings or descriptions outlined in this document, or if anything is found that will cause problems during operation, the IST representative will contact the Erector so that an immediate correction or resolution can be conducted.

The construction manager or appointed personnel should review the following checklist to ensure that all activities, associated with the ducting installation, are complete.

- Inspect all ducting components for shipping damage:
  - Gas Turbine Discharge Expansion Joint
  - Inlet Transition Duct #1
  - Inlet Transition Duct #2
  - Dilution Air Duct
  - Lower Inlet Plenum
  - Upper Inlet Plenum
  - Lower OTSG Module
  - SCR Module
  - Upper OTSG Module
  - Lower Exhaust Hood
  - Upper Exhaust Hood
  - Stack Adapter
  - Exhaust Stack

- Inspect all items listed below for shipping damage:
  - Safety Valve Silencer
  - Selective Catalyst Reduction (SCR) System
  - Carbon Monoxide (CO) Catalyst
  - Dilution Air System
  - Stack Damper
  - Valves and Instruments

- All base plates, soleplates and Fabreeka pads installed per drawing, level and in the correct position.
- Anchor bolts installed with nuts fixed in position by welding or jam nut.
- Lower Inlet Plenum installed, positioned properly, and level.
- Lower Inlet Plenum columns welded to base plates.
- Center the four (4) loose columns from the Upper Inlet Plenum onto their respective base plates and brace in place.
- Upper Inlet Plenum is lifted into proper position above the Lower Inlet Plenum.

- With the Upper Inlet Plenum still on the crane hook, the four loose columns are bolted to the Upper Inlet Plenum columns and welded to the base plates.
- Erection plates installed between the Lower Inlet Plenum and Upper Inlet Plenum, both bolted and welded.
- All shipping beams and braces in the Lower Inlet Plenum and along the base of the Upper Inlet Plenum are removed and all bolt holes are sealed.
- Internal and external seal weld between the Lower Inlet Plenum and Upper Inlet Plenum complete.
- Inlet Plenum diagonal brace installed.
- Lower OTSG Module installed, properly positioned, and level.
- Erection plates installed between Lower OTSG Module and Upper Inlet Plenum, both bolted and welded.
- Internal and external seal weld between Lower OTSG Module and Upper Inlet Plenum complete.
- All shipping beams and braces in the Upper Inlet Plenum and along the base of the Lower OTSG Module are removed and all bolt holes in the lower sidewall beams sealed.
- Remove four (4) lifting channels in the Lower OTSG Module sidewall and install the two remaining AIG lance assemblies.
- SCR Module installed, properly positioned, and level.
- Erection plates installed between SCR Module and Lower OTSG Module, both bolted and welded.
- Internal and external seal weld between SCR Module and Lower OTSG Module complete.
- All shipping beams and braces in the Lower OTSG Module and along the base of the SCR Module are removed and all bolt holes in the lower sidewall beams are sealed.
- All top support beam shipping restraint angles on Lower OTSG Module removed (except at the last tubesheet at the rear of the module) and sidewall bolt holes sealed.
- All Lower OTSG Module restraining studs removed at each end of all top support beams including the last support beam where the shipping angle remains.
- Upper OTSG Module installed, properly positioned, and level.
- Erection plates installed between Upper OTSG Module and SCR Module, both bolted and welded.
- Internal and external seal weld between Upper OTSG Module and Lower OTSG Module complete.
- All shipping beams and braces in the SCR Module and the Upper OTSG Module are removed and all bolt holes are sealed.
- All SCR catalyst support beam shipping restraint angles on the SCR Module removed (except at the front support closest to the header) and sidewall bolt holes are sealed.
- All SCR Module restraining studs removed at each end of all support beams including the front support beam where the shipping angle remains.
- Lower Exhaust Hood installed, properly positioned, and level.
- Erection Plates installed between Lower Exhaust Hood and Upper OTSG Module, both bolted and welded.
- All Lower Exhaust Hood shipping beams removed and all bolt holes sealed.

- Internal and external seal weld between Lower Exhaust Hood and Upper OTSG Module complete.
- All top support beam shipping restraint angles on Upper OTSG Module removed (except at the last rear tubesheet) and bolt holes sealed.
- All Upper OTSG Module restraining studs removed at each end of all the top support beams including the last beam (furthest from header end) where the shipping angle remains.
- All platform steel will be fully erected and bracing installed prior to the placement of the Upper Exhaust Hood.
- Upper Exhaust Hood installed, properly positioned, and level.
- Erection Plates installed between Upper Exhaust Hood and Lower Exhaust Hood, both bolted and welded.
- All Upper Exhaust Hood shipping beams removed and all bolt holes sealed.
- Internal and external seal weld between Upper Exhaust Hood and Lower Exhaust Hood complete.
- Closure plates between the Upper Exhaust Hood and Lower Exhaust Hood are seal welded to the casing exterior.
- Stack Adapter installed, properly positioned, and level.
- Erection Plates installed between Upper Exhaust Hood and Stack Adapter, both bolted and welded.
- Shipping braces in the Stack Adapter are removed and all bolt holes sealed.
- Internal and external seal weld between Upper Exhaust Hood and Stack Adapter complete.
- Exhaust Stack installed, properly positioned, and level.
- Erection Plates installed between the Exhaust Stack and Stack Adapter, both bolted and welded.
- Install obstruction lighting (supplied by Erector) and ensure they are operational as soon as erection of exhaust stack is complete.
- Dilution Air Duct installed, positioned properly, and level.
- Internal stitch and external seal weld between Dilution Air Duct and Inlet Plenum complete.
- Gusset plates to the underside of Dilution Air Duct at columns B7 and E7 are seal welded in place.
- Inlet Transition Duct #2 installed, positioned properly, and level.
- Internal stitch and external seal weld between Inlet Transition Duct #2 and Burner Duct #1 complete.
- Inlet Transition Duct #1 installed, positioned properly, and level.
- Internal stitch and external seal weld between Inlet Transition Duct #1 and Inlet Transition Duct #2 complete.
- Expansion joint installed and mechanically connected (bolted) to Inlet Transition Duct #1 support flange and gas turbine outlet flange. Expansion joint preset bars removed.
- All Joint Assembly Kit (JAK) installed accordingly,
  - Insulation used for JAKs on all OTSG duct work joints including expansion joint. Ensure insulation density applied at each joint is in accordance with drawings.
  - Insulation layers installed at a depth of 6” (150mm) and compressed to 5.5” (140mm).
  - Insulation layers are lapped to prevent hot spots.

- Liner panels overlapped in correct sequence.
- All nuts are installed correctly (not too tight to prevent thermal movement) and tack welded in position.
- JAK at Upper OTSG Module-to-Lower Exhaust Hood provides for expansion of top support beams.

- All closure kits are installed accordingly,
  - Insulation used for JAKs on all OTSG duct work joints including expansion joint. Ensure insulation density applied at each joint is in accordance with drawings.
  - Insulation layers installed at a depth of 6" (150mm) and compressed to 5.5" (140mm).
  - Insulation layers are lapped to prevent hot spots.
  - Liner panels overlapped in correct sequence.
  - All nuts are installed correctly (not too tight to prevent thermal movement) and tack welded in position.
- All intermodule field jumper installation installed.
- All debris is cleared from the module side gas baffles ("V seals") locations.
- All end seals and floors are installed and adjusted to prevent gas passage.
- All scaffolding and equipment removed from all OTSG components.
- All temporary shipping bracing removed from ducting components
- All temporary cribbing / supports removed.
- All return bend protective rubbers removed.
- All Pressure part restraint gaps adjusted per instructions.
- All damage to external surfaces has been touched-up with primer as specified which includes all areas of external casing welds, erection plate welding, and base plate welding.
- All access doors can be opened fully and then tightly sealed.
- Safety relief valves installed correctly.
- Safety relief valve vent pipes are properly supported and sufficient clearance exists between the vent pipe and the valve discharge pipe.
- All boiler external piping and valves are installed as required.
- All orifices and strainers are installed as required.
- All vents and drains are piped to safe or designated locations.
- All valves are installed in correct flow direction.
- All valves checked for proper operation (manual or automatic).
- All flanged connections tight and proper gaskets installed.
- All instruments installed (i.e. tubing and wiring).
- All sampling port and drain connections to the ducting are capped.
- Hydrostatic testing conducted according to the required regulations. Water used was demineralized and met IST water quality specification.
- Safety valve silencer installed and secured.
- Safety valve silencer drain line piped.
- Damaged silencer surfaces are primed and painted as required.
- Dilution air elements and end supports are installed and secured.

- Dilution air skid is installed and leveled on foundation per manufacturer's instructions. Ducting connection the dilution air skid and dilution air elements (supplied by Erector) are installed.
- Ammonia Flow Control Unit (AFCU) skid is placed and anchored to the foundation. Grounding cable is installed.
- Ammonia Distribution Manifold (ADM) is placed and anchored to the foundation.
- Interconnecting piping (supplied by Erector) between AFCU, ADM, and AIG is installed.
- Stack damper is installed and secured to Exhaust Stack.
- Instrumentation is wired to the DCS and all required control logic properly programmed.
- All utilities – including natural gas, aqueous ammonia, and instrument air – as required by the OTSG and IST supplied equipment is provided.
- Install grounding cables from foundation to grounding connections located on the Lower Inlet Plenum.

Checked by: _____ Date: _____

18 CUSTOMER / CONTRACTOR BACKCHARGE PROCEDURE

The customer, or the designated Erector, should be aware of the following:

Any work that is deemed as extra to the contract, by which IST is considered wholly or partially responsible for, should be first brought to the attention of IST by filling out a Backcharge Procedure form. After all the specific details have been defined and work scope identified, this form is to be faxed to IST head office for approval before proceeding. This provides IST with an opportunity to give input and/or engineering solutions, and the option to have either an on site vendor or an outside contractor perform the work. The Backcharge Procedure form can be found in Appendix B.

NOTE

IST will not honour extra work charges without prior approval.

19 SYSTEM CLEANING

19.1 DRY RUN OPERATION

An advantage to the Innovative Steam Technologies OTSG is the ability to operate dry without any water in the pressure circuits. This has significant advantages because the gas turbine can be commissioned before the OTSG has been fully completed and operational. It also allows for increased plant operation flexibility.

There are, however, several conditions that must be completed before dry run operation can commence.

- The OTSG must be flushed using demineralised feedwater meeting the IST specification ES-020 to remove any desiccant in the steam header and other impurities in the tubes. **Note that the OTSG pressure parts are supplied in a clean state and free of oils.**

- Internal OTSG mechanical construction must be completed and signed off. All punch list items completed. Refer to OTSG related items in the checklist found in Section 19.

- Steam and feedwater piping connections (if connected to the OTSG), must be fully supported placing no strain on the header nozzles. If the piping has not been attached to the OTSG, it is **strongly recommended** the open pipe connections be blanked off and vented to a safe

location to prevent personnel exposure to high temperature steam. Residual water from the flush will convert to steam and exit the feedwater and steam header openings.

- OTSG support columns must be installed and anchor bolt nuts adjusted as per the drawing requirements.
- Expansion joint alignment shipping brackets removed.
- During dry operation, the gas turbine exhaust gas temperature must be recorded on a regular schedule to ensure the maximum OTSG dry running temperature is not exceeded.
- Specific instructions with respect to the safety valve status must be given to the project site manager to be followed.

19.2 FEEDWATER SYSTEM CLEANING

To accomplish an effective cleaning and flush of the feedwater system, water flow rates should be as high as possible. The condensate and/or boiler feedwater pumps provide circulation and the condensate tank and condenser hotwell provide additional storage and surge capacity.

Prior to flushing the feedwater system, the condenser, hotwell, and deaerator storage tank are normally hand cleaned followed by a general hose washing. If there is a long delay before the deaerator is cleaned and brought to service, flash rusting will quickly occur. This will result in a dirty system that will require additional flushing and cleaning. A high-pressure water blast may be used to remove rust formed in the deaerator.

Demineralized water is used to flush the feedwater system. Flushing normally begins with the condenser hotwell, and continues stepwise through the condenser and feedwater systems up to the check valve on the OTSG feedwater inlet. Water flushing of the OTSG is not permitted until the feedwater piping is cleaned. Failure to do this may result in plugging the flow distribution orifices at the inlet flex tubes of the OTSG.

Any water that enters the OTSG tubing must meet the water requirements given IST Engineering Specification ES-020.

During the various cleaning operations, consideration must be given to the isolation and cleaning of all branch lines (drains, vents, isolation) to ensure an adequately cleaned system.

All feedwater control valves should be disassembled and the trim removed prior to flushing and orifice plates should not be installed until after the flush. Strainers are normally installed at the inlets to the condensate and feedwater pumps to protect them from damage by suspended material.

The high pressure feedwater check valve should be disassembled and undergo a full flush. Subsequently, stop the flush and inspect the feedwater flow control valve piping (or other low point in the feedwater piping) to ensure the line is clear and free of any grit. The flush should be repeated until the line is clear.

To aid in determining if the piping system is clean, collect a conductivity sample from the influent water supply and compare it to the effluent flush sample. When both conductivity readings are comparable, and within IST feedwater limits, the line is considered to be clean. After the flush, all strainers should be examined, cleaned and reinstalled.

The OTSG modules are assembled at the factory and the OTSG unit is assembled at site. An advantage to the OTSG is the elimination of grease and rolling oils that are used for the construction of drum type HRSG's. A simple flush is all that is required to clean the tubing of an IST OTSG. Once the entire unit is assembled and before the first steam production, demineralized water must be flushed through the unit to ensure a clear path and remove of any dirt particles or desiccant that may have been introduced during shipping.

This procedure can be accomplished in the following manner:

1. Ensure the water supply system upstream of the feedwater control valves is clean, tested, and meets the water specification (See ES-020).
2. Disconnect the feedwater flow meter impulse lines and remove the feedwater flow orifice.
3. Ensure the main steam pipe stop check valve is closed.
4. Open the main steam pipe drain valves located before the main steam pipe stop check valve, and then open feedwater control valves to flush the OTSG.
5. Observe the drain connections and continue to flush until the effluent water appears clean. Test the effluent water conductivity and ensure it is the same as the influent water.
6. Flush the feedwater meter impulse lines.
7. When the effluent water is clean, close the feedwater pipe block valve and completely drain the OTSG. Ensure the feedwater vent block valves are open. Dry the tubing as required in Engineering Specification ES-020.
8. Remove the attemperator feedwater flow orifice and disconnect the attemperator from the feedwater line.
9. Flush the attemperator feedwater line by opening the motorized feedwater block valve and then close the motorized valve when the line is clean.
10. Repeat the above procedure for all pressure circuits.

CAUTION

DO NOT INTRODUNCE ANY CAUSTIC OR ACIDIC SOLUTIONS INTO THE OTSG WITHOUT FIRST CONSULTING WITH IST.

Appendix A

Reference Figures for Erection and Installation Instructions

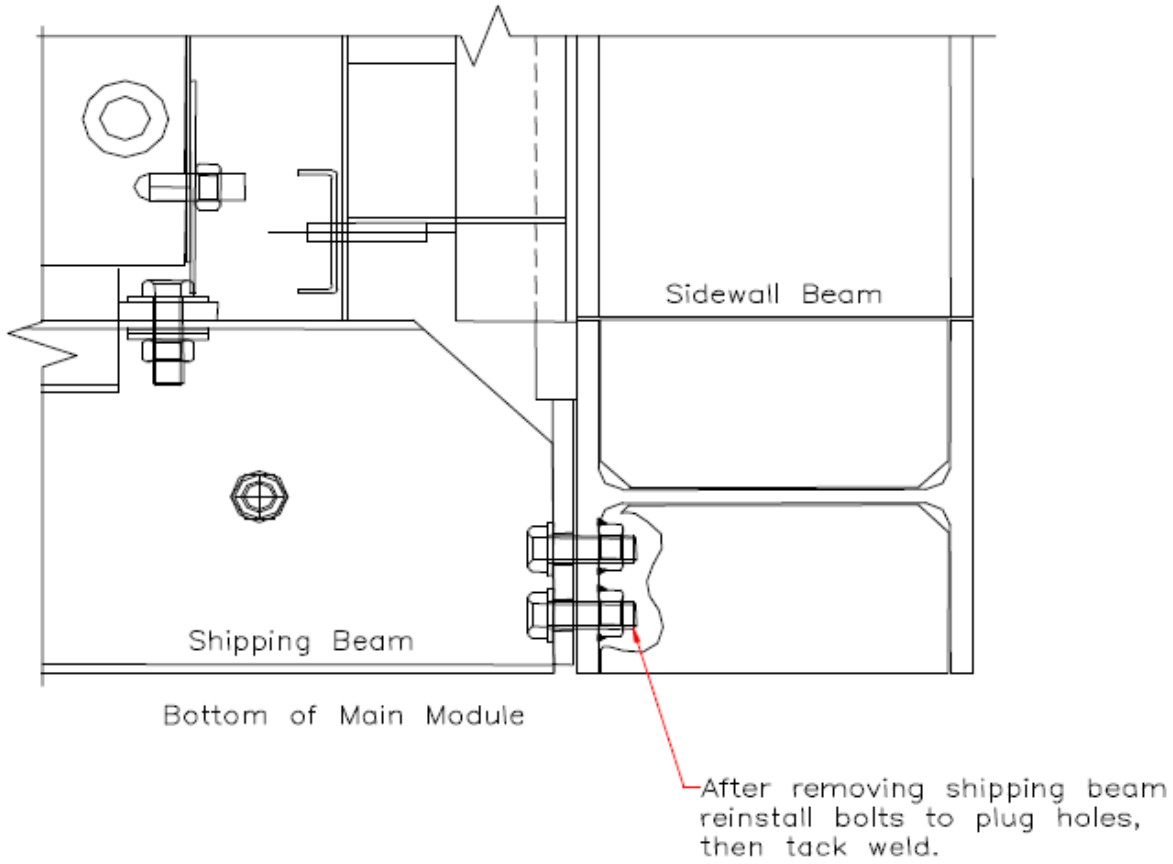


Figure 1 – OTSG Module Shipping Beam Detail

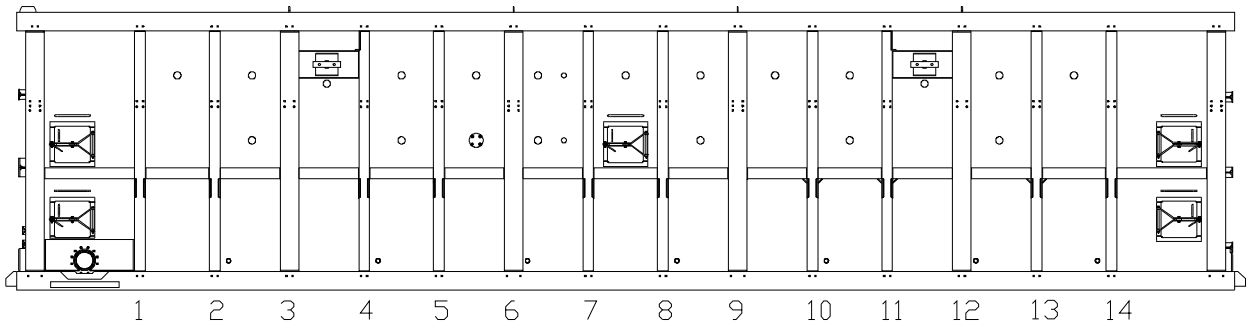


Figure 2 –Lower OTSG Module Shipping Beam Location

Prior to module lift into position, shipping beams 1, 2, 4, 5, 7, 8, 10, 11, 13, and 14 can be removed.

All other beams to remain in position until module has been lifted and secured on the Upper Inlet Plenum.

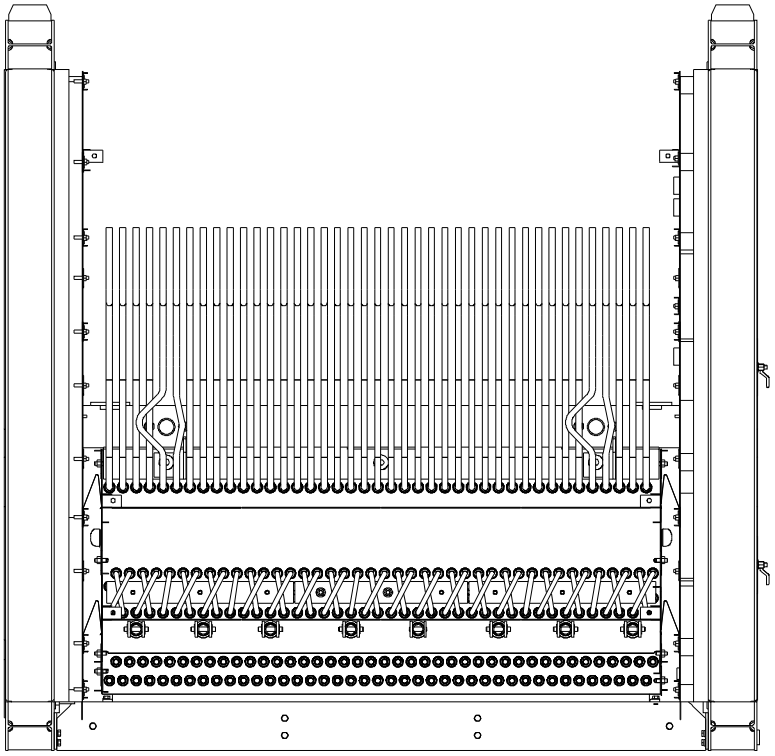


Figure 3 – Cross Section Through Lower OTSG Module

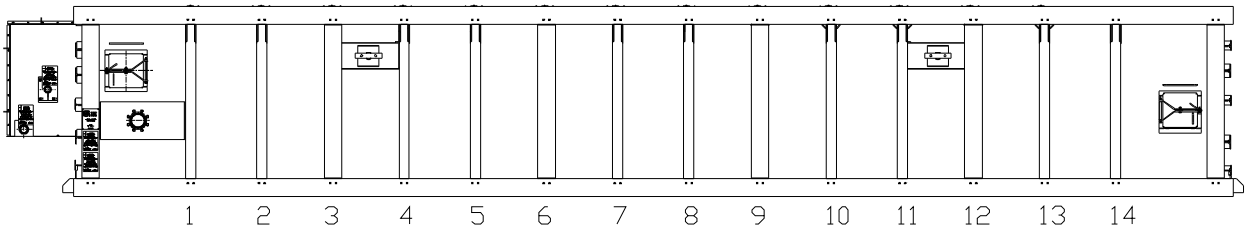


Figure 4 – Upper OTSG Module Shipping Beam Location

Prior to module lift into position, shipping beams 1, 2, 4, 5, 7, 8, 10, 11, 13, and 14 can be removed.

All other beams to remain in position until module has been lifted and secured on the SCR Module.

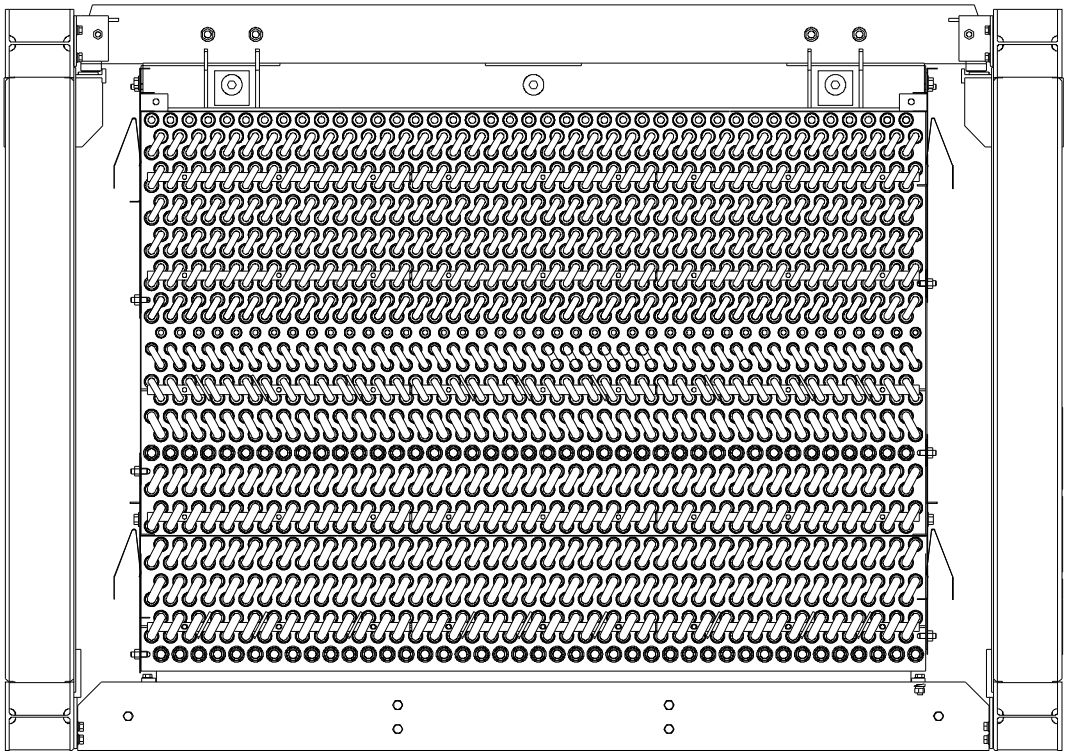
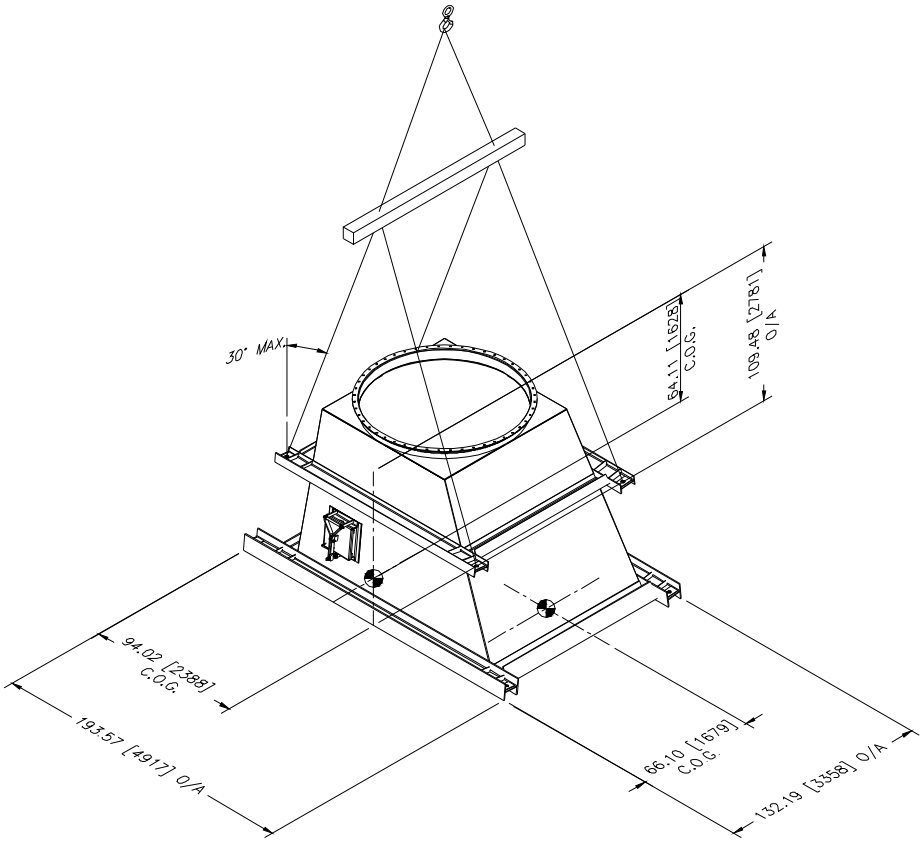


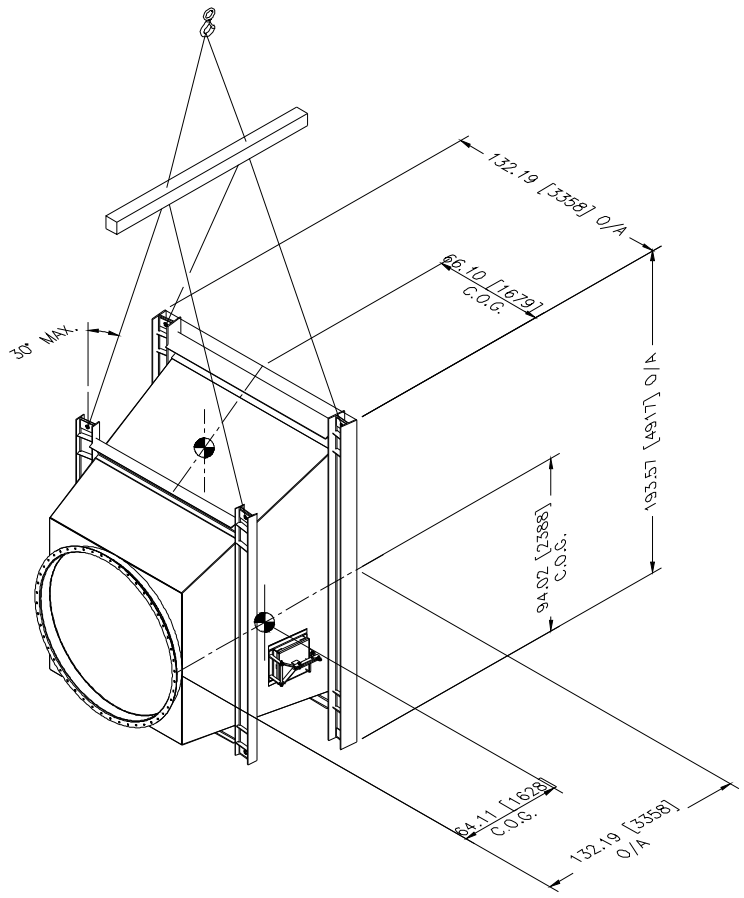
Figure 5 – Cross Section Through Upper OTSG Module



Project No. C10082
Weight: 13,500 lbs [6,124 kg] (approx)

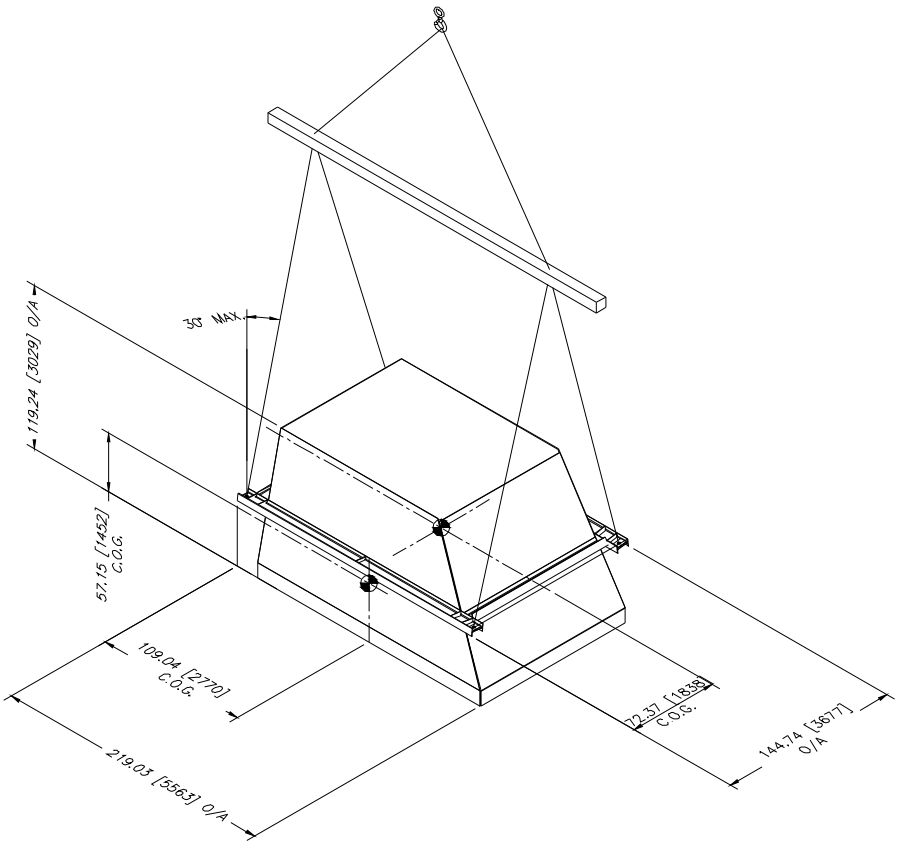
* Shipper shall be responsible for levelling duct work for transit.

Figure 6 – Inlet Transition Duct #1 Lifting Layout for Shipping



Project No. C10082
Weight: 13,500 lbs [6,124 kg] (approx)

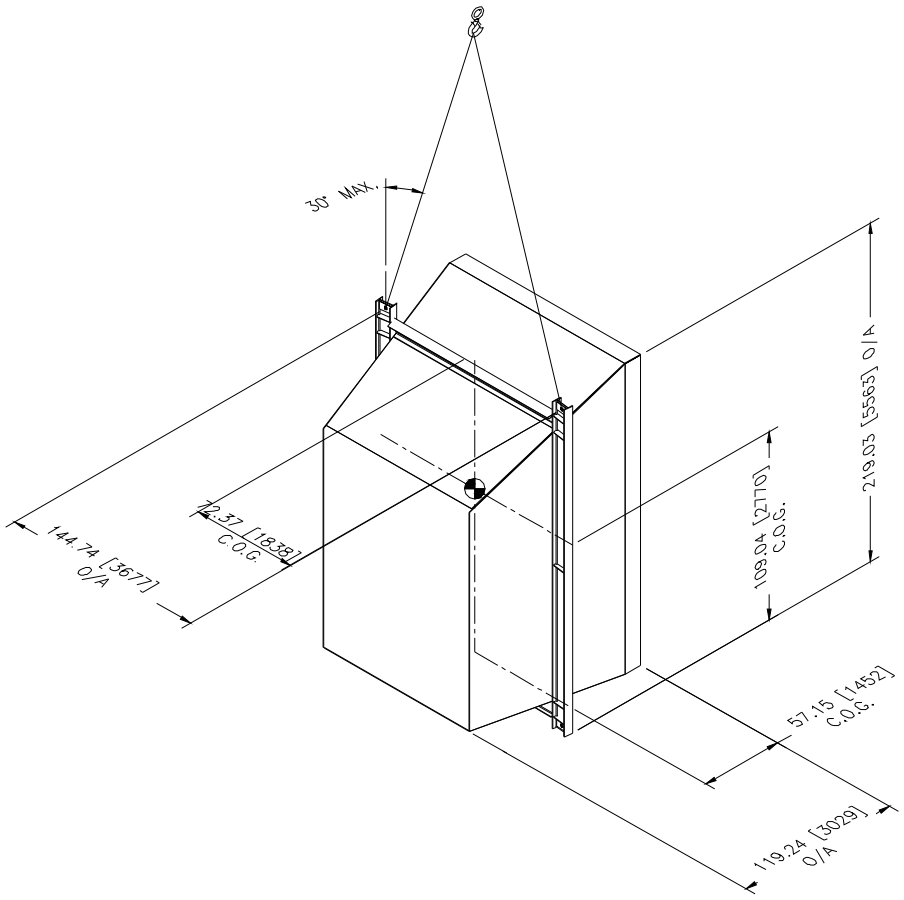
Figure 7 – Inlet Transition Duct #1 Lifting Layout for Positioning



Project No. C10082
Weight: 16,000 lbs [7,258 kg] (approx)

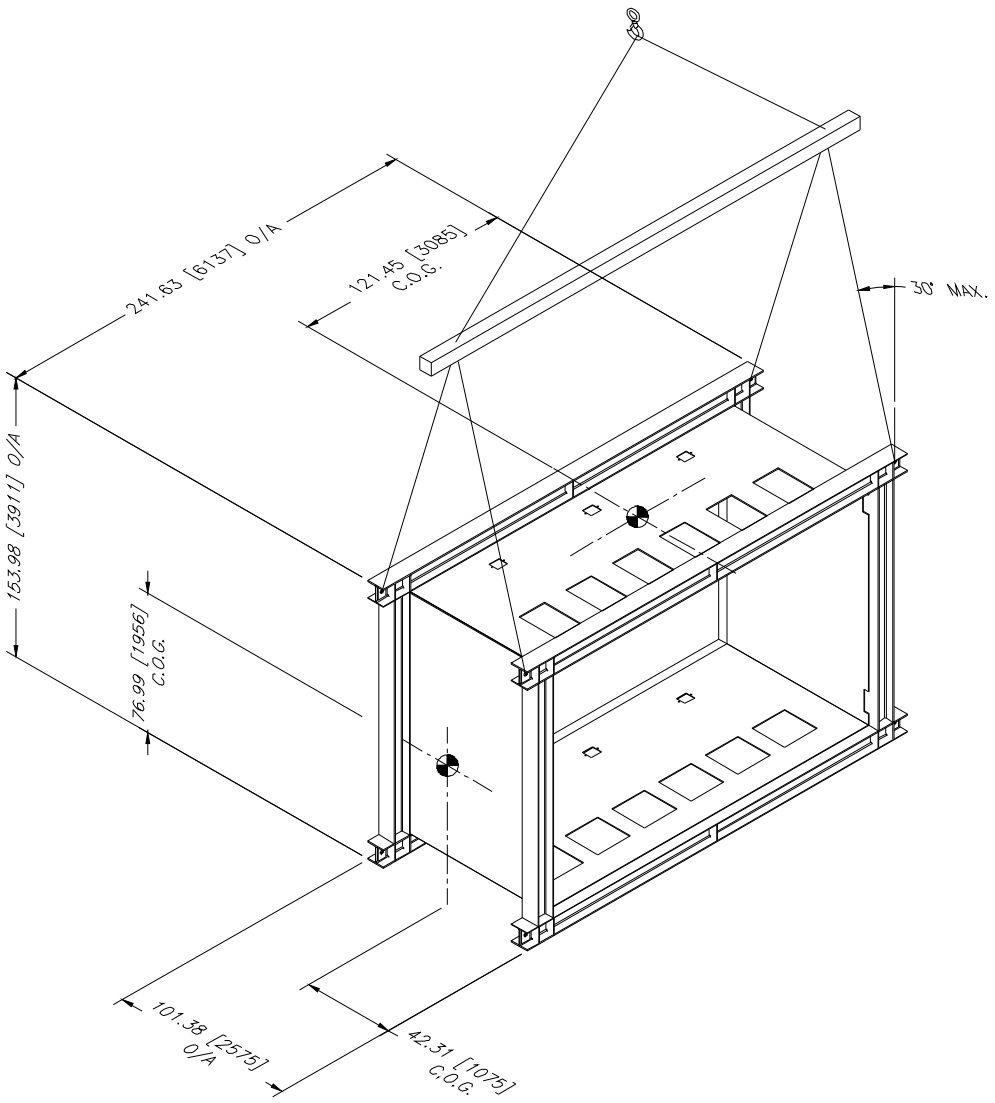
* Shipper shall be responsible for levelling duct work for transit.

Figure 8 – Inlet Transition Duct #2 Lifting Layout for Shipping



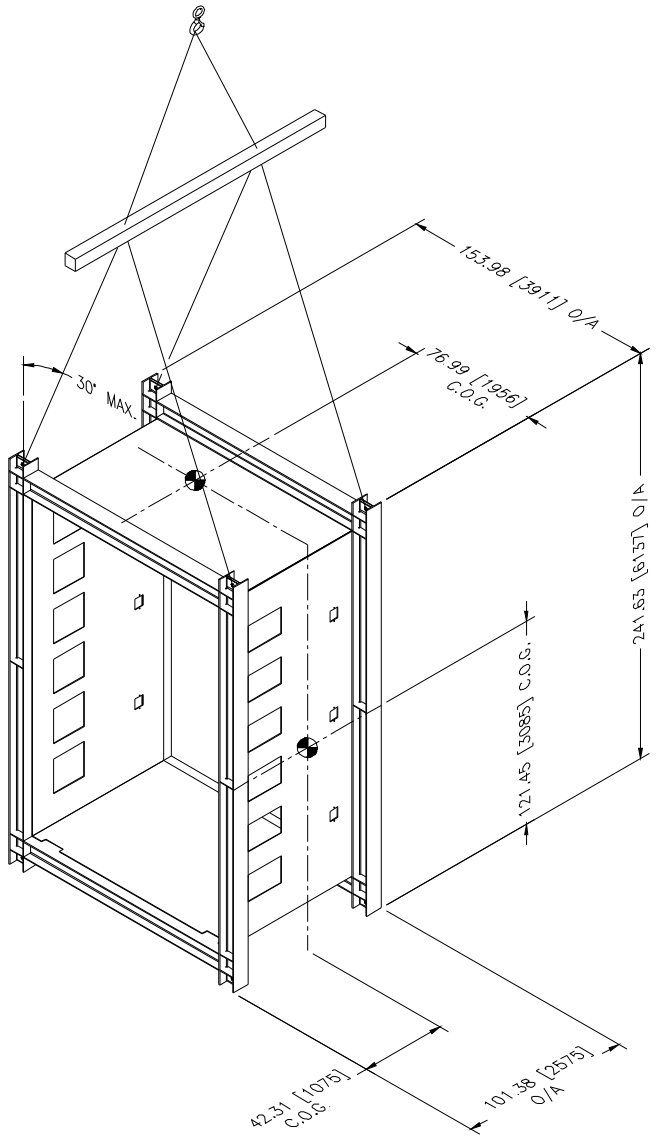
Project No. C10082
Weight: 16,000 lbs [7,258 kg] (approx)

Figure 9 – Inlet Transition Duct #2 Lifting Layout for Positioning



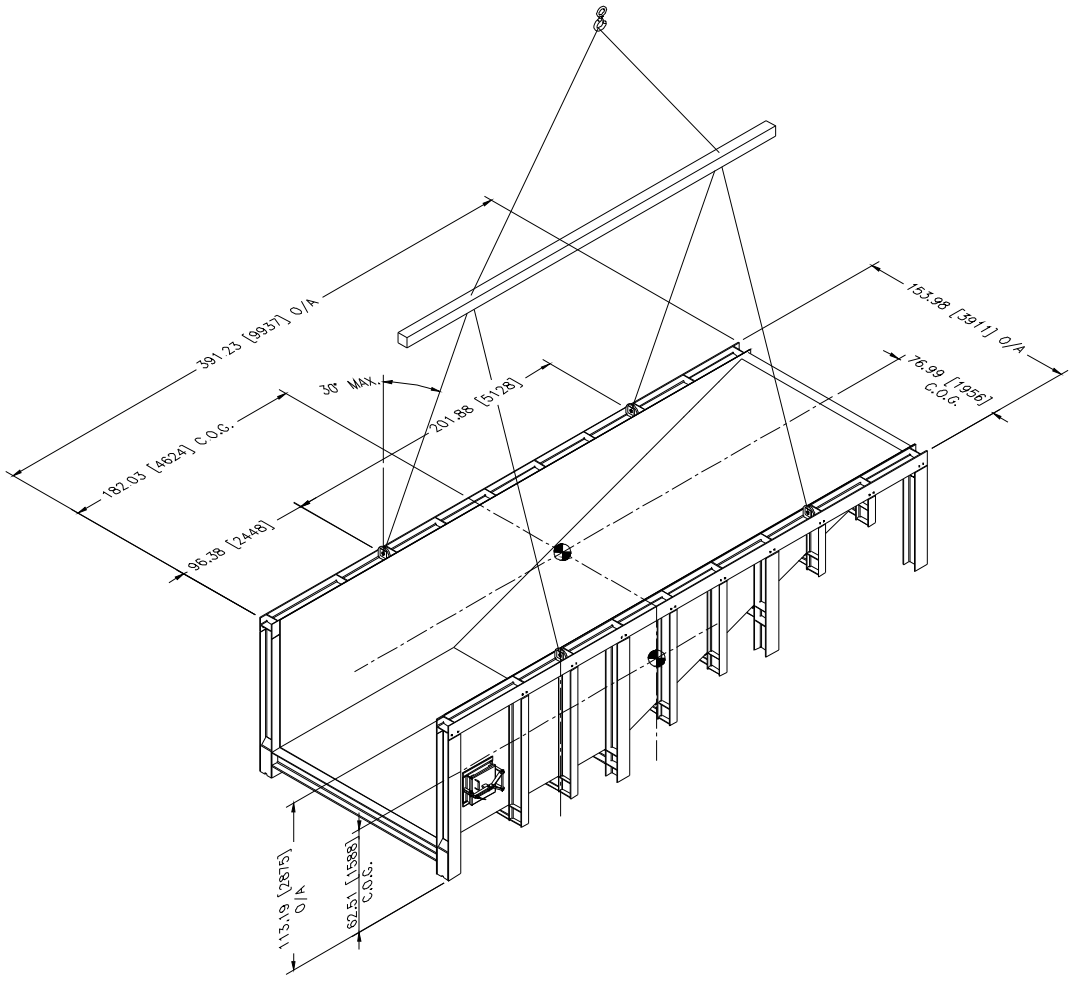
Project No. C10082
Weight: 25,000 lbs [11,340 kg] (approx)

Figure 10 – Dilution Air Duct Lifting Layout for Shipping



Project No. C10082
Weight: 25,000 lbs [11,340 kg] (approx)

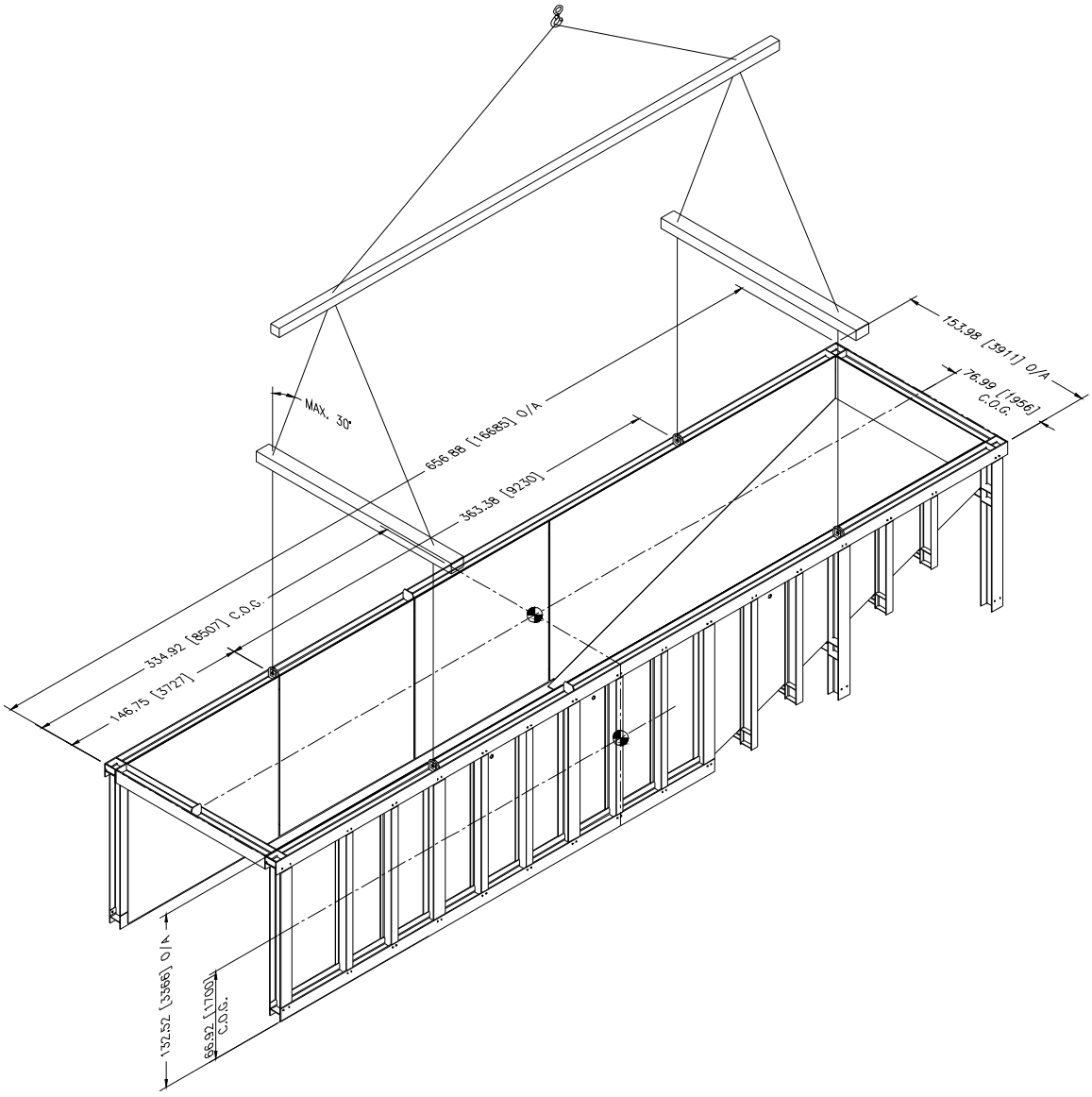
Figure 11 – Dilution Air Lifting Layout for Positioning



Project No. C10082
Weight: 33,100 lbs [15,014 kg] (approx)

* Shipper shall be responsible for levelling duct work for transit.

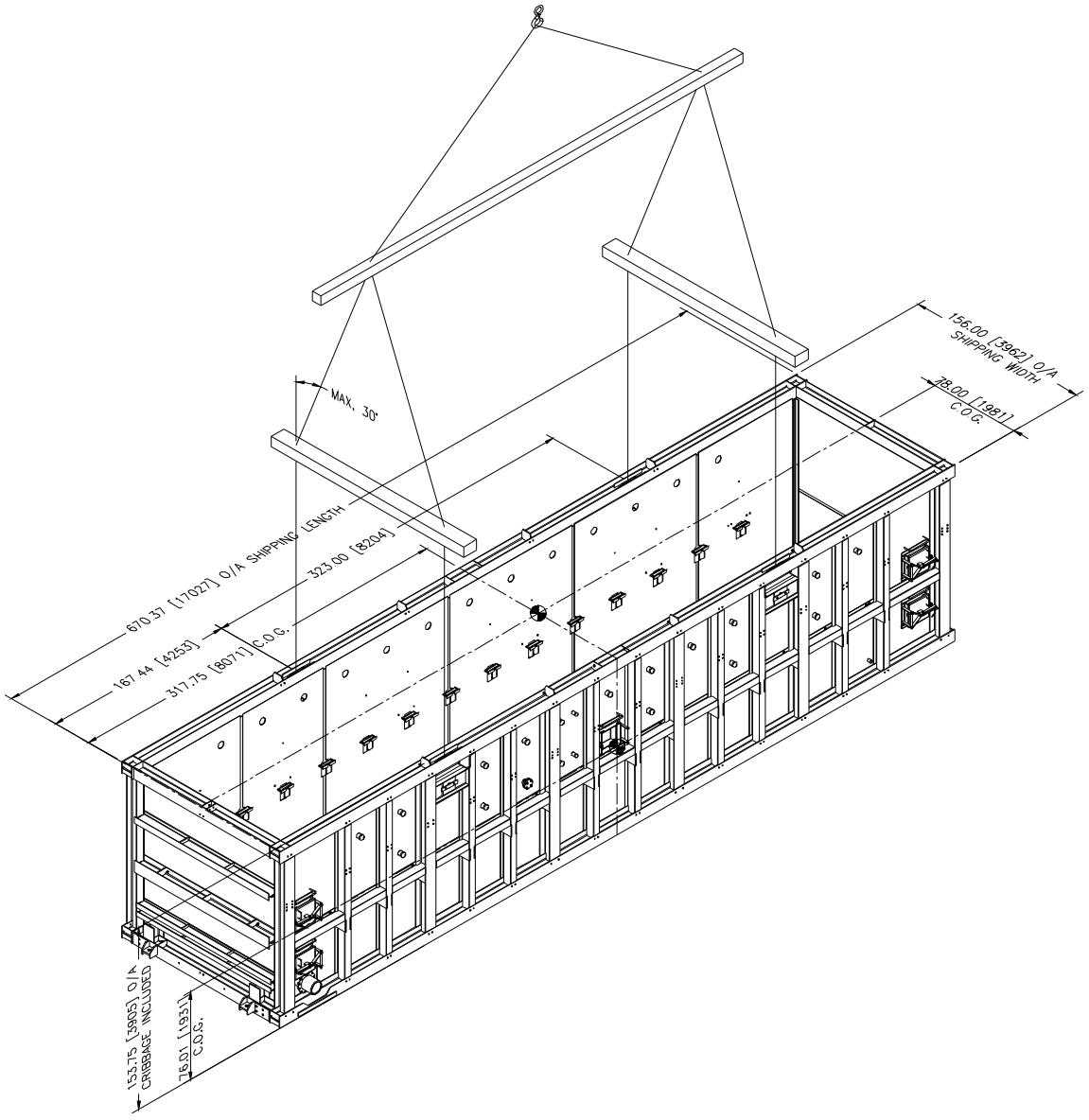
Figure 12 – Lower Inlet Plenum Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 60,700 lbs [27,533 kg]. (approx)

* Shipper shall be responsible for levelling duct work for transit.

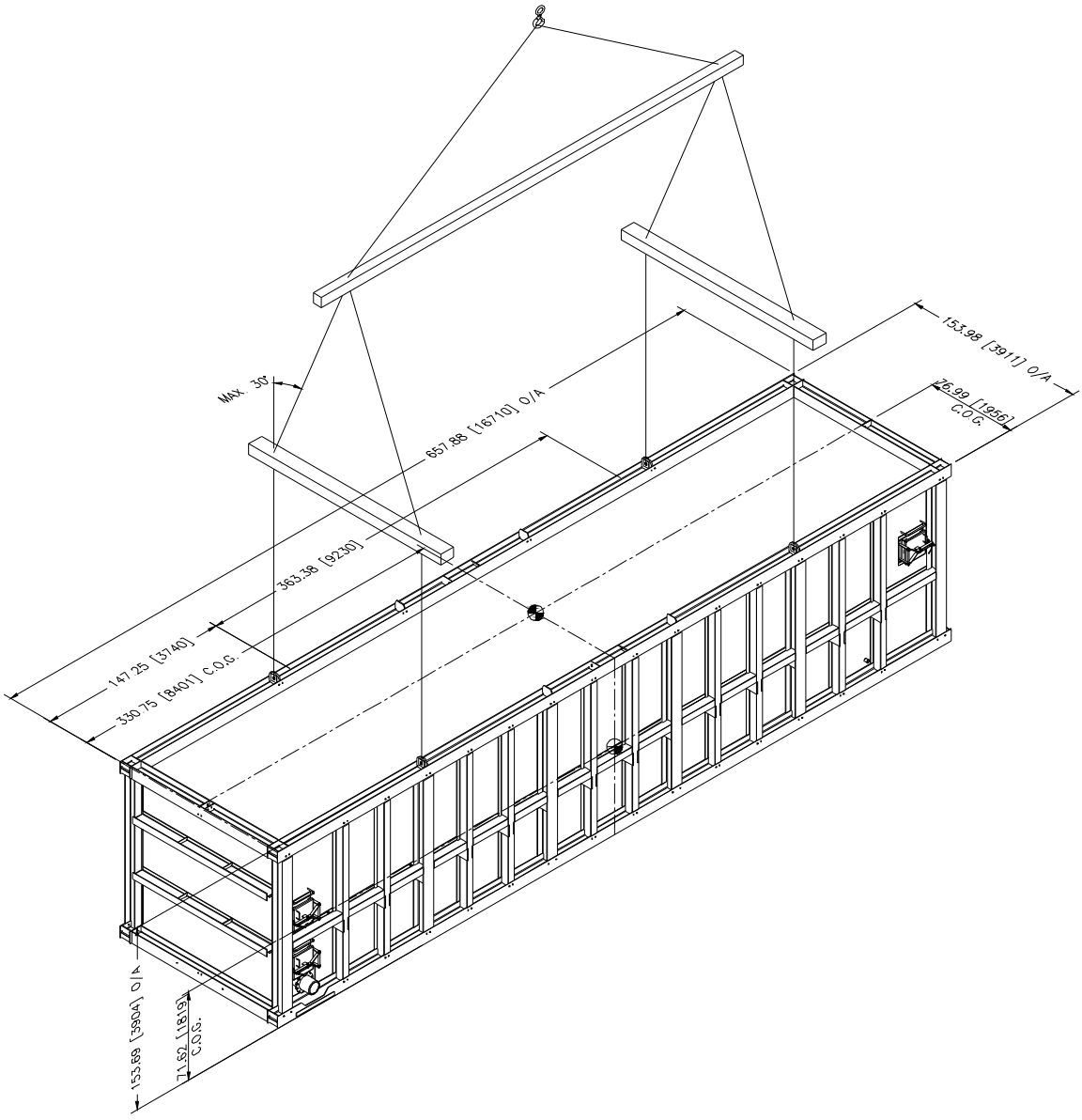
Figure 13 – Upper Inlet Plenum Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 162,000 lb. [73,482 kg.] (approx)

* Module shall be shipped below deck for transit over water.

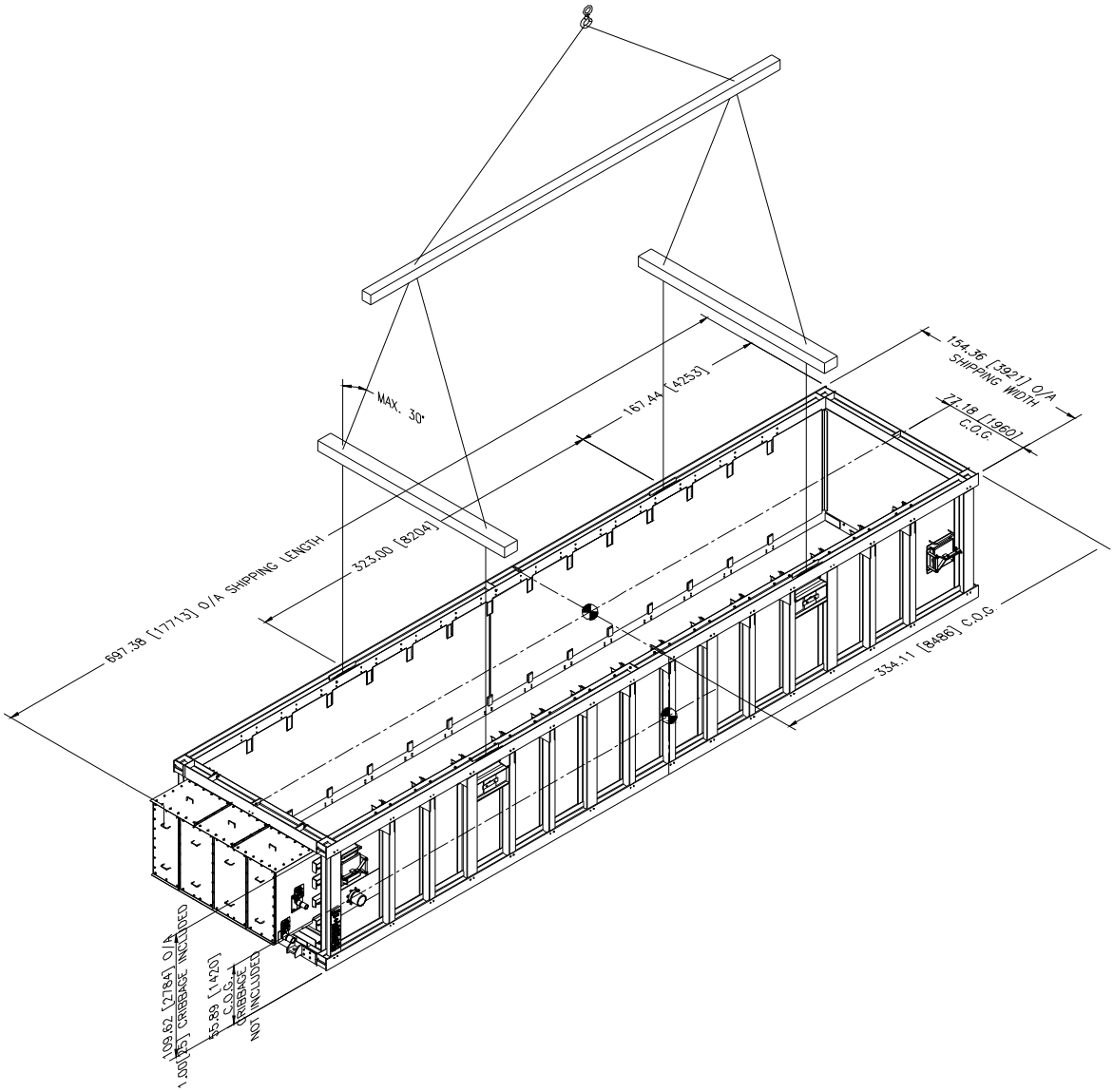
Figure 14 – Lower OTSG Module Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 75,000 lb. [34,020 kg.] (approx)

* Module shall be shipped below deck for transit over water.

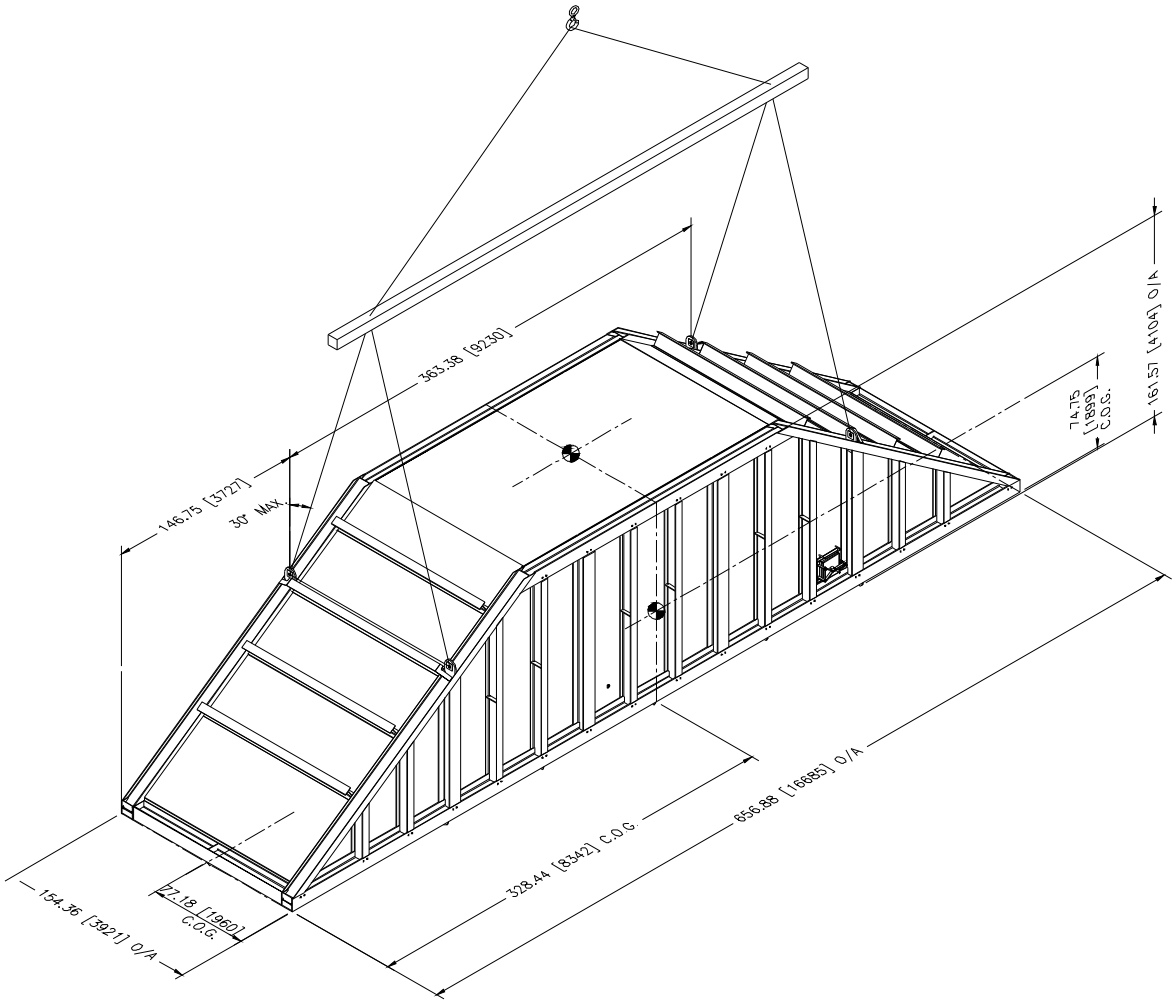
Figure 15 – SCR Module Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 304,000 lb. [137,892 kg.] (approx)

* Module shall be shipped below deck for transit over water.

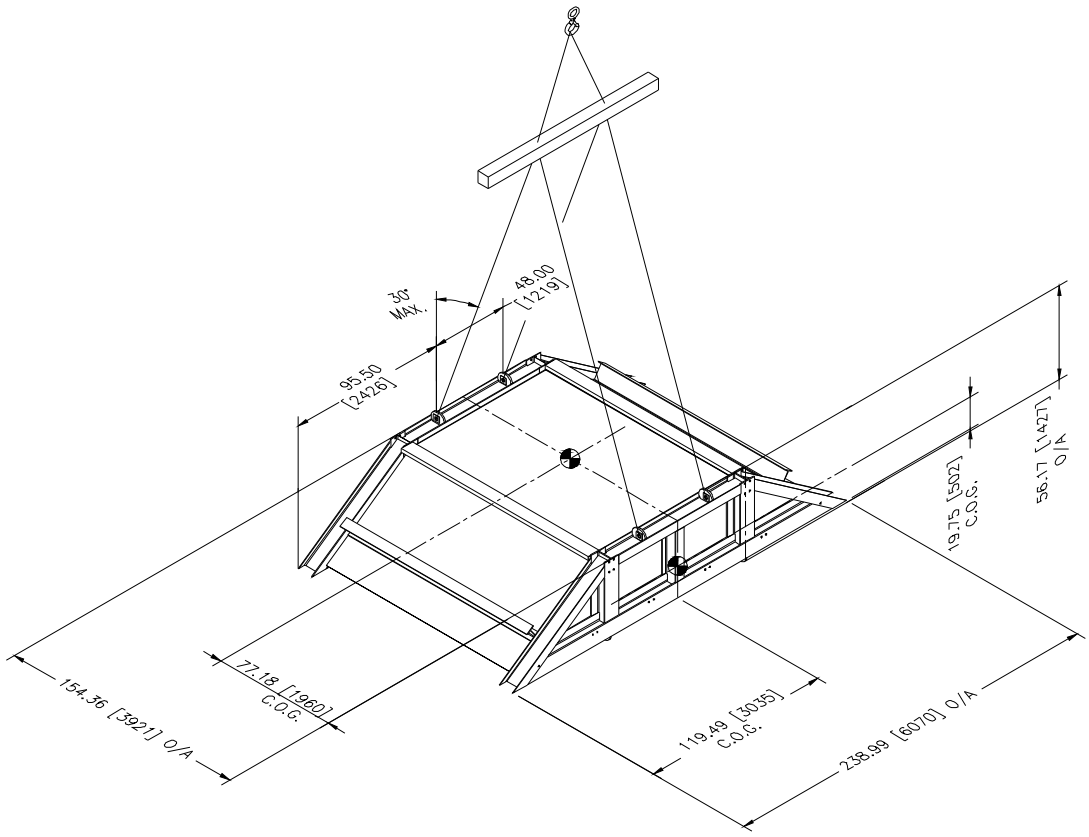
Figure 16 – Upper OTSG Module Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 106,500 lbs [48,308 kg] (approx)

* Shipper shall be responsible for levelling duct work for transit.

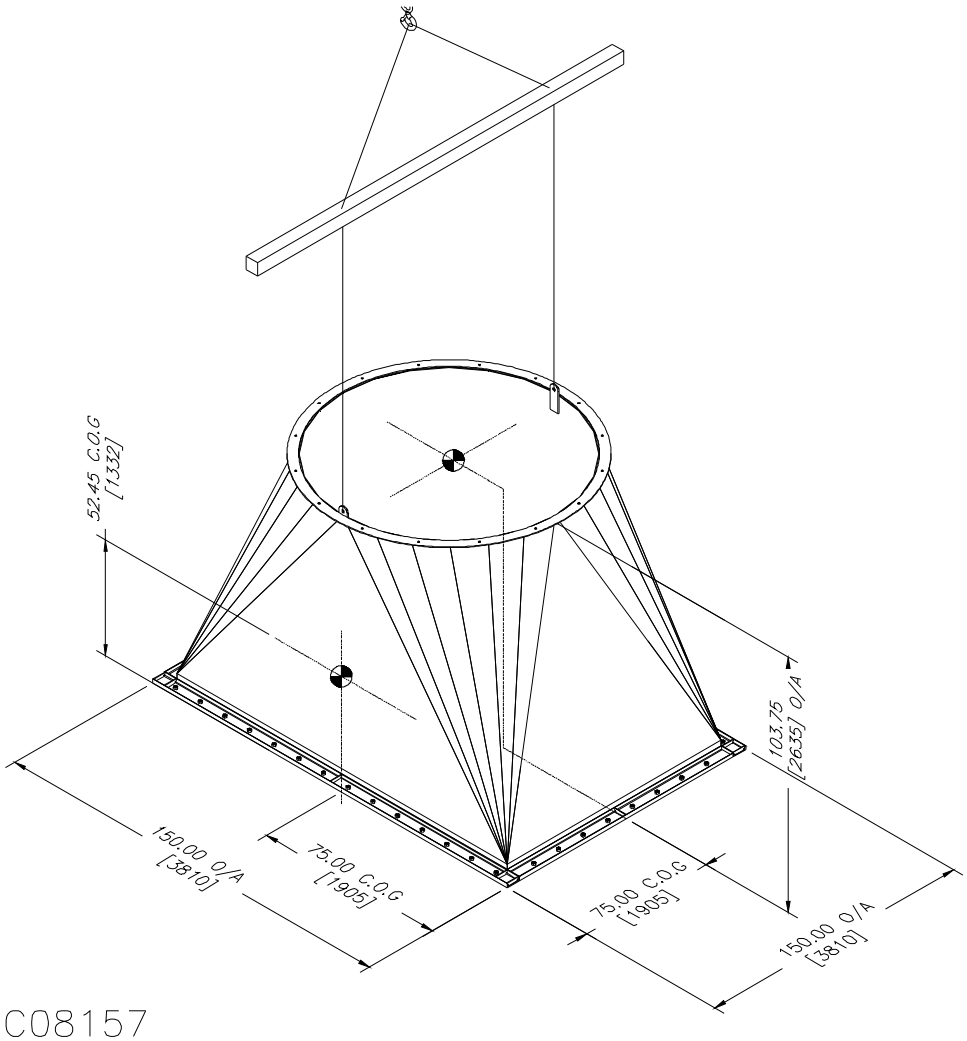
Figure 17 – Lower Exhaust Hood Lifting Layout for Shipping and Positioning



Project No. C10082
Weight: 11,500 lbs [5,216 kg] (approx)

* Shipper shall be responsible for levelling duct work for transit.

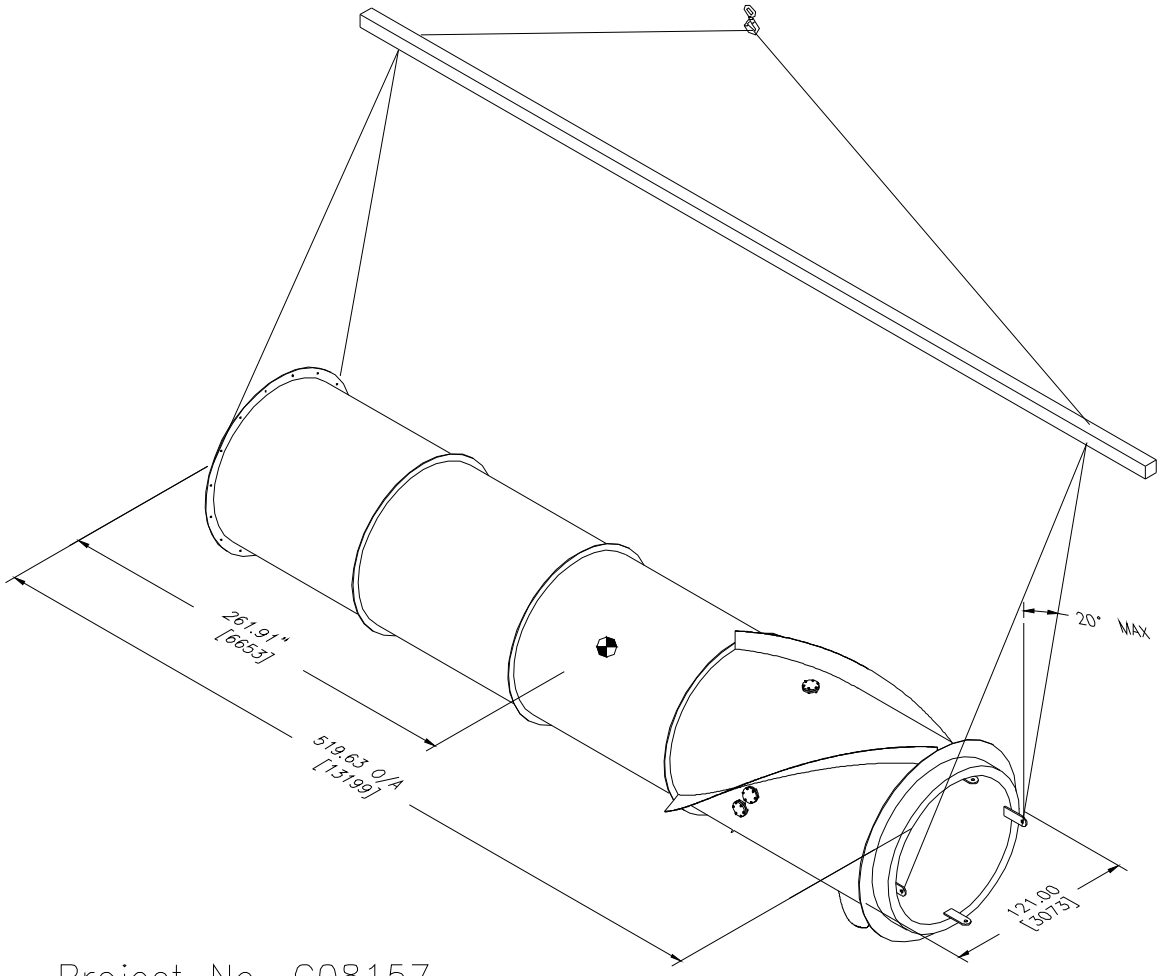
Figure 18 – Upper Exhaust Hood Lifting Layout for Shipping and Positioning



Project No. C08157
Weight: 9,200 lb [4,170] Kg (approx)

* ALL primary dimensions are in inches, all secondary [in brackets] dimensions are millimeters.

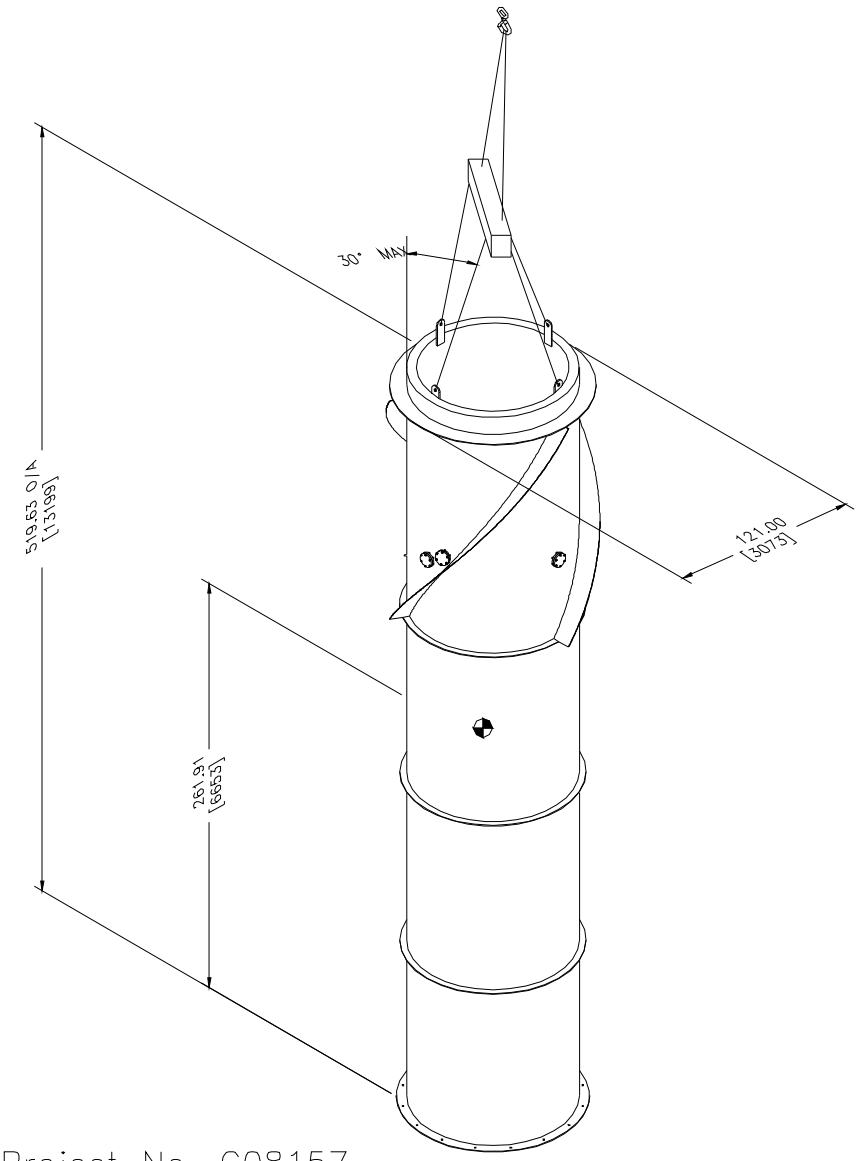
Figure 19 –Stack Adapter Lifting Layout for Shipping and Positioning



Project No. C08157
Weight: 27,200 lb [12,340] Kg (approx)

* ALL primary dimensions are in inches, all secondary [in brackets] dimensions are millimeters.

Figure 20 – Exhaust Stack Lifting Layout for Shipping



Project No. C08157
Weight: 27,200 lb [12,340] Kg (approx)

* ALL primary dimensions are in inches, all secondary [in brackets] dimensions are millimeters.

Figure 21 – Exhaust Stack Lifting Layout for Positioning

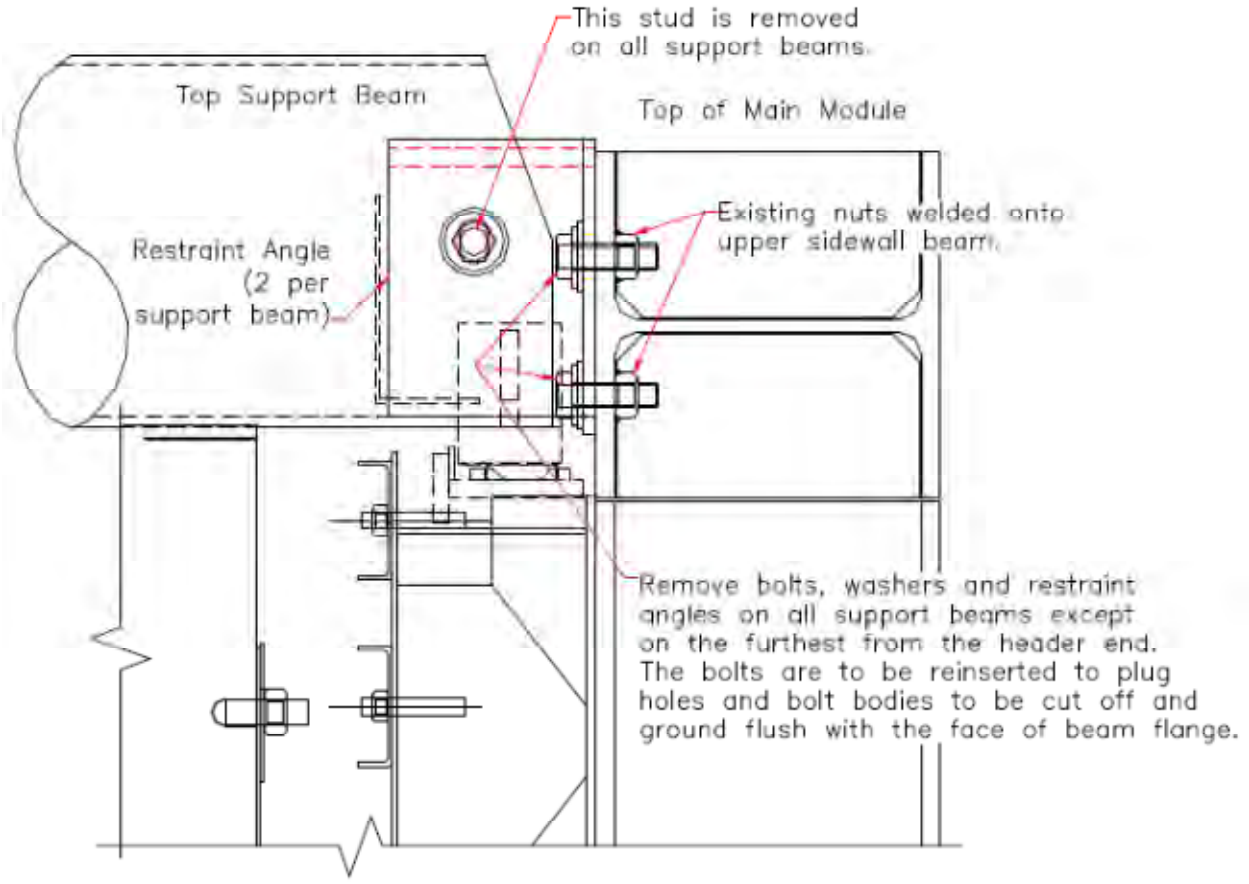


Figure 22 – OTSG Module Top Support Beam Detail

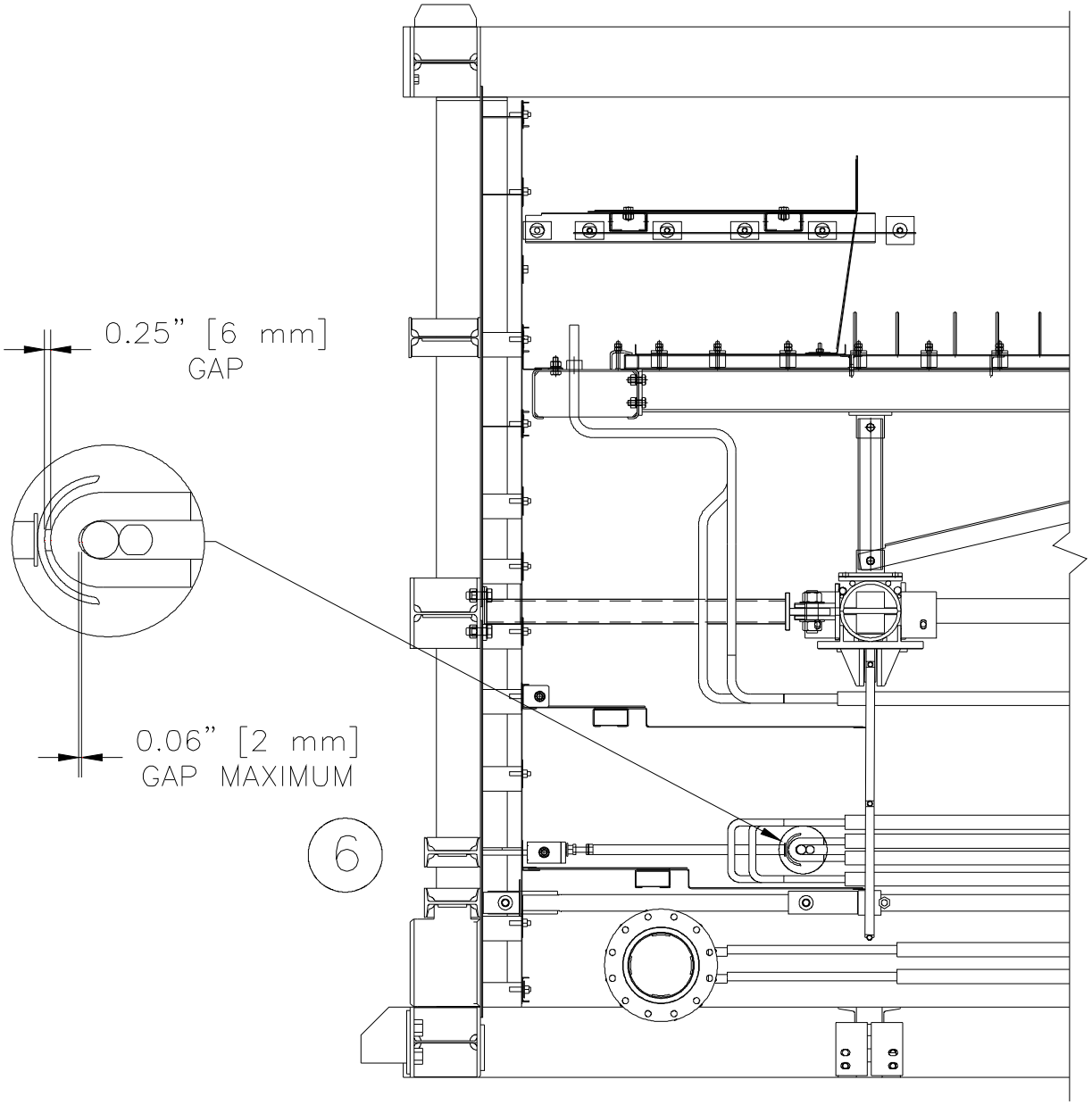


Figure 23 – Lower OTSG Module Front Restraint Rod / Endseal Detail

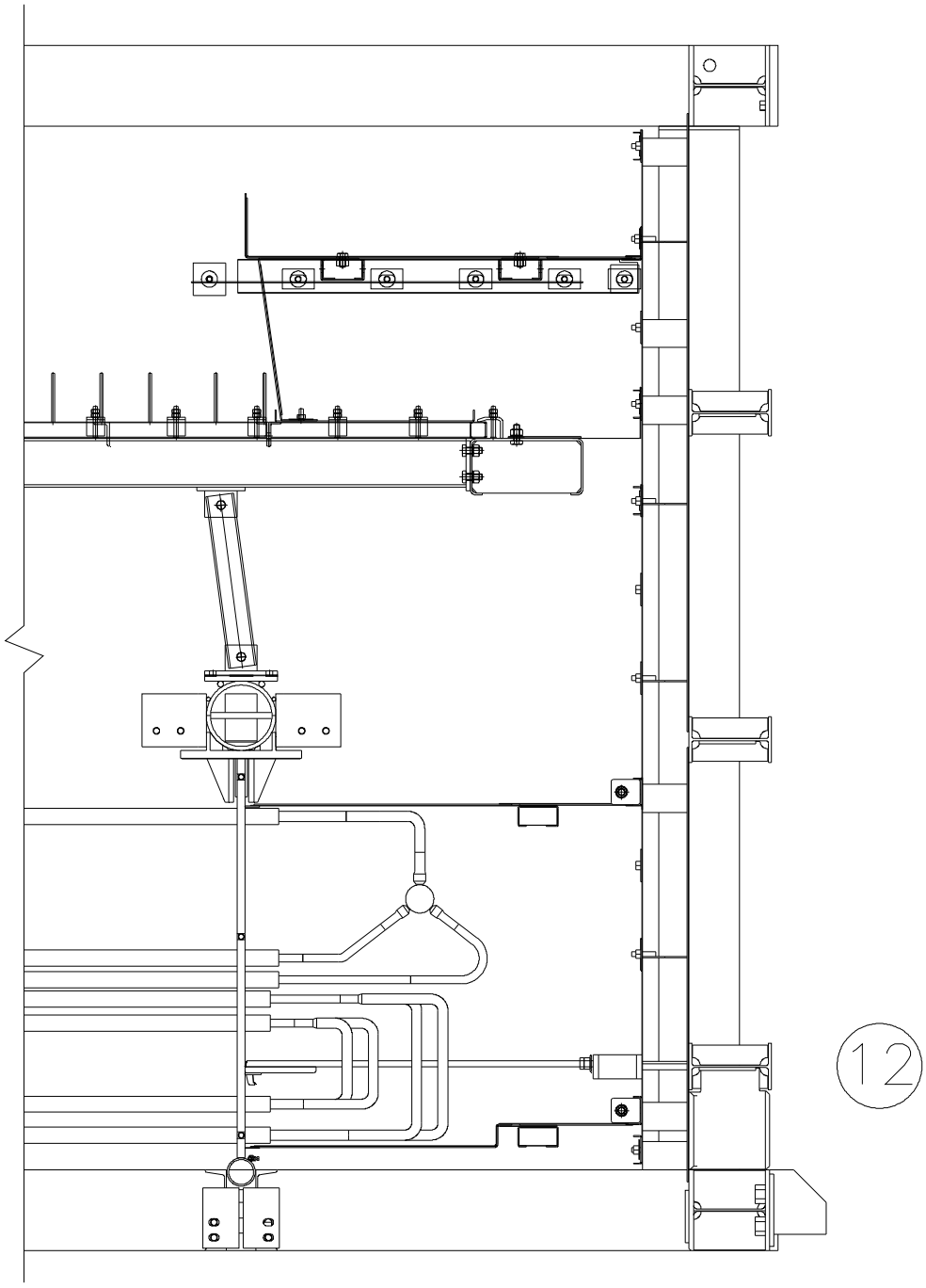


Figure 24 – Lower OTSG Module Rear Restraint Rod / Endseal Detail

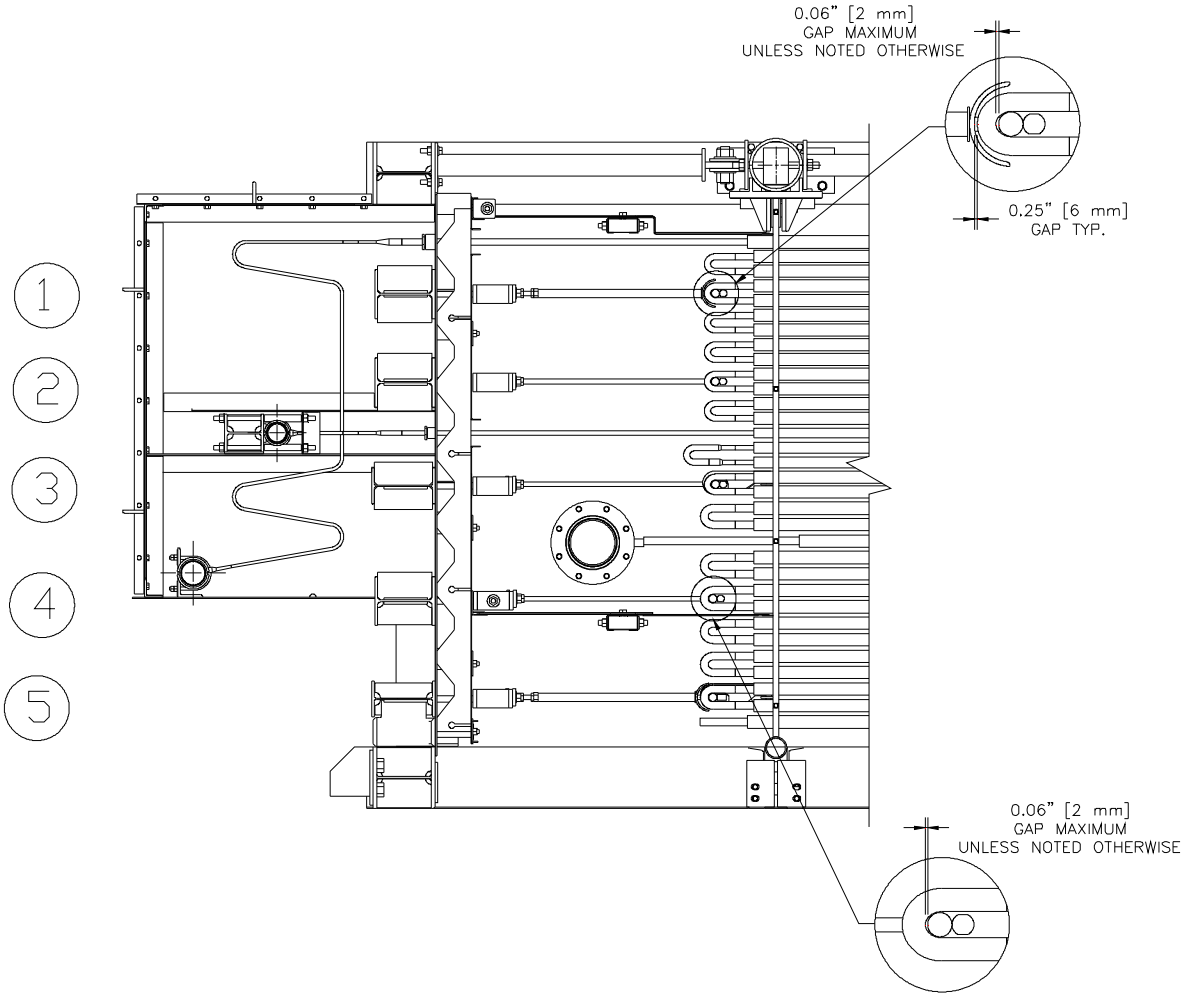


Figure 25 – Upper OTSG Module Front Restraint Rod / Endseal Detail

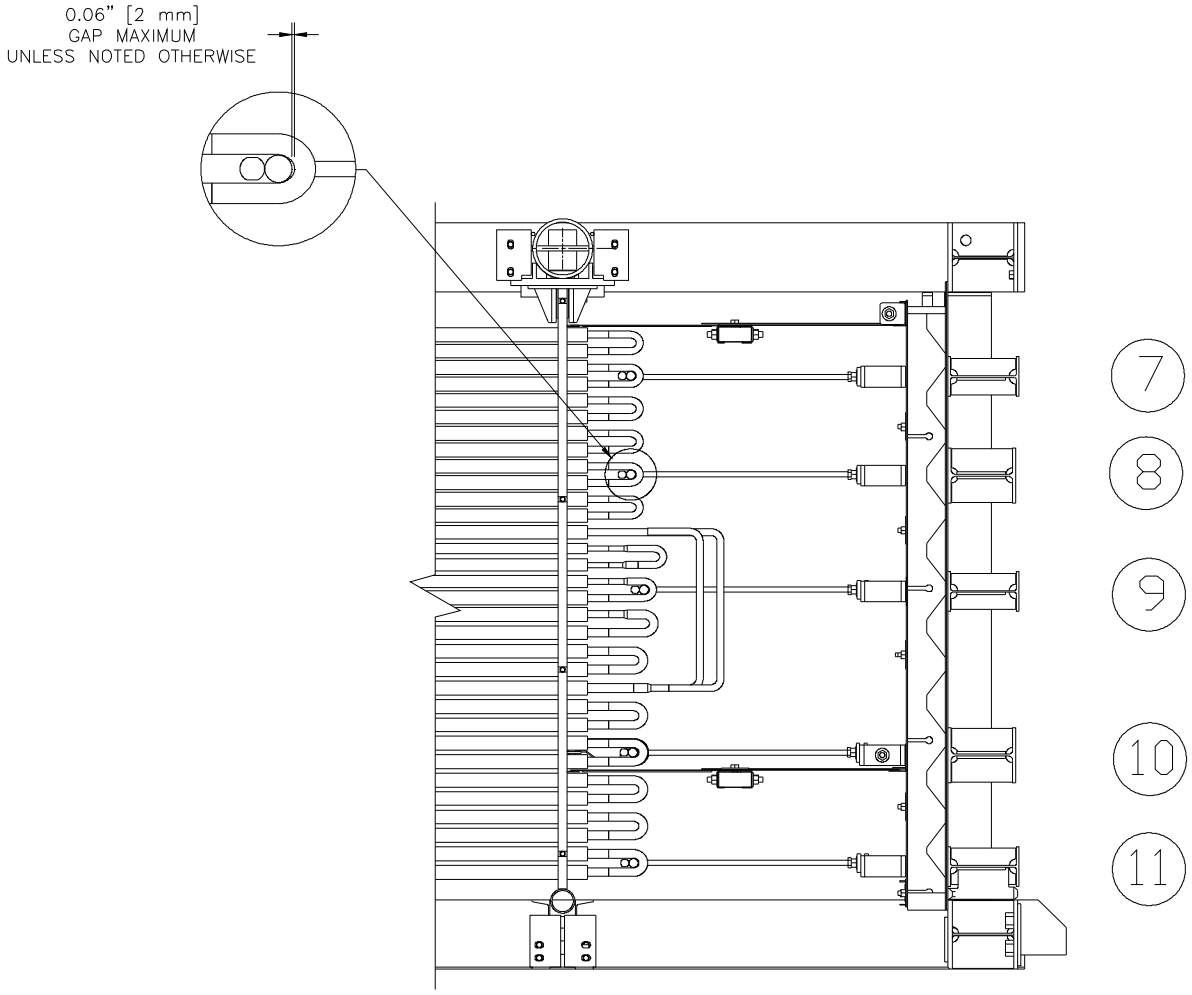


Figure 26 – Upper OTSG Module Rear Restraint Rod / Endseal Detail

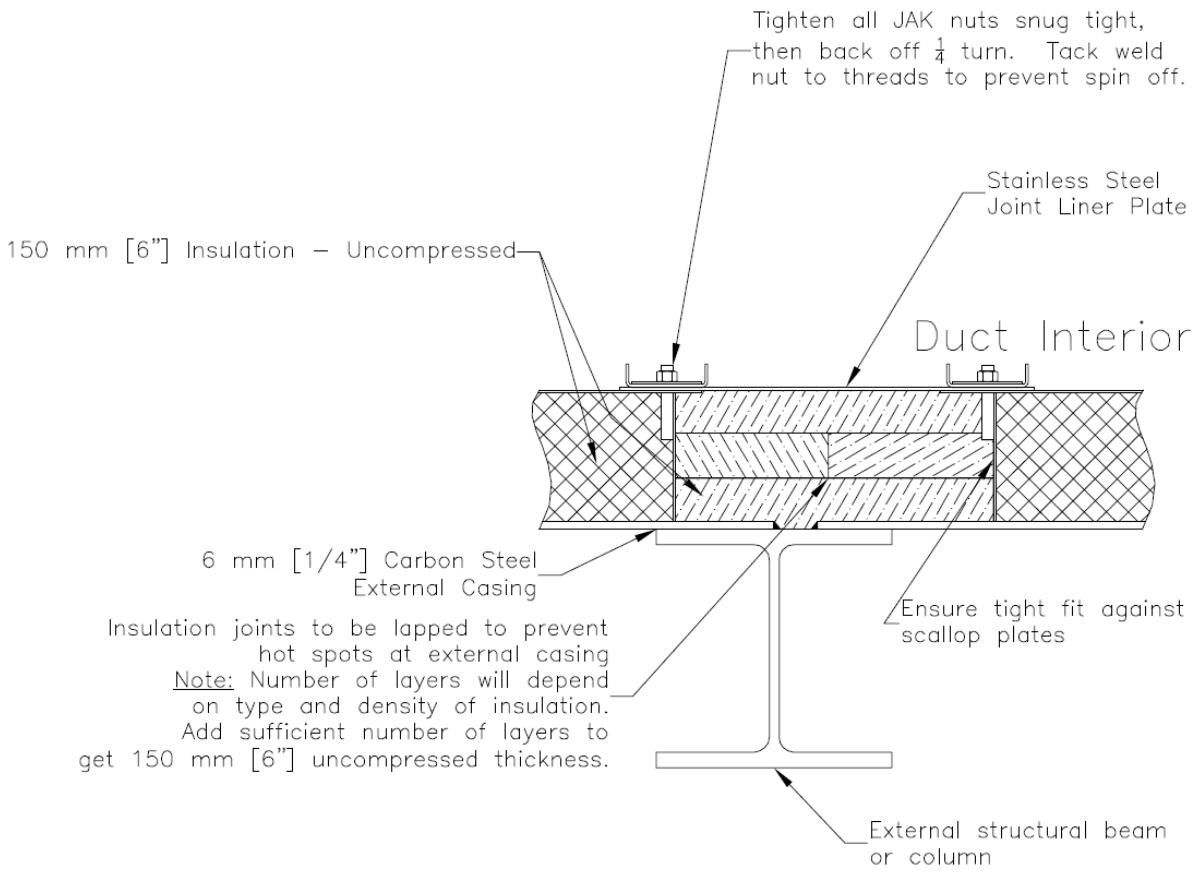


Figure 27 – Duct Joint Insulation Sketch

Appendix B

Extra Work Order Form

SUBCONTRACTOR EXTRA WORK ORDER (EWO)

IST Project Name:		IST Project Number:	
Contractor EWO No.:		Date Issued (dd/mm/yy):	
To (Name /Company):			
From (Name/Company):			

Description of Extra Work:

Cost Type:							
Fixed		Time & Mat'l		Unit Price		Other	

Summary:	Cost	Details
Direct Manhours		
Labour Amount		
Material Amount		
Subcontract Amount		
Equipment Amount		
Other (Specify)		
Subtotal		
Overhead		
Grand TOTAL		Currency

Date work will begin:		Date work will finish:	
Will the schedule, as specified in the purchase order, be impacted (Y/N)			
If YES, State number of days project schedule is impacted			

The above value takes into account all costs and impacts for this extra work. IST is released from any further claim for additional time or money associated with this Extra Work Order.

Subcontrator Sign-off:		Date:

The following section is to be completed by IST

Extra Work Approved by:		Project Manager	Date:	
Extra Work Approved by:		Site Rep.	Date:	
Extra Work Cost Allocation:				
Purchase Order Number:				

Appendix C

Customer Backcharge Procedure and Authorization Form

Customer Backcharge Procedure and Authorization Form

IST is committed to offering our customers the best support possible for our world class technology. Please take the time to familiarize yourself and your staff with this very important procedure. This will help us to respond quickly to any backcharge related issues.

1.0 Introduction

A backcharge is considered to be a method by which a Customer can recover expenses and costs incurred to correct, repair, or replace an assigned item of IST's scope of supply. This includes, but is not limited to, malfunctions, failure to meet specifications, and overs, shorts or damages (OS&D).

2.0 Notification

On knowledge of a possible backcharge, Customer will notify IST on the pending backcharge and shall propose the method of handling, or otherwise request an IST proposed method of handling. IST will first be given the opportunity to inspect and correct the condition considering reasonable time parameters established by the Customer.

3.0 Execution

Customer shall evaluate all recommended methods of correction and select the method that is most economical and advantageous to all parties. Customer will prepare an estimate of charges before IST can approve the field work and any associated procurement. Any verbal instructions between the Customer and Contractor shall be followed by a letter of confirmation. Customer must make an attempt to obtain an IST signature on the backcharge before any work is performed. Failure to notify IST of potential backcharges before the initiation of work associated with the backcharge may result in non-coverage by IST. Backcharge claims received more than 30 calendar days after the work has been initiated will not be accepted by IST. If an IST Field Services Representative is on-site during the execution of a backcharge claim, then copies of all labour and equipment timesheets and all material and supply acquisitions will be handed over to IST Field Services Representative, in a timely manner, for review. Copies are also to be provided to IST together with the official backcharge claim.

4.0 Authorization

Included with this procedure is a form (Field Work Authorization for Backcharges, included as part of this SYS-126) to facilitate communication of acceptance. Other forms of communication/ acknowledgement may be considered valid as well. If an alternate Field Work Authorization form is to be considered then it shall be provided to IST ahead of time for review and understanding. Customer and IST are to jointly agree on the form that will be used prior to initiating the first backcharge event.

Customer's receipt of an approved/ accepted Field Work Authorization for Backcharge shall be the approval to proceed.

Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

5.0 Reconciliation

Backcharge Costs will be limited to the following:

1) Direct labour hours at fully burdened rate
2) Direct costs of 3rd party subcontractors, materials and supplies
3) Direct construction equipment usage will be based on actual hours used. Depending on the rental agreement, hourly rates shall be based on 1/217th of the monthly rental rate or 1/50th of the weekly rate or 1/10th of the daily rental rate. In cases where the equipment is rented solely for the execution of the backcharge work then the full rental cost is applied.
4) Direct design engineering hours at a fully burdened rate
5) Direct cost of 3rd party rentals
6) Mark-up fees for administration and overhead limited to 5%

6.0 Collection

The method for collection of backcharges shall be jointly agreed to between the Customer and IST and will include, but not be limited to, the following:

1) Debit memo applied to last invoice
2) Credit amendment
3) Set off against other monies owed by Customer to IST
4) Direct invoice for payment by IST

7.0 Dispute Resolution

Any backcharge dispute shall be resolved in accordance with the contract terms and conditions for dispute resolution.

IST	BACKCHARGE AUTHORIZATION FORM	SYS-126 REV00

PROJECT NAME:							
LOCATION:		DATE:					
IST CUSTOMER:		SHEET:	1	of	2		
CUSTOMER's CONTRACTOR:							
REPORTED BY:		BACKCHARGE CLAIM #:					
BACKCHARGE DESCRIPTION:							
REQUIRED FIELD WORK START DATE:							
IST RESPONSE REQUIRED BY DATE:							

ESTIMATE SUMMARY

		DOLLARS		
LABOUR			CURRENCY:	
MATERIAL				
EQUIPMENT				
SUBCONTRACTS				
SUBTOTAL				
	%			
ADMINISTRATION AND OVERHEAD	5			
TOTAL				

****

TO BE COMPLETED BY IST

FIELD WORK APPROVED BY: _____ DATE: _____

FIELD WORK APPROVED BY: _____ DATE: _____

IST CHANGE REQUEST No.: _____

COMMENTS: _____

simply generates more profit

IST	BACKCHARGE ESTIMATING WORK SHEET	SYS-126 REV00

PROJECT NAME: _____

LOCATION: _____ DATE: _____

IST CUSTOMER: _____ SHEET: 2 of 2

CUSTOMER's CONTRACTOR: _____

REPORTED BY: _____ BACKCHARGE CLAIM #: _____

LINE	WEIGHT	QTY	DESCRIPTION	MATERIAL UNIT COST	MATERIAL DOLLARS	LABOUR UNIT COST	LABOUR DOLLARS

Appendix D

Painting –
IST Specification 11303-0450
with Vendor Equipment Coating System
Product Datasheets and MSDS

TABLE OF CONTENTS

OTSG and Ducting Coating Specification
- IST Specification ES-010 – Paint Specifications
- Carbozinc 11 HS Product Datasheet
- Carbozinc 11 HS MSDS

Platform Coating Specification
- Zinc Clad II ES Product Datasheet
- Zinc Clad II ES MSDS

Vent Silencer Coating Specification
- Dimetcote 9 Product Datasheet
- Dimetcote 9 MSDS

Selective Catalyst Reduction System Coating Specification
- Carbozinc 859 Product Datasheet
- Carbozinc 859 MSDS
- Carboguard 890 Product Datasheet
- Carboguard 890 MSDS

Stack Damper Coating Specification
- Interzinc 22HS Datasheet
- Interzinc 22HS MSDS
- Intertherm 50 Datasheet
- Intertherm 50 MSDS

product data carboline®

Carbozinc®11 HS

Selection & Specification Data

Generic Type Solvent Based Inorganic Zinc

Description Ultra-low VOC member of the Carbozinc family with extraordinary performance characteristics. Carbozinc 11 HS combines unparalleled performance properties with a 2.4 lbs/gallon (unthinned) and 2.7 lbs/gallon (thinned) formulation that meets even the most stringent VOC restrictions.

Features

- Meets Class B slip co-efficient and creep testing criteria for use on faying surfaces
- Rapid cure. Dry to handle in 1 hour at 75°F (24°C) and 50% relative humidity
- Low temperature cure down to 15°F (-9°C)
- High zinc loading
- Very good resistance to salting
- May be applied with standard airless or conventional spray equipment
- May be used as a weldable pre-construction primer where VOC regulations prohibit traditional coatings. Exhibits long-term corrosion resistance during pre-construction and can be recoated or topcoated as specified for the intended service.
- VOC compliant to current AIM regulations

Color Green (0300)

Finish Flat

Primers Self Priming

Topcoats Not required for certain exposures. Can be topcoated with Epoxies, Polyurethanes, Acrylics, High-Heat Silicones and others as recommended by your Carboline sales representative. Under certain conditions, a mist coat is required to minimize topcoat bubbling.

Dry Film Thickness 2.0-3.0 mils (50-75 microns). Dry film thickness in excess of 6.0 mils (150 microns) per coat is not recommended. When used as a weldable pre-construction primer, the recommended DFT is 0.75-1.25 mils (19-31 microns).

Solids Content By Weight: 91% ± 2%

Zinc Content By Weight: 84% ± 2% in dry film

Theoretical Coverage Rate
1203 mil ft^2/gal (30.0 m^2/l at 25 microns)
401 ft^2 at 3.0 mils (10.0 m^2/l at 75 microns)
Allow for loss in mixing and application

VOC Values
EPA Method 24
Supplied:: 2.4 lbs./gal (288 g/l)
Thinned:
15 oz/gal w/ #26, #33, or #230: 2.95 lbs./gal (354 g/l)
(11 oz/.72 gal. kit or 55 oz/3.6 gal kit)
15 oz/gal w/ #237: 2.77 lbs/gal (332 g/l)
(11 oz/.72 gal. kit or 55 oz/3.6 gal kit)
These are nominal values.

Thinned (As pre-construction primer):
38 oz/gal w/ #26: 3.6 lbs./gal (435 g/l)
27 oz/.72 gallon kit or 138 oz/3.6 gallon kit

Selection & Specification Data Cont.

Dry Temp. Resistance

Untopcoated:
Continuous: 750°F (399°C)
Non-Continuous: 800°F (427°C)
With recommended high heat topcoats:
Continuous: 1000°F (538°C)
Non-Continuous: 1200°F (649°C)

Substrates & Surface Preparation

General Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.

Steel SSPC-SP6
Surface Profile: 1.0-3.0 mils (25-75 micron)

Performance Data

Test Method	System	Results	Report #
ASTM D3363 Pencil hardness	1 ct. CZ11HS	Pencil Hardness 3H	03278
ASTM A-325 or A-490 Slip co-efficient	1 ct. CZ11HS	0.58 meets requirements for Class B rating	08510
AASHTO M300	Blasted steel 1ct. CZ11HS	No blistering or rusting of coating or any bare steel areas.	02934
ASTM B117 Salt Spray	Blasted Steel 1 ct. CZ11HS	No rusting or blistering; slight rust in scribe, no creepage at scribe after 70,000 hours	SR 380

Test reports and additional data available upon written request.

Application Equipment

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

General Guidelines:

Spray Application (General) The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco. Keep material under mild agitation during application. If spraying stops for more than 10 minutes, recirculate the material remaining in the spray line. Do not leave mixed primer in the hoses during work stoppages.

Conventional Spray Agitated pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, with a maximum length of 50', .070" I.D. fluid tip and appropriate air cap.

Airless Spray
Pump Ratio: 30:1 (min.)
GPM Output: 3.0 (min.)
Material Hose: 3/8" I.D. (min.)
Tip Size: .017-.021"
Output PSI: 2100-2500
Filter Size: 60 mesh
Teflon packings are recommended and available from the pump manufacturer.

Brush For touch-up of areas less than one square foot only. Use medium bristle brush and avoid rebrushing.

Roller Not recommended

November 2009 replaces August 2009

0249

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance or injuries resulting from use. Liability, if any, is limited to replacement of products. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Carboline® and Carbozinc® are registered trademarks of Carboline Company.

Carbozinc®11 HS

Mixing & Thinning

Mixing

Power mix base, then combine and power mix as follows. Pour zinc filler very slowly into premixed base with continuous agitation. Mix until free of lumps. Then add activator and mix for another 2 minutes. Pour mixture through a 30 mesh screen. DO NOT MIX PARTIAL KITS. **Note**: Carbozinc 11 HS will not cure without the use of the Activator as defined below.
Tip: Sifting zinc through a window screen will aid in the mixing process by breaking up or catching dry zinc lumps.

Ratio

	.72 Gal Kit	3.6 Gal Kit
Part A:	1 gal. (short fill)	5 gals. (short fill)
Activator:	6.4 fl. oz.	32 fl. oz.
Zinc Filler:	14.6 lbs	73 lbs

Thinning

Normally not required but may be thinned up to 11 oz per .72 gal kit or 55 oz per 3.6 gal kit with Thinner #26, #33, #230 or #237. Use of thinners other than those supplied by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.

For use as a weldable zinc primer to achieve a recommended DFT of 0.75-1.25 mils, thin this product 30% with Thinner #26.

Carboline Thinner #236E may also be used to thin this product to minimize HAP and VOC emissions. Consult Carboline Technical Service for guidance.

Pot Life

8 Hours at 75°F (24°C) and less at higher temperatures. Pot life ends when coating becomes too viscous to use.

Cleanup & Safety

Cleanup

Use Thinner #21 or Isopropyl Alcohol. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

Safety

Read and follow all caution statements on this product data sheet and on the MSDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.

Ventilation

When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. In addition to ensuring proper ventilation, appropriate respirators must be used by all application personnel.

Caution

This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

Application Conditions

Condition	Material	Surface	Ambient	Humidity
Normal	60°-85°F (16°-29°C)	40°-95°F (4°-35°C)	40°-95°F (4°-35°C)	40-90%
Minimum	15°F (-9°C)	15°F (-9°C)	15°F (-9°C)	30%
Maximum	95°F (35°C)	150°F (66°C)	120°F (49°C)	95%

This product simply requires the substrate temperature to be above the dew point. Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

Curing Schedule

Surface Temp. & 50% Relative Humidity	Dry to Handle	Dry to Topcoat
15°F (-9°C)	16 Hours	7 Days
40°F (4°C)	4 Hours	72 Hours
60°F (16°C)	2 Hours	36 Hours
75°F (24°C)	1 Hour	18 Hours
100°F (32°C)	¾ Hour	14 Hours

These times are based on a 3.0 mil (75 micron) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure. Humidity levels below 50% will require longer cure times. **Notes**: Any salting that appears on the zinc surface as a result of prolonged weathering exposure must be removed prior to the application of additional coatings. Also, loose zinc must be removed from the cured film by rubbing with fiberglass or aluminum screen wire when "dry spray/overspray" is evident on the cured film and a topcoat will be applied. For **accelerated curing** or **where the relative humidity is below 40%**, allow an initial 2-hour ambient cure followed by misting with water or steam to keep the coated surface wet for a minimum of 8 hours and/or until the coated surface achieves a "2H" pencil hardness per ASTM D3363.

Packaging, Handling & Storage

Shipping Weight (Approximate)

.72 Gallon Kit	3.6 Gallon Kit
22 lbs (10 kg)	103 lbs (47 kg)

Flash Point (Setaflash)

Carbozinc 11 HS base: 55°F (13°C)
HS Activator: 90°F (33°C)
Zinc Filler: N/A

Storage (General)

Store Indoors.

Storage Temperature & Humidity

40° -100°F (4-38°C).
0-90% Relative Humidity

Shelf Life

Part A: 12 months at 75°F (24°C)
Part B: 24 months at 75°F (24°C)
Part C: Min. 24 months at 75°F (24°C)

***Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.**

carboline®

350 Hanley Industrial Court, St. Louis, MO 63144-1599
314/644-1000 314/644-4617 (fax) www.carboline.com

An RPM Company

November 2009 replaces August 2009

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance or injuries resulting from use. Liability, if any, is limited to replacement of products. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Carboline® and Carbozinc® are registered trademarks of Carboline Company.

Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name: CARBOZINC 11 HS BASE

Identification Number: PLMSDS 0249A1NL

Product Use/Class: Solvent Based Inorganic Zinc - FOR INDUSTRIAL USE ONLY

Manufacturer: **Carboline Company**
2150 Schuetz Road
St. Louis, MO 63146
(800) 848-4645

Revision Date: 03/10/2010

Supercedes : 06/04/2007

Preparer: Regulatory, Department

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
ALKYL SILICATE	PMN# P89-882	40.0	NE	NE	NE	NE
ETHYL ALCOHOL	64-17-5	25.0	1000 PPM	1000 PPM	1900 MGM3	N/E
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	10.0	100 PPM	150 PPM	360 MGM3	NE
MICA	12001-26-2	5.0	3 MGM3	N/E	3 MGM3	N/E
TITANIUM DIOXIDE	13463-67-7	5.0	10 MGM3	N/E	10 MGM3	N/E
ETHYL POLYSILICATE	11099-06-2	5.0	N/E	N/E	N/E	N/E

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

Effects Of Overexposure - Eye Contact: May cause eye irritation.

Effects Of Overexposure - Skin Contact: Direct skin contact may cause irritation. May be harmful if absorbed through the skin.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be

aggravated by exposure to dust or organic vapors, see a physician prior to use.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 55F (12C) (Setaflash)

Lower Explosive Limit, %: 1.2
Upper Explosive Limit, %: 36.0

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application instructions, container label and Product Data Sheet. Avoid breathing vapors or spray mist.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If

not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals. Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	149 F (65 C) - 248 F (120 C)	**Vapor Density:**	Heavier than Air
Odor:	Solvent	**Odor Threshold:**	N/D
Appearance:	Viscous Green, Grey or Red Liquid	**Evaporation Rate:**	Slower Than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	1.26
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50
ALKYL SILICATE	PMN# P89-882	NOT AVAILABLE	NOT AVAILABLE
ETHYL ALCOHOL	64-17-5	7060 MG/KG, ORAL, RAT	20000 PPM/10 HRS, RAT, INHALATION
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	>5180 MG/KG, ORAL, RAT	10000 PPM/4HRS RAT,INHALATION
MICA	12001-26-2	NOT AVAILABLE	NOT AVAILABLE
TITANIUM DIOXIDE	13463-67-7	>25 G/KG, ORAL, RAT	>6.82 MG/L 4 HR, RAT
ETHYL POLYSILICATE	11099-06-2	NOT AVAILABLE	NOT AVAILABLE

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Name:	Flammable Liquid NOS	**Packing Group:**	II
DOT Technical Name:	(Ethanol, Isopropanol)	**Hazard Subclass:**	N/A
DOT Hazard Class:	3	**Resp. Guide Page:**	128
DOT UN/NA Number:	UN 1993		

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

No Section 313 Substances exist in this product

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:

No TSCA 12(B) Substances exist in this product

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	CAS Number
CERAMIC MICROSPHERES	66402-68-4

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	CAS Number
CERAMIC MICROSPHERES	66402-68-4
IRON OXIDE	1332-37-2

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

Chemical Name	CAS Number
MICROCRYSTALLINE SILICA	14808-60-7

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

No California Proposition 65 Reproductive Toxins exist

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2B

Section 16 - Other Information

HMIS Ratings
Health: 2 **Flammability:** 3 **Reactivity:** 1 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): 288

REASON FOR REVISION: Changes made in Section(s): 1, 2, 3, and 11

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name:	CARBOZINC HS ACTIVATOR	**Revision Date:**	07/29/2008
Identification Number:	PLMSDS 0249C1NL	**Supercedes :**	08/01/2005
Product Use/Class:	Catalyst for Inorganic Zinc - FOR INDUSTRIAL USE ONLY		
		Preparer:	Regulatory, Department
Manufacturer:	**Carboline Company 350 Hanley Industrial Ct. St. Louis, MO 63144**		

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	90.0	100 PPM	150 PPM	360 MGM3	NE
ZINC CHLORIDE	7646-85-7	5.0	1 MGM3	2 MGM3	1 MGM3	NE

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

Effects Of Overexposure - Eye Contact: May cause eye burns.

Effects Of Overexposure - Skin Contact: May cause skin burns.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation. May cause lung injury.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be aggravated by exposure to dust or organic vapors, see a physician prior to use.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult

a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 91F (32C) (Setaflash)

Lower Explosive Limit, %: 1.4

Upper Explosive Limit, %: 11.2

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application instructions, container label and Product Data Sheet.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals.

Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	243 F (117 C) - 248 F (120 C)	**Vapor Density:**	Heavier than Air
Odor:	Solvent	**Odor Threshold:**	N/D
Appearance:	Clear, Water Thin Liquid	**Evaporation Rate:**	Slower Than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	0.94
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	>5180 MG/KG, ORAL, RAT	10000 PPM/4HRS RAT,INHALATION
ZINC CHLORIDE	7646-85-7	NOT AVAILABLE	NOT AVAILABLE

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Paint **Packing Group:** III

Name:			
DOT Technical Name:	N/A	**Hazard Subclass:**	N/A
DOT Hazard Class:	3	**Resp. Guide Page:**	128
DOT UN/NA Number:	UN1263		

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

No Section 313 Substances exist in this product

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:

No TSCA 12(B) Substances exist in this product

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	CAS Number
TETRABUTYL TITANATE	5593-70-4

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	CAS Number
TETRABUTYL TITANATE	5593-70-4

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

No California Proposition 65 Carcinogens exist

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

No California Proposition 65 Reproductive Toxins exist

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2B

Section 16 - Other Information

HMIS Ratings
Health: 3 **Flammability:** 3 **Reactivity:** 1 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): 288

REASON FOR REVISION: Routine Update

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Protective & Marine Coatings

ZINC CLAD® II ETHYL SILICATE
INORGANIC ZINC-RICH COATING

PART E	B69V3	BINDER
PART F	B69D11	ZINC DUST

Revised 1/11

PRODUCT INFORMATION

6.02

PRODUCT DESCRIPTION

ZINC CLAD II ETHYL SILICATE is a solvent-based two-package, inorganic ethyl silicate, zinc-rich coating.

- Meets Class B requirements for Slip Coefficient and Creep Resistance, .56
- Meets AASHTO M-300 specification
- 85% zinc content in dry film
- Coating self-heals to resume protection if damaged
- Provides cathodic/sacrificial protection by the same mechanism as galvanizing. Also protects steel by forming an inorganic moisture and solvent barrier

PRODUCT CHARACTERISTICS

Finish:	Flat
Color:	Gray-green
Volume Solids:	62% ± 2%, ASTM D2697, mixed
Weight Solids:	82% ± 2 %, mixed
VOC (calculated): mixed	Unreduced: <500 g/L; 4.17 lb/gal Reduced 10%: <500 g/L; 4.17 lb/gal
Zinc Content in Dry Film:	85% by weight
Mix Ratio:	2 components; premeasured 5 gallons (18.9L) mix

Recommended Spreading Rate per coat:

	Minimum	Maximum
Wet mils (microns)	**3.5** (88)	**6.5** (163)
Dry mils (microns)	**2.0** (50)	**4.0** (100)
~Coverage sq ft/gal (m^2/L)	**248** (6.1)	**496** (12.2)
Theoretical coverage **sq ft/gal** (m^2/L) @ 1 mil / 25 microns dft	**995** (24.3)	

Dry film thickness in excess of 6.0 mils (150 microns) per coat is not recommended.

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 5.0 mils wet (125 microns):

	@ 55°F/13°C	@ 77°F/25°C *50% RH*	@ 100°F/38°C
Rain resistant:	1 hour	20-30 minutes	15 minutes
To touch:	30 minutes	15 minutes	5 minutes
To handle:	3 hours	1-2 hours	20 minutes
To recoat:	48 hours	18 hours	18 hours
To cure:	7 days	7 days	7 days
Immersion service:	14 days	14 days	14 days
Drying time is temperature, humidity, and film thickness dependent.			
Pot Life:	18 hours	8 hours	6 hours

Note: High humidity will shorten the pot life.

Sweat-in-Time: None required

Shelf Life:	Part E: 9 months, unopened Part F: 24 months, unopened Store indoors at 40°F (4.5°C) to 100°F (38°C).
Flash Point:	55°F (13°C), PMCC, mixed
Reducer/Clean Up:	
Below 80°F (27°C):	Xylene, R2K4
Above 80°F (27°C):	Reducer #58, R7K58 or Reducer 100, R2K5

RECOMMENDED USES

For use over properly prepared blasted steel.

- As a one-coat maintenance coating or as a permanent primer for severely corrosive environments (pH range 5-9)
- Economical replacement for galvanizing with similar performance
- Ideal for application at low temperatures or service at high temperatures and/or humidity conditions
- Water intake and discharge lines (non-potable)
- Where abrasion resistance and hardness is required
- Bridges, refineries, drilling rigs
- Shop or field application
- Not recommended for severe acid or alkali exposure
- This product meets specific design requirements for non-safety related nuclear plant applications in Level II, III and Balance of Plant, and DOE nuclear facilities*.
  - Nuclear Power Plants
  - Nuclear fabrication shops
  - DOE Nuclear Fuel Facilities
  - DOE Nuclear Weapons Facilities

* Nuclear qualifications are NRC license specific to the facility.

PERFORMANCE CHARACTERISTICS

Substrate*: Steel

Surface Preparation*: SSPC-SP10/NACE 2

System Tested*:

1 ct. Zinc Clad II @ 3.0 mils dft (75 microns)

*unless otherwise noted below

Test Name	Test Method	Results
Abrasion Resistance	ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load	326 mg loss
Adhesion	ASTM D4541	6.77 MPa = 982 lb psi
Direct Impact Resistance	ASTM D2794	60 in. lbs.
Dry Heat Resistance	ASTM D2485	750°F (399°C)
Immersion Resistance (untopcoated)	1 year	Acceptable for: crude oil, fresh and demineralized water, gasoline
Moisure Condensation Resistance	ASTM D4585, 100°F (38°C), 2000 hours	No Failure
Pencil Hardness	ASTM D3363	3H
Radiation Tolerance	ASTM D4082 / ANSI 5.12	Pass at 5 mils (125 microns)
Salt Fog Resistance	ASTM B117, 2000 hours	No Failure
Slip Coefficient (zinc only)	AISC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts	Class B, 0.56
Wet Heat Resistance	Non-immersion	115°F (46°C)

Provides performance comparable to products formulated to Federal Specifications: Mil-P-38336, Mil-P-46105, and SSPC Paint 20.

continued on back

Protective & Marine Coatings

ZINC CLAD® II ETHYL SILICATE
INORGANIC ZINC-RICH COATING

PART E	B69V3	BINDER
PART F	B69D11	ZINC DUST

PRODUCT INFORMATION

6.02

RECOMMENDED SYSTEMS

		Dry Film Thickness / ct. Mils	(Microns)
Steel, Zinc Primer/Finish, immersion or atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
Steel, Acrylic Topcoat, atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
2 cts.	DTM Acrylic Coating	2.5-4.0	(63-100)
Steel, Coal Tar Epoxy Topcoat, atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
1 ct.	Hi-Mil Sher-Tar Epoxy	16.0-20.0	(400-500)
Steel, Epoxy Topcoat, atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
1-2 cts.	Macropoxy HS	3.0-6.0	(75-150)
Steel, Epoxy Topcoat, atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
2 cts.	Tile-Clad HS Epoxy	3.0-4.0	(75-100)
Steel, Urethane Topcoat, atmospheric:			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
1 ct.	Macropoxy HS	3.0-6.0	(75-150)
1 ct.	Sherthane 2K Urethane	2.0-4.0	(50-100)

NOTE: 1 ct. of DTM Wash Primer or Pro-Cryl Universal Primer can be used as an intermediate coat under recommended topcoats to prevent pinholing.

Steel, Class B Compliant System			
1 ct.	Zinc Clad II Ethyl Silicate	2.0-4.0	(50-100)
1 ct.	Steel Spec Epoxy Primer (red)	4.0-6.0	(100-150)

The systems listed above are representative of the product's use, other systems may be appropriate.

DISCLAIMER

The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Information and Application Bulletin.

SURFACE PREPARATION

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Refer to product Application Bulletin for detailed surface preparation information.

Minimum recommended surface preparation:
Iron & Steel
Atmospheric: SSPC-SP6/ NACE 3, 2 mil (50 micron) profile
Immersion: SSPC-SP10/NACE 2, 2 mil (50 micron) profile

Surface Preparation Standards

	Condition of Surface	ISO 8501-1 BS7079:A1	Swedish Std. SIS055900	SSPC	NACE
White Metal		Sa 3	Sa 3	SP 5	1
Near White Metal		Sa 2.5	Sa 2.5	SP 10	2
Commercial Blast		Sa 2	Sa 2	SP 6	3
Brush-Off Blast		Sa 1	Sa 1	SP 7	4
Hand Tool Cleaning	Rusted	C St 2	C St 2	SP 2	-
	Pitted & Rusted	D St 2	D St 2	SP 2	-
Power Tool Cleaning	Rusted	C St 3	C St 3	SP 3	-
	Pitted & Rusted	D St 3	D St 3	SP 3	-

TINTING

Do not tint.

APPLICATION CONDITIONS

Temperature:	
air and surface:	0°F (-7°C) minimum, 120°F (49°C) maximum
material:	40°F (4.5°C) minimum At least 5°F (2.8°C) above dew point
Relative humidity:	40% - 90% maximum Water misting may be required at humidities below 50%

Refer to product Application Bulletin for detailed application information.

ORDERING INFORMATION

Packaging:	5 gallons (18.9L) mixed
Part E:	3.75 gallons (14.2L) in a 5 gallon (18.9L) can
Part F:	73 lb (33.1 Kg) zinc dust
Weight:	20.9 ± 0.2 lb/gal ; 2.5 Kg/L, mixed

SAFETY PRECAUTIONS

Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

WARRANTY

The Sherwin-Williams Company warrants our products to be free of manufacturing defects in accord with applicable Sherwin-Williams quality control procedures. Liability for products proven defective, if any, is limited to replacement of the defective product or the refund of the purchase price paid for the defective product as determined by Sherwin-Williams. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY SHERWIN-WILLIAMS, EXPRESSED OR IMPLIED, STATUTORY, BY OPERATION OF LAW OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Protective & Marine Coatings

ZINC CLAD® II ETHYL SILICATE
INORGANIC ZINC-RICH COATING

PART E	B69V3	BINDER
PART F	B69D11	ZINC DUST

Revised 1/11

APPLICATION BULLETIN

6.02

SURFACE PREPARATIONS

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Zinc rich coatings require direct contact between the zinc pigment in the coating and the metal substrate for optimum performance.

Iron & Steel (atmospheric service)
Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. Minimum surface preparation is Commercial Blast Cleaning per SSPC-SP6/NACE 3. For better performance, use Near White Metal Blast Cleaning per SSPC-SP10/NACE 2. Blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils / 50 microns). Prime any bare steel the same day as it is cleaned or before flash rusting occurs.

Iron & Steel (immersion service)
Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. Minimum surface preparation is Near White Metal Blast Cleaning per SSPC-SP10/NACE 2. Blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils / 50 microns). Remove all weld spatter and round all sharp edges by grinding. Prime any bare steel the same day as it is cleaned or before flash rusting occurs.

Note: If blast cleaning with steel media is used, an appropriate amount of steel grit blast media may be incorporated into the work mix to render a dense, angular 1.5-2.0 mil (38-50 micron) surface profile. This method may result in improved adhesion and performance.

Surface Preparation Standards

	Condition of Surface	ISO 8501-1 BS7079:A1	Swedish Std. SIS055900	SSPC	NACE
White Metal		Sa 3	Sa 3	SP 5	1
Near White Metal		Sa 2.5	Sa 2.5	SP 10	2
Commercial Blast		Sa 2	Sa 2	SP 6	3
Brush-Off Blast		Sa 1	Sa 1	SP 7	4
Hand Tool Cleaning	Rusted	C St 2	C St 2	SP 2	-
	Pitted & Rusted	D St 2	D St 2	SP 2	-
Power Tool Cleaning	Rusted	C St 3	C St 3	SP 3	-
	Pitted & Rusted	D St 3	D St 3	SP 3	-

APPLICATION CONDITIONS

Temperature:
- air and surface: 0°F (-7°C) minimum, 120°F (49°C) maximum
- material: 40°F (4.5°C) minimum
  At least 5°F (2.8°C) above dew point

Relative humidity: 40% - 90% maximum
Water misting may be required at humidities below 50%

APPLICATION EQUIPMENT

The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compliant with existing VOC regulations and compatible with the existing environmental and application conditions.

Reducer/Clean Up
Below 80°F (27°C) .....Xylene, R2K4
Above 80°F (27°C).....Reducer #58, R7K58 or Reducer 100, R2K5

Airless Spray
(use Teflon packings and continuous agitation)
Pressure.....1800 - 2000 psi
Hose.....3/8" ID
Tip .....017" - .021"
Reduction.....As needed up to 10% by volume

Conventional Spray
(continuous agitation required)
Gun .....Binks 95
Fluid Nozzle 66
Air Nozzle.....63PB
Atomization Pressure.....30 - 40 psi
Fluid Pressure.....10 - 20 psi
Reduction.....As needed up to 10% by volume

Keep pressure pot at level of applicator to avoid blocking of fluid line due to weight of material. Blow back coating in fluid line at intermittent shutdowns, but continue agitation at pressure pot.

Brush .....For touch-up only

If specific application equipment is not listed above, equivalent equipment may be substituted.

continued on back

Protective & Marine Coatings

ZINC CLAD® II ETHYL SILICATE
INORGANIC ZINC-RICH COATING

PART E	B69V3	BINDER
PART F	B69D11	ZINC DUST

APPLICATION BULLETIN

6.02

APPLICATION PROCEDURES

Surface preparation must be completed as indicated.

Zinc Clad II comes in 2 premeasured containers which when mixed provides 5 gallons (18.9L) of read-to-apply material.

Mixing Instructions: Thoroughly agitate Binder Part E using low speed continuous air driven agitation. Slowly mix all of Zinc Dust Part F into all of Binder Part E until mixture is completely uniform. After mixing, pour mixture through 30-60 mesh screen. Mixed material must be used within 8 hours. Do not mix previously mixed material with new.
If reducer solvent is used, add only after both components have been thoroughly mixed.
Continuous agitation of mixture during application is required, otherwise zinc dust will quickly settle out.

Apply paint at the recommended film thickness and spreading rate as indicated below:

Recommended Spreading Rate per coat:

	Minimum	Maximum
Wet mils (microns)	**3.5** (88)	**6.5** (163)
Dry mils (microns)	**2.0** (50)	**4.0** (100)
~Coverage sq ft/gal (m^2/L)	**248** (6.1)	**496** (12.2)
Theoretical coverage **sq ft/gal** (m^2/L) @ 1 mil / 25 microns dft	**995** (24.3)	

Dry film thickness in excess of 6.0 mils (150 microns) per coat is not recommended.

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 5.0 mils wet (125 microns):

	@ 55°F/13°C	@ 77°F/25°C *50% RH*	@ 100°F/38°C
Rain resistant:	1 hour	20-30 minutes	15 minutes
To touch:	30 minutes	15 minutes	5 minutes
To handle:	3 hours	1-2 hours	20 minutes
To recoat:	48 hours	18 hours	18 hours
To cure:	7 days	7 days	7 days
Immersion service:	14 days	14 days	14 days

Drying time is temperature, humidity, and film thickness dependent.

Pot Life:	18 hours	8 hours	6 hours

Note: High humidity will shorten the pot life.

Sweat-in-Time: None required

Application of coating above maximum or below minimum recommended spreading rate may adversely affect coating performance.

CLEAN UP INSTRUCTIONS

Clean spills and spatters immediately with Xylene, R2K4. Clean tools immediately after use with Xylene, R2K4. Follow manufacturer's safety recommendations when using any solvent.

DISCLAIMER

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PERFORMANCE TIPS

Topcoating: Note minimum cure times at normal conditions before topcoating. Longer drying periods are required if primer cannot be water mist sprayed when humidity is low. Water misting may be required at humidities below 50%.
Occasionally topcoats will pinhole or delaminate from zinc-rich coatings. This is usually due to poor ambient conditions or faulty application of topcoats. This can be minimized by:

- Providing adequate ventilation and suitable application and substrate temperature.
- Avoid dry spray of topcoat.
- If pinholing develops, apply a mist coat of the topcoat, reduced up to 50%. Allow 10 minutes flash off and follow with a full coat.
- Applying a wet full coat, but at minimum film build, prior to applying a complete full coat.

Excessive film build, poor ventilation, and cool temperatures may cause solvent entrapment and premature coating failure.

Any salting on the zinc surface due to weathering exposure must be removed prior to topcoating.

Stripe coat all crevices, welds, and sharp angles to prevent early failure in these areas.

When using spray application, use a 50% overlap with each pass of the gun to avoid holidays, bare areas, and pinholes. If necessary, cross spray at a right angle.

Spreading rates are calculated on volume solids and do not include an application loss factor due to surface profile, roughness or porosity of the surface, skill and technique of the applicator, method of application, various surface irregularities, material lost during mixing, spillage, overthinning, climatic conditions, and excessive film build.

Excessive reduction of material can affect film build, appearance, and performance.

Do not mix previously catalyzed material with new.

Do not apply the material beyond recommended pot life.

In order to avoid blockage of spray equipment, clean equipment before use or before periods of extended downtime with Xylene, R2K4.

Keep pressure pot at level of applicator to avoid blocking of fluid line due to weight of material. Blow back coating in fluid line at intermittent shutdowns, but continue agitation at pressure pot.

Application above recommended film thickness may result in mud cracking.

Not recommended for severe acid or alkali exposures.

Oil base, alkyd, epoxy ester, and silicone alkyd topcoats are not recommended.

Polyurethane topcoats require a tie coat of catalyzed epoxy or Pro-Cryl Universal Primer.

Topcoats may be applied once 50 MEK double rubs are achieved. No zinc or only slight traces should be visible. Coin hardness test can also be used.

Cured films of inorganic zinc coatings contain no appreciable amounts of combustible materials. Both Fire and Smoke Indices would be expected to approach 0.

Refer to Product Information sheet for additional performance characteristics and properties.

SAFETY PRECAUTIONS

Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

WARRANTY

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MATERIAL SAFETY DATA SHEET

B69V3
14 00

DATE OF PREPARATION
Feb 5, 2011

SECTION 1 — PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER
B69V3

PRODUCT NAME
ZINC CLAD™ II Ethyl Silicate (Part E), Binder

MANUFACTURER'S NAME
THE SHERWIN-WILLIAMS COMPANY
101 Prospect Avenue N.W.
Cleveland, OH 44115

Telephone Numbers and Websites

Product Information	www.sherwin-williams.com
Regulatory Information	(216) 566-2902 www.paintdocs.com
Medical Emergency	(216) 566-2917
Transportation Emergency*	(800) 424-9300
**for Chemical Emergency ONLY (spill, leak, fire, exposure, or accident)*	

SECTION 2 — COMPOSITION/INFORMATION ON INGREDIENTS

% by Weight	CAS Number	Ingredient	Units	Vapor Pressure
4	**100-41-4**	**Ethylbenzene**		
		ACGIH TLV	100 PPM	7.1 mm
		ACGIH TLV	125 PPM STEL	
		OSHA PEL	100 PPM	
		OSHA PEL	125 PPM STEL	
23	**1330-20-7**	**Xylene**		
		ACGIH TLV	100 PPM	5.9 mm
		ACGIH TLV	150 PPM STEL	
		OSHA PEL	100 PPM	
		OSHA PEL	150 PPM STEL	
1	**67-56-1**	**Methanol**		
		ACGIH TLV	200 ppm (Skin)	92 mm
		ACGIH TLV	250 ppm (Skin) STEL	
		OSHA PEL	200 ppm (Skin)	
		OSHA PEL	250 ppm (Skin) STEL	
26	**64-17-5**	**Ethanol**		
		ACGIH TLV	1000 PPM	44 mm
		OSHA PEL	1000 PPM	
2	**108-10-1**	**Methyl Isobutyl Ketone**		
		ACGIH TLV	50 PPM	16 mm
		ACGIH TLV	75 PPM STEL	
		OSHA PEL	50 PPM	
		OSHA PEL	75 PPM STEL	
5	**78-10-4**	**Ethyl Silicate**		
		ACGIH TLV	Not Available	1 mm
		OSHA PEL	100 PPM	
9	**14808-60-7**	**Quartz**		
		ACGIH TLV	0.025 mg/m3 as Resp. Dust	
		OSHA PEL	0.1 mg/m3 as Resp. Dust	

SECTION 3 — HAZARDS IDENTIFICATION

ROUTES OF EXPOSURE
INHALATION of vapor or spray mist.
EYE or SKIN contact with the product, vapor or spray mist.
Contains alcohols and acetates which can be absorbed through the skin.

HMIS Codes

Health	3*
Flammability	3
Reactivity	0

EFFECTS OF OVEREXPOSURE

EYES: Irritation.
SKIN: Prolonged or repeated exposure may cause irritation.
INHALATION: Irritation of the upper respiratory system.

May cause nervous system depression. Extreme overexposure may result in unconsciousness and possibly death.
Prolonged overexposure to hazardous ingredients in Section 2 may cause adverse chronic effects to the following organs or systems:

- the liver
- the urinary system
- the reproductive system

SIGNS AND SYMPTOMS OF OVEREXPOSURE

Headache, dizziness, nausea, and loss of coordination are indications of excessive exposure to vapors or spray mists.
Redness and itching or burning sensation may indicate eye or excessive skin exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

None generally recognized.

CANCER INFORMATION

For complete discussion of toxicology data refer to Section 11.

SECTION 4 — FIRST AID MEASURES

EYES: Flush eyes with large amounts of water for 15 minutes. Get medical attention.
SKIN: Wash affected area thoroughly with soap and water.
Remove contaminated clothing and launder before re-use.
INHALATION: If affected, remove from exposure. Restore breathing. Keep warm and quiet.
INGESTION: Do not induce vomiting. Get medical attention immediately.

SECTION 5 — FIRE FIGHTING MEASURES

FLASH POINT	LEL	UEL	FLAMMABILITY CLASSIFICATION
60 °F PMCC	1.0	36.5	RED LABEL -- Flammable, Flash below 100 °F (38 °C)

EXTINGUISHING MEDIA

Carbon Dioxide, Dry Chemical, Foam

UNUSUAL FIRE AND EXPLOSION HAZARDS

Closed containers may explode when exposed to extreme heat.
Application to hot surfaces requires special precautions.
During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

SPECIAL FIRE FIGHTING PROCEDURES

Full protective equipment including self-contained breathing apparatus should be used.
Water spray may be ineffective. If water is used, fog nozzles are preferable. Water may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat.

SECTION 6 — ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Remove all sources of ignition. Ventilate the area.
Remove with inert absorbent.

SECTION 7 — HANDLING AND STORAGE

STORAGE CATEGORY

DOL Storage Class IB

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Contents are FLAMMABLE. Keep away from heat, sparks, and open flame.
During use and until all vapors are gone: Keep area ventilated - Do not smoke - Extinguish all flames, pilot lights, and heaters - Turn off stoves, electric tools and appliances, and any other sources of ignition.
Consult NFPA Code. Use approved Bonding and Grounding procedures.
Keep container closed when not in use. Transfer only to approved containers with complete and appropriate labeling. Do not take internally. Keep out of the reach of children.

SECTION 8 — EXPOSURE CONTROLS/PERSONAL PROTECTION

PRECAUTIONS TO BE TAKEN IN USE

Use only with adequate ventilation.
Avoid contact with skin and eyes. Avoid breathing vapor and spray mist.
Wash hands after using.

This coating may contain materials classified as nuisance particulates (listed "as Dust" in Section 2) which may be present at hazardous levels only during sanding or abrading of the dried film. If no specific dusts are listed in Section 2, the applicable limits for nuisance dusts are ACGIH TLV 10 mg/m3 (total dust), 3 mg/m3 (respirable fraction), OSHA PEL 15 mg/m3 (total dust), 5 mg/m3 (respirable fraction).

VENTILATION

Local exhaust preferable. General exhaust acceptable if the exposure to materials in Section 2 is maintained below applicable exposure limits. Refer to OSHA Standards 1910.94, 1910.107, 1910.108.

RESPIRATORY PROTECTION

If personal exposure cannot be controlled below applicable limits by ventilation, wear a properly fitted organic vapor/particulate respirator approved by NIOSH/MSHA for protection against materials in Section 2.

When sanding or abrading the dried film, wear a dust/mist respirator approved by NIOSH/MSHA for dust which may be generated from this product, underlying paint, or the abrasive.

PROTECTIVE GLOVES

Wear gloves which are recommended by glove supplier for protection against materials in Section 2.

EYE PROTECTION

Wear safety spectacles with unperforated sideshields.

OTHER PROTECTIVE EQUIPMENT

Use of barrier cream on exposed skin is recommended.

OTHER PRECAUTIONS

Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal.

SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES

PRODUCT WEIGHT	8.17 lb/gal	978 g/l
SPECIFIC GRAVITY	0.98	
BOILING POINT	148 - 335 °F	64 - 168 °C
MELTING POINT	Not Available	
VOLATILE VOLUME	76%	
EVAPORATION RATE	Slower than ether	
VAPOR DENSITY	Heavier than air	
SOLUBILITY IN WATER	N.A.	

VOLATILE ORGANIC COMPOUNDS (VOC Theoretical - As Packaged)

5.24 lb/gal	628 g/l	Less Water and Federally Exempt Solvents
5.10 lb/gal	612 g/l	Emitted VOC

SECTION 10 — STABILITY AND REACTIVITY

STABILITY — Stable

CONDITIONS TO AVOID

None known.

INCOMPATIBILITY

None known.

HAZARDOUS DECOMPOSITION PRODUCTS

By fire: Carbon Dioxide, Carbon Monoxide

HAZARDOUS POLYMERIZATION

Will not occur

SECTION 11 — TOXICOLOGICAL INFORMATION

CHRONIC HEALTH HAZARDS

Reports have associated repeated and prolonged overexposure to solvents with permanent brain and nervous system damage.

Ethylbenzene is classified by IARC as possibly carcinogenic to humans (2B) based on inadequate evidence in humans and sufficient evidence in laboratory animals. Lifetime inhalation exposure of rats and mice to high ethylbenzene concentrations resulted in increases in certain types of cancer, including kidney tumors in rats and lung and liver tumors in mice. These effects were not observed in animals exposed to lower concentrations. There is no evidence that ethylbenzene causes cancer in humans.

Crystalline Silica (Quartz, Cristobalite) is listed by IARC and NTP. Long term exposure to high levels of silica dust, which can occur only when sanding or abrading the dry film, may cause lung damage (silicosis) and possibly cancer.

TOXICOLOGY DATA

CAS No.	Ingredient Name			
100-41-4	**Ethylbenzene**			
		LC50 RAT	4HR	Not Available
		LD50 RAT		3500 mg/kg
1330-20-7	**Xylene**			
		LC50 RAT	4HR	5000 ppm
		LD50 RAT		4300 mg/kg
67-56-1	**Methanol**			
		LC50 RAT	4HR	64000 ppm
		LD50 RAT		5630 mg/kg
64-17-5	**Ethanol**			
		LC50 RAT	4HR	Not Available
		LD50 RAT		7060 mg/kg
108-10-1	**Methyl Isobutyl Ketone**			
		LC50 RAT	4HR	Not Available
		LD50 RAT		2080 mg/kg
78-10-4	**Ethyl Silicate**			
		LC50 RAT	4HR	Not Available
		LD50 RAT		6270 mg/kg
14808-60-7	**Quartz**			
		LC50 RAT	4HR	Not Available
		LD50 RAT		Not Available

SECTION 12 — ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

No data available.

SECTION 13 — DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Waste from this product may be hazardous as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.
Waste must be tested for ignitability to determine the applicable EPA hazardous waste numbers.
Incinerate in approved facility. Do not incinerate closed container. Dispose of in accordance with Federal, State/Provincial, and Local regulations regarding pollution.

SECTION 14 — TRANSPORT INFORMATION

Multi-modal shipping descriptions are provided for informational purposes and do not consider container sizes. The presence of a shipping description for a particular mode of transport (ocean, air, etc.), does not indicate that the product is packaged suitably for that mode of transport. All packaging must be reviewed for suitability prior to shipment, and compliance with the applicable regulations is the sole responsibility of the person offering the product for transport.

US Ground (DOT)

1 Gallon and Less may be Classed as CONSUMER COMMODITY, ORM-D
Larger Containers are Regulated as:
UN1263, PAINT, 3, PG II, (ERG#128)

DOT (Dept of Transportation) Hazardous Substances & Reportable Quantities

Ethyl benzene 1000 lb RQ
Xylenes (isomers and mixture) 100 lb RQ

Bulk Containers may be Shipped as (check reportable quantities):

RQ, UN1263, PAINT, 3, PG II, (XYLENES (ISOMERS AND MIXTURE)),
(ERG#128)

Canada (TDG)

UN1263, PAINT, CLASS 3, PG II, (ERG#128)

IMO

1 Gallon (3.78 Liters) and Less may be Shipped as Limited Quantity.
UN1263, PAINT, CLASS 3, PG II, (16 C c.c.), EmS F-E, S-E, ADR (D/E)

IATA/ICAO

UN1263, PAINT, 3, PG II

SECTION 15 — REGULATORY INFORMATION

SARA 313 *(40 CFR 372.65C)* SUPPLIER NOTIFICATION

CAS No.	CHEMICAL/COMPOUND	% by WT	% Element
100-41-4	Ethylbenzene	4	
1330-20-7	Xylene	23	
67-56-1	Methanol	1	
108-10-1	Methyl Isobutyl Ketone	2	

CALIFORNIA PROPOSITION 65

WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

TSCA CERTIFICATION

All chemicals in this product are listed, or are exempt from listing, on the TSCA Inventory.

SECTION 16 — OTHER INFORMATION

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

B69D11

MATERIAL SAFETY DATA SHEET

DATE OF PREPARATION
December 3, 2009

2009a

SECTION 1 -- PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER
B69D11

PRODUCT NAME
ZINC CLAD® Zinc Dust (Part F)

MANUFACTURER'S NAME
THE SHERWIN-WILLIAMS COMPANY
101 Prospect Avenue N.W.
Cleveland, OH 44115

Telephone Numbers and Websites

Regulatory Information	(216) 566-2902
Medical Emergency	(216) 566-2917
Transportation Emergency*	(800) 424-9300

*for Chemical Emergency ONLY (spill, leak, fire, exposure, or accident)

SECTION 2 -- COMPOSITION/INFORMATION ON INGREDIENTS

% by Weight	CAS Number	Ingredient Units
100	7440-66-6	Zinc
		ACGIH TLV Not Available
		OSHA PEL Not Available

SECTION 3 -- HAZARDS IDENTIFICATION

HMIS Codes

Health	2
Flammability	0
Reactivity	1

ROUTES OF EXPOSURE
INHALATION of dust.
EYE or SKIN contact with the product or dust.

EFFECTS OF OVEREXPOSURE
EYES: Irritation.
SKIN: Prolonged or repeated exposure to dust may cause irritation.
INHALATION: Irritation of the upper respiratory system.

SIGNS AND SYMPTOMS OF OVEREXPOSURE
Redness and itching or burning sensation may indicate eye or excessive skin exposure.

Continued on page 2

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
None generally recognized.

CANCER INFORMATION
For complete discussion of toxicology data refer to Section 11.

SECTION 4 -- FIRST AID MEASURES

EYES: Flush eyes with large amounts of water for 15 minutes. Get medical attention.
SKIN: Wash affected area thoroughly with soap and water. If irritation persists or occurs later, get medical attention. Remove contaminated clothing and launder before re-use.
INHALATION: If affected, remove from exposure. Restore breathing. Keep warm and quiet.
INGESTION: Do not induce vomiting. Get medical attention immediately.

SECTION 5 -- FIRE FIGHTING MEASURES

FLASH POINT
Not Applicable

LEL
N.A.

UEL
N.A.

FLAMMABILITY CLASSIFICATION
Not Applicable

EXTINGUISHING MEDIA
Carbon Dioxide, Dry Chemical, Foam

UNUSUAL FIRE AND EXPLOSION HAZARDS
Dry zinc dust will not ignite spontaneously. In contact with atmospheric moisture, zinc dust can form an explosive mixture with air. When dampened in confined spaces, explosive concentrations of hydrogen may form.

During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

SPECIAL FIRE FIGHTING PROCEDURES
Do not use water. Full protective equipment including self-contained breathing apparatus should be used.

SECTION 6 -- ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
* Remove all sources of ignition.
* Sweep up material taking care not to generate airborne dust.

Continued on page 3

SECTION 7 -- HANDLING AND STORAGE

STORAGE CATEGORY
Not Applicable

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE
Use entire container at one time. Do not reseal opened containers containing Zinc dust. Do not transfer Zinc dust to other containers. Keep out of the reach of children.

SECTION 8 -- EXPOSURE CONTROLS/PERSONAL PROTECTION

PRECAUTIONS TO BE TAKEN IN USE
Use only with adequate ventilation. Avoid eye and prolonged skin contact with dust. Avoid generating or breathing airborne dust. Wash hands after using.

This product may contain materials classified as nuisance particulates (listed "as Dust" in Section 2) which may be present at hazardous levels only during sanding or abrading of the dried film. If no specific dusts are listed in Section 2, the applicable limits for nuisance dusts are ACGIH TLV 10 mg/m3 (total dust), 3 mg/m3 (respirable fraction), OSHA PEL 15 mg/m3 (total dust), 5 mg/m3 (respirable fraction).

VENTILATION
Local exhaust preferable. General exhaust acceptable if the exposure to materials in Section 2 is maintained below applicable exposure limits. Refer to OSHA Standards 1910.94, 1910.107, 1910.108.

RESPIRATORY PROTECTION
If personal exposure cannot be controlled below applicable limits by ventilation, wear a properly fitted particulate respirator approved by NIOSH/MSHA for protection against materials in Section 2.

PROTECTIVE GLOVES
Required for long or repeated contact.

EYE PROTECTION
Wear safety spectacles with unperforated sideshields.

SECTION 9 -- PHYSICAL AND CHEMICAL PROPERTIES

PRODUCT WEIGHT	58.6 lb/gal 7020 g/l
SPECIFIC GRAVITY	7.053
BOILING POINT	Not Applicable
MELTING POINT	Not Available
VOLATILE VOLUME	0%
EVAPORATION RATE	N.A.
VAPOR DENSITY	N.A.
SOLUBILITY IN WATER	N.A.

VOLATILE ORGANIC COMPOUNDS (VOC Theoretical - As Packaged)
0.0 lb/gal 0 g/l Less Water and Federally Exempt Solvents
0.0 lb/gal 0 g/l Emitted VOC

Continued on page 4

SECTION 10 -- STABILITY AND REACTIVITY

STABILITY -- Stable

CONDITIONS TO AVOID
Avoid contamination of Zinc dust or Zinc-containing mixtures with water. Avoid excess dusting of Zinc dust portions.

INCOMPATIBILITY
Contamination with Water, Acids, or Alkalis can cause evolution of hydrogen, which may result in dangerously increased pressures in closed containers.

HAZARDOUS DECOMPOSITION PRODUCTS
By fire: Oxides of Metals in Section 2

HAZARDOUS POLYMERIZATION -- Will not occur

SECTION 11 -- TOXICOLOGICAL INFORMATION

CHRONIC HEALTH HAZARDS
No ingredient in this product is an IARC, NTP or OSHA listed carcinogen.

TOXICOLOGY DATA

CAS No.	Ingredient Name	
7440-66-6	Zinc	
	LC50 RAT 4HR	Not Available
	LD50 RAT	Not Available

SECTION 12 -- ECOLOGICAL INFORMATION

No data available.

SECTION 13 -- DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD
Waste from this product is not hazardous as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Dispose of in accordance with Federal, State/Provincial, and Local regulations regarding pollution.

Continued on page 5

SECTION 14 -- TRANSPORT INFORMATION

US Ground (DOT)
Not Regulated for Transportation.

DOT (Dept of Transportation) Hazardous Substances & Reportable Quantities
Zinc 1000 lb RQ

Bulk Containers may be Shipped as (check reportable quantities):
RQ, UN3077, ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (ZINC), 9, PG III, (ERG#171)

Canada (TDG)
Not Regulated for Transportation.

IMO
Not Regulated for Transportation.

SECTION 15 -- REGULATORY INFORMATION

SARA 313 (40 CFR 372.65C) SUPPLIER NOTIFICATION

CAS No.	CHEMICAL/COMPOUND	% by WT	% Element
	Zinc		97

CALIFORNIA PROPOSITION 65
WARNING: This product contains chemicals known to the State of California to cause birth defects or other reproductive harm.

TSCA CERTIFICATION
All chemicals in this product are listed, or are exempt from listing, on the TSCA Inventory.

SECTION 16 -- OTHER INFORMATION

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

AMERCOAT®

Dimetcote® 9

9 Series — *Inorganic-zinc silicate primer*

Product Data/ Application Instructions

- A heavy-duty primer that protects with a single coat.
- Outstanding application characteristics over a wide range of atmospheric conditions.
- Can be applied by airless or conventional spray leaving a smooth film with negligible overspray even in hot weather.
- Excellent heavy-build film tolerance in corners and angles.
- High-metallic zinc content provides long-term corrosion protection that reduces maintenance costs.
- Abrasion resistance and minimum burn-back during welding reduce touch-up requirements.
- Applied over blasted or pickled surfaces.

Typical Uses

As a single coat, Dimetcote 9 resists severe weathering and marine environments. As a primer with recommended topcoats, Dimetcote 9 is resistant to industrial chemical exposure as well as marine exposure above the saltwater splash zone, structural steel and piping, tank exteriors, bridges, offshore platforms, marine hulls above water line, superstructures and decks.

Qualifications

SSPC – Paint 20

AASHTO – M300

AASHTO – Standard Specification for Highway Bridges Table 10.32.3C Allowable Load for Slip Critical Connections Class B

AISC – Specification for Structural Joints Using ASTM A325 or A490 Bolts RCSC Specification for Structural Joints Table 3 Class B

Resistance

Dimetcote 9 without a topcoat has excellent resistance to weathering and ultraviolet exposure, water and neutral salts, refined petroleum products, alcohols and solvents, animal and vegetable oils (up to 2½% free fatty acid). In addition to the above, with suitable topcoats Dimetcote 9 is recommended for fumes and splash of mild alkalies, dilute acids (fumes only), salt solutions of most types.

Dimetcote 9 is not recommended for immersion service or spillage of acid or alkaline solutions. For specific recommendations, consult your PPG representative.

Physical Data

Finish	Flat
Color	Green

Note: At temperatures over 350°F the Dimetcote 9 green color will change to a reddish-brown.

Components	2
Curing mechanism	Solvent release and reaction with atmospheric moisture
Dry film thickness	2.0 - 5.0 mils
Coats	1

Theoretical coverage	ft²/gal	m²/L
1 mil (25 microns)	992	24.3
2½ mils (65 microns)	397	9.7

VOC	lb/gal	g/L
mixed	4.1	491
mixed/thinned (1 pt/gal)	5.0	599

Temperature resistance, dry	°F	°C
	750	399

Flash point	°F	°C
liquid	60	15
mixed	58	14
Amercoat 65	81	27
Amercoat 101	145	63
Amercoat 12	2	-17

Application Data

Applied over	Prepared steel, galvanizing
Surface preparation	Abrasive blast SSPC-SP6 or 10
Method	Airless or conventional spray
Mixing ratio (by volume)	As packaged – 1- and 5-gal units

Pot life (hours)	°F/°C
	70/21
	24

Environmental conditions		
Temperature	°F	°C
air	0 to 120	-18 to 49
surface	0 to 130	-18 to 54
Relative humidity	50-90%	

Surface temperatures must be at least 5°F (3°C) above dew point to prevent condensation. At freezing temperatures, surface must be free of ice.

Drying time (ASTM D1640) 2½ mils and 50-90% RH

	°F/°C
	70/21
touch (minutes)	10
through (minutes)	18
topcoat with most topcoats (hours)	24

Thinner	
below 70°F (21°C)	Amercoat 65
above 70°F (21°C)	Amercoat 101
Equipment cleaner	Amercoat 12

Surface Preparation

Steel – New without pits or depressions – Dry abrasive blast, SSPC-SP6 or pickle.

Previously painted or pitted – Dry abrasive blast, SSPC-SP10. Remove all traces of previous organic coatings as Dimetcote 9 will not adhere to organic coatings.

Blast to achieve a 1- to 3-mil (25- to 75-microns) profile as determined with a Keane-Tator Surface Profile Comparator, Testex Tape or similar device. Rougher profiles are acceptable but require increased film thickness for equivalent protection.

Apply Dimetcote 9 as soon as possible to avoid rusting or other recontamination. Do not leave blasted steel uncoated overnight. Spot reblast if needed.

Galvanizing – Remove oil, soap film or grease with neutral detergent or emulsion cleaner and blast lightly with fine abrasive to SSPC-SP7.

Environmental Conditions

Temperature	°F	°C
air	0 to 120	-18 to 49
surface	0 to 130	-18 to 54

Surface temperature must be at least 5°F (3°C) above dew point to prevent condensation. At freezing temperatures, surface must be free of ice.

Application Equipment

The following is a guide; suitable equipment from other manufacturers may be used. Changes in pressure, hose and tip size may be needed for proper spray characteristics.

Airless spray – Standard equipment, such as Graco Bulldog Hydra-Spray or Speeflo Alaskan PZ and a fluid tip with a 0.021-inch (0.53 mm) orifice or larger

Conventional spray – Industrial equipment such as a DeVilbiss MBC gun with 2E or 704E cap/tip, or a Binks 18 gun with a 66SS x 67PB nozzle setup. A variable speed agitator in the pressure pot and an oil and moisture trap in the main air supply line are essential. Separate air and fluid pressure regulators are recommended.

Power mixer – Jiffy Mixer, powered by an air or explosion-proof electric motor

Application Procedure

Dimetcote 9 is packaged in the correct proportions which must be mixed together before use.

1. Flush all equipment with thinner or Amercoat® 12 to remove any moisture which that may be present. Moisture can cause hardening of coating in equipment.
2. Stir liquid with an explosion-proof power mixer.
3. Discard desiccant bag from powder can and gradually stir powder into liquid. Continue stirring until powder is well dispersed, and uniformly blended to a workable consistency.
4. Strain material through 30 mesh screen to remove undispersed material and to prevent possible clogging of equipment.
5. Do not mix more coating than will be used within the following times:

Pot life (hours)	°F/°C			
	120/49	90/32	70/21	50/10
	4	12	24	72

***Important** – At the end of the pot life, "kick-out" or separation of liquid and solids occurs, together with gassing. Do not keep mixed material which will not be used before the end of the pot life in tightly closed containers as gassing can create enough pressure to cause containers to burst. Cover containers loosely.*

6. Keep containers loosely covered until ready to use to prevent skinning or gelling due to moisture in air. Skins should be skimmed off the top and the material strained through cheesecloth or 30 mesh screen to remove any remaining pieces of skin. Discard gelled material.
7. Thin only for workability or when a rough film or "dry spray" is obtained due to fast solvent evaporation during hot weather or high wind. Use no more than 1 pint thinner per gallon mixed coating, as follows:

Surface temperature	Thinner
above 70°F	Amercoat 101
below 70°F	Amercoat 65

8. Adjust spray equipment to apply an even wet coat with minimum overspray.
9. Continue slow stirring during application to maintain uniformity of material. Avoid fast stirring as this may cause a rise in material temperature, shortening pot life.
10. Apply in even, parallel passes; overlap each pass 50 percent. Pay special attention to welds, cut-outs, sharp edges, rivets, bolts, etc., to insure proper thickness. Keep pressure pot at approximately the same elevation as spray gun for proper material delivery to gun.
11. Prevent contact with water until the freshly applied coating is dry to touch.

Drying time (ASTM D1640) 2½ mils and 50-90% RH

	°F/°C
	70/21
touch (minutes)	10
through (minutes)	18
topcoat with most topcoats (hours)	24

12. When dry through, check film thickness with a nondestructive dry film thickness gauge. Recoat if greater thickness is required. Normal average thickness range is 2.0 - 5.0 mils. Spot readings should not exceed 8 mils as higher thicknesses may develop cracking. For high temperature applications, a maximum of 3 mils dry film thickness is required.

***Note** – Drying and topcoating times will be longer when film thickness is over 2½ mils, ventilation and air movement are restricted, temperatures are lower or relative humidities are lower. A water mist sprayed over the coating when the film is dry to touch will accelerate hardening at lower humidities.*

13. Random pinholes, holidays and small damaged or bare areas can be touched up by brush when film is dry to touch. Larger areas should be resprayed.
14. In confined areas, ventilate with clean air during application and drying until all solvents are removed. Temperature and relative humidity of the ventilating air must be such that moisture will not condense on the surface until after dry to touch.
15. Clean equipment with thinner or Amercoat 12 cleaner immediately after use or at least at the end of each working day or shift. Clean spray guns more often during hot weather. When left in equipment, Dimetcote 9 will harden and plug spray equipment.

Topcoating

Dimetcote 9 surface must be clean and dry before topcoating. Water soluble contaminants may be washed off with water. Remove grease and similar contaminants with an emulsion type cleaner or neutral detergent. Rinse with clean water and allow to dry. Solvent wiping is not satisfactory as contamination may only be spread and not removed. In some cases a mist coat/full coat technique may be required to prevent application bubbling.

Repair

Spot-blast rusted areas in accordance with surface preparation instructions before touching up with Dimetcote 9. When blasting is not practical, Amercoat 68HS may be used for repair. See primer product literature for selection according to topcoat compatibility.

Topcoats

Dimetcote 9 may be topcoated with epoxies, vinyls, acrylics, chlorinated rubbers or other topcoats when used in industrial or marine maintenance systems. Typical PPG topcoats are Amercoat® 385, Amerlock® 400 or Amercoat 370. In some cases a mist coat/full coat technique may be required to prevent application bubbling.

Safety Precautions

Read each component's material safety data sheet before use. Mixed product has hazards of each component. Safety precautions must be strictly followed during storage, handling and use.

CAUTION – Improper use and handling of this product can be hazardous to health and cause fire or explosion.

Do not use this product without first taking all appropriate safety measures to prevent property damage and injuries. These measures may include, without limitation: implementation of proper ventilation, use of proper lamps, wearing of proper protective clothing and masks, tenting and proper separation of application areas. Consult your supervisor. Proper ventilation and protective measures must be provided during application and drying to keep spray mists and vapor concentrations within safe limits and to protect against toxic hazards. Necessary safety equipment must be used and ventilation requirements carefully observed, especially in confined or enclosed spaces, such as tank interiors and buildings.

This product is to be used by those knowledgeable about proper application methods. PPG makes no recommendation about the types of safety measures that may need to be adopted because these depend on application environment and space, of which PPG is unaware and over which it has no control.

If you do not fully understand these warnings and instructions or if you cannot strictly comply with them, do not use the product.

Note: Consult Code of Federal Regulations Title 29, Labor, parts 1910 and 1915 concerning occupational safety and health standards and regulations, as well as any other applicable federal, state and local regulations on safe practices in coating operations.

This product is for professional use only. Not for residential use in California.

Shipping Data

Packaging units	1 gal	5 gal
Shipping weight (approx)	lb	kg
1-gal unit		
liquid	7.6	3.4
powder	14.5	6.6
5-gal unit		
liquid	36	16.4
powder	71	32.2

Shelf life when stored indoors at 40 to 100°F (5 to 38°C)

powder	2 years from shipment date
liquid	18 months from manufacture date

Numerical values are subject to normal manufacturing tolerances, color and testing variances. Allow for application losses and surface irregularities.

The mixed product is nonphotochemically reactive as defined by the South Coast Air Quality Management District's Rule 102 or equivalent regulations.

PPG Protective & Marine Coatings
www.ppgpmc.com/northamerica
One PPG Place, Pittsburgh, PA 15272 • Tel: 888-9PPGPMC

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Material Safety Data Sheet

Date of issue 22 December 2010
Version 3

1 . Product and company identification

Product name : DIMETCOTE 9 LIQUID
Code : DI9-A/01
Supplier : PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272
Emergency telephone number : (412) 434-4515 (U.S.)
(514) 645-1320 (Canada)
01-800-00-21-400 (Mexico)
Technical Phone Number : (412) 492-5200 (ALLISON PARK, PA) 8:00 a.m. - 5:00 p.m. EST

2 . Hazards identification

Emergency overview : DANGER!

FLAMMABLE LIQUID AND VAPOR. HARMFUL IF INHALED. CAUSES RESPIRATORY TRACT AND EYE IRRITATION. MAY BE HARMFUL IF SWALLOWED. SANDING AND GRINDING DUSTS MAY BE HARMFUL IF INHALED. ASPIRATION HAZARD. CAN ENTER LUNGS AND CAUSE DAMAGE. PROLONGED OR REPEATED CONTACT MAY DRY SKIN AND CAUSE IRRITATION. CONTAINS MATERIAL THAT CAN CAUSE TARGET ORGAN DAMAGE. CANCER HAZARD - CONTAINS MATERIAL WHICH CAN CAUSE CANCER.

Keep away from flames, such as a pilot light, and any object that sparks, such as an electric motor. Keep away from heat. Do not smoke. Do not breathe vapor or mist. Do not swallow. Avoid contact with eyes, skin and clothing. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.

Potential acute health effects

Inhalation : Harmful if inhaled. Severely irritating to the respiratory system. Can irritate eyes, nose, mouth and throat.
Ingestion : May be harmful if swallowed. Aspiration hazard if swallowed. Can enter lungs and cause damage.
Skin : May cause skin dryness and irritation.
Eyes : Irritating to eyes.

Over-exposure signs/symptoms

Repeated exposure to high vapor concentrations may cause irritation of the respiratory system and permanent brain and nervous system damage. Inhalation of vapor/aerosol concentrations above the recommended exposure limits causes headaches, drowsiness and nausea and may lead to unconsciousness or death. There is some evidence that repeated exposure to organic solvent vapors in combination with constant loud noise can cause greater hearing loss than expected from exposure to noise alone. This product contains crystalline silica which can cause lung cancer or silicosis. The risk of cancer depends on the duration and level of exposure to dust from sanding surfaces or mist from spray applications.

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

This Material Safety Data Sheet has been prepared in accordance with Canada's Workplace Hazardous Materials Information System (WHMIS) and the OSHA Hazard Communication Standard (29 CFR 1910.1200).

See toxicological information (Section 11)

Powered by ATRION

3 . Composition/information on ingredients

Name	CAS number	%
Isopropanol	67-63-0	15 - 40
Silicic acid, ethyl ester	11099-06-2	10 - 30
Kaolin	1332-58-7	7 - 13
1-Methoxy-2-propanol	107-98-2	5 - 10
tetraethyl silicate	78-10-4	5 - 10
Toluene	108-88-3	1 - 5
Silicate, mica	12001-26-2	1 - 5
Ethanol	64-17-5	0.1 - 1
zinc chloride	7646-85-7	0.1 - 1
Quartz (SiO2) (<10 microns)	14808-60-7	0.1 - 1

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4 . First aid measures

If ingestion, irritation, any type of overexposure or symptoms of overexposure occur during or persists after use of this product, contact a POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN immediately; have Material Safety Data Sheet information available. Never give anything by mouth to an unconscious or convulsing person.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek immediate medical attention.

Skin contact : Remove contaminated clothing and shoes. Wash skin thoroughly with soap and water or use recognized skin cleanser. Do NOT use solvents or thinners.

Inhalation : Remove to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel.

Ingestion : If swallowed, seek medical advice immediately and show this container or label. Keep person warm and at rest. Do not induce vomiting.

Notes to physician : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5 . Fire-fighting measures

Flammability of the product : Flammable liquid. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.

Extinguishing media

Suitable : Use dry chemical, CO_2, water spray (fog) or foam.

Not suitable : Do not use water jet.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous combustion products : Decomposition products may include the following materials:
carbon oxides
metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Powered by ATRION

6 . Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Use spark-proof tools and explosion-proof equipment. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

7 . Handling and storage

Handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Do not breathe vapor or mist. Do not swallow. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. Vapors are heavier than air and may spread along floors. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container. If this material is part of a multiple component system, read the Material Safety Data Sheet(s) for the other component or components before blending as the resulting mixture may have the hazards of all of its parts.

Storage : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. Do not store above the following temperature: 120F / 49C.

8 . Exposure controls/personal protection

Name	Result	ACGIH	OSHA	Ontario	Mexico	PPG

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8 . Exposure controls/personal protection

Isopropanol	TWA	200 ppm	400 ppm	200 ppm	400 ppm	Not established
	STEL	400 ppm	Not established	400 ppm	500 ppm	Not established
Kaolin	TWA	2 mg/m³ R	5 mg/m³ R 15 mg/m³ TD	2 mg/m³ R	10 mg/m³	Not established
	STEL	Not established	Not established	Not established	20 mg/m³	Not established
1-Methoxy-2-propanol	TWA	100 ppm	Not established	100 ppm	Not established	Not established
	STEL	150 ppm	Not established	150 ppm	Not established	Not established
tetraethyl silicate	TWA	10 ppm	100 ppm	10 ppm	10 ppm	Not established
	STEL	Not established	Not established	Not established	30 ppm	Not established
Toluene	TWA	20 ppm	200 ppm Z	20 ppm	50 ppm S	Not established
	STEL	Not established	500 ppm Z A 300 ppm Z C	Not established	Not established	Not established
Silicate, mica	TWA	3 mg/m³ R	20 mppcf Z	3 mg/m³ R	3 mg/m³	Not established
Ethanol	TWA	Not established	1000 ppm	Not established	1000 ppm	Not established
	STEL	1000 ppm	Not established	1000 ppm	Not established	Not established
zinc chloride	TWA	1 mg/m³ F	1 mg/m³ F	1 mg/m³ F	1 mg/m³	Not established
	STEL	2 mg/m³ F	Not established	2 mg/m³ F	2 mg/m³	Not established
Quartz (SiO2) (<10 microns)	TWA	0.025 mg/m³ R	10 mg/m³ R Z 30 mg/m³ TD Z 250 mppcf R Z	0.1 mg/m³ R	0.1 mg/m³ R	Not established

Key to abbreviations

A	=	Acceptable Maximum Peak	S	=	Potential skin absorption
ACGIH	=	American Conference of Governmental Industrial Hygienists.	SR	=	Respiratory sensitization
C	=	Ceiling Limit	SS	=	Skin sensitization
F	=	Fume	STEL	=	Short term Exposure limit values
IPEL	=	Internal Permissible Exposure Limit	TD	=	Total dust
OSHA	=	Occupational Safety and Health Administration.	TLV	=	Threshold Limit Value
R	=	Respirable	TWA	=	Time Weighted Average
Z	=	OSHA 29CFR 1910.1200 Subpart Z - Toxic and Hazardous Substances			

Consult local authorities for acceptable exposure limits.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

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8 . Exposure controls/personal protection

Engineering measures : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protection

Eyes : Safety glasses with side shields.

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Gloves : For prolonged or repeated handling, use the following type of gloves:

Recommended: nitrile rubber, foil, fluor rubber

Respiratory : If workers are exposed to concentrations above the exposure limit, they must use appropriate, certified respirators. Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

9 . Physical and chemical properties

Physical state : Liquid.

Flash point : Closed cup: 15.56°C (60°F)

Explosion limits : Lower: 1.8%

Color : Not available.

Odor : Not available.

pH : Not available.

Boiling/condensation point : >37.78°C (>100°F)

Melting/freezing point : Not available.

Specific gravity : 1.02

Density (lbs / gal) : 8.51

Vapor pressure : 4 kPa (30.2 mm Hg) [20°C]

Vapor density : Not available.

Volatility : 76% (v/v), 60.64% (w/w)

Odor threshold : Not available.

Evaporation rate : 254 (butyl acetate = 1)

Partition coefficient: n-octanol/water : Not available.

% Solid. (w/w) : 39.36

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10 . Stability and reactivity

Stability : The product may not be stable under certain conditions of storage or use.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Avoid increased storage temperature. Pressure hazard

Materials to avoid : Reactive or incompatible with the following materials:,water,acids,oxidizing materials,strong alkalis

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

11 . Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isopropanol	LD50 Oral	Rat	4.396 g/kg	-
	LD50 Dermal	Rabbit	12800 mg/kg	-
	LC50 Inhalation Vapor	Rat	72600 mg/m3	4 hours
Kaolin	LD50 Oral	Rat	>5000 mg/kg	-
1-Methoxy-2-propanol	LD50 Oral	Rat	5.2 g/kg	-
	LD50 Dermal	Rabbit	13 g/kg	-
tetraethyl silicate	LD50 Oral	Rat	6.27 g/kg	-
	LD50 Dermal	Rabbit	5.878 g/kg	-
Toluene	LD50 Oral	Rat	636 mg/kg	-
	LD50 Dermal	Rabbit	8.39 g/kg	-
	LC50 Inhalation	Rat	49 g/m3	4 hours
Ethanol	LD50 Oral	Rat	7 g/kg	-
	LC50 Inhalation	Rat	124700 mg/m3	4 hours
zinc chloride	LD50 Oral	Rat	0.35 g/kg	-

Chronic toxicity

Conclusion/Summary : Not available.

Defatting irritant? : Prolonged or repeated contact can defat the skin and lead to irritation, cracking and/or dermatitis.

Target organs : Contains material which causes damage to the following organs: lungs, brain, eyes, central nervous system (CNS).
Contains material which may cause damage to the following organs: blood, kidneys, liver, heart, upper respiratory tract, skin, stomach.

Carcinogenicity

Carcinogenicity : Contains material which can cause cancer. Risk of cancer depends on duration and level of exposure.

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Isopropanol	A4	3	-	-	-	-
Kaolin	A4	-	-	-	-	-
Toluene	A4	3	-	-	-	-
Quartz (SiO2) (<10 microns)	A2	1	-	+	Proven.	-

Mutagenicity

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity

Teratogenicity : Contains material which may cause birth defects, based on animal data.

Reproductive toxicity

Developmental effects : Contains material which may cause developmental abnormalities, based on animal data.

Fertility effects : Contains material which may impair male fertility, based on animal data. Contains material which may impair female fertility, based on animal data.

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12 . Ecological information

Environmental effects : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
Isopropanol	Acute LC50 >1400000 ug/L	Fish - Bluegill - Lepomis macrochirus	96 hours
Toluene	Acute LC50 5800 ug/L Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss	96 hours
	Acute EC50 6000 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
	Chronic NOEC 28000 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
Ethanol	Acute LC50 42000 ug/L Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss	4 days
	Acute EC50 2000 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
	Chronic NOEC <6.3 g/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
zinc chloride	Acute LC50 66 to 79 ug/L Fresh water	Fish - Rainbow trout,donaldson trout - Oncorhynchus mykiss	96 hours
	Acute EC50 100 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	48 hours
	Chronic NEL 170 ug/L Fresh water	Daphnia - Water flea - Daphnia magna	2 days

13 . Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees. Section 6. Accidental release measures

14 . Transport information

Regulation	UN number	Proper shipping name	Classes	PG*	Additional information
UN	1263	PAINT	3	II	-
IMDG	1263	PAINT	3	II	-
DOT	1263	PAINT	3	II	-

PG* : Packing group

Reportable quantity RQ : CERCLA: Hazardous substances.: Toluene: 1000 lbs. (454 kg); zinc chloride: 1000 lbs. (454 kg);

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14 . Transport information

15 . Regulatory information

United States inventory (TSCA 8b) : All components are listed or exempted.
Australia inventory (AICS) : All components are listed or exempted.
Canada inventory (DSL) : All components are listed or exempted.
China inventory (IECSC) : All components are listed or exempted.
Europe inventory (REACH) : Please contact your supplier for information on the inventory status of this material.
Japan inventory (ENCS) : All components are listed or exempted.
Korea inventory (KECI) : All components are listed or exempted.
New Zealand (NZIoC) : Substance Use Restricted
Philippines inventory (PICCS) : All components are listed or exempted.

United States

U.S. Federal regulations :

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: 1-Methoxy-2-propanol; Kaolin; Silicate, mica; Isopropanol; Toluene; tetraethyl silicate
CERCLA: Hazardous substances.: Toluene: 1000 lbs. (454 kg); zinc chloride: 1000 lbs. (454 kg);

SARA 311/312 MSDS Distribution - Chemical Inventory - Hazard Identification:

Chemical name	CAS #	Acute	Chronic	Fire	Reactive	Pressure
Isopropanol	**67-63-0**	Y	N	Y	N	N
Silicic acid, ethyl ester	**11099-06-2**	Y	N	N	N	N
Kaolin	**1332-58-7**	Y	N	N	N	N
1-Methoxy-2-propanol	**107-98-2**	Y	N	Y	N	N
tetraethyl silicate	**78-10-4**	Y	N	Y	Y	N
Toluene	**108-88-3**	Y	Y	Y	N	N
Silicate, mica	**12001-26-2**	N	N	N	N	N
zinc chloride	**7646-85-7**	Y	Y	N	Y	N
Quartz (SiO2) (<10 microns)	**14808-60-7**	N	Y	N	N	N
	Product as-supplied :	Y	Y	Y	Y	N

SARA 313

Supplier notification :

Chemical name	CAS number	Concentration
Isopropanol	67-63-0	15 - 40
Toluene	108-88-3	1 - 5

Additional environmental information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Canada

WHMIS (Canada) : Class B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). Class D-1B: Material causing immediate and serious toxic effects (Toxic). Class D-2A: Material causing other toxic effects (Very toxic). Class D-2B: Material causing other toxic effects (Toxic).

Mexico

Classification

Flammability : 3 **Health** : 3 **Reactivity** : 1

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16 . Other information

Hazardous Material Information System (U.S.A.)

Health : 3 * **Flammability** : 3 **Physical hazards** : 1

(*) - Chronic effects

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

Health : 3 **Flammability** : 3 **Instability** : 1

Date of previous issue : **7/21/2010.**

Organization that prepared the MSDS : EHS

Indicates information that has changed from previously issued version.

Disclaimer

The information contained in this data sheet is based on present scientific and technical knowledge. The purpose of this information is to draw attention to the health and safety aspects concerning the products supplied by PPG, and to recommend precautionary measures for the storage and handling of the products. No warranty or guarantee is given in respect of the properties of the products. No liability can be accepted for any failure to observe the precautionary measures described in this data sheet or for any misuse of the products.

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Carbozinc® 859

MARINE/OFFSHORE COATINGS product data

Selection & Specification Data

Generic Type Organic Zinc-Rich Epoxy

Description Low VOC organic zinc epoxy steel primer with extremely fast cure-to-topcoat characteristics for in-shop applications and quick turnaround requirements in the field. Carbozinc 859 has less than 3.0 lbs/gallon VOC (thinned) and is used extensively in virtually all industrial markets.

Features

- Meets Class B slip co-efficient and creep testing criteria for use on faying surfaces
- Rapid cure. Dry to recoat in 30 minutes at 75°F (24°C) and 50% relative humidity.
- Low temperature cure down to 35°F (2°C)
- Excellent adhesion
- Protects against undercutting corrosion
- Available in ASTM D520, Type II zinc version
- Field proven primer that applies well by spray methods
- Excellent touch-up primer by brush or roll for small areas.
- VOC compliant to current AIM regulations

Color Green (0300)

Finish Flat

Primers Self Priming

Topcoats Can be topcoated with Epoxies, Polyurethanes, Acrylics and others as recommended by your Carboline sales representative. Under certain conditions, a mist coat is required to minimize topcoat bubbling.

Dry Film Thickness 3.0-5.0 mils (75-125 microns). Dry film thickness in excess of 10.0 mils (250 microns) per coat is not recommended.

Solids Content* By Volume: 66% ± 2%
*Tested in accordance with ASTM D2697

Zinc Content By Weight: 81% ± 2% in dry film

Theoretical Coverage Rate 1,059 mil ft^2 (24.0 m^2/l at 25 microns)
353 ft^2 at 3.0 mils (8.0 m^2/l at 75 microns)
Allow for loss in mixing and application

VOC Values As Supplied: 2.72 lbs./gal (326 g/l)

Dry Temp. Resistance Continuous: 400°F (204°C)
Non-Continuous: 425°F (218°C)

Substrates & Surface Preparation

General Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.

Steel SSPC-SP6 with a 1.0-3.0 mil (25-75 micron) surface profile.
SSPC-SP2 or SP3 for touch-up.

Performance Data

Test Method	System	Results	Report #
ASTM D4541 Adhesion	A. Carbozinc 859 B. 859 / Polyurethane C. 859/Epoxy/ Polyurethane	A. 841 psi Pneumatic B. 1,100 min. psi Pneumatic C. 602 psi Elcometer	03343 03343 03390
ASTM D522 Flexibility	A. 859 B. 859 / Polyurethane	A. > 6% B. > 5%	03343
ASTM D2794 Impact	A. 859 B. 859 / polyurethane Gardner Impact Tester,Direct (intrusion), inch-pounds, over 1/8" steel	A. 160 B. 100 min.	03343
Slip Co-Efficient	Carbozinc 859 A-490 bolt spec; 6 mils dry film maximum, 10% max. thinning	Meets requirements for class B rating	03617
ASTM D970 Immersion	A. Carbozinc 859/Epoxy/ Polyurethane Salt Water (5% sodium chloride) at 75°F,30 days B. 859 / Epoxy / Polyurethane Fresh water at 75°F,30 days	A & B had no rusting in the scribe; and no blistering, softening or discoloration with either environment	03390

Test reports and additional data available upon written request.

Application Equipment

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.
General Guidelines:

Spray Application (General) The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco. Keep material under mild agitation during application.

Conventional Spray Agitated pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip and appropriate air cap.

Airless Spray

Pump Ratio:	30:1 (min.)*
GPM Output:	3.0 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	.017-.023"
Output PSI:	2000-2200
Filter Size:	60 mesh

*Teflon packings are recommended and available from the pump manufacturer.

Brush/Roller For small areas and touch-up only. Preferred method for large areas is spray application.

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Carbozinc® 859

Mixing & Thinning

Mixing Power mix Part A completely. Then slowly sift in the zinc filler under agitation. Power mix Part B separately and add slowly to the mixture. Pour mixture through a 30 mesh screen. DO NOT MIX PARTIAL KITS.
Tip: Sifting zinc through a window screen will aid in mixing process by breaking up or catching dry zinc lumps.

	.80 Gal Kit	4.00 Gal. Kit
Ratio	Part A: .35 gallons	1.77 gallons
	Part B: .20 gallons	1 gallon
	Zinc Filler: 14.6 lbs	73 lbs

Thinning Normally not required but may be thinned up to 13 oz/gal (10%) with Thinner #2 or Thinner #76. In hot or windy conditions, may be thinned up to 13 oz/gal with Thinner #33. Use of thinners other than those supplied by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.

Carboline Thinner #236E may also be used to thin this product to minimize HAP and VOC emissions. Consult Carboline Technical Service for guidance.

Pot Life 4 Hours at 75°F (24°C) and less at higher temperatures. Pot life ends when coating loses body and begins to sag.

Cleanup & Safety

Cleanup Use Thinner #2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

Safety Read and follow all caution statements on this product data sheet and on the MSDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.

Ventilation When used in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. In addition to ensuring proper ventilation, appropriate respirators must be used by all application personnel.

This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

Application Conditions

Condition	Material	Surface	Ambient	Humidity
Normal	60°-85°F (16°-29°C)	60°-90°F (16°-32°C)	60°-90°F (16°-32°C)	0-90%
Minimum	40°F (4°C)	35°F (2°C)	35°F (2°C)	0%
Maximum	90°F (32°C)	120°F (49°C)	110°F (43°C)	95%

Industry standards are for the substrate temperatures to be 5°F (3°C) above the dew point. This product simply requires the substrate temperature to be above the dew point. Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

Curing Schedule

Surface Temp. & 50% Relative Humidity	Dry to Handle	Dry to Topcoat
35°F (2°C)	8 Hours	6 Hours
50°F (10°C)	5 Hours	2 Hours
75°F (24°C)	2 Hours	30 Minutes
100°F (32°C)	1 Hour	30 Minutes

These times are based on a 3.0 mil (75 micron) dry film thickness. Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure. **Specific topcoat products can be used in a much shorter re-coat interval. Consult Carboline for recommendations and test results.**
Maximum Recoat: Unlimited. Must have a clean, dry surface for topcoating. “Loose” chalk or salts must be removed in accordance with good painting practice. Consult Carboline Technical Service for specific information.

Packaging, Handling & Storage

Shipping Weight (Approximate)	.80 Gallon Kit 22 lbs (10 kg)	4.00 Gallon Kit 105 lbs (48 kg)
Flash Point (Setaflash)	Part A: 49°F (9°C) Part B: 38°F (3°C) Zinc Filler: NA	
Storage (General)	Store Indoors.	
Storage Temperature & Humidity	40° – 110°F (4° - 43°C). 0-95% Relative Humidity	
Shelf Life	Part A: Min. 36 months at 75°F (24°C) Part B: Min. 24 months at 75°F (24°C) Part C: 24 months at 75°F (24°C)	

***Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.**

carboline®
350 Hanley Industrial Court, St. Louis, MO 63144-1599
314/644-1000 314/644-4617 (fax) www.carboline.com
An RPM Company

August 2006 - Marine

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Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name: CARBOZINC 859 PART A

Identification Number: PLMSDS 0486A1NL

Product Use/Class: Organic Zinc-Rich Epoxy - FOR INDUSTRIAL USE ONLY

Manufacturer: **Carboline Company**
2150 Schuetz Road
St. Louis, MO 63146

Revision Date: 07/10/2009

Supercedes : 03/13/2009

Preparer: Regulatory, Department

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
TOLUENE	108-88-3	25.0	20 PPM	N/E	375 MGM3	NE
EPOXY RESIN	25036-25-3	20.0	N/E	N/E	N/E	N/E
EPOXY RESIN	25068-38-6	10.0	NE	NE	NE	NE
METHYL ETHYL KETONE	78-93-3	5.0	200 PPM	300 PPM	590 MGM3	N/E
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	5.0	N/E	N/E	N/E	N/E
META-XYLENE	108-38-3	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
N-BUTANOL	71-36-3	5.0	20 PPM	50 PPM	100 PPM	150 MGM3
1-METHOXY-2-PROPANOL ACETATE	108-65-6	5.0	N/E	N/E	N/E	N/E
CARBON BLACK	1333-86-4	1.0	3.5 MG/M3	N/E	3.5 MG/M3	N/E
ETHYL BENZENE	100-41-4	0.7	100 PPM	125 PPM	435 MGM3	N/E

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

Effects Of Overexposure - Eye Contact: May cause eye irritation.

Effects Of Overexposure - Skin Contact: Direct skin contact may cause irritation. May cause allergic skin reaction. May be harmful if absorbed through the skin.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be aggravated by exposure to dust or organic vapors, see a physician prior to use. If sensitized to amines, epoxies, or other chemicals do not use. See a physician if a medical condition exists.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 49F (9C) (Setaflash)

Lower Explosive Limit, %: 0.9
Upper Explosive Limit, %: 11.2

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application instructions, container label and Product Data Sheet. Avoid breathing vapors or spray mist.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals. Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	175 F (79 C) - 486 F (252 C)	**Vapor Density:**	Heavier than Air
Odor:	Solvent	**Odor Threshold:**	N/D
Appearance:	Viscous Liquid, Various Colors	**Evaporation Rate:**	Slower Than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	1.30
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50
TOLUENE	108-88-3	5.0 G/KG RAT ORAL, 14G/KG RABBIT DERMAL	8000 PPM/4HRS, RAT, INHALATION
EPOXY RESIN	25036-25-3	NOT AVAILABLE	NOT AVAILABLE
EPOXY RESIN	25068-38-6	11.4G/KG RAT,ORAL	>20ML/KG SKIN,SENSITIZER
METHYL ETHYL KETONE	78-93-3	2737MG/KG RAT,ORAL	> 5000 PPM/1 HOUR RAT,INHALATION
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	>5000 MG/KG, ORAL, RAT	NOT AVAILABLE
META-XYLENE	108-38-3	NOT AVAILABLE	NOT AVAILABLE
N-BUTANOL	71-36-3	2500MG/KG RAT,ORAL	>800PPM/4HRS RAT,INHALATION
1-METHOXY-2-PROPANOL ACETATE	108-65-6	NOT AVAILABLE	NOT AVAILABLE
CARBON BLACK	1333-86-4	NOT AVAILABLE	>8000 MG/KG, ORAL, RAT
ETHYL BENZENE	100-41-4	3500 MG/KG RAT,ORAL	NOT AVAILABLE

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Name:	Paint	**Packing Group:**	II
DOT Technical Name:	N/A	**Hazard Subclass:**	N/A
DOT Hazard Class:	3	**Resp. Guide Page:**	128
DOT UN/NA Number:	UN1263		

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
TOLUENE	108-88-3
META-XYLENE	108-38-3
N-BUTANOL	71-36-3
ETHYL BENZENE	100-41-4

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:

No TSCA 12(B) Substances exist in this product

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	CAS Number
CERAMIC MICROSPHERES	66402-68-4
NEPHELINE SYENITE	37244-96-5
BLACK IRON OXIDE	1317-61-9

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	CAS Number
CERAMIC MICROSPHERES	66402-68-4
NEPHELINE SYENITE	37244-96-5
BLACK IRON OXIDE	1317-61-9
TITANIUM DIOXIDE	13463-67-7
IRON OXIDE	1332-37-2
YELLOW IRON OXIDE	51274-00-1

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

Chemical Name	CAS Number
CARBON BLACK	1333-86-4
ETHYL BENZENE	100-41-4
FORMALDEHYDE	50-00-0
MICROCRYSTALLINE SILICA	14808-60-7

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

Chemical Name	CAS Number
TOLUENE	108-88-3

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2A D2B

Section 16 - Other Information

HMIS Ratings
Health: 2 **Flammability:** 3 **Reactivity:** 0 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): 326

REASON FOR REVISION: Changes made in Section(s): 2, 11, and 15

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name: CARBOZINC 859 PART B

Identification Number: PLMSDS 0486C1NL

Product Use/Class: Organic Zinc Rich Epoxy - FOR INDUSTRIAL USE ONLY

Manufacturer: **Carboline Company**
2150 Schuetz Road
St. Louis, MO 63146

Revision Date: 03/13/2009

Supercedes : 03/30/2007

Preparer: Regulatory, Department

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
TOLUENE	108-88-3	50.0	20 PPM	N/E	375 MGM3	NE
ISOPROPANOL	67-63-0	25.0	200 PPM	400 PPM	400 PPM	N/E
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	10.0	N/E	N/E	N/E	N/E
TRIS-2,4,6-(DIMETHYLAMINOMETHYL) PHENOL	90-72-2	10.0	NE	N/E	NE	NE
BENZYL ALCOHOL	100-51-6	5.0	N/E	N/E	N/E	N/E
CYCLOALIPHATIC AMINE	TRADE SECRET	5.0	NE	N/E	NE	NE
POLYOXYPROPYLENEDIAMINE	9046-10-0	5.0	N/E	N/E	N/E	N/E
CYCLOALIPHATIC AMINE	TRADE SECRET	5.0	NE	N/E	NE	NE
DIAMINOCYCLOHEXANE	694-83-7	5.0	N/E	N/E	N/E	N/E
META-XYLENE	108-38-3	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
ETHYL BENZENE	100-41-4	0.7	100 PPM	125 PPM	435 MGM3	N/E

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. Skin and eye irritant.

Effects Of Overexposure - Eye Contact: Can cause eye burns.

Effects Of Overexposure - Skin Contact: May be harmful if absorbed through the skin. Can cause skin burns.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation. May cause lung irritation. May cause allergic respiratory reaction, effects may be permanent.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be aggravated by exposure to dust or organic vapors, see a physician prior to use. If sensitized to amines, epoxies, or other chemicals do not use. See a physician if a medical condition exists.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 38F (3C) (Setaflash)

Lower Explosive Limit, %: 1.0

Upper Explosive Limit, %: 12.0

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Evacuate hazard area of unprotected personnel. Use a NIOSH approved self-contained breathing unit and complete body protection. Cool surrounding containers with water in case of fire exposure. Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application instructions, container label and Product Data Sheet.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals. Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	176 F (80 C) - 284 F (140 C)	**Vapor Density:**	Heavier than Air
Odor:	Solvent	**Odor Threshold:**	N/D
Appearance:	Thin, Brown Liquid	**Evaporation Rate:**	Slower Than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	0.88
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50
TOLUENE	108-88-3	5.0 G/KG RAT ORAL, 14G/KG RABBIT DERMAL	8000 PPM/4HRS, RAT, INHALATION
ISOPROPANOL	67-63-0	4720MG/KG RAT,ORAL	22500 PPM/8HRS RAT,INHALATION
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	>5000 MG/KG, ORAL, RAT	NOT AVAILABLE
TRIS-2,4,6-(DIMETHYLAMINOMETHYL) PHENOL	90-72-2	2169 MG/KG ORAL	NOT AVAILABLE
BENZYL ALCOHOL	100-51-6	1230MG/KG RAT,ORAL	1000PPM/8HRS RAT,INHALATION
CYCLOALIPHATIC AMINE	TRADE SECRET	1230 MG/KG ORAL RAT,2000 MG/KG DERMAL	NOT AVAILABLE
POLYOXYPROPYLENEDIAMINE	9046-10-0	.48 G/KG, ORAL, RAT	NOT AVAILABLE

CYCLOALIPHATIC AMINE	TRADE SECRET	1230 MG/KG ORAL RAT,2000 MG/KG DERMAL	NOT AVAILABLE
DIAMINOCYCLOHEXANE	694-83-7	1752 MG/KG,RAT,ORAL	NOT AVAILABLE
META-XYLENE	108-38-3	NOT AVAILABLE	NOT AVAILABLE
ETHYL BENZENE	100-41-4	3500 MG/KG RAT,ORAL	NOT AVAILABLE

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Name: Paint
DOT Technical Name: N/A
DOT Hazard Class: 3
DOT UN/NA Number: UN 1263
Packing Group: II
Hazard Subclass: N/A
Resp. Guide Page: 128

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
TOLUENE	108-88-3
META-XYLENE	108-38-3
ETHYL BENZENE	100-41-4

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:

No TSCA 12(B) Substances exist in this product

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

Chemical Name	CAS Number
ETHYL BENZENE	100-41-4

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

Chemical Name	CAS Number
TOLUENE	108-88-3

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2A D2B

Section 16 - Other Information

HMIS Ratings
Health: 3 **Flammability:** 3 **Reactivity:** 0 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): 326

REASON FOR REVISION: Changes made in Section(s) 1, 2, 3, 5, 8, 11, and 15.

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Carboguard® 890 & 890 LT

carboline®

MARINE/OFFSHORE COATINGS product data

Selection & Specification Data

Generic Type
Cycloaliphatic Amine Epoxy

Description
Highly chemical resistant epoxy mastic coating with exceptionally versatile uses in all industrial markets. Self-priming and suitable for application over most existing coatings, and tightly adherent to rust. Carboguard 890 serves as stand-alone system for a variety of chemical environments. Carboguard 890 is also designed for various immersion conditions.

Features
- Excellent chemical resistance
- Surface tolerant characteristics
- Conventional and low-temperature versions
- Self-priming and primer/finish capabilities
- Very good abrasion resistance
- VOC compliant to current AIM regulations
- Suitable for use in USDA inspected facilities

Color
Refer to Carboline Color Guide. Certain colors may require multiple coats for hiding. Note: The low temperature formulation will cause most colors to yellow or discolor more than normal in a short period of time. (Epoxies lose gloss, discolor and chalk in sunlight exposure.)

Finish
Gloss

Primers
Self-priming. May be applied over inorganic zinc primers and other tightly adhering coatings. A mist coat may be required to minimize bubbling over inorganic zinc primers.

Topcoats
Acrylics, Epoxies, Polyurethanes

Dry Film Thickness
4.0-6.0 mils (100-150 microns) per coat
6.0-8.0 mils (150-200 microns) over light rust and for uniform gloss over inorganic zincs.
Don't exceed 10 mils (250 microns) in a single coat. Excessive film thickness over inorganic zincs may increase damage during shipping or erection.

Solids Content
By Volume (890): 75% ± 2%
(890LT): 80% ± 2%

Theoretical Coverage Rate
890: 1203 mil ft^2 (30.0 m^2/l at 25 microns)
241 ft^2 at 5 mils (6.0 m^2/l at 125 microns)
890LT: 1283 mil ft^2 (31.0 m^2/l at 25 microns)
257 ft^2 at 5 mils (6.3 m^2/l at 125 microns)
Allow for loss in mixing and application

VOC Values

	890	890 LT
As supplied	1.7lbs/gal (214 g/l)	1.5lbs/gal (180g/l)
Thinned w/#2*:	7oz/gal=2.0lbs/gal (250g/l) 13oz/gal=2.2lbs/gal (271g/l)	15oz/gal=2.0lbs/gal (250g/l)
Thinned w/#33*:	7oz/gal=2.0lbs/gal (250g/l) 16oz/gal=2.3lbs/gal (285g/l)	14oz/gal=2.0 lbs/gal (250g/l) 16oz/gal=2.1lbs/gal (258g/l)

*Use Thinner #76 up to 8 oz/gal for 890 and 16 oz/gal for 890 LT where non-photochemically reactive solvents are required.

Dry Temp. Resistance
Continuous: 250°F (121°C)
Non-Continuous: 300°F (149°C)
Discoloration and loss of gloss is observed above 200°F (93°C).

Limitations
Do not apply over latex coatings. For immersion projects use only factory made material in special colors. Consult Technical Service for specifics. Carboguard 890 LT should not be used for immersion and should only be used as a primer or intermediate coat. Discoloration may be objectionable if used as a topcoat.

Substrates & Surface Preparation

General
Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.

Steel
Immersion: SSPC-SP10
Non-immersion: SSPC-SP6
1.5-3.0 mils (38-75 microns)
SSPC-SP2 or SP3 are suitable cleaning methods for mild environments.

Galvanized Steel
Prime with specific Carboline primers as recommended by your Carboline Sales Representative. Refer to the specific primer's Product Data Sheet for substrate preparation requirements.

Concrete or CMU
Concrete must be cured 28 days at 75°F (24°C) and 50% relative humidity or equivalent. Prepare surfaces in accordance with ASTM D4258 Surface Cleaning of Concrete and ASTM D4259 Abrading Concrete. Voids in concrete may require surfacing. Mortar joints should be cured a min of 15 days. Prime with itself, Carboguard® 1340, or suitable filler/sealer.

Drywall & Plaster
Joint compound and plaster should be fully cured prior to coating application. Prime with Carbocrylic® 120 or Carboguard 1340.

Previously Painted Surfaces
Lightly sand or abrade to roughen surface and degloss the surface. Existing paint must attain a minimum 3B rating in accordance with ASTM D3359 "X-Scribe" adhesion test.

Performance Data

Test Method	System	Results	Report #
ASTM D3359 Adhesion	Blasted Steel 1 ct. 890	5A	0270
ASTM D4060 Abrasion	Blasted Steel 1 ct. Epoxy Pr. 1 ct. 890	85 mg. loss after 1000 cycles, CS17 wheel, 1000 gm. load	02411
ASTM B117 Salt Fog	Blasted Steel 2 cts. 890	No effect on plane, rust in scribe. 1/16" undercutting at scribe after 2000 hours	02594
ASTM B117 Salt Fog	Blasted Steel 1 ct. IOZ 1 ct. 890	No effect on plane, no rust in scribe and no undercutting after 4000 hours	L40-42,45,95
ASTM D1735 Water Fog	Blasted Steel 1 ct. Epoxy Pr. 1 ct. 890	No blistering, rusting or delamination after 2800 hours	08564
ASTM D3363 Pencil Hardness	Blasted Steel 2 cts. 890	Greater than 8H	02775
ASTM D2486 Scrub Resistance	Blasted Steel 1 ct. 890	93% gloss retained after 10,000 cycles w/ liquid scrub medium	03142
ASTM E84 Flame and Smoke	2 ct. 890	5 Flame 5 Smoke Class A	03110

Test reports and additional data available upon written request.

June 2010 replaces April 2007

0986/0983

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance or injuries resulting from use. Liability, if any, is limited to replacement of products. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Carboline® and Carboguard® are registered trademarks of Carboline Company.

Carboguard® 890 & 890 LT

Application Equipment

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results. **General Guidelines**:

Spray Application (General) This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco.

Conventional Spray Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip and appropriate air cap.

Airless Spray

Pump Ratio:	30:1 (min.)*
GPM Output:	3.0 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	.017"-.021"
Output PSI:	2100-2300
Filter Size:	60 mesh

*Teflon packings are recommended and available from the pump manufacturer.

Brush & Roller (General) Multiple coats may be required to obtain desired appearance, recommended dry film thickness and adequate hiding. Avoid excessive re-brushing or re-rolling. For best results, tie-in within 10 minutes at 75°F (24°C).

Brush Use a medium bristle brush.

Roller Use a short-nap synthetic roller cover with phenolic core.

Mixing & Thinning

Mixing Power mix separately, then combine and power mix. DO NOT MIX PARTIAL KITS.

Ratio 890 and 890 LT 1:1 Ratio (A to B)

Thinning* Spray: Up to 13 oz/gal (10%) w/ #2
Brush: Up to 16 oz/gal (12%) w/ #33
Roller: Up to 16 oz/gal (12%) w/ #33
Thinner #33 can be used for spray in hot/windy conditions. Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.
*See VOC values for thinning limits.

Pot Life 890 3 Hours at 75°F (24°C)
890 LT 2 Hours at 75°F (24°C)
Pot life ends when coating loses body and begins to sag. Pot life times will be less at higher temperatures.

Cleanup & Safety

Cleanup Use Thinner #2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

Safety Read and follow all caution statements on this product data sheet and on the MSDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.

Ventilation When used as a tank lining or in enclosed areas, thorough air circulation must be used during and after application until the coating is cured. The ventilation system should be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to insure all personnel are below guidelines. If not sure or if not able to monitor levels, use MSHA/NIOSH approved supplied air respirator.

Caution This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

Application Conditions

890

Condition	Material	Surface	Ambient	Humidity
Normal	60°-85°F (16°-29°C)	60°-85°F (16°-29°C)	60°-90°F (16°-32°C)	0-80%
Minimum	50°F (10°C)	50°F (10°C)	50°F (10°C)	0%
Maximum	90°F (32°C)	125°F (52°C)	110°F (43°C)	80%

890 LT

Normal	60-85°F (16-29°C)	60-85°F (16-29°C)	60-90°F (16-32°C)	10-80%
Minimum	40°F (4°C)	35°F (2°C)	35°F (2°C)	0%
Maximum	90°F (32°C)	125°F (52°C)	110°F (43°C)	80%

This product simply requires the substrate temperature to be above the dew point. Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

Curing Schedule

890 (Based on 4–8 mils, 100-200 microns dry film thickness.)

Surface Temp. & 50% Relative Humidity	Dry to Recoat	Dry to Topcoat w/ Other Finishes	Final Cure	
			General	Immersion
50°F (10°C)	12 Hours	24 Hours	3 Days	N/R
60°F (16°C)	8 Hours	16 Hours	2 Days	10 Days
75°F (24°C)	4 Hours	8 Hours	1 Day	5 Days
90°F (32°C)	2 Hours	4 Hours	16 Hours	3 Days

890 LT (Based on 5 mils, 125 microns dry film thickness.)

Surface Temp. & 50% Relative Humidity	Dry to Touch	Dry to Handle	Dry to Recoat & Topcoat w/ Others	Final Cure General Service
35°F (2°C)	5 Hours	18 Hours	20 Hours	7 Days
40°F (4°C)	4.5 Hours	15.5 Hours	16 Hours	5 Days
50°F (10°C)	3.5Hours	6.5 Hours	12 Hours	3 Days
60°F (16°C)	2 Hours	5 Hours	8 Hours	2 Days
75°F (24°C)	1.5Hours	2 Hours	4 Hours	24 Hours
90°F (32°C)	1 Hour	1.5 Hours	2 Hours	16 Hours

Higher film thickness, insufficient ventilation or cooler temperatures will require longer cure times and could result in solvent entrapment and premature failure. Excessive humidity or condensation on the surface during curing can interfere with the cure, can cause discoloration and may result in a surface haze. Any haze or blush must be removed by water washing before recoating. During high humidity conditions, it is recommended that the application be done while temperatures are increasing. **Maximum recoat/topcoat times are 30 days for epoxies and 90 days for polyurethanes at 75ºF (24ºC)**. If the maximum recoat times have been exceeded, the surface must be abraded by sweep blasting or sanding prior to the application of additional coats. 890 LT applied below 50°F (10°C) may temporarily soften as temperatures rise to 60°F (16°C). This is a normal condition and will not affect performance.

Packaging, Handling & Storage

Shipping Weight (Approximate)	2 Gallon Kit 29 lbs (13 kg)	10 Gallon Kit 145 lbs (66 kg)

Flash Point (Setaflash) 89°F (32°C) for Part A; 890 & 890 LT
73°F (23°C) for Part B; 890 & 890 LT
71°F (22°C) for 890 mixed
85°F (29°C) for 890 LT mixed

Storage Temperature & Humidity 40° -110°F (4°-43°C) Store indoors.
0-100% Relative Humidity

Shelf Life: 890 & 890LT Part A: 36 months at 75°F (24°C)
890 Part B: 15 months at 75°F (24°C)
890 LT Part B: 15 months at 75°F (24°C)

***Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.**

carboline®
Coatings - Linings - Fireproofing
2150 Schuetz Rd., St. Louis, MO 63146
PH: 314-644-1000 Toll-Free: 800-848-4645
www.carboline.com

An RPM Company

June 2010 replaces April 2007

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance or injuries resulting from use. Liability, if any, is limited to replacement of products. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Carboline® and Carboguard® are registered trademarks of Carboline Company.

Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name: CARBOGUARD 890 PART A

Identification Number: PLMSDS 0986A1NL

Product Use/Class: Cycloaliphatic Amine Epoxy - FOR INDUSTRIAL USE ONLY

Manufacturer: **Carboline Company**
2150 Schuetz Road
St. Louis, MO 63146

Revision Date: 03/16/2009

Supercedes : 03/30/2007

Preparer: Regulatory, Department

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
EPOXY RESIN	25036-25-3	45.0	N/E	N/E	N/E	N/E
EPOXY RESIN	25068-38-6	30.0	NE	NE	NE	NE
MICROCRYSTALLINE SILICA	14808-60-7	25.0	0.025 MG/M3 (respirable)	N/E	0.1 MG/M3 (respirable)	N/E
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	20.0	N/E	N/E	N/E	N/E
META-XYLENE	108-38-3	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
CARBON BLACK	1333-86-4	5.0	3.5 MG/M3	N/E	3.5 MG/M3	N/E
TOLUENE	108-88-3	5.0	20 PPM	N/E	375 MGM3	NE
SILICA AMORPHOUS	67762-90-7	5.0	10 MG/M3, INHALABLE	N/E	6 MG/M3	N/E
PARA-XYLENE	106-42-3	5.0	100 PPM	150 PPM	435 MGM3	N/E
ETHYL BENZENE	100-41-4	5.0	100 PPM	125 PPM	435 MGM3	N/E
METHYL ETHYL KETONE	78-93-3	5.0	200 PPM	N/E	300 PPM	N/E
ORTHO-XYLENE	95-47-6	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
1-METHOXY-2-PROPANOL ACETATE	108-65-6	5.0	N/E	N/E	N/E	N/E

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. Warning! May cause allergic skin reactions. May cause irritation. Contains SILICA which can cause cancer. Risk of Cancer depends on duration and level of exposure.

Effects Of Overexposure - Eye Contact: May cause eye irritation.

Effects Of Overexposure - Skin Contact: May cause allergic skin reaction. Direct skin contact may cause irritation.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Crystalline silica is known to cause silicosis. Crystalline silica (Quartz) is classified as a known human carcinogen (Group 1) by IARC. Exposure is by route of inhalation. If material is in a liquid matrix it is unlikely to be inhaled. However, when sanding or grinding the finished product, there may be potential for crystalline silica to become airborne.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be aggravated by exposure to dust or organic vapors, see a physician prior to use. If sensitized to amines, epoxies, or other chemicals do not use. See a physician if a medical condition exists.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 89F (31C) (Setaflash)

Lower Explosive Limit, %: 0.5

Upper Explosive Limit, %: 7.0

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application instructions, container label and Product

Data Sheet. Avoid breathing vapors or spray mist.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals. Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	175 F (79 C) - 486 F (252 C)	**Vapor Density:**	Heavier than Air
Odor:	Epoxy	**Odor Threshold:**	N/D
Appearance:	Viscous liquid, Various colors	**Evaporation Rate:**	Slower than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	app. 1.40
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50

EPOXY RESIN	25036-25-3	NOT AVAILABLE	NOT AVAILABLE
EPOXY RESIN	25068-38-6	11.4G/KG RAT,ORAL	>20ML/KG SKIN,SENSITIZER
MICROCRYSTALLINE SILICA	14808-60-7	NOT AVAILABLE	NOT AVAILABLE
1,2-BENZENEDICARBOXIOLIC ACID, DI-C6-12-BRANCHED AND LINEAR ALKYL ESTERS	392662-40-7	>5000 MG/KG, ORAL, RAT	NOT AVAILABLE
META-XYLENE	108-38-3	NOT AVAILABLE	NOT AVAILABLE
CARBON BLACK	1333-86-4	NOT AVAILABLE	>8000 MG/KG, ORAL, RAT
TOLUENE	108-88-3	5.0 G/KG RAT ORAL, 14G/KG RABBIT DERMAL	8000 PPM/4HRS, RAT, INHALATION
SILICA AMORPHOUS	67762-90-7	> 5000 MG/KG, ORAL , RAT	NOT AVAILABLE
PARA-XYLENE	106-42-3	NOT AVAILABLE	NOT AVAILABLE
ETHYL BENZENE	100-41-4	3500 MG/KG RAT,ORAL	NOT AVAILABLE
METHYL ETHYL KETONE	78-93-3	2737MG/KG RAT,ORAL	> 5000 PPM/1 HOUR RAT,INHALATION
ORTHO-XYLENE	95-47-6	NOT AVAILABLE	NOT AVAILABLE
1-METHOXY-2-PROPANOL ACETATE	108-65-6	NOT AVAILABLE	NOT AVAILABLE

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Name: Paint
DOT Technical Name: N/A
DOT Hazard Class: 3
DOT UN/NA Number: 1263
Packing Group: III
Hazard Subclass: N/A
Resp. Guide Page: 128

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
META-XYLENE	108-38-3
TOLUENE	108-88-3
PARA-XYLENE	106-42-3
ETHYL BENZENE	100-41-4
ORTHO-XYLENE	95-47-6

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA

12(B) if exported from the United States:

Chemical Name	CAS Number
PARA-XYLENE	106-42-3

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	CAS Number
TITANIUM DIOXIDE	13463-67-7

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	CAS Number
TITANIUM DIOXIDE	13463-67-7
ORGANIC PIGMENT	31837-42-0
AZO PIGMENT	2786-76-7
IRON OXIDE	1332-37-2
ORGANIC PIGMENT	5567-15-7

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

Chemical Name	CAS Number
MICROCRYSTALLINE SILICA	14808-60-7
CARBON BLACK	1333-86-4
ETHYL BENZENE	100-41-4

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

Chemical Name	CAS Number
TOLUENE	108-88-3

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2A D2B

Section 16 - Other Information

HMIS Ratings
Health: 2 **Flammability:** 3 **Reactivity:** 0 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): Mixed with 890 Part B: 214 ; mixed with 890LT Part B: 180

REASON FOR REVISION: Changes made in Section(s) 1, 2, 3, 5, 8, 11, and 15.

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Material Safety Data Sheet

CHEMTREC Transportation Emergency Phone: 800-424-9300

Pittsburgh Poison Control Center Health Emergency No.: 412-681-6669

NOTE: The CHEMTREC Transportation Emergency Phone is to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

Section 1 - Chemical Product / Company Information

Product Name:	CARBOGUARD 890 PART B	**Revision Date:**	09/18/2008
Identification Number:	PLMSDS 0986B1NL	**Supercedes :**	08/15/2006
Product Use/Class:	Cycloaliphatic Amine Epoxy - FOR INDUSTRIAL USE ONLY		
		Preparer:	Regulatory, Department
Manufacturer:	**Carboline Company 350 Hanley Industrial Ct. St. Louis, MO 63144**		

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA-CEIL
MICROCRYSTALLINE SILICA	14808-60-7	65.0	0.025 MG/M3 (respirable)	N/E	0.1 MG/M3 (respirable)	N/E
BENZYL ALCOHOL	100-51-6	10.0	N/E	N/E	N/E	N/E
META-XYLENE	108-38-3	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
TOLUENE	108-88-3	5.0	20 PPM	N/E	375 MGM3	NE
ISOPROPANOL	67-63-0	5.0	200 PPM	400 PPM	400 PPM	N/E
ISOPHORONEDIAMINE	2855-13-2	5.0	NE	NE	NE	NE
PARA-XYLENE	106-42-3	5.0	100 PPM	150 PPM	435 MGM3	N/E
AMINE ADDUCT	68609-08-5	5.0	N/E	N/E	N/E	N/E
ETHYL BENZENE	100-41-4	5.0	100 PPM	125 PPM	435 MGM3	N/E
CYCLOALIPHATIC AMINE	TRADE SECRET	5.0	NE	N/E	NE	NE
POLYOXYPROPYLENEDIAMINE	9046-10-0	5.0	N/E	N/E	N/E	N/E
ORTHO-XYLENE	95-47-6	5.0	434 Mg/M3	651 Mg/M3	434 Mg/M3	N/E
AROMATIC HYDROCARBON	64742-95-6	5.0	N/E	N/E	N/E	N/E
1,2,4 TRIMETHYLBENZENE	95-63-6	5.0	25 PPM	N/E	125 MGM3	N/E
DIAMINOCYCLOHEXANE	694-83-7	5.0	N/E	N/E	N/E	N/E
N-BUTANOL	71-36-3	5.0	20 PPM	50 PPM	100 PPM	150 MGM3

Section 3 - Hazards Identification

Emergency Overview: Warning! Flammable. Harmful if inhaled. Causes eye and skin irritation. Aspiration may cause lung damage. May cause dizziness and drowsiness. Keep away from heat, sparks, flame. Avoid breathing vapor. Avoid contact with eyes, skin and clothing. Do not swallow. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. Contains SILICA which can cause cancer. Risk of Cancer depends on duration and level of exposure. Skin and eye irritant.

Effects Of Overexposure - Eye Contact: Can cause eye burns.

Effects Of Overexposure - Skin Contact: Can cause skin burns. May be harmful if absorbed through the skin.

Effects Of Overexposure - Inhalation: Harmful if inhaled, may affect the brain or nervous system, causing dizziness, headache, or nausea. May cause nose and throat irritation. May cause lung irritation. May cause allergic respiratory reaction, effects may be permanent.

Effects Of Overexposure - Ingestion: Harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Crystalline silica is known to cause silicosis. Crystalline silica (Quartz) is classified as a known human carcinogen (Group 1) by IARC. Exposure is by route of inhalation. If material is in a liquid matrix it is unlikely to be inhaled. However, when sanding or grinding the finished product, there may be potential for crystalline silica to become airborne.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Medical Conditions Prone to Aggravation by Exposure: If you have a condition that could be aggravated by exposure to dust or organic vapors, see a physician prior to use. If sensitized to amines, epoxies, or other chemicals do not use. See a physician if a medical condition exists.

Section 4 - First Aid Measures

First Aid - Eye Contact: If material gets into eyes, flush with water immediately for 15 minutes. Consult a physician.

First Aid - Skin Contact: In case of contact, immediately flush skin with plenty of water while removing contaminated clothing and shoes. Launder clothing before reuse. If rash or irritation develops, consult a physician.

First Aid - Inhalation: If inhaled, remove to fresh air. Administer oxygen if necessary. Consult a physician if symptoms persist or exposure was severe.

First Aid - Ingestion: If swallowed do not induce vomiting. Seek immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point, F: 71F (21C) (Setaflash)

Lower Explosive Limit, %: 0.8

Upper Explosive Limit, %: 12.0

Extinguishing Media: Carbon Dioxide, Dry Chemical, Foam, Water Fog

Unusual Fire And Explosion Hazards: Flammable Liquid. Vapors are heavier than air and will accumulate. Vapors will form explosive concentrations with air. Vapors travel long distances and will flashback. Use mechanical ventilation when necessary to keep percent vapor below the "Lower Explosion Level" (LEL). Eliminate all ignition sources. Keep away from sparks, open flames and heat sources. All electric equipment and installations should be made and grounded in accordance with the National Electrical Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and to wear conductive and non-sparking shoes.

Special Firefighting Procedures: Evacuate hazard area of unprotected personnel. Use a NIOSH approved self-contained breathing unit and complete body protection. Cool surrounding containers with water in case of fire exposure. Flammable. Cool fire-exposed containers using water spray.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. Evacuate the area of unprotected personnel. Wear appropriate personal protection clothing and equipment. Follow exposure controls/personal protection guidelines in Section 8. Contain and soak up residual with an aborbent (clay or sand). Take up absorbant material and seal tightly for proper disposal. Dispose of in accordance with local, state and federal regulations. Refer to Section 15 for SARA Title III and CERCLA information.

Section 7 - Handling And Storage

Handling: Avoid breathing vapors or spray mist. Do not get in eyes, on skin, or on clothing. Keep container tightly closed when not in use. Wear personal protection equipment. Do not breathe vapors. Wash thoroughly after handling. If pouring or transferring materials, ground all containers and tools. Do not weld, heat, cut or drill on full or empty containers. Use only in accordance with Carboline application

instructions, container label and Product Data Sheet.

Storage: Keep away from heat, sparks, open flames and oxidizing agents. Keep containers closed. Store in a cool, dry place with adequate ventilation.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use explosion-proof ventilation when required to keep below health exposure guidelines and Lower Explosion Limit (LEL).

Respiratory Protection: Use only with ventilation to keep levels below exposure guidelines listed in Section 2. User should test and monitor exposure levels to ensure all personnel are below guidelines. If not sure, or not able to monitor, use MSHA/NIOSH approved supplied air respirator. Follow all current OSHA requirements for respirator use. For silica containing coatings in a liquid state, and/or if no exposure limits are established in Section 2 above, supplied air respirators are generally not required.

Skin Protection: Recommend impervious gloves and clothing to avoid skin contact. If material penetrates to skin, change gloves and clothing. The use of protective creams may be beneficial to certain individuals. Protective creams should be applied before exposure.

Eye Protection: Recommend safety glasses with side shields or chemical goggles to avoid eye contact.

Other protective equipment: Eye wash and safety showers should be readily available.

Hygienic Practices: Wash with soap and water before eating, drinking, smoking, applying cosmetics, or using toilet facilities. Use of a hand cleaner is recommended. Launder contaminated clothing before reuse. Leather shoes can absorb and allow hazardous materials to pass through. Check shoes carefully after soaking before reuse.

Section 9 - Physical And Chemical Properties

Boiling Range:	176 F (80 C) - 401 F (205 C)	**Vapor Density:**	Heavier than Air
Odor:	Solvent	**Odor Threshold:**	N/D
Appearance:	Viscous liquid	**Evaporation Rate:**	Slower than Ether
Solubility in H2O:	N/D		
Freeze Point:	N/D	**Specific Gravity:**	1.6
Vapor Pressure:	N/D	**PH:**	N/D
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Heat, sparks and open flames.

Incompatibility: Keep away from strong oxidizing agents, heat and open flames.

Hazardous Decomposition Products: Carbon monoxide, nitrogen oxides, and unidentified organic compounds. Consider all smoke and fumes from burning material as very hazardous. Welding, cutting or abrasive grinding can create smoke and fumes. Do not breathe any fumes or smoke from these operations.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Product LD50: N/D

Product LC50: N/D

Chemical Name	CAS Number	LD50	LC50

MICROCRYSTALLINE SILICA	14808-60-7	NOT AVAILABLE	NOT AVAILABLE
BENZYL ALCOHOL	100-51-6	1230MG/KG RAT,ORAL	1000PPM/8HRS RAT,INHALATION
META-XYLENE	108-38-3	NOT AVAILABLE	NOT AVAILABLE
TOLUENE	108-88-3	5.0 G/KG RAT ORAL, 14G/KG RABBIT DERMAL	8000 PPM/4HRS, RAT, INHALATION
ISOPROPANOL	67-63-0	4720MG/KG RAT,ORAL	22500 PPM/8HRS RAT,INHALATION
ISOPHORONEDIAMINE	2855-13-2	>0.5 G/KG, ORAL	NOT AVAILABLE
PARA-XYLENE	106-42-3	NOT AVAILABLE	NOT AVAILABLE
AMINE ADDUCT	68609-08-5	>0.5 G/KG ORAL, RAT	NOT AVAILABLE
ETHYL BENZENE	100-41-4	3500 MG/KG RAT,ORAL	NOT AVAILABLE
CYCLOALIPHATIC AMINE	TRADE SECRET	1230 MG/KG ORAL RAT,2000 MG/KG DERMAL	NOT AVAILABLE
POLYOXYPROPYLENEDIAMINE	9046-10-0	.48 G/KG, ORAL, RAT	NOT AVAILABLE
ORTHO-XYLENE	95-47-6	NOT AVAILABLE	NOT AVAILABLE
AROMATIC HYDROCARBON	64742-95-6	4700 MG/KG, ORAL, RAT	3670 PPM/8 HOURS, RAT, INHALATION
1,2,4 TRIMETHYLBENZENE	95-63-6	5 GM/KG, ORAL, RAT	18 GM/M3/4HOURS
DIAMINOCYCLOHEXANE	694-83-7	1752 MG/KG,RAT,ORAL	NOT AVAILABLE
N-BUTANOL	71-36-3	2500MG/KG RAT,ORAL	>800PPM/4HRS RAT,INHALATION

Section 12 - Ecological Information

Ecological Information: No data

Section 13 - Disposal Information

Disposal Information: Dispose of in accordance with State, Local, and Federal Environmental regulations. Responsibility for proper waste disposal is with the owner of the waste.

Section 14 - Transportation Information

DOT Proper Shipping Name: Paint
DOT Technical Name: N/A
DOT Hazard Class: 3
DOT UN/NA Number: 1263
Packing Group: II
Hazard Subclass: N/A
Resp. Guide Page: 128

Additional Notes: None.

Section 15 - Regulatory Information

CERCLA - SARA HAZARD CATEGORY

This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD

SARA SECTION 313

This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
META-XYLENE	108-38-3
TOLUENE	108-88-3
PARA-XYLENE	106-42-3
ETHYL BENZENE	100-41-4
ORTHO-XYLENE	95-47-6
1,2,4 TRIMETHYLBENZENE	95-63-6
N-BUTANOL	71-36-3

TOXIC SUBSTANCES CONTROL ACT

All components of this product are listed on the TSCA inventory.

This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:

Chemical Name	CAS Number
PARA-XYLENE	106-42-3

U.S. STATE REGULATIONS AS FOLLOWS:

NEW JERSEY RIGHT-TO-KNOW

The following materials are non-hazardous, but are among the top five components in this product.

PENNSYLVANIA RIGHT-TO-KNOW

The following non-hazardous ingredients are present in the product at greater than 3%.

CALIFORNIA PROPOSITION 65

Warning: The following ingredients present in the product are known to the state of California to cause Cancer:

Chemical Name	CAS Number
MICROCRYSTALLINE SILICA	14808-60-7
ETHYL BENZENE	100-41-4
FORMALDEHYDE	50-00-0

Warning: The following ingredients present in the product are known to the state of California to cause birth defects, or other reproductive hazards:

Chemical Name	CAS Number
TOLUENE	108-88-3

INTERNATIONAL REGULATIONS AS FOLLOWS:

CANADIAN WHMIS

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: B2 D2A D2B

Section 16 - Other Information

HMIS Ratings
Health: 3 **Flammability:** 3 **Reactivity:** 0 **Personal Protection:** X

VOLATILE ORGANIC COMPOUNDS, GR/LTR MIXED (UNTHINNED): 214

REASON FOR REVISION: Routine Update

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by use of this material. It is the responsibility of the user to comply with all applicable federal, state, and local laws and regulations

Interzinc 22HS

Inorganic Zinc Silicate

PRODUCT DESCRIPTION

A two pack inorganic zinc-rich silicate based primer providing good abrasion resistance and outstanding corrosion protection for correctly prepared steel surfaces. Contains 82% zinc in the dry film for long term corrosion protection. Low VOC.

INTENDED USES

A primer for a wide range of above water organic coating schemes to greatly enhance corrosion resistance. For use at Newbuilding or Maintenance & Repair.

PRODUCT INFORMATION

Color	QH5055H-Reddish Grey
Finish/Sheen	Matt
Part B (Curing Agent)	QH5056H (zinc dust)
Volume Solids	78% ±2% (ASTM D2697-86)
Mix Ratio	1 weight(s) Part A to 2.86 weight(s) Part B
Typical Film Thickness	3 mils dry (3.8 mils wet)
Theoretical Coverage	417 ft²/US Gal at 3 mils dft, allow appropriate loss factors. * Coverage rates are calculated based upon volume solids test (ISO 3233:1998) determinations. Conduct usage rate observation for best determination of actual coverage.
Method of Application	Airless Spray, Conventional Spray
Flash Point	Part A 67°F; Part B Non-infamable; Mixed 70°F (Setaflash) (ASTM D-3278)
Induction Period	Not required

Drying Information	50°F	59°F	77°F	104°F
Touch Dry [ASTM D1640 7.5.1]	30 mins	25 mins	15 mins	15 mins
Hard Dry [ASTM D1640 7.7]	2 hrs	1.5 hrs	60 mins	60 mins
Pot Life	12 hrs	10 hrs	8 hrs	4 hrs

Overcoating Data - see limitations

	Substrate Temperature							
	50°F		59°F		77°F		104°F	
Overcoated By	Min	Max	Min	Max	Min	Max	Min	Max
Intergard 269	48 hrs	ext	37 hrs	ext	24 hrs	ext	24 hrs	ext

Note Overcoating is dependent upon ambient conditions. The figures above have been determined at the quoted temperature and 50% relative humidity.

REGULATORY DATA

VOC 340 g/lt (2.83 lbs/US gal) as supplied (EPA Method 24)

Note: VOC values are typical and are provided for guidance purposes only. These may be subject to variation depending on factors such as differences in color and normal manufacturing tolerances.

MIL SPEC Refer to Chapter 631 - Naval Ships Technical Manual, Paragraph 631-8.23.2.1

Complies with: SSPC Paint Specification No.20 Type 1C.

SYSTEMS AND COMPATIBILITY

Consult your International Paint representative for the system best suited for the surfaces to be protected.

SURFACE PREPARATIONS

Paint only clean, dry surfaces. Remove all grease, oil, soluble contaminants and other foreign matter by "solvent cleaning" (SSPC-SP1).

NEWBUILDING
Dependent on yard procedures. Consult International Paint.

Steel:
For optimum performance "Near White Blast Cleaning" (SSPC-SP10) is recommended.
Surface profile should be between 2 mils and 2.5 mils.

Shop Primed Surfaces:
Consult your International Paint representative for specific recommendations.

Prior to overcoating, Interzinc 22 HS must be clean, dry and free from both soluble salts and excessive zinc corrosion products.

Applied Film Thickness:
As a characteristic with high solids coatings, care should be taken to maintain the recommended wet film thickness in order to avoid excessive dry film thickness.
Excessive film thickness and/or over-application of Interzinc 22 HS will lead to mudcracking, which will require complete removal of the affected areas by abrasive blasting and re-application in accordance with the original specification.

Topcoating:
Overcoating time will vary depending upon the generic type of top coat and specific application conditions. (1) Allow to cure a minimum of 24 hours at greater than 77°F and 50% relative humidity with good air circulation. Since cure times may vary with conditions, check for cure to accept topcoats by performing a solvent rub test in accordance with ASTM D4752. (2) Before topcoating, clean surface thoroughly, removing all dirt grease, oil or other contaminants. (3) Prepare corroded, welded or damaged areas by abrasive blasting (SSPC-SP10) and prime these recleaned areas with an inhibitive, organic primer. (4) When applying topcoats a mist coat may be required. As necessary, apply a mist coat of topcoat material followed by a full coat at proper film thickness to help prevent solvent bubbling. (5) Apply only topcoats specifically recommended by International Paint.
It is recommended that prior to overcoating a solvent rub test to ASTM D-4752 should be undertaken. A value of 4 indicates a satisfactory degree of cure for overcoating purpose.
The minimum overcoating interval is dependant upon the relative humidity during cure. Below 55% relative humidity the minimum recoat period will normally be at least 24 hours, but will be dependent upon the ambient temperature and relative humidity during the application and curing period.

APPLICATION

Apply by conventional spray or airless spray. When spraying, pressure (material) tank must be located above or on the same level as work, material hoses should be extended full length - avoid loops, sags and coils. Allow for losses due to surface irregularities and application methods. Strain material through a minimum 60 mesh screen before application. Apply 3.8 mils wet which will yield 3.0 mils dry film thickness. Consult the following equipment recommendations or utilize suitable equal.
Note: Do not apply in excess of 5.0 mils dry film thickness.

The curing time will vary depending upon dry film thickness and conditions that exist during the application and throughout the curing period.

Mixing

Material is supplied in 2 containers as a unit. Always mix a complete unit in the proportions supplied. (1) Agitate Part A with a power agitator, (2) Remove moisture absorbent packing from Powder (Part B) and discard. (3) Slowly add Powder into Part A (Liquid) while agitating with power mixer and allow to mix at least 5 minutes. (4) Strain material through a 30-60 mesh screen into air agitator equipped tank, container or pressure pot. (5) Operate air agitator at low speed (approximately 20 R.P.M.) sufficient to keep powder in suspension. (6) Keep system closed, free of moisture. Pot life will be reduced and material may "set up" if excessive moisture is present during mixing or in equipment. Pot life varies with temperature and humidity conditions.

Thinner

DO NOT THIN BEYOND YOUR STATE'S COMPLIANCY. Material is supplied at spray viscosity and normally does not need thinning. If thinning is necessary, thin up to a maximum of 8 ounces per gallon with International GTA138, or for tropical conditions use GTA027.

Airless Spray

Minimum 30:1 ratio pump, with Teflon packings. Use 60 mesh filter in pump manifold or an in-line filter. 0.015"-0.021" (381-533 microns) orifice tip; 3/8" (9.5mm) ID high pressure hose.

Conventional Spray

DeVilbiss MBC or JGA gun with a heavy mastic spring, E tip and 704 or 765 air cap, 3/8" (9.5 mm) ID material hose, 50 feet (15.2 m) length maximum; double regulated air agitator equipped pressure tank with oil and moisture separator.

Work Stoppages and Cleanup

Maintain material under constant low speed agitation. Clean all equipment immediately after use with International GTA138 Thinner. Spray equipment requires flushing with this solvent. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency will depend upon factors such as amount sprayed, temperature and elapsed time including work stoppages. Monitor material condition. Do not exceed pot life limitations.

Welding

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation. In North America do so in accordance with instruction in ANSI/ASC Z49.1 "Safety in Welding and Cutting."

SAFETY

All work involving the application and use of this product should be performed in compliance with all relevant national Health, Safety & Environmental standards and regulations.

Prior to use, obtain, consult and follow the Material Safety Data Sheet for this product concerning health and safety information. Read and follow all precautionary notices on the Material Safety Data Sheet and container labels. If you do not fully understand these warnings and instructions or if you can not strictly comply with them, do not use this product. Proper ventilation and protective measures must be provided during application and drying to keep solvent vapor concentrations within safe limits and to protect against toxic or oxygen deficient hazards. Take precautions to avoid skin and eye contact (ie. gloves, goggles, face masks, barrier creams etc.) Actual safety measures are dependant on application methods and work environment.
EMERGENCY CONTACT NUMBERS:
USA/Canada - Medical Advisory Number 1-800-854-6813
Europe - Contact (44) 191 4696111. For advice to Doctors & Hospitals only contact (44) 207 6359191
R.O.W. - Contact Regional Office

LIMITATIONS

Apply in good weather when air and surface temperatures are above 41°F. Surface temperatures must be at least 5° F above dew point. For optimum application properties, bring material to 70-81°F prior to mixing and application.
Unmixed material (in closed containers) should be maintained in protected storage between 40 and 95°F.
Care should be taken at temperatures close to freezing that surfaces are free from ice.
At relative humidities below 50%, curing will be severely retarded and humidity may need to be increased by use of steam or water spraying.
For high temperature systems the thickness of Interzinc 22HS should be restricted to 2 mils d.f.t. Continuous dry temperature resistance of Interzinc 22HS is 752°F if left untopcoated. However, if this product is used as a primer for Intertherm 50, the dry temperature resistance will be 1004°F.
Interzinc 22HS is not suitable for exposure in acid or alkaline conditions.
When applying Interzinc 22HS in confined spaces, ensure adequate ventilation.
Overcoating information is given for guidance only and is subject to regional variation depending upon local climate and environmental conditions. Consult your local International Paint representative for specific recommendations.
Technical and application data herein is for the purpose of establishing a general guideline of the coating and proper coating application procedures. Test performance results were obtained in a controlled laboratory environment and International Paint makes no claim that the exhibited published test results, or any other tests, accurately represent results actually found in all field environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection, verification of performance and use of the coating.
In the overcoating data section 'ext' = extended overcoating period. Please refer to our Marine Painting Guide - Definitions and Abbreviations available on our website.

UNIT SIZE

Unit Size	Part A		Part B	
	Vol	Pack	Vol	Pack
3.5 US gal	2.32 US gal	5 US gal	1.18 US gal	3 US gal

For availability of other unit sizes consult International Paint

UNIT SHIPPING WEIGHT

Unit Size	Unit Weight
3.5 US gal	100 lb

STORAGE

Shelf Life	Part A Binder: 6 months from date of manufacture when maintained in protected storage at 40 -95°F Part B Zinc Dust: 12 months from date of manufacture when maintained in protected storage at 40-95°F Subject to reinspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

WORLDWIDE AVAILABILITY

Consult International Paint.

IMPORTANT NOTE

The information in this data sheet is not intended to be exhaustive: any person using the product for any purpose other than that specifically recommended in this data sheet without first obtaining written confirmation from us as to the suitability of the product for the intended purpose does so at their own risk. All advice given or statements made about the product (whether in this data sheet or otherwise) is correct to the best of our knowledge but we have no control over the quality or the condition of the substrate or the many factors affecting the use and application of the product. Therefore, unless we specifically agree in writing to do so, we do not accept any liability at all for the performance of the product or for (subject to law) any loss or damage arising out of the use of the product. All products supplied and technical advice given are subject to our Conditions of Sale. You should request a copy of this document and review it carefully. The information contained in this data sheet is liable to modification from time to time in the light of experience and our policy of continuous development. It is the user's responsibility to check with their local International Paint representative that this data sheet is current prior to using the product.

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www.international-marine.com

MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

INTERZINC 22HS GRAY

MSDS Revision No: A1 -6
MSDS Revision Date: 01/07/2004

International Paint Inc.
6001 Antoine Drive
Houston, Texas 77091

EMERGENCY NUMBERS:

(800) 424-9300	CHEMTREC (USA)
(703) 527-3887	CHEMTREC (Intl)
(800) 854-6813	Poison Control Center

CUSTOMER SERVICE: (Non-Emergency)

(800) 589-1267	International Paint
(800) 631-7481	Interlux

1. GENERAL INFORMATION

Product Identity: INTERZINC 22HS GRAY

Bulk Sales Reference No: QH5067H

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.
NOTICE: OSHA hazardous chemicals are listed in Section 2 if present at 1% or more. Carcinogens and extraordinarily/special hazardous chemicals are listed in Section 2 if present at .1% or more. Additional regulatory information for specific chemical categories is included in Section 15.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
000064-17-5	Ethyl alcohol 1.0 - 10% by Weight	OSHA:	1000 ppm TWA; 1900 mg/m3 TWA
		ACGIH:	1000 ppm TWA
		NIOSH:	1000 ppm TWA; 1900 mg/m3 TWA3300 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	1000 ppm TWAEV; 1900 mg/m3 TWAEV
		Mexico:	1000 ppm TWA; 1900 mg/m3 TWA
		Brazil:	780 ppm TWA; 1480 mg/m3 TWA
		Source	**Health Data**
		NIOSH:	Eye respiratory
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data

000078-10-4	Ethyl silicate 1.0 - 10% by Weight	OSHA:	100 ppm TWA; 850 mg/m3 TWA
		ACGIH:	10 ppm TWA
		NIOSH:	10 ppm TWA; 85 mg/m3 TWA700 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	10 ppm TWAEV; 85 mg/m3 TWAEV
		Mexico:	10 ppm TWA; 85 mg/m3 TWA30 ppm STEL; 255 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Eye and nose irritation; lung liver
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
000107-98-2	Propylene glycol monomethyl ether 10 - 25% by Weight	OSHA:	150 ppm STEL; 540 mg/m3 STEL
		ACGIH:	100 ppm TWA150 ppm STEL
		NIOSH:	100 ppm TWA; 360 mg/m3 TWA150 ppm STEL; 540 mg/m3 STEL
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 365 mg/m3 TWAEV150 ppm STEV; 550 mg/m3 STEV
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Eye nose
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
000110-43-0	Methyl n-amyl ketone 1.0 - 10% by Weight	OSHA:	100 ppm TWA; 465 mg/m3 TWA
		ACGIH:	50 ppm TWA
		NIOSH:	100 ppm TWA; 465 mg/m3 TWA800 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	25 ppm TWAEV; 115 mg/m3 TWAEV
		Mexico:	50 ppm TWA; 235 mg/m3 TWA100 ppm STEL; 465 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Irritation; liver kidney
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
000111-76-2	BUTO YETHANOL 1.0 - 10% by Weight	OSHA:	50 ppm TWA; 240 mg/m3 TWA
		ACGIH:	20 ppm TWA
		NIOSH:	5 ppm TWA; 24 mg/m3 TWA700 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	20 ppm TWAEV
		Mexico:	26 ppm TWA; 120 mg/m3 TWA75 ppm STEL; 360 mg/m3 STEL
		Brazil:	39 ppm TWA; 190 mg/m3 TWA
		Source	**Health Data**
		NIOSH:	Adverse effects on blood and hematopoietic system tissue irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001317-80-2	Rutile (TiO2) 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001332-58-7	Kaolin 1.0 - 10% by Weight	OSHA:	15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)
		ACGIH:	2 mg/m3 TWA (respirable fraction, particulate matter containing no asbestos and 1% crystallin
		NIOSH:	10 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable dust)
		Supplier:	No Data Available
		OHSA, CAN:	2 mg/m3 TWAEV (total dust, no asbestos and less than 1% crystalline silica)
		Mexico:	10 mg/m3 TWA (nuisance particulate)20 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Skin and mucous membrane injury respiratory effects
		Source	**Carcinogen Data**

		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
012001-26-2	Mica (containing less than 1% quartz) 10 - 25% by Weight	OSHA:	No Data Available
		ACGIH:	3 mg/m3 TWA (respirable fraction)
		NIOSH:	3 mg/m3 TWA (respirable dust, containing less than 1% quartz)1500 mg/m3 IDLH (containing less than 1% quartz)
		Supplier:	No Data Available
		OHSA, CAN:	6 mg/m3 TWAEV (total dust); 3 mg/m3 TWAEV (respirable dust, no asbestos and less than 1% crysta
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	respirable dust; Fibrotic pneumoconiosis
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
014808-60-7	Quartz 0.10 - 1.0% by Weight	OSHA:	No Data Available
		ACGIH:	0.05 mg/m3 TWA (respirable fraction)
		NIOSH:	0.05 mg/m3 TWA (respirable dust)50 mg/m3 IDLH (respirable dust)
		Supplier:	No Data Available
		OHSA, CAN:	0.10 mg/m3 TWAEV0.10 mg/m3 TWEAV; (See Ontario Reg. 845 for full information)
		Mexico:	10 mg/m3 TWA
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Chronic lung disease (silicosis)
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: Yes
		NTP:	Known Carcinogen: Yes; Suspected Carcinogen: No
		IARC:	Group 1: Yes; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
		OSHA:	150 ppm STEL; 900 mg/m3 STEL

034590-94-8	Dipropylene glycol monomethyl ether 1.0 - 10% by Weight	ACGIH:	100 ppm TWA150 ppm STEL
		NIOSH:	100 ppm TWA; 600 mg/m3 TWA150 ppm STEL; 900 mg/m3 STEL600 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 776 mg/m3 TWAEV150 ppm STEV; 910 mg/m3 STEV
		Mexico:	100 ppm TWA; 60 mg/m3 TWA150 ppm STEL; 900 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Narcotic effects mild irritation of the nose and eyes
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Avoid contact with eyes, skin and clothing.		
Inhalation:	Harmful if inhaled. Causes nose and throat irritation. Vapors may affect the brain or nervous system causing dizziness, headache or nausea.		
Eyes:	Causes severe eye irritation. Do not get in eyes.		
Skin:	Causes skin irritation. May be harmful if absorbed through the skin.		
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.		
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient). Birth defect hazard. Contains an ingredient which can cause birth defects (See Section 2 and Section 15 for each ingredient). Cancer hazard. Contains an ingredient which can cause cancer (See Section 2 and Section 15 for each ingredient). Risk of cancer depends on duration and level of exposure.		
HMIS Rating:	Health: 2*	Flammability: 3	Reactivity: 0

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	If swallowed, immediately contact Poison Control Center at 1-800-854-6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Select equipment to provide protection from the ingredients listed in Section 2 of this document. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates dust, vapor, or mist levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1-800-243-4630, in Canada call 1-800-267-4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.

Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: 67 C: 19
Lower Explosive Limit (LEL):	1.1 (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	Flammable liquid and vapor. FLAMMABLE/COMBUSTIBLE MATERIALS: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks) creating a vapor explosion hazard. Runoff to sewers may create fire or explosion hazard. Containers may explode when heated.
Fire Fighting Procedures:	CAUTION: This product has a very low flashpoint. Use of water spray when fighting fire may be inefficient. SMALL FIRES: Use dry chemical, CO2, water spray or alcohol-resistant foam. LARGE FIRES: Use water spray, fog, or alcohol-resistant foam. Do not use straight streams. Move containers from fire area if you can do so without risk. Runoff from fire control may cause pollution. Dike fire control water for later disposal. Do not scatter the material. **Also Reference Emergency Response Guide Number:** 127

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
pH:	Not Determined
Specific Gravity:	1.23458
Boiling Point (F):	169
Vapor Density:	Heavier than air
VOC Content (lbs):	Refer to the Technical Data Sheet for this product.
Evaporation Rate:	Slower than ether

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 32 and 120 F
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Vapors may cause flash fire or ignite explosively. Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation. Do not get in eyes, on skin or clothing. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Use only non-sparking equipment to handle spilled material and absorbent. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers. Use non-sparking tools to collect absorbed material.
Public Safety:	CALL CHEMTREC at (800)-424-9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. LARGE SPILLS: Consider initial downwind evacuation for at least 300 meters (1000 feet). **Also, Reference Emergency Response Guide Number: 127**

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		**IMO / IMDG (Ocean Transportation)**	
DOT Proper Shipping Name: PAINT		**IMDG Proper Shipping Name:** PAINT	
DOT Hazard Class:	3	**IMDG Hazard Class:**	3.2 - Intermediate flashpoint flammable liquids
UN / NA Number:	UN 1263	**UN Number:**	UN 1263
DOT Packing Group:	II	**IMDG Packing Group:**	II
CERCLA/DOT RQ:	4469 gal. / 45956 lbs.	**System Reference Code:**	28

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory. **Note:** Any chemical ingredients listed in Section 15, that do not also appear in Section 2, are contained in the product at a concentration below the applicable OSHA threshold level of 1% or 0.1%.
WHMIS Classification:	B2; D2
Regulatory List	**Product Ingredients on List**
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%):	
(No Product Ingredients Listed)	
EPCRA 311/312 Chemicals and RQs (>.1%) :	
000100-41-4	Ethyl benzene : 1000 lb final RQ; 454 kg final RQ
000095-47-6	o- ylene : 1000 lb final RQ (Listed under ylene, mixed); 454 kg final RQ (Listed under ylene, mixed)

000108-38-3	YLENE : 1000 lb final RQ (Listed under " ylene, mixed); 454 kg final RQ (Listed under " ylene, mixed)
001330-20-7	ylenes (o-, m-, p- isomers) : 100 lb final RQ; 45.4 kg final RQ

EPCRA 302 Extremely Hazardous (>.1%) :

(No Product Ingredients Listed)

EPCRA 313 Toxic Chemicals (>.1%) :

000872-50-4	1-Methyl-2-pyrrolidone
000111-76-2	BUTO YETHANOL
066402-68-4	Ceramic materials and wares, chemicals
000100-41-4	Ethyl benzene
000095-47-6	o- ylene
000107-98-2	Propylene glycol monomethyl ether
000108-38-3	YLENE
001330-20-7	ylenes (o-, m-, p- isomers)

Mass RTK Substances (>1%) :

000111-76-2	BUTO YETHANOL
034590-94-8	Dipropylene glycol monomethyl ether
000064-17-5	Ethyl alcohol
000078-10-4	Ethyl silicate
001332-58-7	Kaolin
000110-43-0	Methyl n-amyl ketone
012001-26-2	Mica (containing less than 1% quartz)
000107-98-2	Propylene glycol monomethyl ether

Mass Extraordinarily Haz Sub (>.01%) :

014808-60-7	Quartz
007664-93-9	Sulfuric acid

Penn RTK Substances (>1%) :

000111-76-2	BUTO YETHANOL
034590-94-8	Dipropylene glycol monomethyl ether
000064-17-5	Ethyl alcohol
000078-10-4	Ethyl silicate
001332-58-7	Kaolin
000110-43-0	Methyl n-amyl ketone
012001-26-2	Mica (containing less than 1% quartz)
000107-98-2	Propylene glycol monomethyl ether
001317-80-2	Rutile (TiO2)

Penn Special Hazardous Substances (>.01%) :

(No Product Ingredients Listed)

Rhode Island Hazardous Substances (>.1%) :

000111-76-2	BUTO YETHANOL
034590-94-8	Dipropylene glycol monomethyl ether
000064-17-5	Ethyl alcohol
000100-41-4	Ethyl benzene
000078-10-4	Ethyl silicate
001332-58-7	Kaolin
000110-43-0	Methyl n-amyl ketone
012001-26-2	Mica (containing less than 1% quartz)
000107-98-2	Propylene glycol monomethyl ether
014808-60-7	Quartz
001330-20-7	ylenes (o-, m-, p- isomers)

RCRA Status (>.01%) :

(No Product Ingredients Listed)

N.J. RTK Substances (>1%) :

000111-76-2	BUTO YETHANOL
034590-94-8	Dipropylene glycol monomethyl ether
000064-17-5	Ethyl alcohol
000078-10-4	Ethyl silicate
000110-43-0	Methyl n-amyl ketone
012001-26-2	Mica (containing less than 1% quartz)
000107-98-2	Propylene glycol monomethyl ether

N.J. Special Hazardous Substances (>.01%) :

000064-17-5	Ethyl alcohol
000107-98-2	Propylene glycol monomethyl ether

N.J. Env. Hazardous Substances (>.1%) :

000872-50-4	1-Methyl-2-pyrrolidone
000111-76-2	BUTO YETHANOL
066402-68-4	Ceramic materials and wares, chemicals
000100-41-4	Ethyl benzene
000095-47-6	o- ylene
000107-98-2	Propylene glycol monomethyl ether
000108-38-3	YLENE

001330-20-7	ylenes (o-, m-, p- isomers)
Proposition 65 - Carcinogens (>0%):	
014808-60-7	Quartz
Proposition 65 - Female Repro Toxins (>0%):	
(No Product Ingredients Listed)	
Proposition 65 - Male Repro Toxins (>0%):	
(No Product Ingredients Listed)	
Proposition 65 - Developmental Toxins (>0%):	
000872-50-4	1-Methyl-2-pyrrolidone
000064-17-5	Ethyl alcohol

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

End Of Document

MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

INTERZINC 22HS PART B

MSDS Revision No: A3 –8
MSDS Revision Date: 05/27/2008

International Paint LLC
6001 Antoine Drive
Houston, Texas 77091

EMERGENCY NUMBERS:

(800) 424–9300	CHEMTREC (USA)
(703) 527–3887	CHEMTREC (Intl)
(800) 854–6813	Poison Control Center
CUSTOMER SERVICE:	(Non–Emergency)
(800) 589–1267	International Paint
(800) 631–7481	Interlux

1. GENERAL INFORMATION

Product Identity: INTERZINC 22HS PART B

Bulk Sales Reference No: QH5056H

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.

NOTICE: OSHA hazardous chemicals are listed in Section 2 if present at 1% or more. Carcinogens and extraordinarily/special hazardous chemicals are listed in Section 2 if present at .1% or more. Additional regulatory information for specific chemical categories is included in Section 15.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
001314–13–2	Zinc oxide 10 – 25% by Weight	OSHA:	5 mg/m3 TWA (fume); 15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)10 mg/m3 STEL (fume)
		ACGIH:	2 mg/m3 TWA (respirable fraction)10 mg/m3 STEL (respirable fraction)
		NIOSH:	5 mg/m3 TWA (dust and fume)10 mg/m3 STEL (fume)15 mg/m3 Ceiling (dust)500 mg/m3 IDLH
		Supplier:	No Established Limit
		OHSA, CAN:	2 mg/m3 TWAEV (respirable)10 mg/m3 STEV (respirable)
		Mexico:	5 mg/m3 TWA (fume); 10 mg/m3 TWA (dust)10 mg/m3 STEL (fume)
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	Metal fume fever
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
007440–66–6	Zinc 75 – 100% by Weight	OSHA:	No Established Limit
		ACGIH:	No Established Limit
		NIOSH:	No Established Limit
		Supplier:	No Established Limit
		OHSA, CAN:	No Established Limit
		Mexico:	No Established Limit
		Brazil:	No Established Limit
		Source	Health Data
		NIOSH:	No Established Limit
		Source	Carcinogen Data
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No

	IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	Avoid contact with eyes, skin and clothing.
Inhalation:	Harmful if inhaled. Causes nose and throat irritation.
Eyes:	Causes severe eye irritation. Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site–specific condition of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thouroughly cleaned, or discarded after each use.
Skin:	Causes skin irritation. May be harmful if absorbed through the skin.
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient).
HMIS Rating:	Health: 2* Flammability: 1 Reactivity: 0

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	If swallowed, immediately contact Poison Control Center at 1–800–854–6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Avoid breathing dust. Use a NIOSH approved respirator in accordance with 29CFR 1910.134 to remove particulates (and vapors if there is overexposure to vapors generated during the processing of this product). FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1–800–243–4630, in Canada call 1–800–267–4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site–specific condition of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thouroughly cleaned, or discarded after each use. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site–specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site–specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Depending on the site–specific conditions of use, provide adequate ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water. Avoid contact with eyes and clothing. Avoid prolonged or repeated contact with skin.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: No Established Limit C: No Established Limit
Lower Explosive Limit (LEL):	No Established Limit (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	May react violently or explosively on contact with water. Material may be transported in flammable liquids. May be ignited by friction, heat, sparks, or flames. May burn with intense heat. Dust or fumes may form

	explosive mixtures in air. Containers may explode when heated. May re–ignite after fire is extinguished.
Fire Fighting Procedures:	SMALL FIRES: DO NOT USE WATER, FOAM, OR CO2. Dousing metallic fires with water may generate hydrogen gas, an extremely dangerous explosion hazard, particularly if fire is in a confined area. Use DRY sand, graphite powder, dry sodium chloride based extinguishers, G–1 or Met–L–X powder. Confining or smothering metal fires is preferable rather than applying water. Move containers from fire area if you can do so without risk. Also Reference Emergency Response Guide Number: 170

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
pH:	No Established Limit
Specific Gravity:	7.1
Boiling Point (F):	No Established Limit
Vapor Density:	Not Applicable
VOC Content (lbs):	Refer to the Technical Data Sheet for this product.
Evaporation Rate:	Not Applicable

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur. Not sensitive to mechanical impact. Excessive heat and fumes generation can occur if improperly handled.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 40–100F (4–38C).
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Finely divided powders are potentially explosive when suspended in air. Isolate from heat, sparks, electrical equipment and open flame. Do not get in eyes, on skin or clothing. Do not breathe dust. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. Use non–sparking equipment to collect spilled material and transfer to containers for later disposal. DO NOT GET WATER INSIDE CONTAINERS.
Public Safety:	CALL CHEMTREC at (800)–424–9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Also, Reference Emergency Response Guide Number: 170

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		IMO / IMDG (Ocean Transportation)	
DOT Proper Shipping Name: ZINC DUST (NOT HAZARDOUS BY TESTING IN ACCORDANCE WITH UN MANUAL OF TESTS AND CRITERIA)		IMDG Proper Shipping Name: ZINC DUST	
DOT Hazard Class:	NR	IMDG Hazard Class:	4.3 – Dangerous when wet materials
UN / NA Number:	Not Regulated	UN Number:	UN 1436
DOT Packing Group:	Not Regulated	IMDG Packing Group:	III
CERCLA/DOT RQ:	19 gal. / 1111 lbs.	System Reference Code:	12

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all–inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory. **Note:** Any chemical ingredients listed in Section 15, that do not also appear in Section 2, are contained in the product at a concentration below the applicable OSHA threshold level of 1% or 0.1%.
WHMIS Classification:	No Established Limit
Regulatory List	Product Ingredients on List
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%):	
(No Product Ingredients Listed)	
EPCRA 311/312 Chemicals and RQs (>.1%) :	
007440–66–6	Zinc : 1000 lb final RQ (no reporting of releases of this hazardous substance is required if the diame
EPCRA 302 Extremely Hazardous (>.1%) :	
(No Product Ingredients Listed)	
EPCRA 313 Toxic Chemicals (>.1%) :	
007440–66–6	Zinc
Mass RTK Substances (>1%) :	
007440–66–6	Zinc
001314–13–2	Zinc oxide
Mass Extraordinarily Haz Sub (>.01%) :	
(No Product Ingredients Listed)	
Penn RTK Substances (>1%) :	
007440–66–6	Zinc
001314–13–2	Zinc oxide
Penn Special Hazardous Substances (>.01%) :	
(No Product Ingredients Listed)	
Rhode Island Hazardous Substances (>.1%) :	
007440–66–6	Zinc
001314–13–2	Zinc oxide
RCRA Status (>.01%) :	
(No Product Ingredients	

Listed)
N.J. RTK Substances (>1%) :
007440–66–6 Zinc
001314–13–2 Zinc oxide
N.J. Special Hazardous Substances (>.01%) :
(No Product Ingredients Listed)
N.J. Env. Hazardous Substances (>.1%) :
007440–66–6 Zinc
Proposition 65 – Carcinogens (>0%):
(No Product Ingredients Listed)
Proposition 65 – Female Repro Toxins (>0%):
(No Product Ingredients Listed)
Proposition 65 – Male Repro Toxins (>0%):
(No Product Ingredients Listed)
Proposition 65 – Developmental Toxins (>0%):
(No Product Ingredients Listed)

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

FOR PROFESSIONAL USE ONLY

IMPORTANT NOTE The information in this data sheet is not intended to be exhaustive and is based on the present state of our knowledge and on current laws: any person using the product for any purpose other than that specifically recommended in the technical data sheet without first obtaining written confirmation from us as to the suitability of the product for the intended purpose does so at his own risk. It is always the responsibility of the user to take all necessary steps to fulfill the demands set out in the local rules and legislation. Always read the Material Data Sheet and the Technical Data Sheet for this product if available. All advice we give or any statement made about the product by us (whether in this data sheet or otherwise) is correct to the best of our knowledge but we have no control over the quality or the condition of the substrate or the many factors affecting the use and application of the product. Therefore, unless we specifically agree in writing otherwise, we do not accept any liability whatsoever for the performance of the product or for any loss or damage arising out of the use of the product. All products supplied and technical advice given are subject to our standard terms and conditions of sale. You should request a copy of this document and review it carefully. The information contained in this data sheet is subject to modification from time to time in the light of experience and our policy of continuous development. It is the user's responsibility to verify that this data sheet is current prior to using the product.

Brand names mentioned in this data sheet are trademarks of or are licensed to Akzo Nobel.

Head Office

International Paint, LLC, 6001 Antoine Drive, Houston, Texas 77091. http://www.international–pc.com or http://www.international–marine.com

End Of Document

Intertherm 50

High Temperature Silicone

PRODUCT DESCRIPTION

A single component, high temperature coating, based on a moisture curing silicone binder.

The moisture curing crosslinking mechanism allows multiple coats to be applied without heat curing. Suitable for temperatures up to 1004°F (540°C).

INTENDED USES

For the protection of steel from corrosion on areas including flare stacks, chimneys, exhausts, vents and pipework, at temperatures up to 1004°F (540°C).

Where maximum corrosion protection is required, application should be over a zinc silicate primer (e.g. Interzinc 22).

PRACTICAL INFORMATION FOR INTERTHERM 50

Color	Aluminum, Black
Gloss Level	Not applicable
Volume Solids	45%
Typical Thickness	1 mils (25 microns) dry equivalent to 2.2 mils (56 microns) wet
Theoretical Coverage	722 sq.ft/US gallon at 1 mils d.f.t and stated volume solids 18 m²/liter at 25 microns d.f.t and stated volume solids
Practical Coverage	Allow appropriate loss factors
Method of Application	Air Spray, Brush, Roller

Drying Time

			Overcoating Interval with recommended topcoats	
Temperature	**Touch Dry**	**Hard Dry**	*Minimum*	*Maximum*
41°F (5°C)	90 minutes	5 hours	24 hours	Extended□
59°F (15°C)	60 minutes	3 hours	16 hours	Extended□
77°F (25°C)	30 minutes	2 hours	12 hours	Extended□
104°F (40°C)	15 minutes	1 hour	6 hours	Extended□

□See International Protective Coatings Definitions & Abbreviations

REGULATORY DATA

Flash Point	77°F (25°C)	
Product Weight	9.4 lb/gal (1.13 kg/l)	
VOC	4.13 lb/gal (495 g/lt) 509 g/kg	EPA Method 24 EU Solvent Emissions Directive (Council Directive 1999/13/EC)

See Product Characteristics section for further details

SURFACE PREPARATION

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application, all surfaces should be assessed and treated in accordance with ISO 8504:2000.

Oil or grease should be removed in accordance with SSPC-SP1 solvent cleaning.

Abrasive Blast Cleaning

Abrasive blast clean to a minimum of SSPC-SP6 or Sa2 (ISO 8501-1:2007). If oxidation has occurred between blasting and application of Intertherm 50, the surface should be reblasted to the specified visual standard.

Surface defects revealed by the blast cleaning process, should be ground, filled, or treated in the appropriate manner.

A surface profile of 1-2 mils (25-50 microns) is recommended.

Hand or Power Tool Preparation

Any coatings present on the surface must be removed prior to the application of Intertherm 50.
Hand or power tool clean to a minimum SSPC-SP3 or St3 (ISO 8501-1:2007).
Note, all scale must be removed and areas which cannot be prepared adequately by chipping or needle gun should be spot blasted to a minimum standard of SSPC-SP6 or Sa2 (ISO 8501-1:2007). Typically this would apply to C or D grade rusting in this standard.

Primed Surfaces

Intertherm 50 is suitable for application to unweathered steelwork freshly coated with zinc silicate shop primers. If the zinc shop primer shows extensive or widely scattered breakdown, or excessive zinc corrosion products, overall sweep blasting will be necessary. Other types of shop primer are not suitable for overcoating and will require complete removal by abrasive blast cleaning.

Weld seams and damaged areas should be blast cleaned to SSPC-SP6 or Sa2 (ISO 8501-1:2007).

Aluminium Metal Spray

Metal sprayed surfaces should be fresh, clean and free from moisture, or surface contamination.

APPLICATION

Mixing	This material is a one component coating and should always be mixed thoroughly with a power agitator before application.	
Mix Ratio	Not applicable	
Airless Spray	Not recommended	
Air Spray (Pressure Pot)	Recommended	Gun DeVilbiss MBC or JGA Air Cap 704 or 765 Fluid Tip E
Air Spray (Conventional)	Recommended	Use suitable proprietary equipment.
Brush	Suitable - Small areas only	Typically 0.6-0.8 mils (15-20 microns) can be achieved
Roller	Suitable - Small areas only	Typically 0.6-0.8 mils (15-20 microns) can be achieved
Thinner	International GTA007	Do not thin more than allowed by local environmental legislation
Cleaner	International GTA007	

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA007. Partially filled containers may show surface skinning and/or a viscosity increase of the material after storage.

Clean Up

Clean all equipment immediately after use with International GTA007. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

PRODUCT CHARACTERISTICS

Intertherm 50 is moisture curing, and does not evolve water vapor during the heat curing mechanism as with standard silicones. Application at thicknesses of 1 mil (25 microns) are therefore possible rather than normal thicknesses of 0.6 mil (15 microns).

Maximum thickness which can be applied in a single coat without subsequent blistering on heating is 1.6 mil (40 microns).

Up to 3 coats at a maximum of 1 mil (25 microns) per coat can be applied without the requirement of heating between coats. This provides maximum corrosion protection when it is not possible to use a zinc silicate priming system.

Intertherm 50 is available in an aluminium or black version. It is recommended that the aluminium version is always used where possible due to its superior performance. The black version should only be used for specialist applications / requirements. For further information contact International Protective Coatings.

Intertherm 50 Aluminium version is suitable for the protection of abrasive blast cleaned steel operating at continuous dry temperatures up to 1004°F (540°C). However, the maximum service temperature over hand prepared substrates is 752°F (400°C).

Intertherm 50 Black version is suitable for the protection of abrasive blast cleaned steel operating at continuous dry temperatures up to 752°F (400°C). However, the maximum service temperature over hand prepared substrates is 572°F (300°C).

When using high heat coatings over inorganic zinc primer, the products should be applied in strict accordance with film thickness specifications, since application of excessive thicknesses may cause blistering. Determine that the inorganic zinc primer is thoroughly cured prior to application of the high heat coating by following the curing instructions given on the relevant product data sheet.

When using a zinc silicate primer to obtain maximum corrosion resistance the recommended thickness of zinc silicate is 2 mils (50 microns) dry film thickness to ensure maximum surface strength for any subsequent temperature cycling and to avoid flaking of topcoats..

It is preferable to overcoat zinc silicate before weathering but in cases where this is not possible then the zinc silicate surface should be clean and free of zinc corrosion products.

In corrosive environments, the use of Intertherm 50 Black directly over zinc silicate primer can lead to a marked color change from black to grey due to the salting of the underlying primer. This color change can be significantly reduced by first sealing the zinc silicate primer with a single coat of Intertherm 50 Aluminium prior to the application of Intertherm 50 Black. The maximum dry temperature resistance of this system is 752°F (400°C).

Intertherm 50 is not suitable for exposure in acid or alkaline environments.

Intertherm 50 Aluminium version has the following specification approvals:
- BS5493 (1977) : CP7
- Shell Specification DEP 40.48.00.30 Gen. Chapter VI (h)

Note: VOC values are typical and are provided for guidance purpose only. These may be subject to variation depending on factors such as differences in color and normal manufacturing tolerances.

Low molecular weight reactive additives, which will form part of the film during normal ambient cure conditions, will also affect VOC values determined using EPA Method 24.

SYSTEMS COMPATIBILITY

This specialist coating is only compatible with a very limited number of products.
Suitable primers are:

Interzinc 22

Suitable topcoats are:

Intertherm 50

For other suitable primers consult International Protective Coatings.

ADDITIONAL INFORMATION

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following documents available at www.international-pc.com:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage

Individual copies of these information sections are available upon request.

SAFETY PRECAUTIONS

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

PACK SIZE

Unit Size	Vol	Pack
5 US gal	5 US gal	5 US gal
5 liter	5 liter	5 liter

For availability of other pack sizes contact International Protective Coatings

SHIPPING WEIGHT

Unit Size	
5 liter	6.2 kg
5 US gal	50.5 lb

STORAGE

Shelf Life	12 months minimum at 77°F (25°C). Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

Important Note

The information in this data sheet is not intended to be exhaustive: any person using the product for any purpose other than that specifically recommended in this data sheet without first obtaining written confirmation from us as to the suitability of the product for the intended purpose does so at their own risk. All advice given or statements made about the product (whether in this data sheet or otherwise) is correct to the best of our knowledge but we have no control over the quality or the condition of the substrate or the many factors affecting the use and application of the product. Therefore, unless we specifically agree in writing to do so, we do not accept any liability at all for the performance of the product or for (subject to law) any loss or damage arising out of the use of the product. All products supplied and technical advice given are subject to our Conditions of Sale. You should request a copy of this document and review it carefully. The information contained in this data sheet is liable to modification from time to time in the light of experience and our policy of continuous development. It is the user's responsibility to check with their local International Paint representative that this data sheet is current prior to using the product.

Issue date: 7/7/2009

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MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

INTERTHERM 50 ALUMINUM

MSDS Revision No: A7 -4
MSDS Revision Date: 10/14/2002

International Paint Inc.
6001 Antoine Drive
Houston, Texas 77091

EMERGENCY NUMBERS:

(800) 424-9300	CHEMTREC (USA)
(703) 527-3887	CHEMTREC (Intl)
(800) 854-6813	Poison Control Center

CUSTOMER SERVICE: (Non-Emergency)

(800) 589-1267	International Paint
(800) 631-7481	Interlux

1. GENERAL INFORMATION

Product Identity: INTERTHERM 50 ALUMINUM

Bulk Sales Reference No: HTA097

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
000100-41-4	Ethyl benzene 1.0 - 10% by Weight	OSHA:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL
		ACGIH:	100 ppm TWA125 ppm STEL
		NIOSH:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL800 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 435 mg/m3 TWAEV125 ppm STEV; 540 mg/m3 STEV
		Mexico:	100 ppm TWA; 435 mg/m3 TWA125 ppm STEL; 545 mg/m3 STEL
		Brazil:	78 ppm; 340 mg/m3; medium degree of harm
		Source	**Health Data**
		NIOSH:	Eye skin
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: Yes; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
000108-88-3	Toluene 0.10 - 1.0% by Weight	OSHA:	200 ppm TWA150 ppm STEL; 560 mg/m3 STEL
		ACGIH:	50 ppm TWA
		NIOSH:	100 ppm TWA; 375 mg/m3 TWA150 ppm STEL; 560 mg/m3 STEL500 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	50 ppm TWAEV; 376 mg/m3 TWAEV150 ppm STEV; 564 mg/m3 STEV
		Mexico:	100 ppm TWA; 375 mg/m3 TWA150 ppm STEL; 560 mg/m3 STEL
		Brazil:	78 ppm; 290 mg/m3; skin absorber; medium degree of harm
		Source	**Health Data**
		NIOSH:	Central nervous system depressant
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001330-20-7	Xylenes (o-, m-, p- isomers) 10 - 25% by Weight	OSHA:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		ACGIH:	100 ppm TWA150 ppm STEL
		NIOSH:	100 ppm TWA; 435 mg/m3 TWA900 ppm IDLH
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 435 mg/m3 TWAEV150 ppm STEV; 650 mg/m3 STEV
		Mexico:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		Brazil:	78 ppm; 340 mg/m3; skin absorber; medium degree of harm
		Source	**Health Data**
		NIOSH:	Central nervous system depressant; respiratory and eye irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
007429-90-5	Aluminum 10 - 25% by Weight	OSHA:	15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)
		ACGIH:	10 mg/m3 TWA (metal dust)
		NIOSH:	10 mg/m3 TWA (total); 5 mg/m3 TWA (respirable dust); 5 mg/m3 TWA (pyro powders and welding fumes)
		Supplier:	No Data Available
		OHSA, CAN:	5 mg/m3 TWAEV (powder); 10 mg/m3 TWAEV (metal and oxide dust)
		Mexico:	10 mg/m3 TWA20 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**

		NIOSH:	Lung changes that may lead to pulmonary fibrosis; respiratory and skin irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
064742-95-6	Petroleum naphtha, light aromatic 10 - 25% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Avoid contact with eyes, skin and clothing.
Inhalation:	Harmful if inhaled. Causes nose and throat irritation. Vapors may affect the brain or nervous system causing dizziness, headache or nausea.
Eyes:	Causes severe eye irritation. Do not get in eyes.
Skin:	Causes skin irritation. May be harmful if absorbed through the skin.
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient). Possible cancer hazard. Contains an ingredient which may cause cancer based on animal data (See Section 2 and Section 15 for each ingredient). Risk of cancer depends on duration and level of exposure.
HMIS Rating:	Health: 2* Flammability: 3 Reactivity: 0

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	If swallowed, immediately contact Poison Control Center at 1-800-854-6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Select equipment to provide protection from the ingredients listed in Section 2 of this document. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates dust, vapor, or mist levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1-800-243-4630, in Canada call 1-800-267-4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: 77 C: 25
Lower Explosive Limit (LEL):	.9 (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	Flammable liquid and vapor. FLAMMABLE/COMBUSTIBLE MATERIALS: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks) creating a vapor explosion hazard. Runoff to sewers may create fire or explosion hazard. Containers may explode when heated.
Fire Fighting Procedures:	CAUTION: This product has a very low flashpoint. Use of water spray when fighting fire may be inefficient. SMALL FIRES: Use dry chemical, CO2, water spray or alcohol-resistant foam. LARGE FIRES: Use water spray, fog, or alcohol-resistant foam. Do not use straight streams. Move containers from fire area if you can do so without risk. Runoff from fire control may cause pollution. Dike fire control water for later disposal. Do not scatter the material. **Also Reference Emergency Response Guide Number:** 127

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
pH:	Not Determined
Specific Gravity:	1.140262
Boiling Point (F):	148
Vapor Density:	Heavier than air
VOC Content (lbs):	Refer to the Technical Data Sheet for this product
Evaporation Rate:	Slower than ether

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 32 and 120 F
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Vapors may cause flash fire or ignite explosively. Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation. Do not get in eyes, on skin or clothing. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Use only non-sparking equipment to handle spilled material and absorbent. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers. Use non-sparking tools to collect absorbed material.
Public Safety:	CALL CHEMTREC at (800)-424-9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. LARGE SPILLS: Consider initial downwind evacuation for at least 300 meters (1000 feet). **Also, Reference Emergency Response Guide Number: 127**

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		**IMO / IMDG (Ocean Transportation)**	
DOT Proper Shipping Name: PAINT		**IMDG Proper Shipping Name:** PAINT	
DOT Hazard Class:	3	**IMDG Hazard Class:**	3.3 - High flashpoint flammable liquids
UN / NA Number:	UN 1263	**UN Number:**	UN 1263
DOT Packing Group:	III	**IMDG Packing Group:**	III

CERCLA/DOT RQ:	51 gal. / 488 lbs.	**System Reference Code:**	2

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory.
WHMIS Classification:	B2; D2B

Regulatory List	**Product Ingredients on List**
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%):	
(No Product Ingredients Listed)	
EPCRA 311/312 Chemicals and RQs:	
000100-41-4	Ethyl benzene : final RQ = 1000 pounds (454 kg)
000067-56-1	Methyl alcohol : final RQ = 5000 pounds (2270 kg)
000108-88-3	Toluene : final RQ = 1000 pounds (454 kg)
001330-20-7	Xylenes (o-, m-, p- isomers) : final RQ = 100 pounds (45.4 kg)
EPCRA 302 Extremely Hazardous:	
(No Product Ingredients Listed)	
EPCRA 313 Toxic Chemicals:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
000067-56-1	Methyl alcohol
000108-88-3	Toluene
001330-20-7	Xylenes (o-, m-, p- isomers)
Mass RTK Substances:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
001330-20-7	Xylenes (o-, m-, p- isomers)
Mass Extraordinarily Haz Substances:	
(No Product Ingredients Listed)	
Penn RTK Substances:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
001330-20-7	Xylenes (o-, m-, p- isomers)
Penn Special Hazardous Substances:	
000108-88-3	Toluene
Rhode Island Hazardous Substances:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
000067-56-1	Methyl alcohol
000108-88-3	Toluene
001330-20-7	Xylenes (o-, m-, p- isomers)
RCRA Status:	
(No Product Ingredients Listed)	
N.J. RTK Substances:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
001330-20-7	Xylenes (o-, m-, p- isomers)
N.J. Special Hazardous Substances:	
000100-41-4	Ethyl benzene
001330-20-7	Xylenes (o-, m-, p- isomers)
N.J. Env. Hazardous Substances:	
007429-90-5	Aluminum
000100-41-4	Ethyl benzene
000067-56-1	Methyl alcohol
000108-88-3	Toluene
001330-20-7	Xylenes (o-, m-, p- isomers)
Proposition 65 - Carcinogens:	
000108-88-3	Toluene
Proposition 65 - Female Reproductive Toxins:	
(No Product Ingredients Listed)	
Proposition 65 - Male Reproductive Toxins:	
(No Product Ingredients Listed)	
Proposition 65 - Developmental Toxins:	

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

End Of Document

Appendix E

Hydrostatic Testing – IST Specification ES-020

ENGINEERING SPECIFICATION

WATER QUALITY REQUIREMENTS FOR HYDROSTATIC TESTING

SPECIFICATION NO. ES-020

REVISION 09

simply generates more profit

Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

Revision Page

Revision Number	Description of Revision	Prepared By	Approved By	Approval Date
01	General update	--------	--------	--------
02	Address updated to Conestoga Blvd.	--------	--------	Nov 13/00
03	Revised title	--------	--------	June 12/03
04	Major revision	--------	--------	Apr 5/03
05	Various changes	AB	JM	May 1/03
06	Table 1.0 and notes, Section 2.3	AB	JM	July 2/03
07	Section 2.1, Table 1.0, added Table 2.0	AB	JM	Apr. 18/05
08	Paragraph 2.2(d) rewritten	BM	JL	June 14/05
09	Format change update to new logo/font	SV		March 2/07

Table of Contents

1.0 INTRODUCTION 1
2.0 WATER QUALITY REQUIREMENTS 1
2.1 Hydrotest Water Specification 1
2.2 Post Hydrotest Drying Requirements 4
2.3 Water Quality Inspection 5

1.0 INTRODUCTION

This specification details the water quality required for a hydrotest of an Innovative Steam Technologies (IST) Once Through Steam Generator (OTSG) and auxiliary piping. Deviations from the limits and requirements must have specific written approval from Innovative Steam Technologies.

The technical criteria for formulating these guidelines includes:

- Prevention of corrosion in the OTSG and external piping. If necessary, more stringent limits can be used based on the requirements for other components in the system, which may be more sensitive to impurities.
- Prevention of suspended solids from entering the OTSG, which could end up plugging the stabilization orifices.

2.0 WATER QUALITY REQUIREMENTS

2.1 Hydrotest Water Specification

The rationale for determination of the water quality requirements for these guidelines is based on the requirements for the OTSG and auxiliary piping. The following water quality requirements provided in Tables 1.0 or 2.0 shall be met.

If a mixed bed unit is used to purify the water and the de-ionized water is sent directly to the steam generator to fill the unit, then the water quality measurements shall be taken at the mixed bed outlet.

If the de-ionized water is stored in a tank, then the water quality measurements shall be taken at the tank outlet.

Conductivity and pH readings shall be continuously monitored. Chlorides and sulfates shall be measured as required to ensure compliance during the hydro fill.

Parameter	Limit	Unit	Notes
pH	≥ 7.0	------	3, 9
Water Specific Conductivity	≤ 0.077	µS/cm	5, 7, 8
Water Specific Resistivity	≥ 13.0	megohm/cm	
Suspended Solids	Not detectable	ppb	2

Table 1.0 Hydrotest water quality specification without measuring chloride and sulfate levels.

Table 1.0 Notes:

1) Conductivity and pH measured at 25°C.
2) Suspended solids must be prevented to avoid clogging of feedwater orifices. Suspended solids are commonly measured by examining the undissolved material trapped on a 0.45 micrometer filter after filtration. Material that passes through is referred to as dissolved solids.
3) pH below 7.0 is prohibited.
4) No turbidity, oil or sediment is allowed.
5) Water test temperature to be in accordance with ASME Section I or B31.1 guidelines.
6) Water resistivity is the reciprocal of water conductivity and either parameter may be used.
7) Resistivity level corresponds to Total Dissolved Solids at 10 ppb.
8) To help achieve the resistivity levels, it may be necessary to recirculate the water through the mixed bed polisher before the water is flowed through the bed and into the OTSG.
9) The pH reading must be made on a moving flow stream without exposure to the atmosphere (i.e. inside the pipe). Carbon dioxide in the air will lower the pH in the water by naturally forming carbonic acid.

Parameter	Limit	Unit	Notes
pH	≥ 7.0	------	3, 9
Water Specific Conductivity	≤ 0.27	µS/cm	6, 7, 8
Water Specific Resistivity	≥ 3.70	megohm/cm	
Chloride (Organic and inorganic)	< 10	ppb	
Sulfate (Organic and inorganic)	< 10	ppb	
Suspended Solids	Not detectable	ppb	2

Table 2.0 Hydrotest water quality specification when chloride and sulfate levels are measured.

Table 2.0 Notes:

1) Conductivity and pH measured at 25°C.
2) Suspended solids must be prevented to avoid clogging of feedwater orifices. Suspended solids are commonly measured by examining the undissolved material trapped on a 0.45 micrometer filter after filtration. Material that passes through is referred to as dissolved solids.
3) pH below 7.0 is prohibited.
4) No turbidity, oil or sediment is allowed.
5) Water test temperature to be in accordance with ASME Section I or B31.1 guidelines.
6) Water resistivity is the reciprocal of water conductivity and either parameter may be used.
7) Chloride and sulfate levels must be initially met and maintained in order to use the conductivity level in this table.
8) To help achieve the resistivity levels in Table 1.0, it may be necessary to recirculate the water through the mixed bed polisher before the water is flowed through the bed and into the OTSG.
9) The pH reading must be made on a moving flow stream without exposure to the atmosphere (i.e. inside the pipe). Carbon dioxide in the air will lower the pH in the water by naturally forming carbonic acid.

2.2 Post Hydrotest Drying Requirements

The OTSG and associated piping should be hydrotested with water in accordance with the specifications given in Table 1.0 or 2.0. After testing is completed, the OTSG and associated piping shall be thoroughly drained and dried (all high point vents should be open during draining).

The tube surface must be dried to remove any chlorides or bacteria which can lead to corrosion. Acceleration of corrosion can occur as a result of the influence of microbial activity. Certain strains of bacteria can grow on the metal surface and provide a location of stagnant and highly acidic water between the growth and tube surface. Iron bacteria called Gallionella, and iron/manganese bacteria called Siderocapsa, have been documented to cause severe corrosion. These problems can be avoided provided the water is not allowed to stay on the metal surface for extended periods of time. For this reason, the boiler and piping must be drained and dried of hydrotest water immediately after testing.

The following procedures are to be followed:

Shop Hydrotest

Idle Time Between Hydrotest and Transportation by Rail or Truck	Drying Requirements
Up to 1 week	OTSG will be drained using gravity immediately after hydrotest. Prior to loading the module on the rail car, the OTSG will be rocked in the fore and aft direction on the trailer until no water exits the steam header. A slow rocking pattern will be used to give the water time to run down through the tubing.
Greater than 1 week	The tubing will be dried using high pressure oil free compressed air. Each circuit will be individually isolated and purged. Isolating dams will be required at the inlet headers to isolate individual circuits. In modules with mixing headers, nitrogen shall be used for drying the tubes.

Field Hydrotest

Idle Time Between Hydrotest and OTSG Start-Up	Drying Requirements
Up to 1 week	OTSG will be drained using gravity immediately after the hydrotest. OTSG start up to occur within 1 week time span
Greater than 1 week	The tubing and piping will be dried using nitrogen. The gas will be fed through the feedwater piping and towards the steam outlet pipe. Once dry, the OTSG can remain off-line as long as required. In marine of other corrosive locations, the pressure parts will be given a nitrogen purge once the inside surface has been dried.

The following notes are applicable:

a) Ensure that the pressure tubing is protected from water freezing in cold climates. If a potential of freezing exists, the water is to be drained and the tubing immediately blown dry, or if in the field, the tubing heated with the gas turbine to boil out the remaining water.
b) The field hydrotest should not be conducted until after a thorough flush of the module and feedwater piping has occurred.
c) Confirmation of the final field weld X-rays and inspections on both the steam and feedwater piping must be submitted to the site contractor before filling and pressurizing the circuits during the field hydrotest.
8 d) During hydrotest, the extra weight of the water will impose additional loads on the steam piping. Additional pipe supports and/or stops may be required during hydrotest to minimize the transfer of these loads to the OTSG steam outlet header.
e) The Authorized Inspector must be present for the hydrotesting.

2.3 Water Quality Inspection

The hydrotest water shall be inspected by Quality Control prior to hydrotesting to ensure it meets the requirements of Table 1.0 or 2.0, as applicable. Maintaining the conductivity limits in Table 1.0 will ensure the chloride and sulfate levels are within acceptable limits and separate measurements of chloride and sulfates are not required.

ISO form SYS-116 shall be filled out and included in the document control package for each shop hydrotested OTSG. The calibration record of the conductivity (resistivity) meter shall be recorded on the form.

Appendix F

Pipe Cleaning – IST Specification ES-021

ENGINEERING SPECIFICATION

Pipe Cleaning Specification

SPECIFICATION NO. ES-021
REVISION 06

Revision Page

Revision Number	Description of Revision	Prepared By	Approved By	Approval Date
00	Original Issue			April 23, 1996
01	Added sections 2.6 and 3.7			Dec. 17, 1996
02	Address updated to Conestoga Blvd.			Nov 13, 2000
03	Format change update to new font/logo			March 2/07
04	Added Incoloy to Section 2.0 Additional notes added to Section 2.2			October 23/09
05	Added Section 4.0 - cleaning requirements for carbon steel piping	AB	JL	Dec 3/09
06	Added note requiring steam headers to be internally cleaned. Altered title of sections 3.0 and 4.0	CK	JL	Sept 27/11

Table of Contents

Paragraph Number		Page
1.0	Scope	1
2.0	Stainless steel and Incoloy (NO8800 & NO8825) pipe cleaning requirements	1
3.0	Chromoly steel pipe cleaning requirements	1
4.0	Carbon steel pipe cleaning requirements	1

1.0 Scope - This specification outlines cleaning requirements for boiler piping.

2.0 Stainless steel and Incoloy (NO8800 & NO8825) pipe cleaning requirements

2.1 Remove all weld flux and splatter using power or hand tools as necessary. Verify all nozzle inside surfaces at run pipe welded connections are free of weld grapes and other obstructions.

2.2 Surface damage caused by cleaning tools is to be avoided, such as burrs and sharp cuts. In order to avoid trace amounts of material transfer that cause rust, do not use cutting or cleaning tools that have been used on carbon steel.

2.3 Thoroughly clean the inside of pipe using a compressed air blow with special care taken to ensure all welded nozzles/branches are free of obstructions.

2.4 Immediately following the air blow, pipe and branch ends are to be sealed with plastic end caps securely fastened. Care should be taken to ensure there is no ingress of foreign material into the pipe at this stage.

2.5 If the pipe has been hydro tested, <u>all</u> water must be removed prior to the sealing of the pipe and branch ends.

2.6 Water for hydro test must conform with specification ES-020.



3.0 Chroloy pipe cleaning requirements for steam headers and piping not subject to steam blows prior to operation

3.1 Remove all weld flux and splatter using power or hand tools as necessary. Verify all nozzle inside surfaces at run pipe welded connections are free of weld grapes and other obstructions.

3.2 Surface damage caused by cleaning tools is to be avoided, such as burrs and sharp cuts.

3.3 Following post weld heat treatment, sand blast inside pipe surface per

SSPC-SP10.

3.4 Thoroughly blow out, using compressed air, all sand residue from inside of pipe following sand blasting, and immediately coat the inside surface with CORTEC VCI-307 or equal corrosion inhibitor.

3.5 Following the application of the inhibitor, all pipe and branch ends are to be sealed with plastic end caps securely fastened. Care should be taken to ensure there is no ingress of foreign material into the pipe at this stage.

3.6 Should a hydrostatic test be performed on the pipe following the application of the corrosion inhibitor, the pipe must be completely dried and re-coated with the inhibitor.

3.7 Water for hydro test must conform with specification ES-020.



3.8 Steam headers require internal cleaning as sufficient velocity in not developed within the header to adequately clean them during a steam blow.

4.0 Carbon steel pipe cleaning requirements for piping not subject to steam blows prior to operation



4.1 Remove all weld flux and splatter using power or hand tools as necessary. Verify all nozzle inside surfaces at run pipe welded connections are free of weld grapes and other obstructions.

4.2 Surface damage caused by cleaning tools is to be avoided, such as burrs and sharp cuts.

4.3 Thoroughly blow out, using compressed air, all residue from inside of pipe following assembly.

4.4 Should a hydrostatic test be performed, the pipe must be completely dried after the test and confirmed using a humidity meter at the pipe exit.

4.5 All pipe and branch ends are to be sealed with plastic end caps

securely fastened. Care should be taken to ensure there is no ingress of foreign material into the pipe at this stage.

4.6 Water for hydro test must conform with specification ES-020.

Appendix G

Outdoor Storage and Shipping Protection – IST Specification ES-023

ENGINEERING SPECIFICATION

OUTDOOR STORAGE AND SHIPPING PROTECTION REQUIREMENTS

SPECIFICATION NO. ES-023
REVISION 04

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Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

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00	Original Issue	----------	----------	Apr 7 / 98
01	Revised to apply shipping protection	----------	----------	Jan 7/99
02	Address updated to Conestoga Blvd.	----------	----------	Nov 13/00
03	Added 3.3.5 and 3.3.6	AB	JL	June 1/05
04	Format change update to new font/logo	SV		March 2/07

TABLE OF CONTENTS

Paragraph No. Page

1.0 SCOPE.....1

2.0 APPLICABLE DOCUMENTS.....1

3.0 PACKING REQUIREMENTS..... 1
- 3.1 General Requirements
- 3.2 Pipe Openings and Connections
- 3.3 Tubing Bundles
- 3.4 Ducting Components
- 3.5 Vendor Equipment

4.0 QUALITY ASSURANCE PROVISIONS.....3

1.0 SCOPE

This specification covers the outdoor storage and shipping protection of components supplied by Innovative Steam Technologies. If prolonged storage of the units is required (over 3 months), contact IST for additional requirements.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Documents not identified by date, revision or amendment shall be of the latest issue on the date of this specification.

SPECIFICATIONS

Innovative Steam Technologies

Engineering Specification ES-010	Paint Specification
Engineering Specification ES-021	Pipe Cleaning Specification

3.0 PACKING REQUIREMENTS

3.1 General Requirements

- Packaging shall be adequate to prevent contamination, mechanical damage, or deterioration of the components supplied.
- All expendable materials, such as tapes, barriers, plugs, desiccants, desiccant bags, caps, inhibitors etc. to be in contact with austenitic stainless steel or nickel alloys shall not contribute to corrosion during the storage period.
- Metal fasteners, straps, or covers shall not be tack welded to any manufactured part, and shall be of a material compatible with the equipment material to avoid any corrosion.
- Prior to packaging, all components shall be inspected for cleanliness, completely drained and thoroughly dry.
- The packing instructions are applicable immediately after manufacture. Items not immediately packaged after manufacture shall be protected from contamination.

3.2 Pipe Openings and Connections

3.2.1 Prior to packaging of piping, the piping shall be cleaned in accordance with IST Engineering Specification ES-021 (Pipe Cleaning Specification).

3.2.2 All openings shall be closed with temporary closures to prevent entry of dust, dirt, precipitation, moisture or other foreign matter. All openings shall be protected by plastic caps designed to cover the entire weld end area and secured fastened.

3.2.3 Threaded or socket weld connections shall be closed with screwed or snap-in type plastic protectors. Cast iron plugs are not acceptable for shipping protection unless part of the final field assembly.

3.2.4 All exterior unpainted machined surfaces and threaded connections shall be coated with an easily removable rust preventative suitable for six months outdoor storage.

3.2.5 All exposed threads of external bolting shall be coated with an anti-seize compound following assembly.

3.3 Tubing Bundles

3.3.1 All tube bundle module tops shall be covered for outdoor storage and transportation. To prevent contamination from dust, dirt, salt, spray and other forms of contaminants exposed portions of tube bundle module bottoms shall be covered.

3.3.2 Items shall be covered by tarpaulins (or equivalent) to minimize the wetting of the insulation and to prevent contamination from dust, dirt, salt, spray and other forms of contaminants. Cover installation shall be made so that air circulates under the cover to prevent condensation.

3.3.3 Modules are to be stored on a level surface and blocked up a minimum of four inches off the ground at jacking locations. If the module is to be stored for more than two weeks the module shall be blocked up at each column location and at the module ends.

3.3.4 All access doors shall be secured closed.

03 3.3.5 Overseas ship transportation shall be below deck stowage and protected from salt spray. On-deck transportation is strictly prohibited.

03 3.3.6 When the module is sitting on dock for longer than 48 hours or during periods of severe weather, it shall be protected from salt water spray by being fully covered with tarps.

3.4 Ducting Components (including inlet plenum, exhaust hood and exhaust stack)

3.4.1 Ducting components are to be prepared and coated in accordance with IST Engineering Specification ES-010 prior to packaging.

3.4.2 Insulation is to be protected against precipitation if stored outdoors. Open insulated ends of ducting components are to be covered for transportation or outdoor storage.

3.4.3 All ducting openings shall be covered if the ducting is to be transported or stored in a salt air environment.

3.4.4 Items shall be covered by tarpaulins (or equivalent) where possible to prevent contamination from dust, dirt, salt, spray and other forms of contaminants. Cover installation shall be made so that air circulates under the cover to prevent condensation. If the components cannot be covered by tarpaulins (or equivalent), all ducting components shall be thoroughly cleaned by power water wash (or equivalent while minimizing the wetting of insulation) prior to assembly. This is to be the site erector's responsibility.

3.4.5 All access doors shall be secured closed.

3.5 Vendor Equipment

3.5.1 Follow the manufacturers recommended procedures for long term storage of individual components.

4. QUALITY ASSURANCE PROVISIONS

Quality Control shall be responsible to verify compliance with the requirements of this specification by issuing and implementing a quality control plan prior to commencing with the storage of ducting. Engineering and Manufacturing shall approve the quality control plan prior to being issued

Appendix H

Module Shipping and Lifting Instructions – IST Specification ES-024

ENGINEERING SPECIFICATION

OTSG MODULE HANDLING REQUIREMENTS DURING TRANSPORT

SPECIFICATION NO. ES-024

REVISION 08

Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

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01	Revised sections 4.0 & 5.0 Figure 3.0 replaced by figures 3.1, 3.2 & 3.3	-------	-------	June 27/03
02	Revised 3.0 to include B30.20 for lifting equipment, safety meeting requirement, weighing module. Revised 4.0 to eliminate double bolt down but to include fore and aft restraints, general revision, Figure 3.1	JL	AB	Nov 2/05
03	Revised 3.0 to include ground surveys Revised 4.0 for reference of items 01 and 02 to figure 3.1 Revised Figure 1.0 to replace double lug with single lug Revised Figure 3.1 to remove dimensions and project specific references Revised Figure 4.0 to include reference for Detail "A"	PH	JL	Mar 10/06
04	Format change update to new logo/font	SV		March 2/07
05	Revisions to Section 4.0 for module weights and Figure 3.1a and Figure 3.1b	GT	CK	Dec 18/09
06	Revised typical rail car tie down Figure 3.1a and Figure 3.1b	CK	JMcA	Jan 19/11
07	Revised typical rail car tie down Figure 3.1a and Figure 3.1b Removed references to restraint rods	CK	JMcA	April 26/13
08	Page 4. 3g longitudinal and 2g lateral accelerations to generate longitudinal and lateral loads	HG	CK	Oct. 09/13

TABLE OF CONTENTS

Paragraph No.		Page
1.0	PURPOSE	1
2.0	APPLICABLE DOCUMENTS	1
3.0	MODULE HANDLING INSTRUCTIONS	1
4.0	MODULE ATTACHMENT TO RAILCAR	3
5.0	ITEMS REQUIRED FOR HANDLING MODULE	4
6.0	WEATHER PROTECTION	4
7.0	PROTECTION FROM ROAD CHEMICALS	4

1.0 PURPOSE

This specification covers the minimum requirements for moving, draining, handling, outdoor storage and shipping protection during transportation of an OTSG module supplied by Innovative Steam Technologies.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Documents not identified by date, revision or amendment shall be of the latest issue on the date of this specification.

SPECIFICATIONS

IST Engineering Specification ES-023, Outdoor Storage and Shipping Protection
IST Engineering Specification ES-025, OTSG Pre-Operational Long Term Storage
IST Work Instruction 028
IST Work Instruction 029
IST Contract Specific Drawing "Rail Car Tie-down Reinforcing Plate Assembly and Arrangement" Drawing No. XXX888 (XXX to be replaced with contract ID No.)

3.0 MODULE HANDLING INSTRUCTIONS

With the possible exception of the IST lifting links (which are available for rental), there is no special lifting gear required for handling this equipment. The module lifting lugs have been designed for VERTICAL equalized lifts only. Casing structural damage and/or lug failure may result if the cables are not maintained vertical or the load is not equalized.

Refer to Figure 1.0 for a typical lifting arrangement for the module.

Correct length spreader beams are required in BOTH directions to ensure the cable remains vertical and the load is equalized as shown in the figure. Lifting links can be used to connect the lifting cable to the module lifting points as shown in Figure 2.0. ONLY the lifting points designated in Figure 1.0 may be used for lifting the component. Attachment to other locations is strictly prohibited.

The lift shall be accomplished in a smooth and level motion without jerking. Component impacts during lifting or descent are prohibited.

If the module is to be placed temporarily in an area for storage (intermediate moves etc.), it shall be on a level surface, clear of debris. The unit shall be supported at eight locations on a firm foundation to prevent settling resulting in twisting of the unit. These locations shall be directly below the OTSG side wall vertical beams, on either side of the module lift points. All supports are to be level prior to the module being set down. The unit is NOT to be supported on the flange tips at the eight locations but a beam, suitably sized as indicated below if the unit is to be jacked, or 6 inch x8 inch hardwood blocks if the unit is to be pulled up, is to be inserted between the flanges (Fig.4) and the unit blocked off its lower surface.

It is recommended that lifting/jacking equipment be in conformance with ASME B30.20 (Standards for Below the Hook Lifting Devices), that a written lift procedure be prepared, that a prelift safety meeting be held (to minimize personnel in the lift area, discuss any safety issues and implement any required changes, clarify the jobs of the required personnel, designate the person in charge of the lift and designate a signalman, etc.). On lifts where the work is being done by an IST contractor, or his subcontractor, the above are requirements and all custom equipment used (spreaders, lifting beams etc.) as well as any required ground surveys will be stamped by a Professional Engineer and submitted with the Lift Procedure prior to the lift.

If the module is to be jacked up, a member is to be placed within the bottom beam as shown in Figure 4.0, Detail "A". The member is to be of sufficient strength to carry a moment equal to the following:

$$M_{minimum} = \frac{\text{Module weight}}{8} \text{ (lbs) x } \frac{40.375}{2} = \text{in * lbs}$$

$$M_{minimum} = 2.52 \text{ x Module weight} = \text{in * lbs}$$

The member minimum moment of inertia shall be 200 in^4. Alternatively, the design shall permit the structural member to deflect independently of the sidewall beam

The weight on the module assembly drawing will be used to size the rigging for the initial lift however the module shall be weighed prior to loading and transport, and adjustments made to the rigging if necessary. Modules at IST will be weighed using calibrated load cells according to Work Instruction 028.

Before the Module is loaded on a railcar or truck, but prior to it moving outdoors when the expected minimum outdoor temperature will be less than 40F, it shall be rocked from end to end to remove any water remaining in the unit. The rocking procedure will be per Work Instruction 029. Modules will be rocked a minimum of 6 full times (i.e. each end is raised above the other end a minimum of 6 times) after the last time that water was seen to drain from the unit.

Any damage to the equipment or lifting lugs shall be immediately reported to IST.

4.0 MODULE ATTACHMENT TO RAILCAR OR TRUCK

Prior to loading the unit 1"x 6" softwood lumber is to be laid along the length of the carrier, close to the outer edges of the deck to soften the load on the shipping beams located across the bottom of the unit and the endwall beams. The height of the softener is to be adjusted to compensate for any bow in the carrier so that the load on the shipping beams and end walls is equalized. The method of attachment to the railcar is the responsibility of the shipping contractor.

The module restraints are required to resist the forces resulting from fore-aft, lateral and upward loading during transportation.

Tie-down lugs are used to secure the boiler to the bed of the railcar for transportation in one of two standard configurations:

- single bolt tie-down lugs on the bottom beams of the module end walls (figure 3.2)
- single bolt tie-down lugs on the bottom beams of the module side walls (figure 3.3)

On modules weighing up to 200,000 pounds, the rail-car tie down restraint configuration in Figure 3.1a shall be used.

On Modules weighing between 200,001 and 400,000 pounds, the rail-car tie down restraint configuration in Figure 3.1b shall be used.

~~All Modules require two tie down rods at each corner extending down from the top of the unit to, and usually through, the railcar bed. Two 1 3/8 inch diameter holes have been provided in the upper corners of the module for attachment and it is recommended that as a minimum the rods be 1 ¼ inch diameter steel with a minimum yield of 50,000 psi. It is preferred that the rods run directly from the holes provided in the unit to the railcar with no bends which might affect their function. Depending on the connection between the Module attachment holes and the rod welding may be required and if so, the rod material should be such that its yield stress is not reduced by that welding below the design value.~~

07

07

The method of attachment suggested by IST is for information only. The tie-down lugs, fore and aft restraint plates and lateral restraint plates have been sized to resist the transportation loads. It is the responsibility of the contractor to ensure the transportation attachments to the bed are adequate and meet with carrier requirements. Tie down locations other than those specified herein by IST are strictly prohibited.

08 Special precautions shall be made to ensure that NO HUMPING of railcars is allowed. A maximum 3g longitudinal and 2g lateral acceleration force is allowed.

Please refer to IST standards ES-023 and ES-025 for additional shipping and weather protection instructions.

5.0 ITEMS REQUIRED FOR HANDLING MODULE

Equipment	Supply	Comments
Lifting links	By Others (see Note 1 below)	Links can be rented from IST
Module tie down lugs on endwalls	By IST	Total 4 (2 per end) See Fig. 3.2 or 3.3
07 ~~Module end wall attachment holes for tying to railcar~~	~~By IST~~	~~Tie down rods, etc. to rail deck by others~~
Module tie down plates to railcar including rods and nuts	By Others	IST can provide 4 tie down plates see Fig. 3.2 or 3.3
Spreader Beams for lifting	By Others	Common Erection Equipment
Chokers & Shackles for lifting	By Others	Common Erection Equipment
Fore and Aft restraint plates	By Others	IST can provide 4 restraint plates See Fig. 3.1

Note 1) For overseas projects, one set of lifting links is included in IST's scope of supply. Additional lifting links can be purchased from IST.

6.0 WEATHER PROTECTION

Until the unit is ready to be erected, the module is to be protected at the top from rain, snow etc. by tarping or other suitable means. For storage instructions see IST standards ES-023 and ES-025

All test ports, instrumentation connections, header openings etc. are to be capped during transportation and the header caps are to be taped to the header (drain hole to be provided in header cap at the bottom)

7.0 PROTECTION FROM ROAD CHEMICALS

If during the transportation period, road conditions exist such that the road salt or other chemicals may be deposited up into the bottom of the OTSG module, protection is to be provided to ensure that no deposition is allowed to take place and the tubes and fins remain clean.

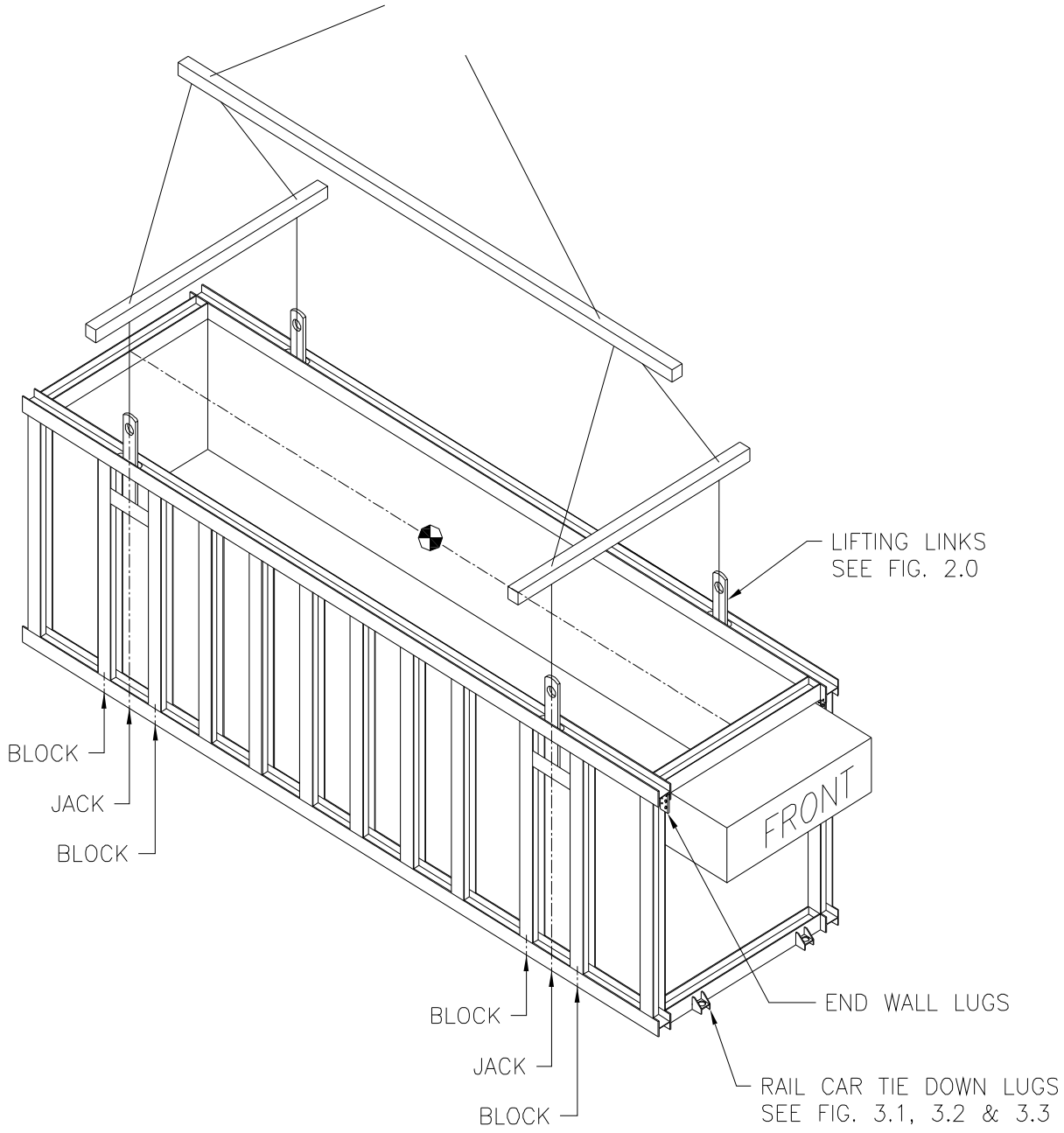


Figure 1.0

NOTE:

1. Rail car tie down lugs quantity and style are project specific
2. See following figures

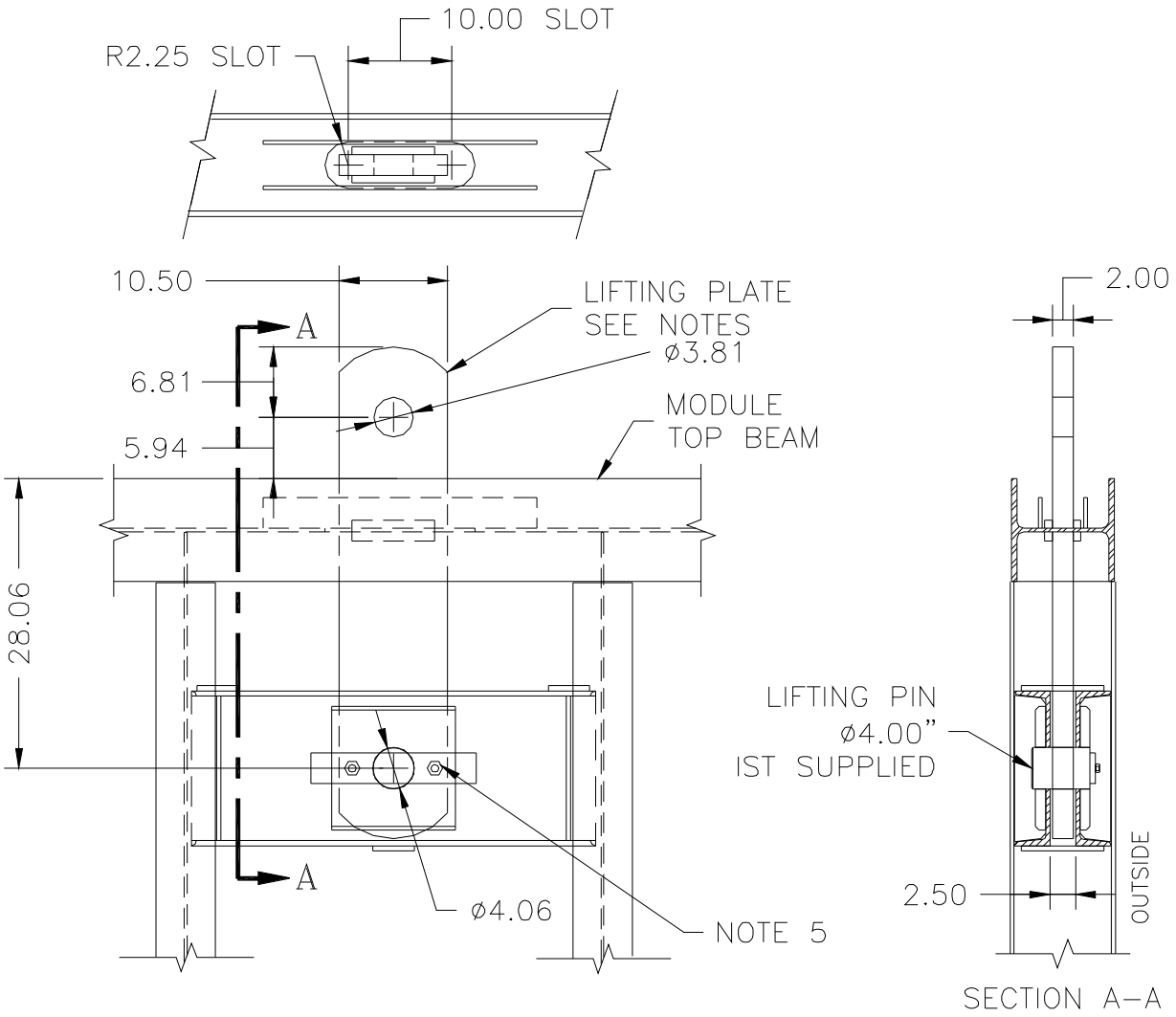
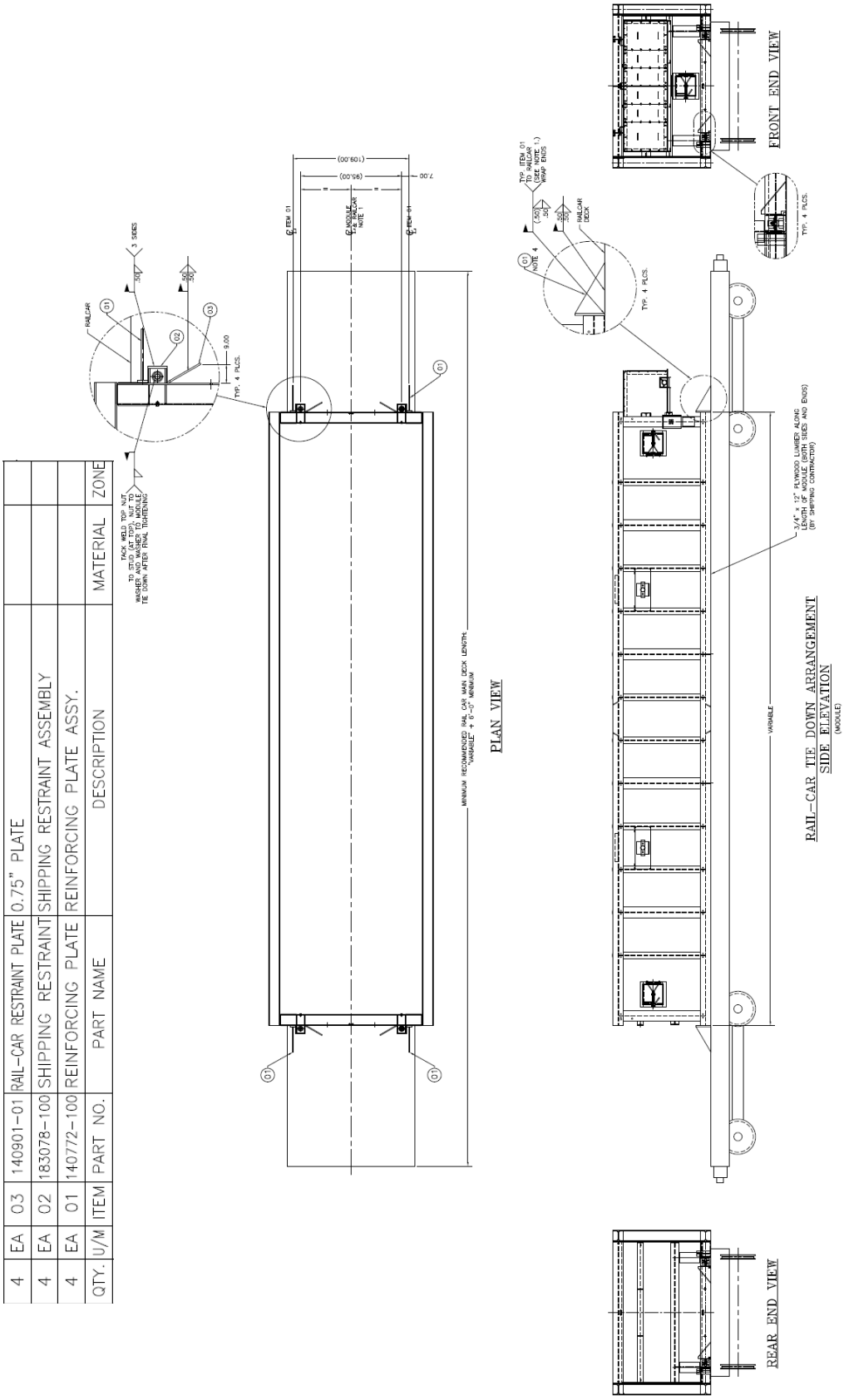


Figure 2.0

Notes:

1. Lifting link supplied by others or requested from IST. Refer to supply list.
2. Depending on module weight a direct cable connection to the 4" pin can be used. Erector to determine feasibility.
3. If others supply lifting link, the contractor is to determine the appropriate design of plate for given load.
4. Dimensions are in inches.
5. Ensure bolts are tightened and pin is completely installed prior to lift.



QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
4	EA	03	140901-01	RAIL-CAR RESTRAINT PLATE	0.75" PLATE		
4	EA	02	183078-100	SHIPPING RESTRAINT	SHIPPING RESTRAINT ASSEMBLY		
4	EA	01	140772-100	REINFORCING PLATE	REINFORCING PLATE ASSY.		

07

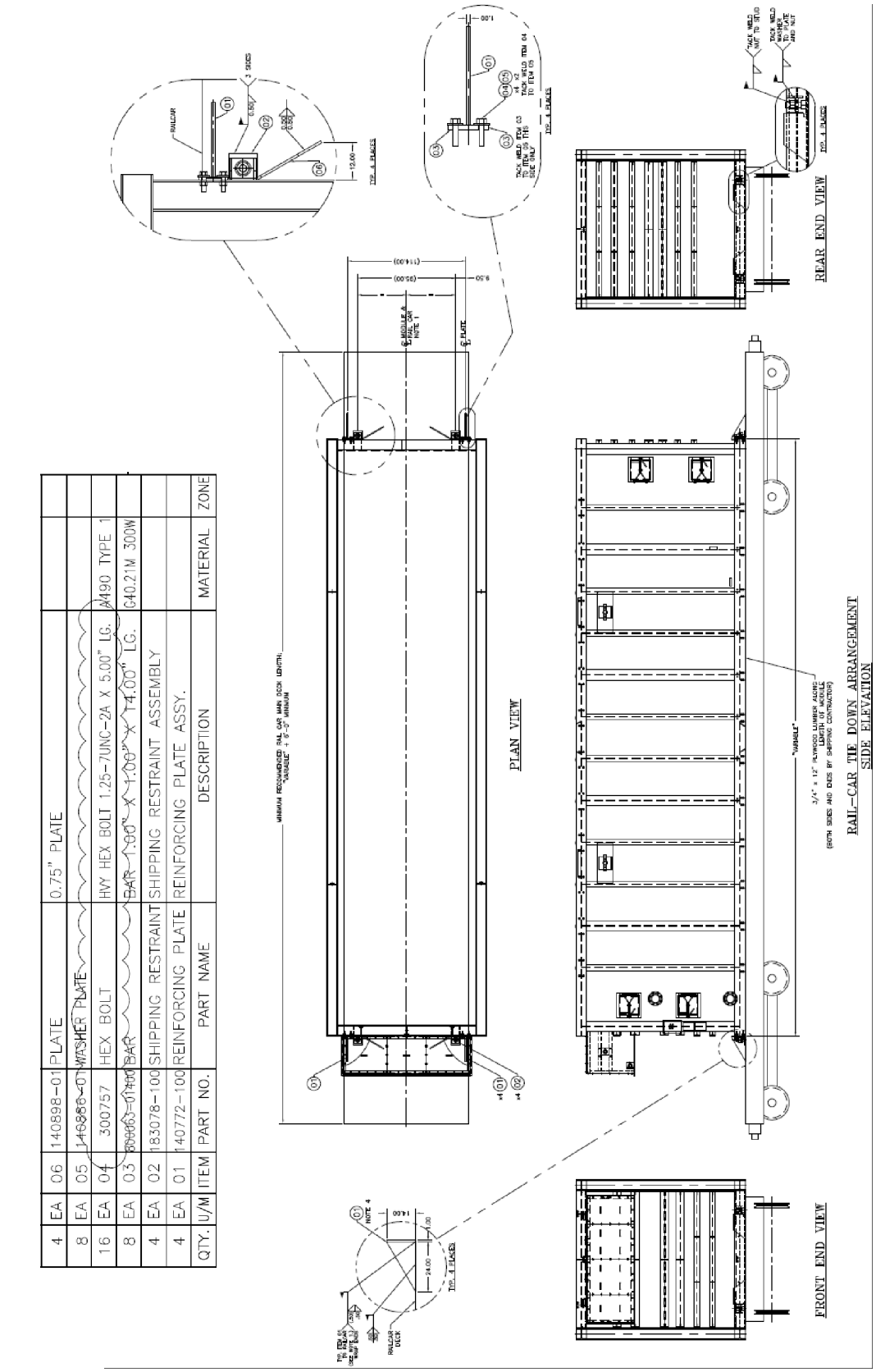
Figure 3.1a
(Notes on Next Page)

Figure 3.1a notes:

1. Shipping contractor shall be responsible for positioning and securing module to rail car. No allowances have been given for module to be off-centre of railcar.
2. The contractor shall confirm adequacy of IST proposed tie-down arrangement and devices. Additional securing devices (not shown) may be required as determined by the contractor such as chains, tie rods, etc.
3. Installation of tie-down devices to the rail car (incl. welding) shall be by the contractor.
4. Tighten shipping restraint nuts (item 02) prior to welding on triangular gusset plate.
5. Rail car and no. of axles shown may changed, as freight forward is to select appropriate car.
6. Welding must be performed by a welder certified in accordance with AAR or American Welding Society (AWS) standards or CWB standards
7. To retain nuts in their original position, three or more threads on rods or bolts must be nicked, chisel-checked, flattened, or otherwise distorted immediately behind single or double nuts, or nuts may be tack welded to the rods to ensure that the nuts will not back off.

07

8. ~~Consult IST engineering if this dimension is < 0.6 H due to the configuration of the rail car.~~
9. ~~Rod to clear inlet header on the outward side by at least 1".~~
10. Refer to supply table for supply of hardware, nuts and rods.
11. Dimensions are in inches.
12. See contract specific drawing "Rail Car Tie-down Reinforcing Plate Assembly and Arrangement" for weld sizes and other details. Drawing No. XXX888 ("XXX" to be replaced with contract ID No.)



QTY.	U/M	ITEM	PART NO.	DESCRIPTION	MATERIAL	ZONE
4	EA	01	140772-100	REINFORCING PLATE	0.75" PLATE	
4	EA	02	183078-100	SHIPPING RESTRAINT	SHIPPING RESTRAINT ASSEMBLY	
8	EA	03	60006-01400	BAR	BAR .90" X 1.00" X 14.00" LG.	G40.21M 300W
16	EA	04	300757	HEX BOLT	HVY HEX BOLT 1.25-7UNC-2A X 5.00" LG.	A490 TYPE 1
8	EA	05	146886-01	WASHER PLATE		
4	EA	06	140898-01	PLATE	0.75" PLATE	

07

Figure 3.1b
(Notes on Next Page)

Figure 3.1b notes:

1. Shipping contractor shall be responsible for positioning and securing module to rail car. No allowances have been given for module to be off-centre of railcar.
2. The contractor shall confirm adequacy of IST proposed tie-down arrangement and devices. Additional securing devices (not shown) may be required as determined by the contractor such as chains, tie rods, etc.
3. Installation of tie-down devices to the rail car (incl. welding) shall be by the contractor.
4. Tighten shipping restraint nuts (item 02) prior to welding on triangular gusset plate.
5. Rail car and no. of axles shown may changed, as freight forward is to select appropriate car.
6. Welding must be performed by a welder certified in accordance with AAR or American Welding Society (AWS) standards or CWB standards
7. To retain nuts in their original position, three or more threads on rods or bolts must be nicked, chisel-checked, flattened, or otherwise distorted immediately behind single or double nuts, or nuts may be tack welded to the rods to ensure that the nuts will not back off.

07

8. ~~Consult IST engineering if this dimension is < 0.6 H due to the configuration of the rail car.~~
9. ~~Rod to clear inlet header on the outward side by at least 1".~~
10. Refer to supply table for supply of hardware, nuts and rods.
11. Dimensions are in inches.
12. See contract specific drawing "Rail Car Tie-down Reinforcing Plate Assembly and Arrangement" for weld sizes and other details. Drawing No. XXX888 ("XXX" to be replaced with contract ID No.)

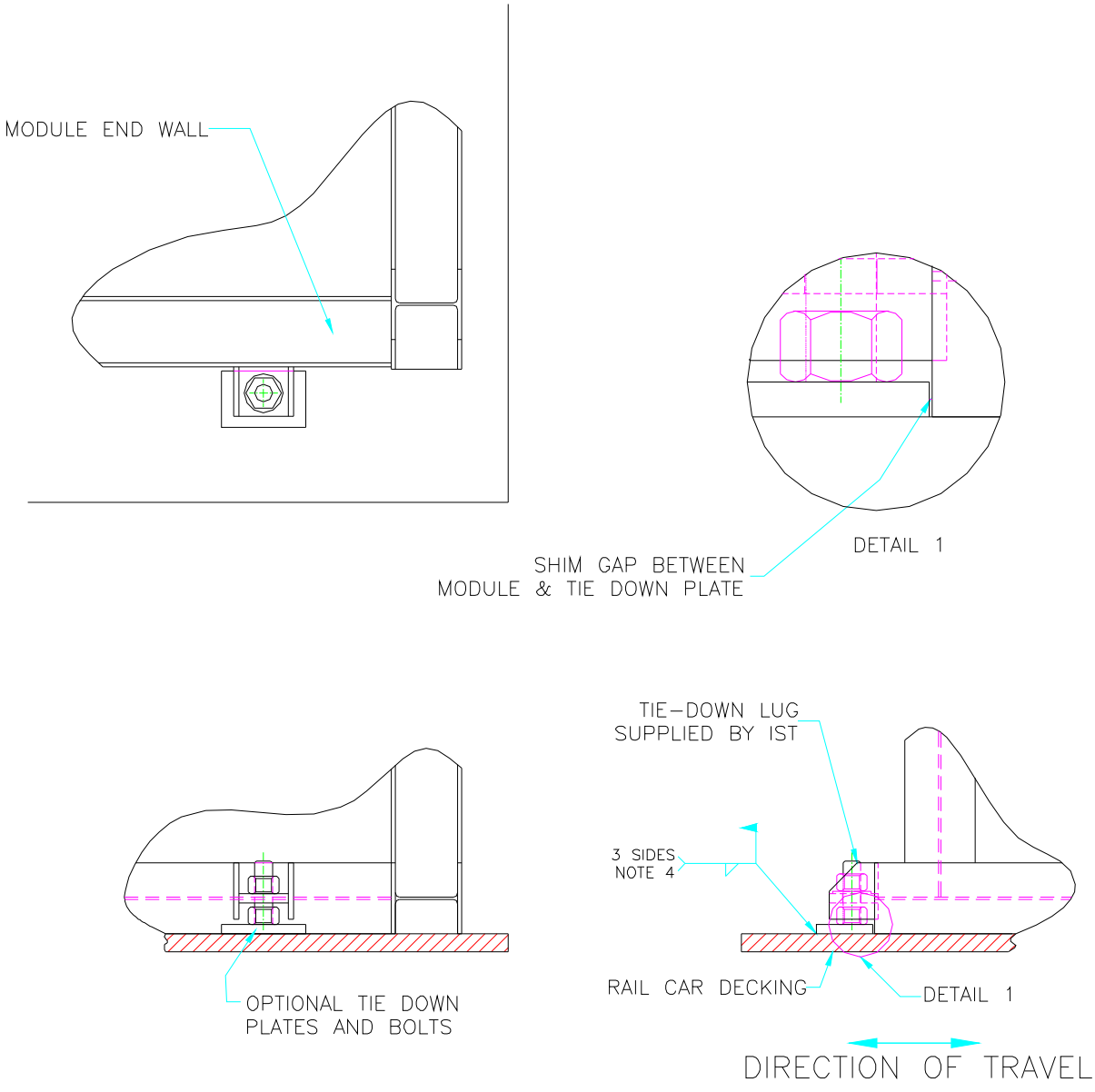


Figure 3.2

Notes:
1. Tie downs are located in 4 places
2. Shipping contractor is to determine appropriate design of tie down plate for given load, if not IST supplied.
3. Refer to supply table for supply of hardware, nuts and rods.
4. Weld type and size specified by others.
5. Dimensions are in inches.

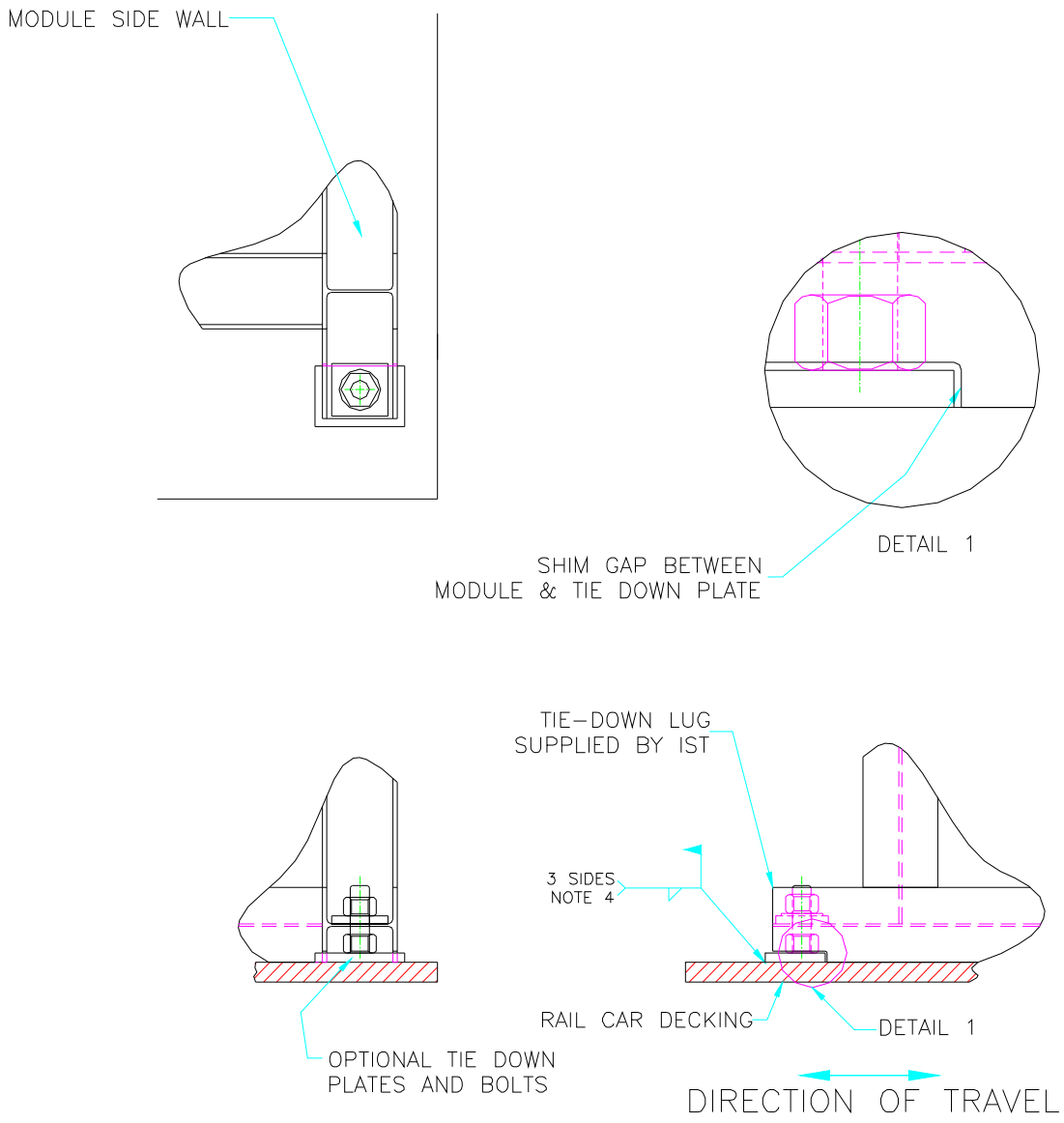
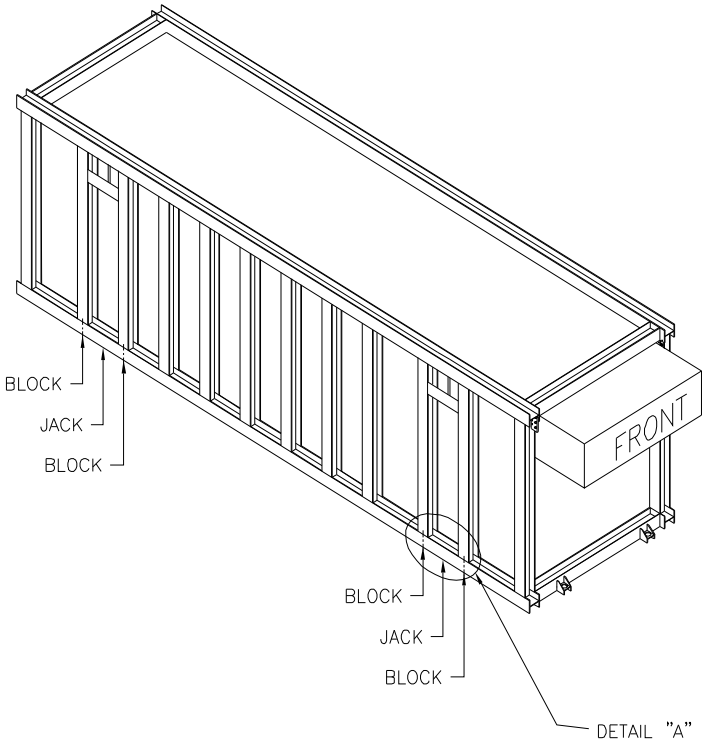
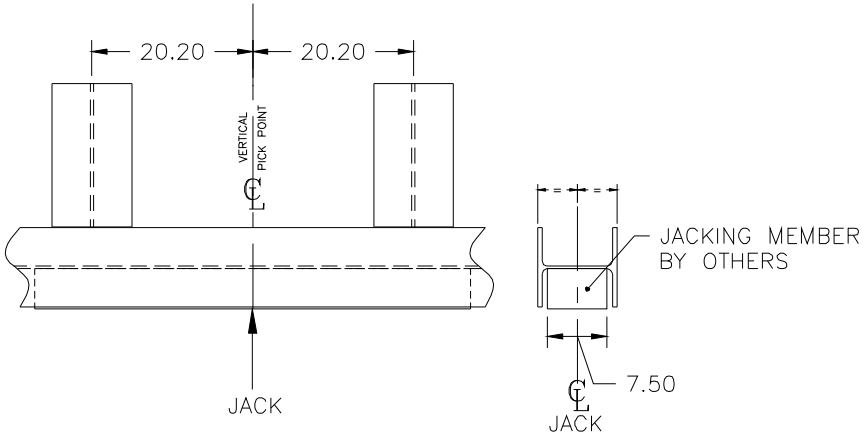


Figure 3.3

Notes:
1. Tie downs are located in 4 places
2. Shipping contractor is to determine appropriate design of tie down plate for given load, if not IST supplied.
3. Refer to supply table for supply of hardware, nuts and rods.
4. Weld type and size specified by others.
5. Dimensions are in inches.





DETAIL "A"

03

Figure 4.0

Notes:

1. Dimensions are in inches
2. Sizing of Jacking member described in Section 3.0

Appendix I

Soluble Fiber Insulating Materials – IST Specification ES-026

ENGINEERING SPECIFICATION

Soluble Fiber Insulating Materials

SPECIFICATION
ES-026

REVISION 02

simply generates more profit

Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

Revision Page

Revision Number	Description of Revision	Developed By	Approved By	Approval Date
00	Original Issue	JMc	JL	Aug 4, 2004
01	Added values for 200 F	JMc	JL	Dec.1, 2004
02	Format change update to new logo/font	SV		March 5, 07

TABLE OF CONTENTS

Paragraph No. Page

1.0 OVERVIEW.....4

2.0 PURPOSE.....4

3.0 REFERENCED STANDARDS.....4

4.0 MATERIALS.....4

1.0 OVERVIEW

1.1 This document details the requirements to be applied to the supply of soluble fibre insulation.

2.0 PURPOSE

2.1 The purpose of this specification is to document the technical requirements that shall be applied to the supply of soluble fiber insulation to IST.

3.0 REFERENCED STANDARDS

3.1 ASTM C167-Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulation

3.2 ASTM C177-Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by means of the Guarded-Hot-Plate Apparatus

3.3 ASTM C892-Standard Specification for High-Temperature Fibre Blanket Thermal Insulation

(Note that most recent addition at order placement applies)

4.0 MATERIALS

The soluble fibre material shall be exonerated from any carcinogenic classification in the countries of the European Union under the provisions of the European Commission Directive 97/69/EC. Certificates of independent animal testing consistent with EU protocol are required.

The insulation shall be free from any visible imperfections including holes, pockets, or local compressed areas which may adversely affect its service qualities. The insulation shall contain no asbestos.

Material nominal thickness and densities shall be as specified on IST Purchase Order. Only spun fibre is acceptable. Material shall contain no binder. Material shall maintain its physical properties once dried, if exposed to water. Material should not dissolve when exposed to rain water.

4.1 Material Composition – Material shall have a composition in accordance with the following limits:

CaO - 25% to 35%
MgO - 2% to 7%
SiO2 - 60% to 70%

4.2 Material Shrinkage – Shrinkage of the soluble fiber shall be < 3% average linear shrinkage after 24 hours at 1800 F.

4.3 Material Strength – Material strength shall be in accordance with the following:

Tensile Strength: 2.5 psi minimum (6 pcf)
4.0 psi minimum (8 pcf)
4.5 psi minimum (10 pcf)

4.4 Density -The density of the supplied product shall not be less than the nominal density specified on the purchase order i.e. no under tolerance is allowed. Density shall be checked per ASTM C167 or equivalent and the results shall be shipped with the order.

4.5 Thickness-The insulation thickness will be measured per ASTM C167 or equivalent. An under tolerance (including measurement error) of 7% and an over tolerance of 25% is acceptable.

4.6 Only new materials shall be used (used or reclaimed material is not permitted).

4.7 Width –Tolerance on specified width shall be -2% ,+10% (per ASTM C892).

4.8 Workmanship, Finish and Appearance –The insulation shall indicate good workmanship in fabrication by a uniform appearance, shall not have visible defects such as tears and holes that will adversely affect the service quality, and shall be free from foreign materials (ASTM C 892 para . 8).

4.9 Unfiberized shot content to be in accordance with Table 5 ASTM C892. Alternative testing may be used for unfiberized shot content but must be equivalent to ASTM C892.

4.9 Thermal Conductivity

Thermal Conductivity shall be tested in accordance with ASTM C177 and, on average, shall not exceed the following values (Btu-in/hr sq. ft .F):

Temperature (°F)	6 lb/ft^3 density	8 lb/ft^3 density	10 lb/ft^3 density
200	0.43	0.41	0.39
400	0.46	0.46	0.46
600	0.63	0.61	0.59
800	0.86	0.79	0.76
1000	1.18	1.03	0.96
1200	1.53	1.29	1.21
1400	1.86	1.64	1.50
1600	2.39	2.07	1.86

Appendix J

Feedwater Quality – IST Specification ES-1000

ENGINEERING SPECIFICATION

Feedwater Quality Requirements for Superheated Steam Applications

SPECIFICATION NO. ES-1000 REVISION 09

simply generates more profit

Innovative Steam Technologies
549 Conestoga Blvd.
Cambridge, ON
Canada N1R 7P4

An AECON Company

P: +1.519.740.0036
F: +1.519.740.2051
www.otsg.com

Revision Page

Revision Number	Description of Revision	Developed By	Approved By	Approval Date
01	General Revision	--------	--------	Sept 11/96
02	General Revision	--------	--------	Sept 23/96
03	Updated address to Conestoga Blvd	--------	--------	Nov 13/00
04	Revision of entire specification	--------	--------	April 3/02
05	Revision of oxygen levels Added Notes to Table 1 and Table 2	--------	--------	Sept 17/02
06	Added note (7) following cycle chemistry limits regarding pH values	--------	--------	Nov 20/02
07	Table 1.0, 2.0, Note (3) for Tables 1.0 and 2.0, Section 2.2	AB	JM	Aug 8/03
08	Format change update to new logo/font	SV		March 5/07
09	Removed specific conductivity	JM	CK	July 22/11

Table of Contents

1.0 INTRODUCTION 2
1.1 BACKGROUND 2
1.2 TREATMENT OPTIONS 2
1.3 MAKEUP AND CONDENSATE RETURN TREATMENT 3
1.4 DEMINERALIZER AND POLISHER 3
1.5 ORGANIC COMPOUNDS 3
1.6 CONTROL PARAMETERS 3
1.7 CHEMICAL FEED POINTS 4
1.8 SAMPLE POINTS 4
2.0 CONTROL PARAMETERS AND LIMITS 4
2.1 CYCLE CHEMISTRY LIMITS 4
2.2 ACTION LEVELS 8
2.3 CORRECTIVE ACTIONS 8

1.0 INTRODUCTION

1.1 Background

This specification details the requirements of feedwater quality for Innovative Steam Technologies Once Through Steam Generators (OTSG's) producing superheated steam. Deviations from the limits and requirements must have specific written approval from Innovative Steam Technologies.

This specification addresses the following:
- all-volatile treatment (AVT) for applications with and without copper alloys in the pre-boiler and steam user systems
- oxygenated treatment for applications with all ferrous (no copper) pre-boiler systems

The technical criteria for formulating these guidelines includes:
- Avoidance of scale formation in the OTSG. Solids (dissolved or suspended) which are carried into the OTSG are either deposited in the tubing or carried through as a solid or vapour into the dry out zone where deposition may occur. Deposits may restrict flow as well as heat transfer and potentially act as corrosion sites.
- Suspended solids could end up plugging the stabilization orifices, which would restrict the flow to individual circuits.
- Prevention of corrosion and deposition in the OTSG. If necessary, more stringent limits can be used based on the requirements for other components in the system, which may be more sensitive to impurities.
- Generation of high purity steam

This specification is not a substitute for complete cycle chemistry guidelines, which should include monitoring of additional cycle streams as required. Successful implementation of this specification requires proper training of operators and is the responsibility of the owner.

1.2 Treatment Options

In once-through boilers, there are only two available options for water treatment, all volatile treatment (AVT) and oxygenated treatment (OT). Both treatments are feedwater treatments.

If copper alloys are used, OT cannot be used because the presence of oxygen accelerates copper alloy corrosion. If polishers are not to be used, or copper is present in the pre-boiler cycle, then AVT is the only option. With polishers and all ferrous pre-boiler metallurgy, either AVT or OT can be used.

Some of the chemicals referred to in this specification are hazardous to human health and/or environment and should be handled with care.

All-Volatile Treatment (AVT) is used to minimize corrosion and erosion corrosion in the pre-boiler system by using deaerated high purity water with an elevated pH. The pH elevation is achieved by the addition of ammonia. The target range for pH depends upon the metallurgy of the pre-boiler system (all-ferrous or Fe-Cu mixed). The oxygen concentration in the feedwater is reduced using an oxygen scavenger, such as hydrazine or carbohydrazide. The result of AVT treatment is a layer of magnetite (Fe_3O_4) on all steel surfaces which protects the metal from corrosion.

Oxygenated Treatment (OT) uses oxygenated high purity water to minimize corrosion and erosion-corrosion in the pre-boiler system. Oxygen, hydrogen peroxide, or air is injected into the feedwater to achieve an oxidizing environment. The pH is adjusted using ammonia, but the target pH range is lower than in AVT. IST has no operating experience to date with oxygenated treatment and as such IST has not

provided recommended feedwater limits for OT.

1.3 Makeup and Condensate Return Treatment

Raw water used for makeup contains impurities that must be removed before the water enters the OTSG. The extent of makeup water purification is system dependent (dependent on makeup rate) and site specific (dependent on raw water quality).

Condensate return water may contain impurities that must be removed before the water enters the OTSG. The extent of purification is system dependent (dependent on where steam is being used and how it is being contaminated).

1.4 Demineralizer and Polisher

The production of good quality feedwater is usually a function of a makeup demineralizer and a condensate polisher, although depending on system requirements, one of these items can sometimes be eliminated. Where demineralizer or polisher requirements are minimal, replacement resin bottles can minimize system capital and operating costs. This can eliminate the need for onsite acid and caustic facilities used for regeneration.

1.5 Organic Compounds

Precautions must be taken to eliminate organics prior to the water reaching the boiler since they can break down to acid type compounds at boiler operating temperatures. These acids can be harmful to the tubing of the OTSG and may have a negative affect on the feedwater treatment system resins.

Corrosion and flow-accelerated corrosion effects and removal of harmful decomposition products must be considered when selecting the type of feedwater treatment and the water treatment chemicals. Use of organic feedwater treatment chemicals (amines and oxygen scavengers) needs to be thoroughly evaluated concerning their decomposition, monitoring, analytical interferences, and toxicity.

Amines are not recommended for control of feedwater pH. They thermally decompose in the boiler and the steam circuits, forming organic acids, carbon dioxide, ammonia, and other decomposition products. This also happens to oxygen scavengers other than hydrazine. The harmful effects of some of the decomposition products may be reduced when condensate polishers are used. Hydrazine or carbohydrazide can be used for oxygen scavenging. Hydrazine is preferred since carbohydrazide decomposes forming acid species making it difficult to meet cation conductivity limits.

1.6 Control Parameters

The most important control parameter for the IST OTSG proper is feedwater cation conductivity. Dissolved oxygen and pH are to be continuously monitored to control corrosion in the pre-boiler system. Conductivity measurement is recommended because there is a direct correlation between dissolved solids and conductivity. The purpose of the cation conductivity measurement is to remove the masking effect of the ammonia/amines and its derivatives, in the water. Specific conductivity is not recommended and is not addressed in this specification.

ORP (oxidation reduction potential) is a method of grading a solution as oxidizing or reducing. The ORP value is a direct reading of the activity of the oxidizing and reducing agents in the water as they correspond to oxidation-reduction reactions. The oxidation-reduction reaction is an electrochemical process in which metal atoms are oxidized to form positive ions (cations) while other chemical species (O_2, H_2O, H+ and other cations) are reduced. This results in a flow of electrons from one site on the metal surface to another. For example, if the ORP is negative, a reducing environment exists that can reduce or eliminate a protective layer of magnetite.

Steam and feedwater conductivity measurements are both required to alert the operator of any components breaking down in the OTSG.

1.7 Chemical Feed Points

The chemical feed points for ammonia and the oxygen scavenger should be after the condensate polishers, since these compounds can be removed by the polisher. However, if the polishers are operated in the ammonia form, the ammonia addition can be at the exit of the condensate pumps. If there is a deaerator in the pre-boiler system, the best location to add the oxygen scavenger is into the drop leg of the deaerator. This allows a greater residence time of the scavenger in the feedwater, increasing its effectiveness.

1.8 Sample Points

To monitor the OTSG, it is recommended that sample points be located on the feedwater piping at the OTSG inlet and on the steam piping at the exit of the OTSG, after attemperating sprays (if installed). In cycles with reheat, hot reheat steam can be monitored instead.

It has been shown that for sampling of superheated steam, an isokinetic sampling nozzle is needed. Multi-port nozzles which are installed in the superheated steam piping are not isokinetic and do not give a representative sample. The same isokinetic sampling is needed when sampling feedwater for suspended oxides (Fe, Cu oxides) to ensure a representative sample.

When sampling cation conductivity a calibration check of the measuring instrument should be made using a standard solution of known value. If the reading is high, the measurement probe may need replacing.

2.0 CONTROL PARAMETERS AND LIMITS

2.1 Cycle Chemistry Limits

The rationale for determination of the cycle chemistry limits for these guidelines is based on the requirements for the OTSG. If necessary, more stringent limits can be used based on the requirements for other components in the system, which may be more sensitive to impurities.

The control limits to be used during normal operation are shown in Tables 1 and 2 for units on AVT. Oxygenated treatment (OT) is presently under investigation and limits have not been provided. These tables also include recommended monitoring frequencies and action levels, which allow exceeding the normal limits for short durations.

Parameter		Monitoring Frequency	Target Value	Action Level 1	Action Level 2	Action Level 3	Action Level 4
pH (see Note 7)	All ferrous	C	9.3 to 9.6	<9.3 or >9.6	-	-	-
	All stainless	C	8.0 to 8.5	<8.0 or >8.5	-	-	-
	Mixed Fe-Cu	C	8.8 to 9.1	<8.8 or >9.1	-	-	-
Water Cation Conductivity (µS/cm)		C	< 0.25	0.25 to 0.45	>0.45 to 0.85	>0.85 to 1.0	> 1.0
Steam Cation Conductivity (µS/cm)		W	< 0.25	0.25 to 0.45	>0.45 to 0.85	>0.85 to 1.0	>1.0
ORP (mV)	All ferrous	T	0 to +100	-	-	-	-
	Mixed Fe-Cu	T	-350 to -300	-	-	-	-
Hydrazine (ppb)	All ferrous	T	0 to 10	> 10	-	-	-
	Mixed Fe-Cu	T	< 20	> 20	-	-	-
Dissolved Oxygen (ppb) (see Notes 5 and 6)	All ferrous	C	< 7	> 7	-	-	-
	All stainless (Water Temp ≤ 50 C) (Water Temp ≤ 100 C)	C C	< 800 < 300	> 800 > 300	- -	- -	- -
	Mixed Fe-Cu	C	< 5	> 5	-	-	-
Sodium (ppb)		W	< 6	6 to 12	>12 to 24	> 24 to 30	> 30
Chloride (Organic and inorganic) (ppb)		T	< 6	6 to 12	>12 to 24	> 24 to 30	> 30
Sulfate (Organic and Inorganic) (ppb)		T	< 6	6 to 12	>12 to 24	> 24 to 30	> 30
Silica (ppb)		D	< 20	20 to 40	>40 to 80	> 80 to 100	> 100
Iron (ppb)		W	< 10	10 – 20	>20 to 40	> 40 to 50	> 50
Copper (ppb)		W	< 2	2 to 4	>4 to 8	> 8 to 10	> 10
Total Organic Carbon (TOC) (ppb)		W	< 100	> 100	-	-	-
Hardness (ppb)		T	< 1	> 1	-	-	-
Suspended Solids (ppb) (see Note 4)		T	Not detectable	-	-	-	-

* Nomenclature and notes follow Table 2. Action levels are given in Section 2.2.

Table 1.0 - All volatile Treatment (AVT) without Reheat

Parameter	Monitoring Frequency	Target Value	Action Level 1	Action Level 2	Action Level 3	Action Level 4

pH (see Note 7)	All ferrous	C	9.3 to 9.6	<9.3 or > 9.6	-	-	-
	All stainless	C	8.0 to 8.5	<8.0 or >8.5	-	-	-
	Mixed Fe-Cu	C	8.8 to 9.1	<8.8 or >9.1	-	-	-
Water Cation Conductivity (µS/cm)		C	< 0.15	0.15 to 0.25	0.25 to 0.45	>0.45 to 0.5	>0.5
Steam Cation Conductivity (µS/cm)		W	< 0.15	0.15 to 0.25	0.25 to 0.45	>0.45 to 0.5	>0.5
ORP (mV)	All ferrous	T	0 to +100	-	-	-	-
	Mixed Fe-Cu	T	-350 to -300	-	-	-	-
Hydrazine (ppb)	All ferrous	T	0 to 10	> 10	-	-	-
	Mixed Fe-Cu	T	< 20	> 20	-	-	-
Dissolved Oxygen (ppb) (see Notes 5 and 6)	All ferrous	C	< 7	> 7	-	-	-
	All stainless (Water Temp ≤ 50 C)	C	< 800	> 800	-	-	-
	(Water Temp ≤ 100 C)	C	< 300	> 300	-	-	-
	Mixed Fe-Cu	C	< 5	> 5	-	-	-
Sodium (ppb)		W	< 3	3 to 6	6 to 12	> 12 to 15	>15
Chloride (organic and inorganic) (ppb)		T	< 3	3 to 6	6 to 12	> 12 to 15	>15
Sulfate (organic and inorganic) (ppb)		T	< 3	3 to 6	6 to 12	> 12 to 15	>15
Silica (ppb)		D	< 10	10 to 20	20 to 40	> 40 to 50	>50
Iron (ppb)		W	< 10	10 to 20	20 to 40	> 40 to 50	>50
Copper (ppb)		W	< 2	2 to 4	4 to 8	> 8 to 10	>10
Total Organic Carbon (TOC) (ppb)		W	< 100	> 100	-	-	-
Hardness (ppb)		T	< 1	> 1	-	-	-
Suspended Solids (see Note 4)		T	Not detectable	--	-	-	-

* Nomenclature and notes follow Table 2. Action levels are given in Section 2.2.

Table 2.0 - All-volatile Treatment (AVT) with Reheat

Nomenclature:

C = continuous
D = grab sample, once per day
W = grab sample, once per week
T = troubleshooting and commissioning

Notes (Table 1 and Table 2):

1) Conductivity and pH measured at 25°C.
2) Grab samples are to be more frequent during startup. Grab samples should be once per day until benchmark levels are obtained.
3) In start-up situations feedwater must be circulated to reduce the dissolved material and suspended particles and should not be introduced into the OTSG until the cation conductivity is below 1.0 µS/cm (or 0.27 µS/cm for specific conductivity)
4) Suspended solids must be prevented to avoid clogging of feedwater orifices. Suspended solids is commonly measured by examining the undissolved material trapped on a 0.45 micrometer filter after filtration. Material that passes through is referred to as dissolved solids.
5) IST can review the allowable oxygen levels for feedwater temperatures less than 50°C.
6) IST can review the allowable oxygen levels for systems with feedwater piping fabricated from stabilized stainless steel material (i.e. 347SS, 321SS etc.).
7) The recommended pH value for all stainless metallurgy is based on achieving improved condensate polisher performance. The pH values recommended for all ferrous metallurgy (i.e. 9.3 to 9.6) are also acceptable for all stainless metallurgy. The pH values recommended for all ferrous metallurgy (i.e. 9.3 to 9.6) should be used for a system with both ferrous and stainless metallurgy.

2.2 Action Levels

Operation at the lowest achievable impurity levels, with the shortest and least frequent excursions, is the most desirable mode of operation. The probability of corrosion damage and deposit formation grows significantly with increasing impurity concentration, and the damage is proportional to the exposure time. When corrosive impurities concentrate on metal surfaces, the breakdown of passivity (damage to the protective oxide layer) occurs within a few minutes to several hours.

To give more flexibility in the water and steam chemistry control, particularly during startups, three action levels are recommended. The target values for Action Levels 1, 2, and 3 were established to allow for and provide guidance during transient or abnormal operating conditions. If the problem is not corrected within the time allotted to each action level, the next higher action level takes effect.

Normal - Values are consistent with long-term system reliability. A safety margin has been provided to avoid concentration of contaminants at surfaces.

Action Level 1 - There is potential for the accumulation of contaminants and corrosion. Normal Limit can be exceeded for one week with the total yearly accumulation of two weeks. If the time allotted is exceeded an orderly shutdown should occur.

Action Level 2 - The accumulation of impurities and corrosion will occur. Operation is limited to 24 hours with the total yearly accumulation of 48 hours. If the time allotted is exceeded an orderly shutdown should occur.

Action Level 3 - The accumulation of impurities and corrosion will occur very quickly. Operation is limited to 4 hours maximum with the total yearly accumulation of 8 hours. Damage to the OTSG can occur when operating in this condition and immediate action is required to return the feedwater to the target value.

During excursions, when the impurity concentration increases sharply, the accumulation of impurities in the cycle occurs quickly, but the subsequent cleanup upon return to good chemistry may take weeks. Therefore, yearly time accumulations were also established as a guide. If the unit is shutdown due to water or steam chemistry (i.e. a major condenser leak), it should be an orderly shutdown, not a trip.

Action Level 4 – Impurity levels are too high and severe damage may occur to the OTSG. Immediate orderly shutdown of the OTSG is recommended.

2.3 Corrective Actions

Typical corrective actions to respond to out-of-specification steam and/or water chemistry conditions are listed in this Section. These corrective actions are not meant to be all-inclusive or universally applicable. Each utility and/or plant should establish plant-specific corrective actions that consider plant design features and other plant-specific concerns. Successful implementation of this specification requires proper training of operators and is the responsibility of the owner. ONLY AFTER DETERMINING THE ROOT CAUSES OF AN EXCURSION CAN A PERMANENT SOLUTION BE SELECTED.

The action to be taken to confirm and correct water and the time to confirm and correct a water chemistry upset depends on the severity of the chemical excursion. On-line and grab sample analysis data must be used to determine the source(s) of ingress of various impurities. Possible causes of feedwater chemistry excursions are described below. Corrective actions for each monitored parameter are listed below

Possible Causes of Feedwater Chemistry Excursions

Out of Limit Parameter	Condenser Leak	Bad Makeup	NH_3 Feed System	O_2 Scavenger Feed	Air In Leakage	Condensate Polisher Malfunction
1) Sodium	X	X				X
2) Chloride	X	X			X	X
3) Sulfate	X	X			X	X
4) Silica		X			X	X
5) Cation/specific conductivity	X	X			X	X
6) Total organic carbon		X				X
7) pH			X		X	X
8) ORP	X			X	X	
9) Iron	X		X	X	X	
10) Copper	X		X	X	X	
11) High dissolved oxygen (AVT)	X	X		X	X	

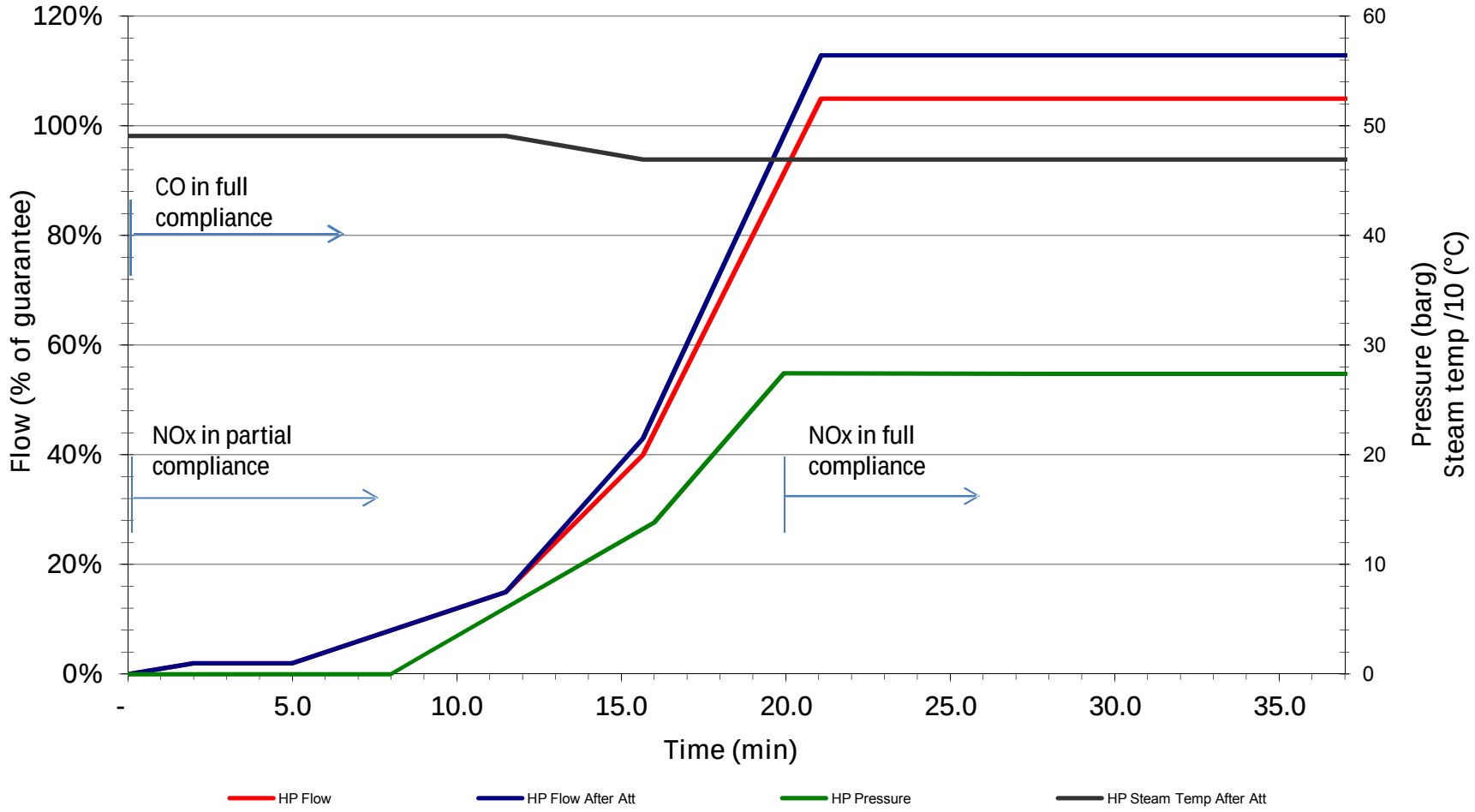
Corrective Actions for Chemistry Excursions

Parameter	Corrective Action
pH	Check ammonia feed and adjust as necessary within allowed limits. Identify sources of possible contaminants by checking: • makeup purity • condensers for tube and air leakage • purity of chemical feeds
Ammonia	Check pH, and adjust chemical feed as necessary.
Cation Conductivity	Identify source of contaminants by checking: • performance of condensate polisher, resin leakage • makeup purity • condensers for tube and air in leakage • purity of chemical feeds
Dissolved Oxygen and Hydrazine	Identify source of dissolved oxygen by checking: • condensers for air in leakage • feedwater train for air in leakage (pump suction, etc.) • condensate storage tanks – saturation in air Check hydrazine residual, and increase hydrazine feed to maintain oxygen within limits. Do not overfeed hydrazine.
ORP	Check hydrazine residual, and adjust hydrazine feed to maintain ORP within limits. Reduce air in leakage.
Sodium, Chloride, Sulfate, Silica, TOC	Identify source of contaminants by checking: • performance of condensate polisher, resin leakage • makeup purity • condensers for tube and air leakage • purity of chemical feeds
Iron and/or Copper	Identify cause by checking: • iron and copper in all streams and lay-up protection • pH and ORP of feedwater • dissolved oxygen in condensate and feedwater, optimize feed and concentration of oxygen scavenger • condensers for air in leakage • erosion-corrosion of carbon steel piping and other cycle components by downtime inspection (wall thickness measurement) and/or iron and copper pickup • exfoliation in the steam pipes

LM6000 (Typical)

OTSG Start-Up Curve

(OTSG Start Permissive approx 15 min from GT ignition with SCR/CO)
TIme zero refers to first FW introduction into OTSG



Innovative Steam Technologies

OTSG INSTALLATION AND ERECTION TRAINING PRESENTATION

Landon Tessmer

March, 2013

List of Topics

- Soleplates, Fabreeka Pads, and Baseplates,
- Inlet Plenum
- Erection Plate Installation
- OTSG Lower Module
- OTSG SCR Module
- OTSG Upper Module
- Exhaust Hood
- Exhaust Stack
- Stack Damper
- Inlet Transition Duct
- Expansion Joint
- Pressure Part Support (Top Support Beams)

List of Topics

- Internal Joint Welding and JAK Installation
- Internal Restraint Adjustment
- Platform Steel Installation
- Module Shipping Lug Removal
- SRV Silencer Installation
- Piping Installation
- “Jumper” Tube Installation
- Instrumentation and Thermocouple Installation
- OTSG Installations

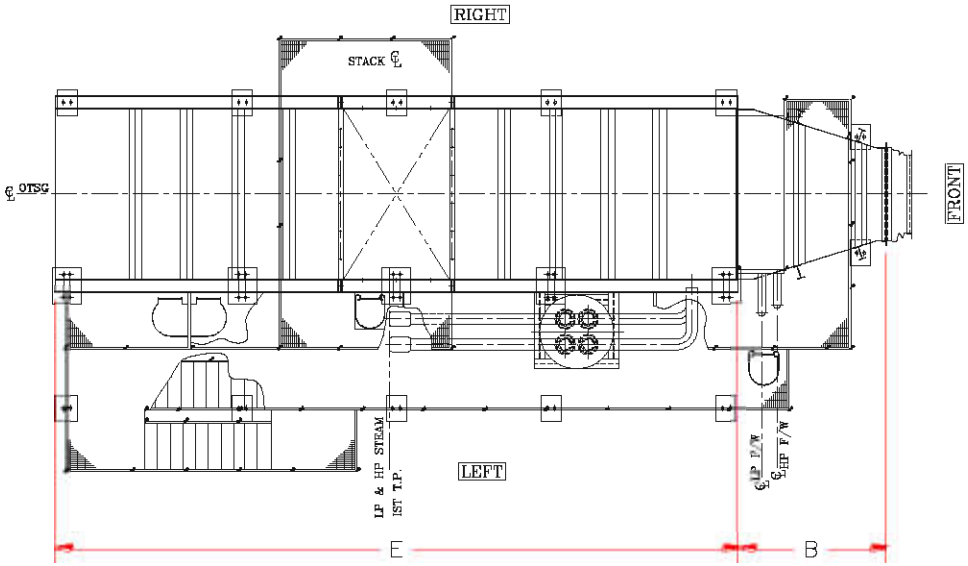
Miscellaneous Installations And Removals

- Shipping Beams
- Pressure Part Top Support Beam Angle Brackets

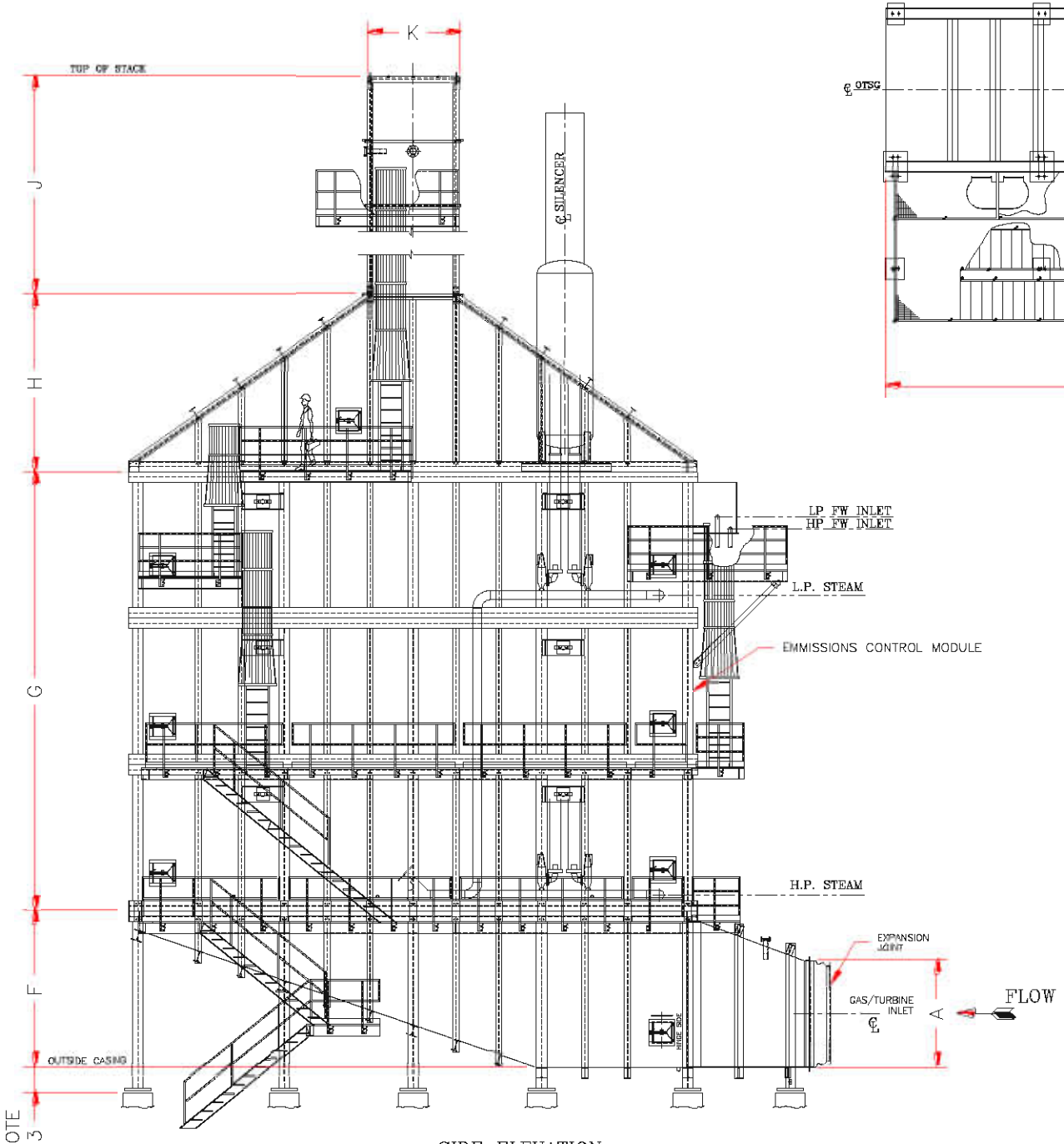
- Shipping Rubber Removal
- Internal Restraint Adjustment

- Internal Joint Welding
- Joint Assembly Kit (JAK) Installation

- Instrumentation and Thermocouple Installation



PLAN VIEW



SIDE ELEVATION

NOTES:

1. DIMENSIONS ARE OUTSIDE STEEL.
2. STEAM AND FEEDWATER CONNECTIONS CAN BE ON EITHER END OF THE OTSG MODULE.
3. DISTANCE FROM THE UNDERSIDE OF THE PLENUM TO TOP OF CONCRETE SET AT 2.00 FT.

TYPICAL OTSG
GENERAL ARRANGEMENT DRAWING
PRELIMINARY

TRIPLE MODULE, UNFIRED
DUAL PRESSURE
EMMISSIONS CONTROL

The Construction Process

Baseplate Installation

- Baseplate assemblies consist of a concrete foundation, anchor bolts, sole plates, Fabreeka pads, baseplates, dust covers and nuts.

- OTSG Baseplate are designed to allow thermal expansion. One Baseplate location is fixed. “Fixed” column does not have a Fabreeka Pad.

- Steel/Platform column Baseplate assemblies do not have a sole plate or Fabreeka pad.

- It is IMPORTANT **to** Check levels & elevations at T.O.C. (top of concrete) using a transit. Avoid installation of shims below the sole plates.

Baseplate Installation (con't)

- Place and center:
  - •Sole Plates in the concrete foundations for the OTSG (verify elevations).
  - •Fabreeka pads on top of sole plates (except at fixed base plate location).
  - •Baseplates on top of Fabreeka pads (Note: the stainless side of the base-plate must sit on the Teflon face of the Fabreeka pad).
  - •Cover slotted holes on baseplates with a special washers "dust cover".

Baseplate Installation (con't)

•Verify levels & elevations of baseplates using a transit.

• All OTSG anchor bolt nuts are to be installed "Snug" tight.
(Except fixed column location)

• "Fixed Column" Anchor bolt nuts on the base plate are to be tightened an additional 1/4 turn and the base plate is welded to the sole plate.

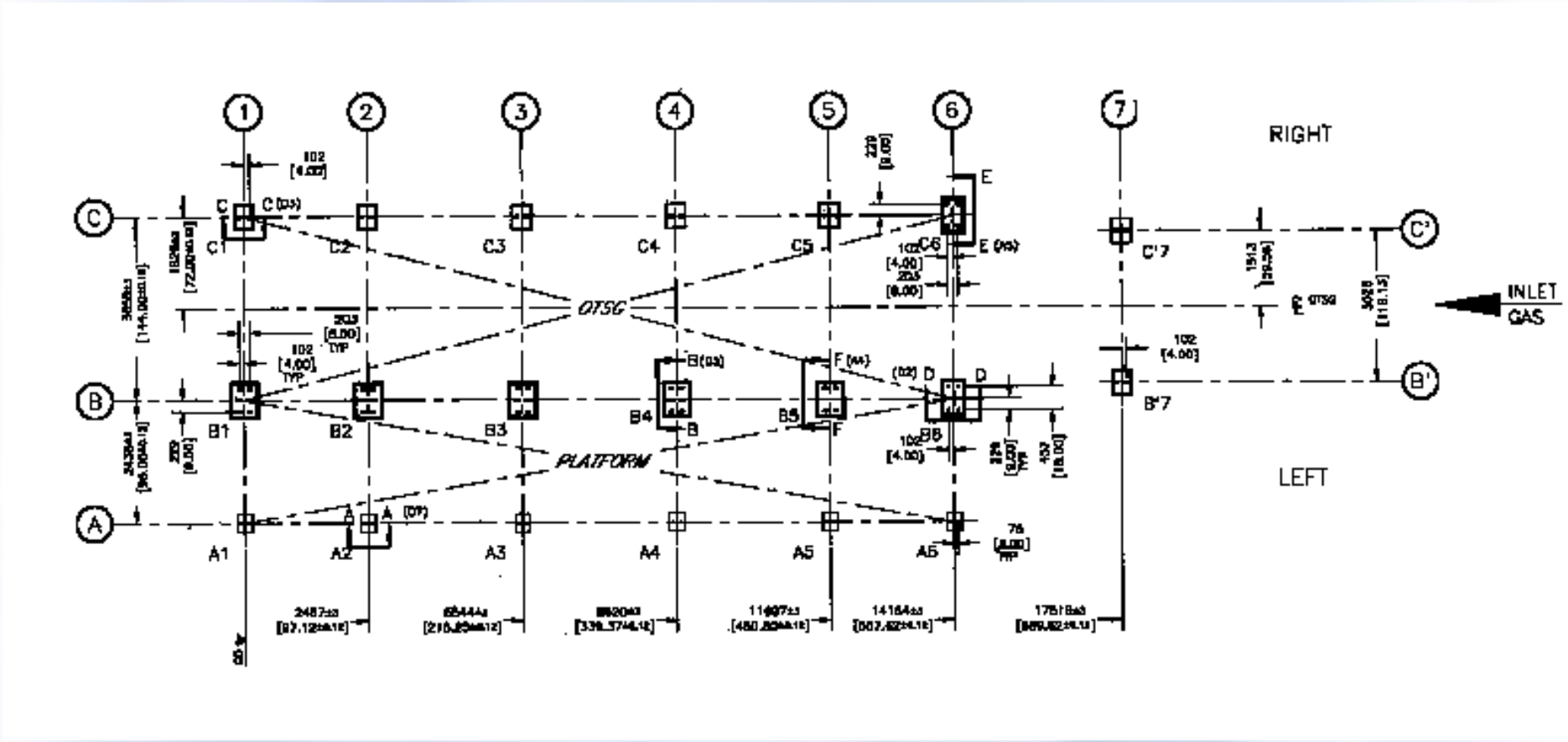
• Lock all anchor bolt nuts in position with a tack weld, or by using a jam nut.

• Measure and scribe centerlines on all baseplates.

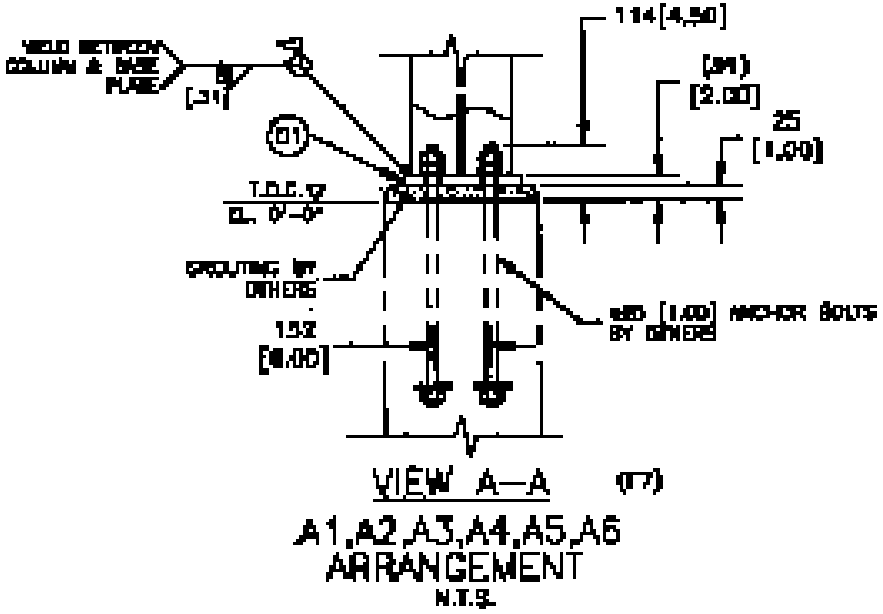
• Grouting of sole plates must be complete prior to the installation of Inlet Plenum.

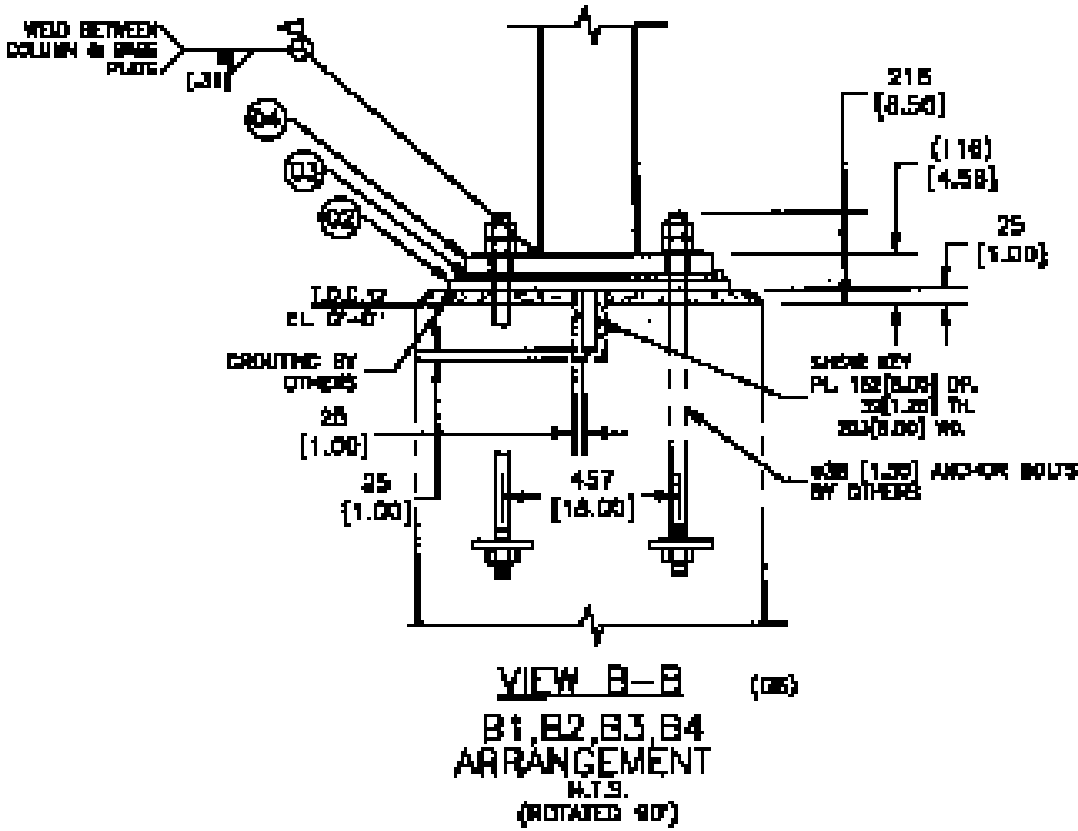
Note:
Perform Check that all baseplates and sole plates are placed in the correct positions

Typical Baseplate Layout



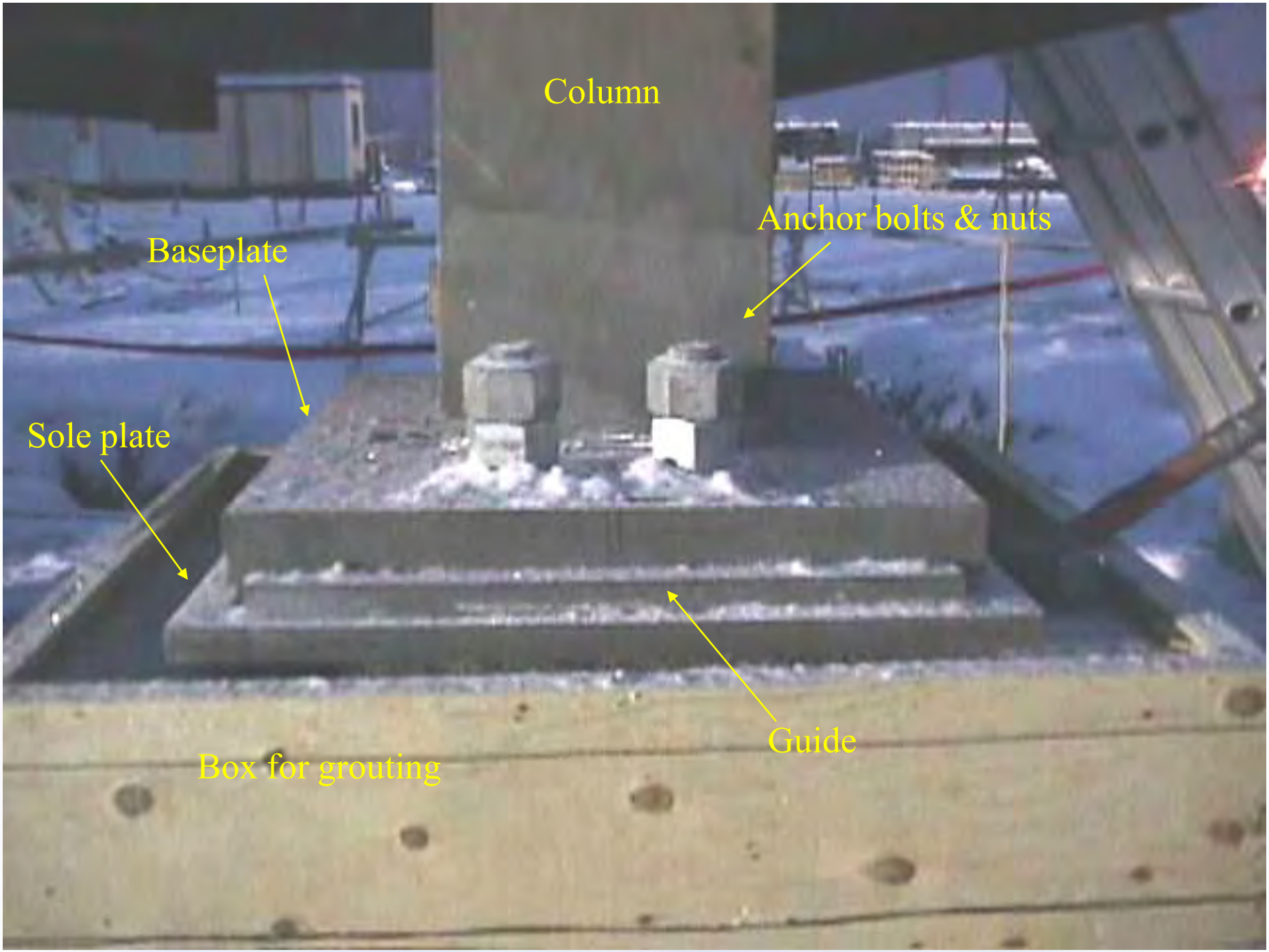
Typical Baseplate Arrangements



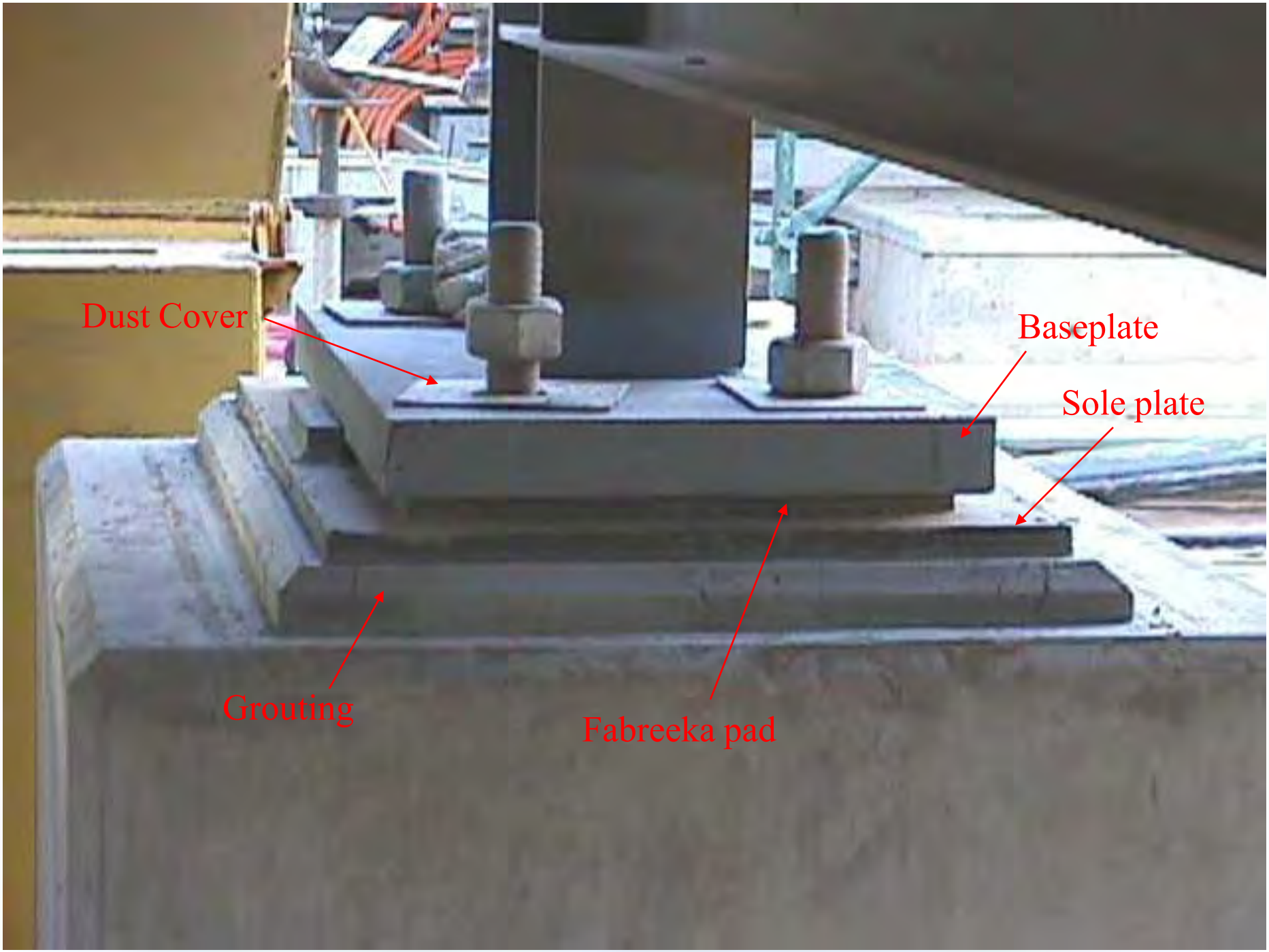




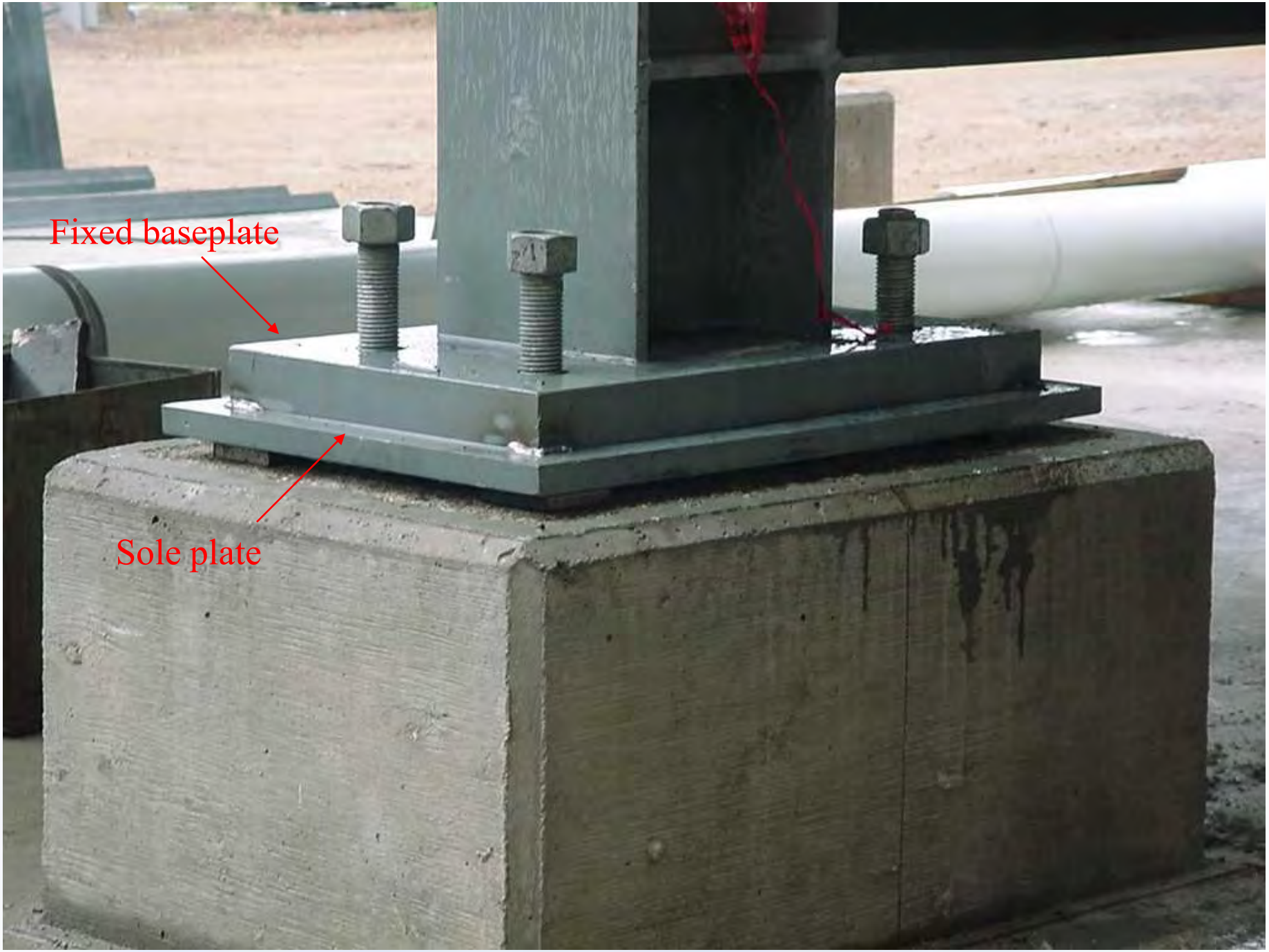
Picture 1: Baseplates and Sole Plates Shipping



Picture 2: Baseplate Assembly



Picture 3: Baseplate Assembly



Picture 4: Typical Fixed Baseplate Assembly

Inlet Plenum Installation

• For easy access to external joint any scaffolding external brackets, planking, and handrails can be installed or have a mobile man-lift available.

• Lift the inlet plenum into position so that each column rests centrally on its respective Baseplate.

Note: It is critical that centerline of the fixed column is verified.

• Check centerline distances to gas turbine discharge to ensure fit-up dimensions are aligned and correct.

• Check the elevation dimension at the four top corners of the inlet plenum, to ensure that the plenum is level and matches the specified elevation on the drawings.

•Once aligned and position is verified, weld out can proceed of inlet plenum columns to base plates.

Note: It is critical the inlet opening is level and centerline is aligned with the centerline of the gas turbine discharge.

Inlet Plenum Installation

• Remove all shipping beams from the top of inlet plenum. Plug holes by reinstalling bolts and seal welding.

• Install scaffolding inside of inlet plenum in preparation for seal welding plenum to Module.

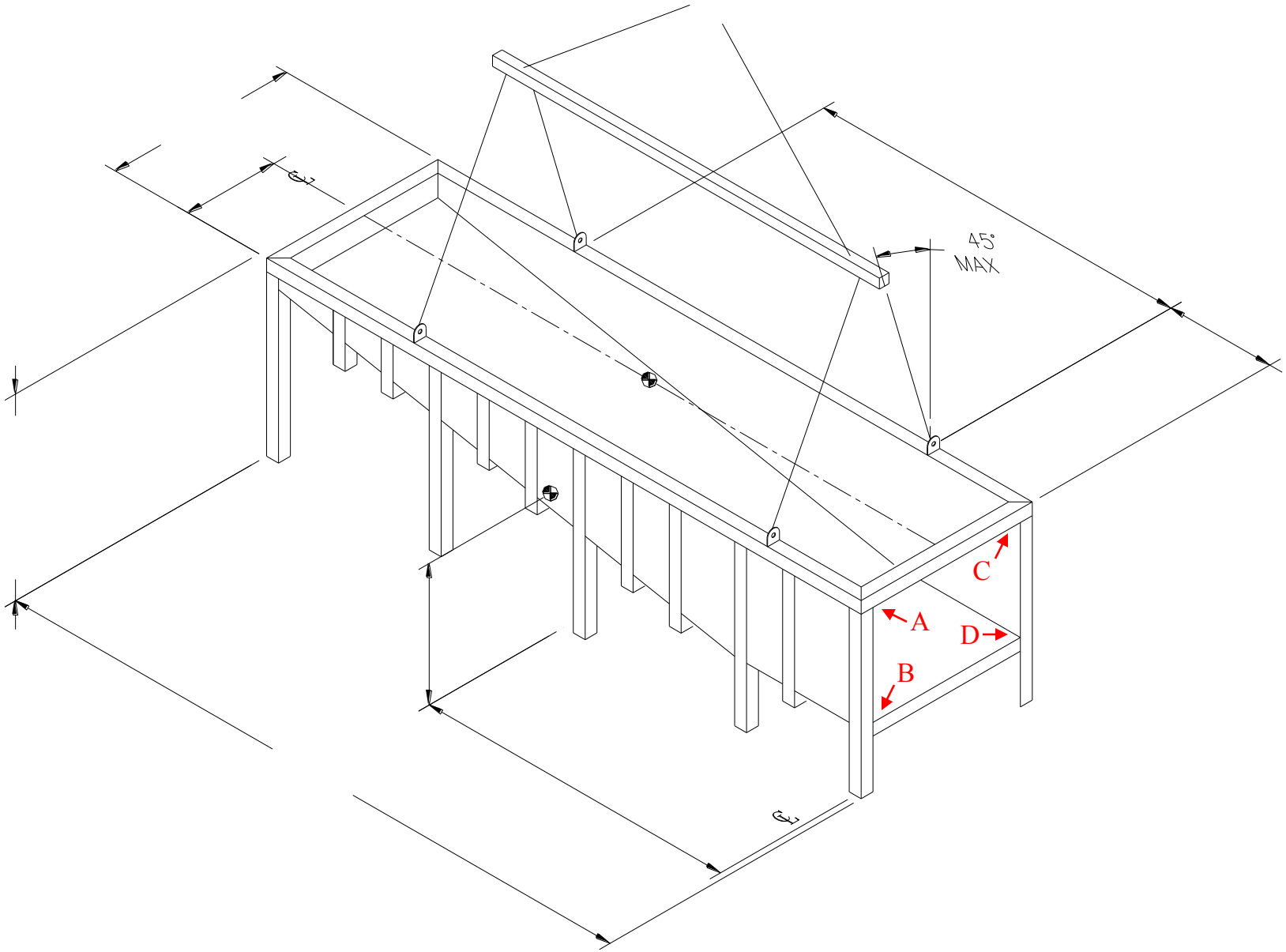


Figure 5: Inlet Plenum Lifting Diagram (using 1 spreader beam)



Picture 5: Inlet Plenum Vertical Lift



Picture 6: Inlet Plenum Vertical Lift



Picture 7: Inlet Plenum Lifting Lug



Picture 8: Inlet Plenum with external brackets



Picture 9: Inlet Plenum with external scaffolding



Picture 10: Inlet Plenum external scaffolding detail



Picture 11: Inlet Plenum internal scaffolding



Picture 12: Inlet Plenum Shipping Beams



Picture 13: Inlet Plenum Installed

Inlet Plenum Configurations

1. Single Component
2. Double Component
3. Triple Component

All double and triple component style inlet plenums will have split rear columns. These spilt columns will have special installation instructions.

Once the bottom inlet plenum is installed, the second and/or third inlet plenum components are installed using the same procedure. For these installations, there will be one or two additional joints that will require erection plates to install, a larger internal scaffold, additional seal welding and the installation of one or two more JAKs.

Erection Plate Installation

• Erection plates are installed at all columns and vertical stiffener locations the entire perimeter (Hardware should be easily accessible).

•Bolts are installed “snug” tight to the exterior of the erection plate and tightened by an additional 1/4 turn.

• Tightening shall progress systematically, from the most rigid part of the joint to its free edges.

• After erection plates are installed around the entire perimeter, weld the erection plates to the beams on 3 edges (top and sides).

Erection Plate Installation

- If the holes are misaligned...
  - 1) Install all erection plates that can be installed
  - 2) Open up any misaligned holes with a carbide burr bit.

- If side or end beams do not align…
  - 1) Install shims or spacers to make plate flush or
  - 2) For minor discrepancies just install the plate tightly, slightly bending the plate.

- If the end perimeter joint has gaps at either end, leave the erection plates unbolted until internal seal welding is complete. Follow Erection instructions on welding sequencing.



Erection Plates



Erection Plates (Inlet Plenum to Module)



Installed Erection Plates



SCR Module Placement



Upper Module Installation

OTSG Lower Module Installation

• Position crane (or cranes) as required in preparation for lift.

• Transfer OTSG module to the lifting location and securely place OTSG module on concrete/steel stool approximately 3’ above the ground in ensure to use blocking per IST Specification and in prescribed locations marked on the module.

• “Prepare” the module by removing the protective tarp, cutting the plywood into strips and set the plywood down in between the top support beams on top of the fin tubes for protection.

• Remove all shipping beams (painted yellow) on the bottom of the lower module except the ones designated to remain in place (see Erection Instructions Manual).

• Plug the holes left by the shipping beams by re-inserting the bolts and seal welding.

OTSG Lower Module Installation

•After loosely installing erection plates around the perimeter of the Module lower beam OR inlet plenum upper beam place the remaining required hardware in the web of the lower module lower beam. So its readily available prior to lifting the lower module.

•Check the inlet plenum and bottom lower module perimeter beams for any obvious obstructions.

• Place the Joint Assembly Kit (JAK), for the joint between OTSG lower module & the SCR module on top of the OTSG lower module prior to the lift.

•Lifting plates (painted yellow) are shipped loose and must be installed prior to hoisting. Lift the OTSG module as recommended with the lifting plates.

• With the crane, position the module at top the inlet plenum such that all perimeter gaps are minimised.

OTSG Lower Module Installation

•Install brackets, scaffold planks and handrails or have man-lift equipment available.

•When the module is positioned on Plenum install all lower erection plates before completely releasing the crane.

• Remove the lifting plates, reinstall and secure the lifting pins.

Notes:
• If gaps are evident at the ends of the module to plenum perimeter joint, reducing the gap can be done by utilizing weld control by starting welding from the center of the perimeter joint and traveling to each end.

• Some erection plates on the ends will have to be left loose to allow welding control.

•See erection instructions for complete details.



Picture 14: Lower Module shipping



Picture 15: Lower Module being transferred



Picture 16: Lower Module being transferred



Picture 17: Lower Module shipping detail



Picture 18: Covering tarp detail



Picture 19: Dunnage detail



Picture 20: Lower Module with external brackets



Picture 21: Inlet Plenum with Erection Plates in place



Picture 22: Preparation of the plywood cover



Picture 23: Plywood strip on top of finned tubes



Picture 24: Lower Module Shipping Beams

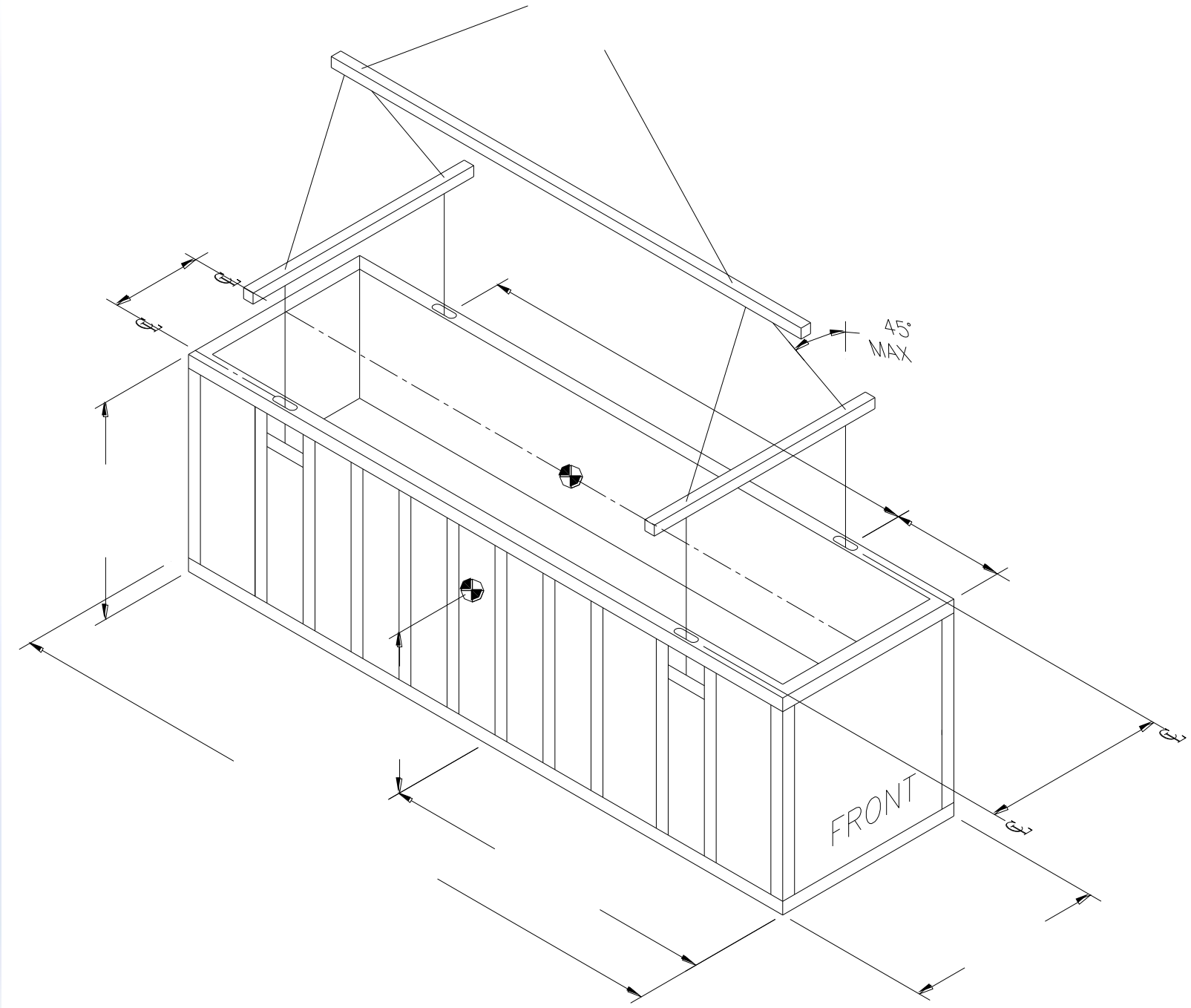


Figure 6: OTSG Lower Module Lifting Arrangement



Module Lifting Plate detail



Picture 26: Lower Module Vertical Lift (1 crane, 3 spreader beams)



Picture 27: Lower Module Vertical Lift



Picture 28: Lower Module Vertical Lift



Picture 29: Lower Module Vertical Lift (2 cranes, 2 spreader beams)



Picture 30: Lower Module Vertical Lift



Picture 31: Lower Module Vertical Lift



Picture 32: Lower Module Vertical Lift



Picture 33: Man Lift



Picture 36: Inlet Plenum & Lower Module with external scaffolding



Picture 37: Lifting Pins

OTSG Lower Module Configurations

1. OTSG tube bundle only
2. OTSG tube bundle with CO Catalyst Support and AIG piping

Both lower module options listed above can be installed in the same manner.

SCR Module

• Depending on the project scope of supply the OTSG can be equipped with an SCR module that will eventually contain catalyst used for reducing NOx emissions.

• At the time of installation, the SCR module will be basically an empty shell and will only contain the catalyst support structure.

• Removable panel doors are located at the rear of the module. These will be used later, during catalyst installation. IST recommends that the panel doors be kept in place during the SCR module lift.

• Prior to installing the SCR module, it must be “prepped” in the same manner as the OTSG lower module (i.e. shipping beams removed, erection plates temporarily installed, etc.)



Picture 43: SCR Module Vertical Lift



Picture 44: SCR Module Vertical Lift



Picture 45: SCR Module Placed



Picture 46: SCR Module Internal View

OTSG Upper Module

•The Upper module contains pressure part tubing and the feedwater inlet headers

• Installation of the Upper module can be done using the same procedure as the Lower module outlined previously.

• Prior to installing the Upper module, it must be “prepped” in the same manner as the OTSG Lower module (i.e. shipping beams removed, erection plates temporarily installed, tubes protected etc.)

•The upper modules come equipped with a cabling restraint system that must be removed once the module is installed and secured.



Picture 50: Upper Module Shipping Arrangement



Picture 51: Upper Module Transfer Arrangement

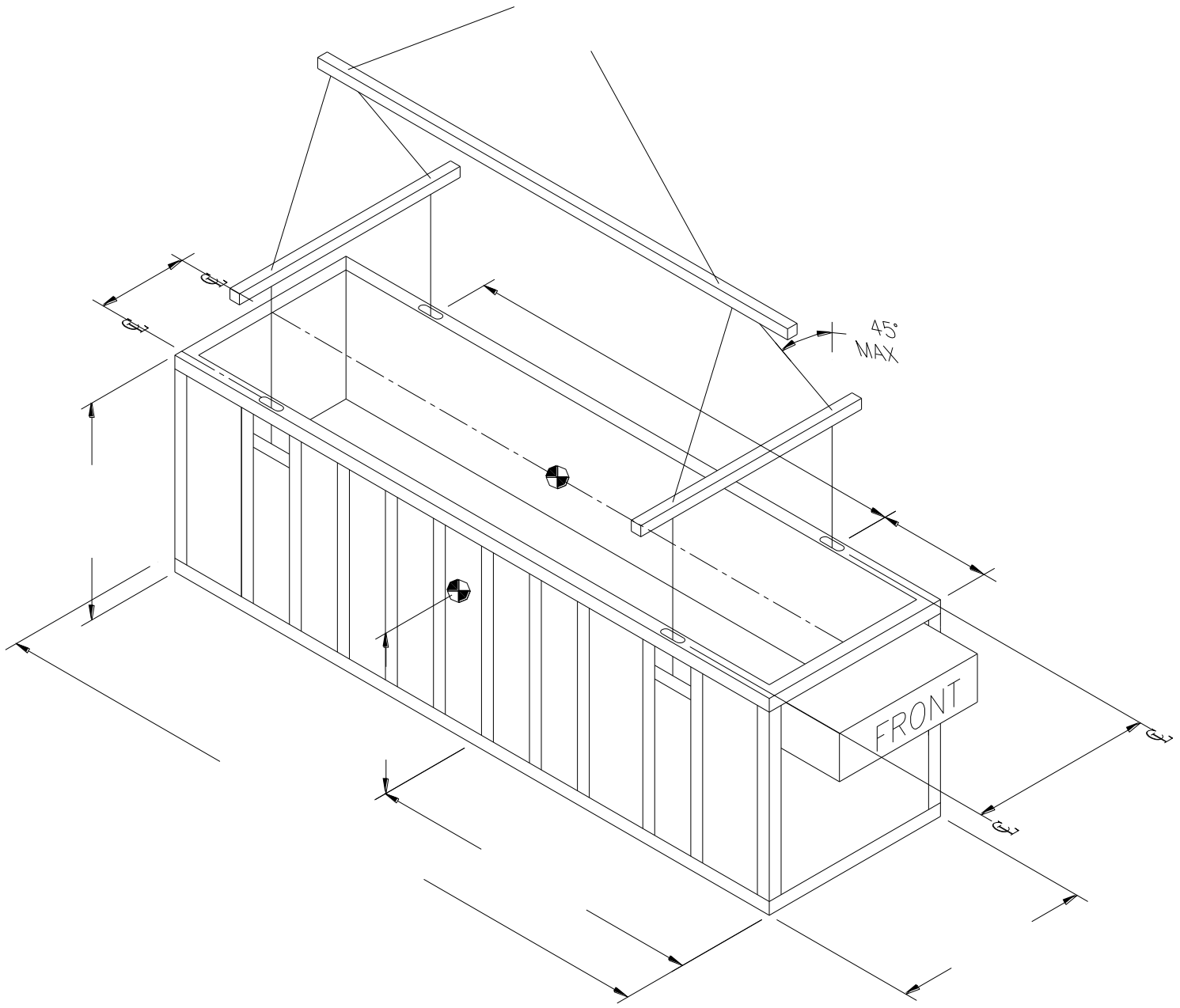


Figure 7: Recommended OTSG Upper Module Lifting Arrangement



Picture 52: Upper Module Vertical Lift (1 crane with 3 spreader beams)



Picture 53: Upper Module Vertical Lift



Picture 54: Upper Module Vertical Lift (2 cranes with 2 spreader beams)



Picture 55: Upper Module Vertical Lift



Picture 56: Upper Module Vertical Lift



Picture 57: Upper Module Vertical Lift



Picture 58: Upper Module Vertical Lift



Picture 59: Upper Module Installation



Picture 60: Upper Module Cabling Restraint

Exhaust Hood Installation

• Check and compare all inside opening dimensions on the bottom of the exhaust hood and top of OTSG module.

• Check the underside of the exhaust hood perimeter beams and top perimeter beams of the module for any obvious obstructions.

• Brackets and scaffold planks with hand railing can be installed prior to lift (optional).

• Prior to installing the Exhaust hood, it must be “prepped” in the same manner as the other modules (i.e. shipping beams removed, erection plates temporarily installed, etc.)

•Corner (4)erection plates can be installed to the upper beam of the exhaust hood. These will connect with the stack. (When applicable)

• Lift, place hood and install all OTSG Module to Hood erection plates. Prior to weld out

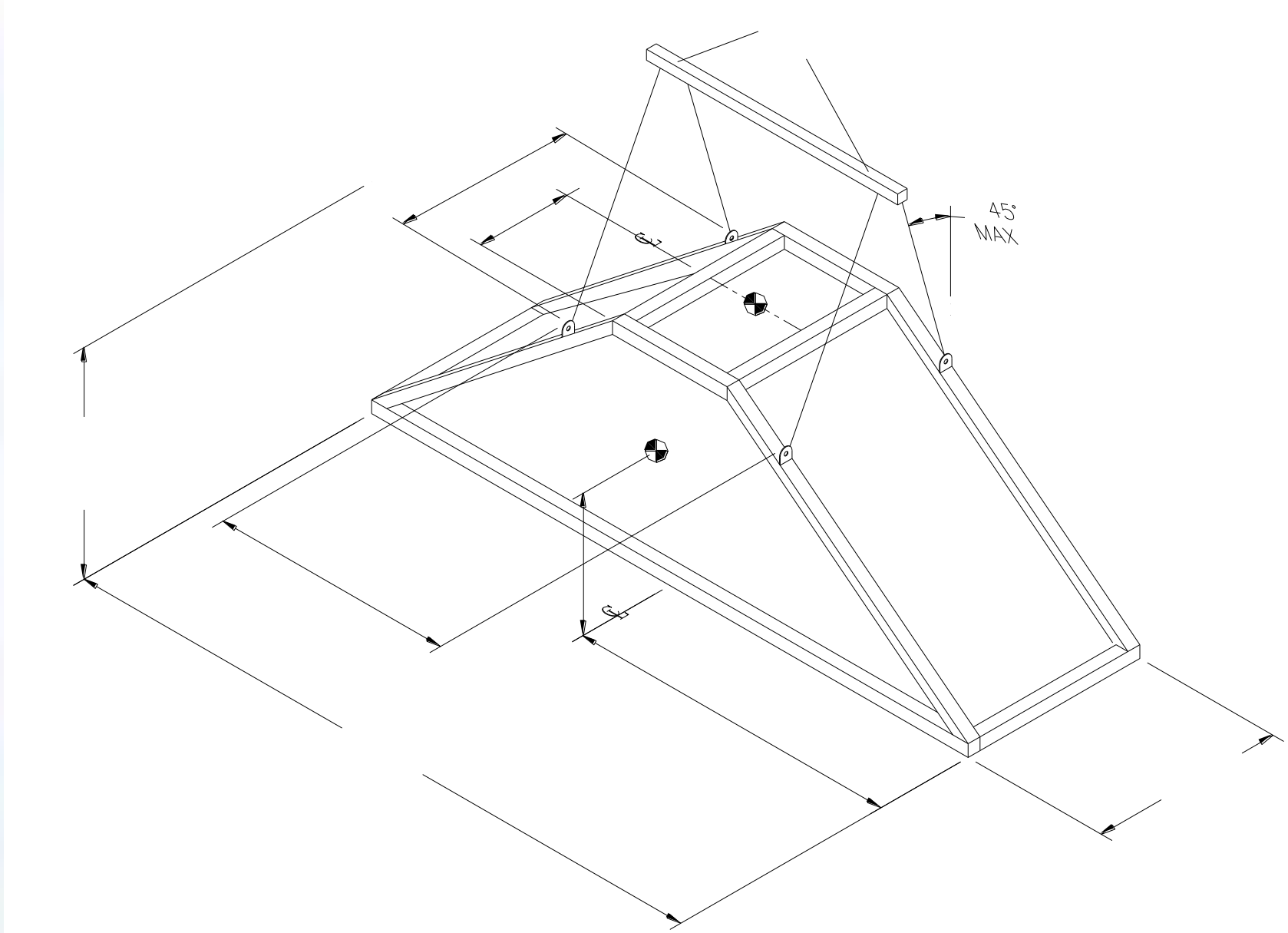


Figure 8: Exhaust Hood Lifting Arrangement



Picture 61: Exhaust Hood Vertical Lift (using 1 spreader beam)



Picture 62: Exhaust Hood in place



Picture 63: Inlet Plenum Vertical Lift (using 2 cranes)



Picture 64: Exhaust Hood Vertical Lift



Picture 65: Exhaust Hood Vertical Lift



Picture 66: Erection Plates - Exhaust Hood to Upper Module

Exhaust Stack

• At site, unload the stack and place it on dunnage such that the strong axis of the top lifting lugs face vertically up.
•If using round stack, adaptor piece and round stack assembly can be assembled at grade.

• Locate position of stack platform attachment clips and weld into place.

• Install the platform, handrails and ladder while the stack is in the horizontal position on the ground (optional).

• Split the lower inlet corners of the stack casing, thus giving it some flexibility for installation into the exhaust hood (optional).

• Lift exhaust stack using 2 cranes; the main crane lifting the 4 lug points at the top and a tailing crane lifting the load at the bottom. Continue lift until the full load of the stack (now in vertical position) is on the main crane boom.

• Raise the stack and insert it into the top of the exhaust hood opening.

• Install the 4 erection plates.

• Full penetration welds are required at the base of each of the 4 corner main structural beams on the stack.



Picture 67: Stack Platform



Picture 68: Stack Vertical Position with Platform Installed

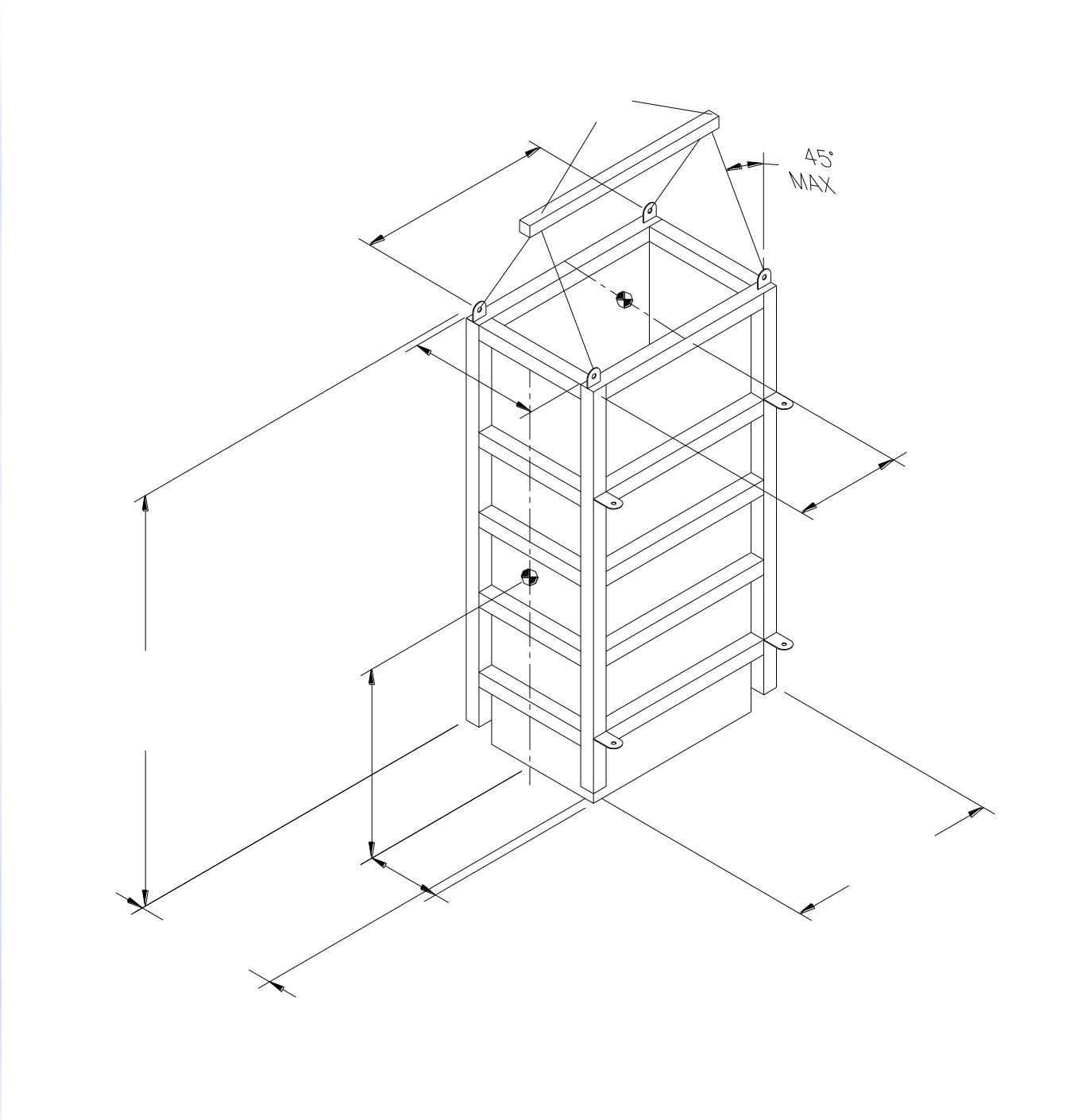


Figure 9: Exhaust Stack Lifting Arrangement (1 spreader beam)



Picture 69: Exhaust Stack Vertical Lifting



Picture 70: Placement of Exhaust Stack



Picture 71: Stack Column Structural Welding



Picture 72: Exhaust Stack Installed

Stack Damper

- Stack dampers are required to be installed if an SCR system is supplied with the OTSG.
- There are two main purposes of the stack damper…
    1) Protect the SCR Catalyst from moisture.
    2) Retain heat in the OTSG.
- The stack damper can be installed immediately after the stack is in place and secure.
- The damper is to be secured onto the stack lifting plates using the hardware provided.
- Lifting lugs are provided on the damper frame for lifting and to assist with installation.
- The damper actuator is shipped loose to prevent damage, but should be mounted to the damper prior to lifting it atop the stack.
- Rain skirt liner panels are also shipped loose and are to be bolted into position after the damper is secured in place.
- Once installed, stroke damper open and closed to check for proper operation.



Picture 73: Typical Stack Damper



Picture 74: Stack Damper Lifting Arrangement



Picture 75: Placement of Stack Damper

Inlet Transition Duct Installation

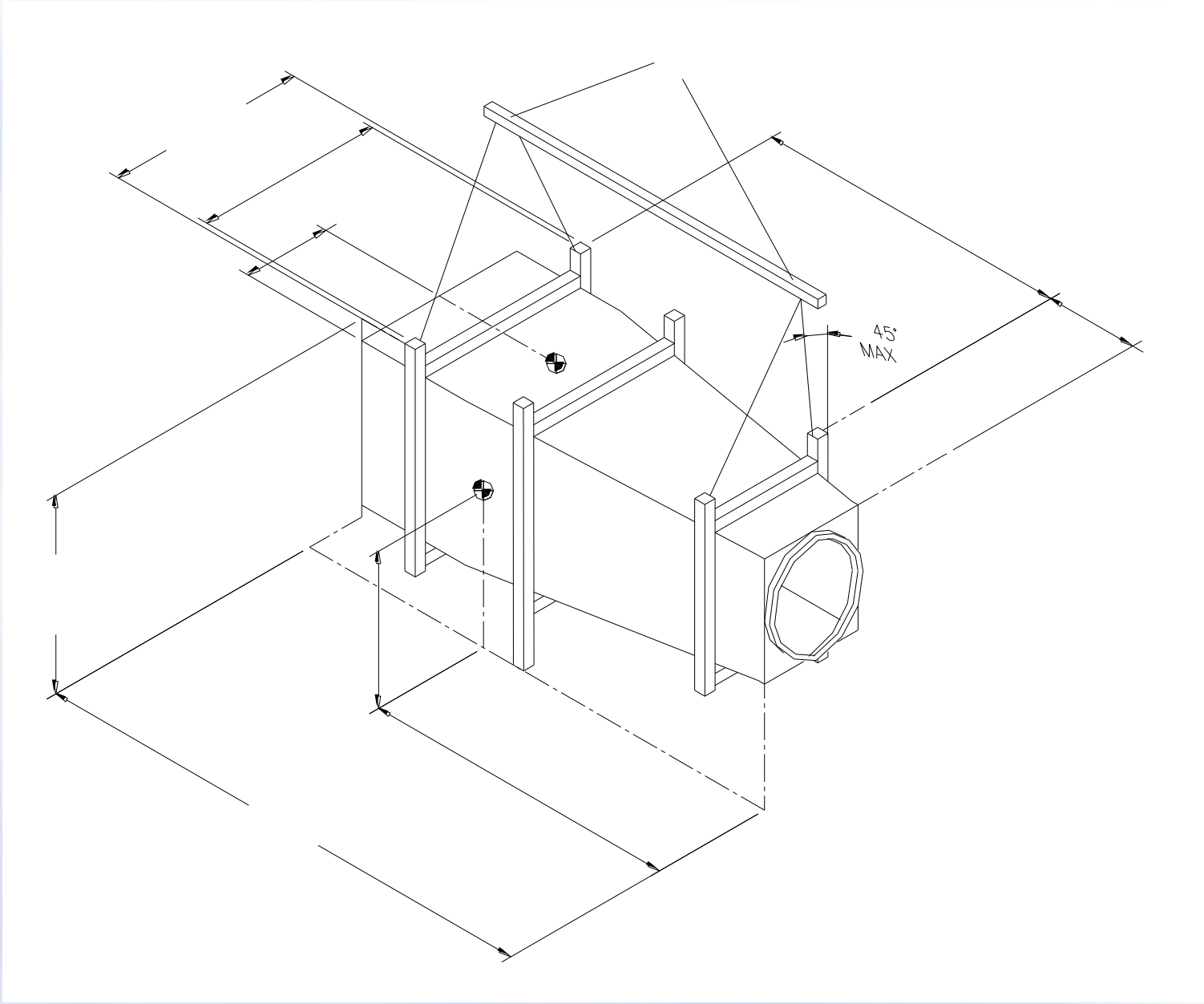
•Place insulation and JAKS inside the inlet plenum for joint between inlet plenum and inlet duct.

• Lift the inlet duct per recommended arrangement.

•Ducting installations are is slip fit connections. While still on the hook of the crane, pull the inlet duct into the inlet plenum opening with come-a-longs.

• Check to ensure all ducts are centered over the base plates in both directions. At the inlet plenum to duct interface, the edge of the duct casing should line up with the plenum bottom horizontal column center-line.

•Check the inlet duct center alignment with the gas turbine centerline and compare distances points on the inlet duct and gas turbine flanges:
(top, bottom, left side & right side).



Inlet Transition Duct Lifting Arrangement (using 1 spreader beam)



Inlet Transition Duct Vertical Lift



Inlet Transition Duct Installation



Inlet Transition Duct Installation

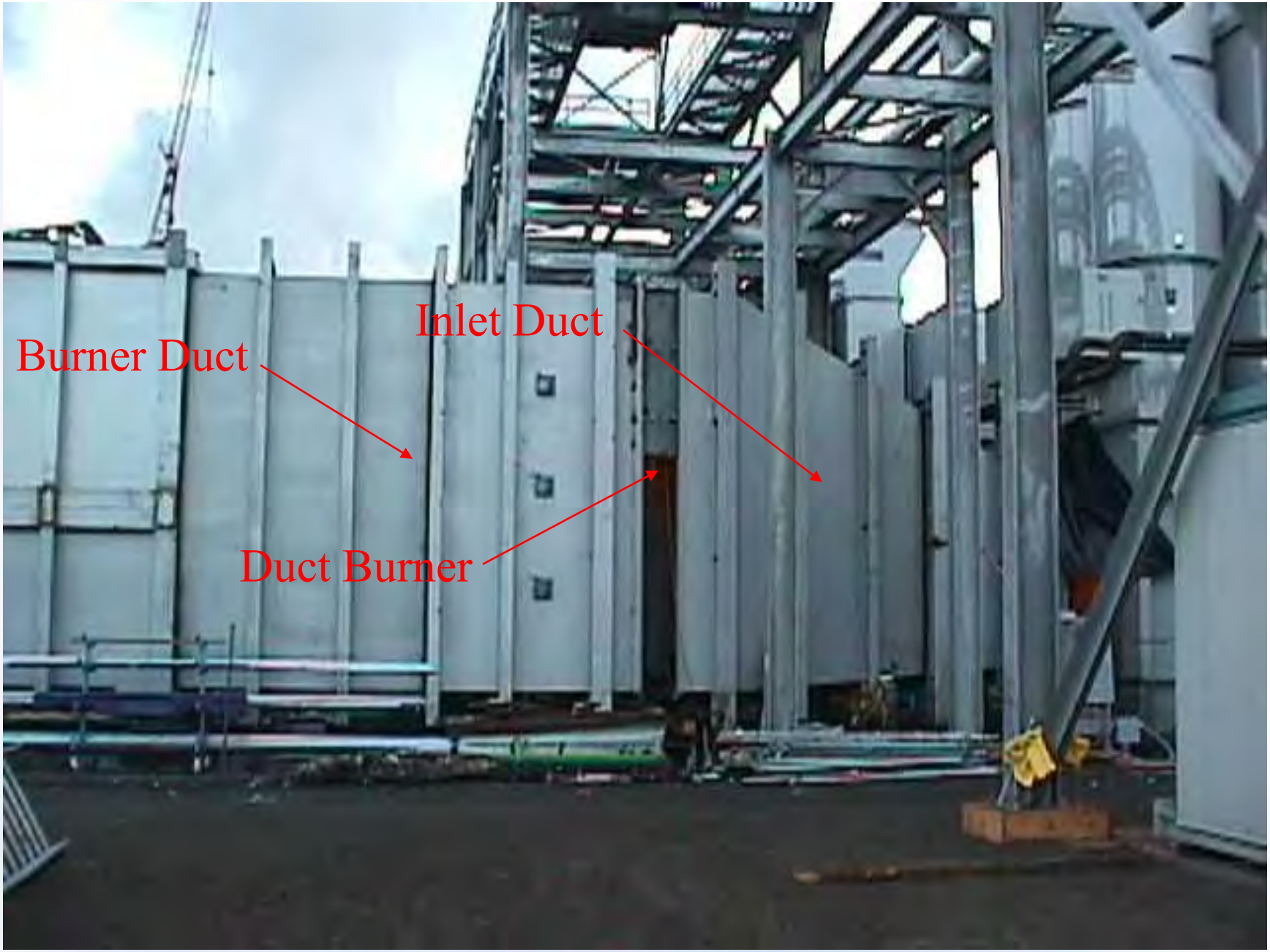
Inlet Duct Design Applications

•Inlet ducting can be design to incorporate various design options. Some of these are as follows…

1. Inlet Transition duct only
2. Inlet duct incorporating duct burner and burner ducting
3. Inlet duct with silencer.
4. Inlet duct with flow screen.
5. Any combination of items 1 & 2 with items 3 & 4.

• If a duct burner is to be installed, the burner assembly and a separate burner ducting will be installed between the inlet duct and the inlet plenum. Burner ducting is to be installed in the same manner as the inlet plenum.

•Flow screens and silencers can be applicable without duct burners. When installed with a duct burner, they are always installed upstream of the burner.



Inlet Ducting with Burner Duct and Duct Burner

Expansion Joint Installation

•Hardware is supplied with the expansion joint installation. Check that all hardware is available.

• Ensure temporary lifting lug for expansion joint is on the top center-line.

• Apply gasket tape to the both side faces of the expansion joint.

• Lift and place the expansion joint between the GT exhaust flange and the OTSG inlet transition duct flange (ensure correct flow direction).Note: the expansion joint is preset in a compressed position.

• Securely bolt the expansion joint to the GT exhaust flange.

Expansion Joint Installation

• Loosen the preset bars on the expansion joint and allow the joint to expand to the inlet duct flange.

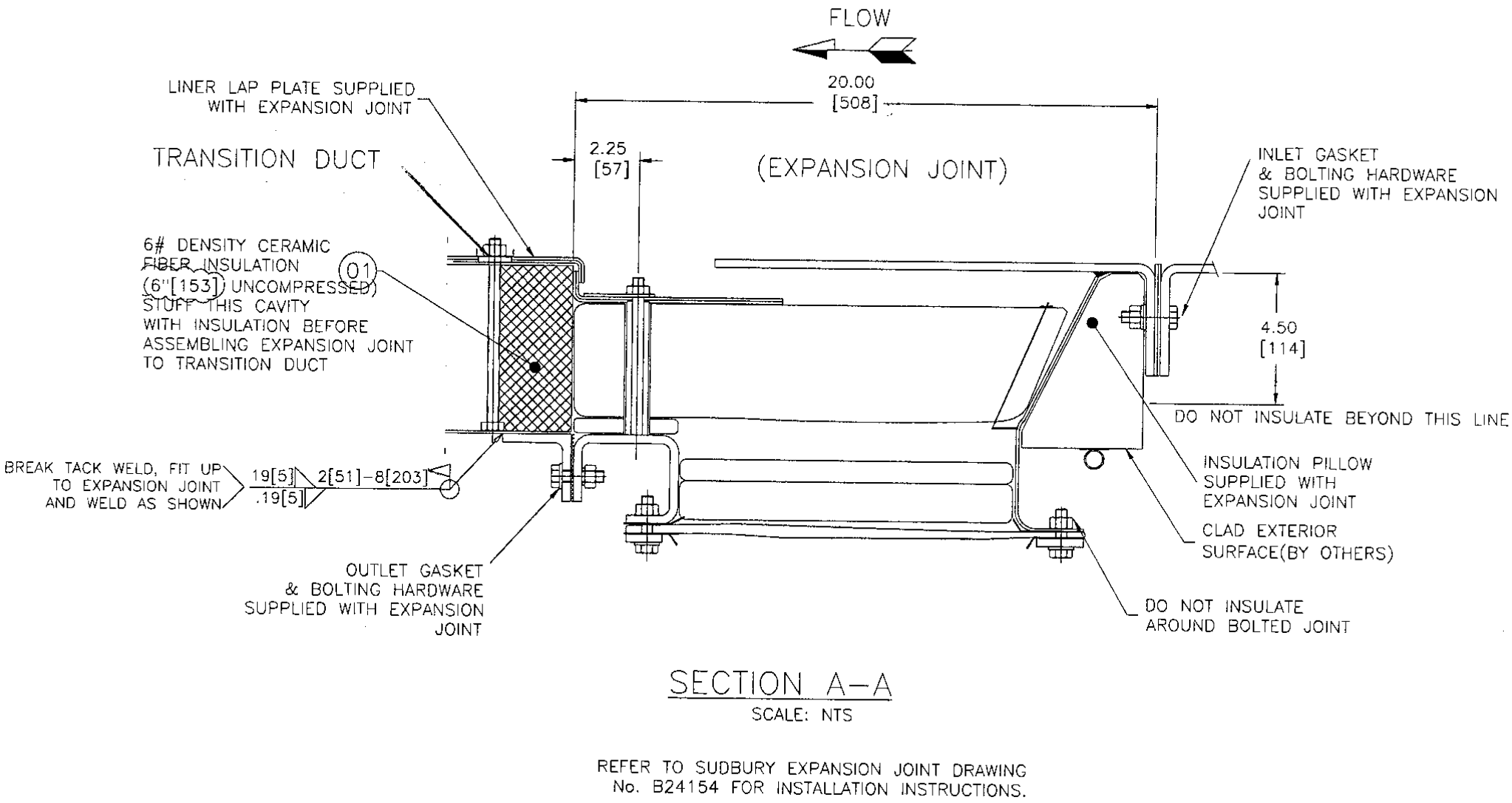
• Securely bolt the expansion joint to the inlet transition duct flange.

• Once flange bolting is entirely completed remove expansion joint preset bars.

• Internally there is a void between the expansion joint and the transition duct insulation. Fill this void with insulation.

• Install closure liner plates (supplied with the expansion joint) that close the gap between the transition duct liner plate and the expansion joint liner plate.

• An insulation pillow is supplied with the expansion joint. This is to be externally installed on the expansion joint beside the inlet flange (Refer to the vendor instructions). Cladding should be installed (by others) over this external insulation pillow.



SECTION A–A

SCALE: NTS

REFER TO SUDBURY EXPANSION JOINT DRAWING No. B24154 FOR INSTALLATION INSTRUCTIONS.

Cross Section - Expansion Joint



Expansion Joint installation



Expansion Joint Preset Bar

OTSG Module Internal Works

•Extreme care must be taken to prevent any possible damage to the pressure tubing.

•Prior to performing any work on top of any OTSG Module, tubes are to be covered with plywood and fire blankets.

- •Failure to do so could result in warranty invalidation.

•Do not support heavy equipment on the tubes and ensure that loads are evenly spread over multiple tube surfaces.

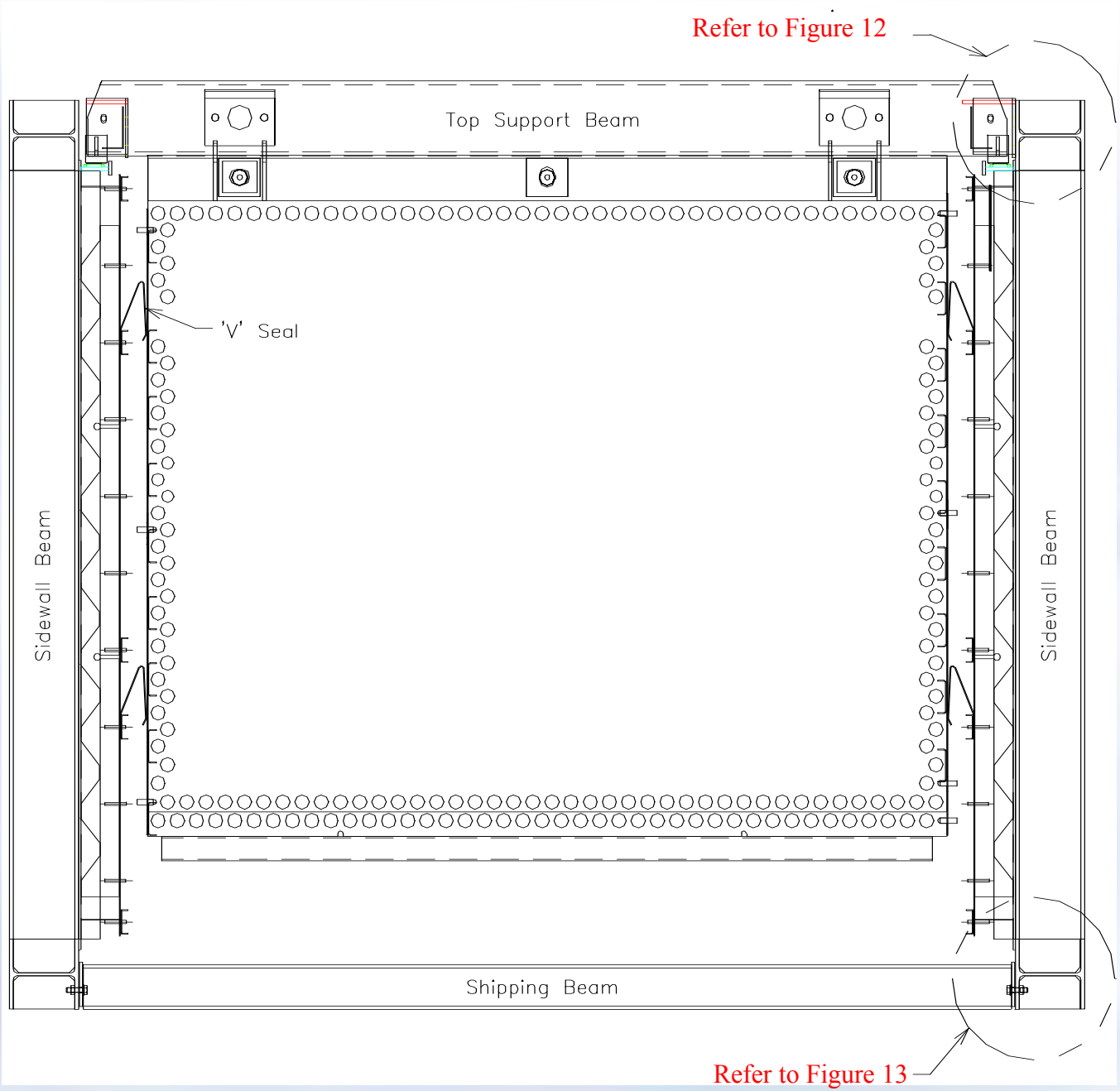
- •Pressure Part Top Support Beam
- •Joints Assembly Kits (JAKS)
- •Restraint Adjustment

Top Support Beams

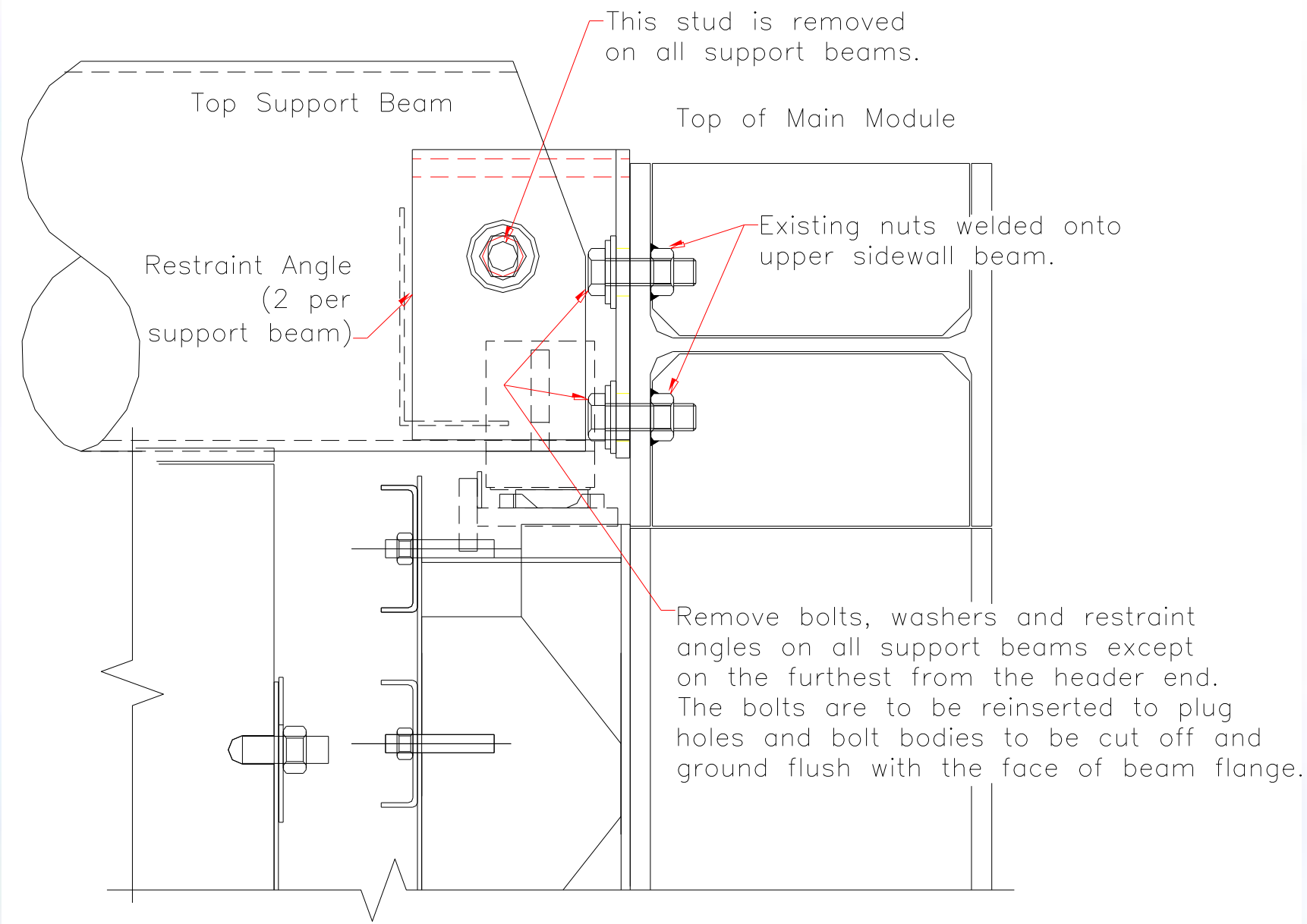
•Remove painted yellow shipping angles from the tubesheet support beams. This will involve removing two bolts that tie into the casing and one stud that attaches into the round support beam.

• On the rear-most support beam (farthest from the header end). Do not remove the angles at this location. Instead, leave in place the bolts tying into and remove the stud that ties into the round support beam.

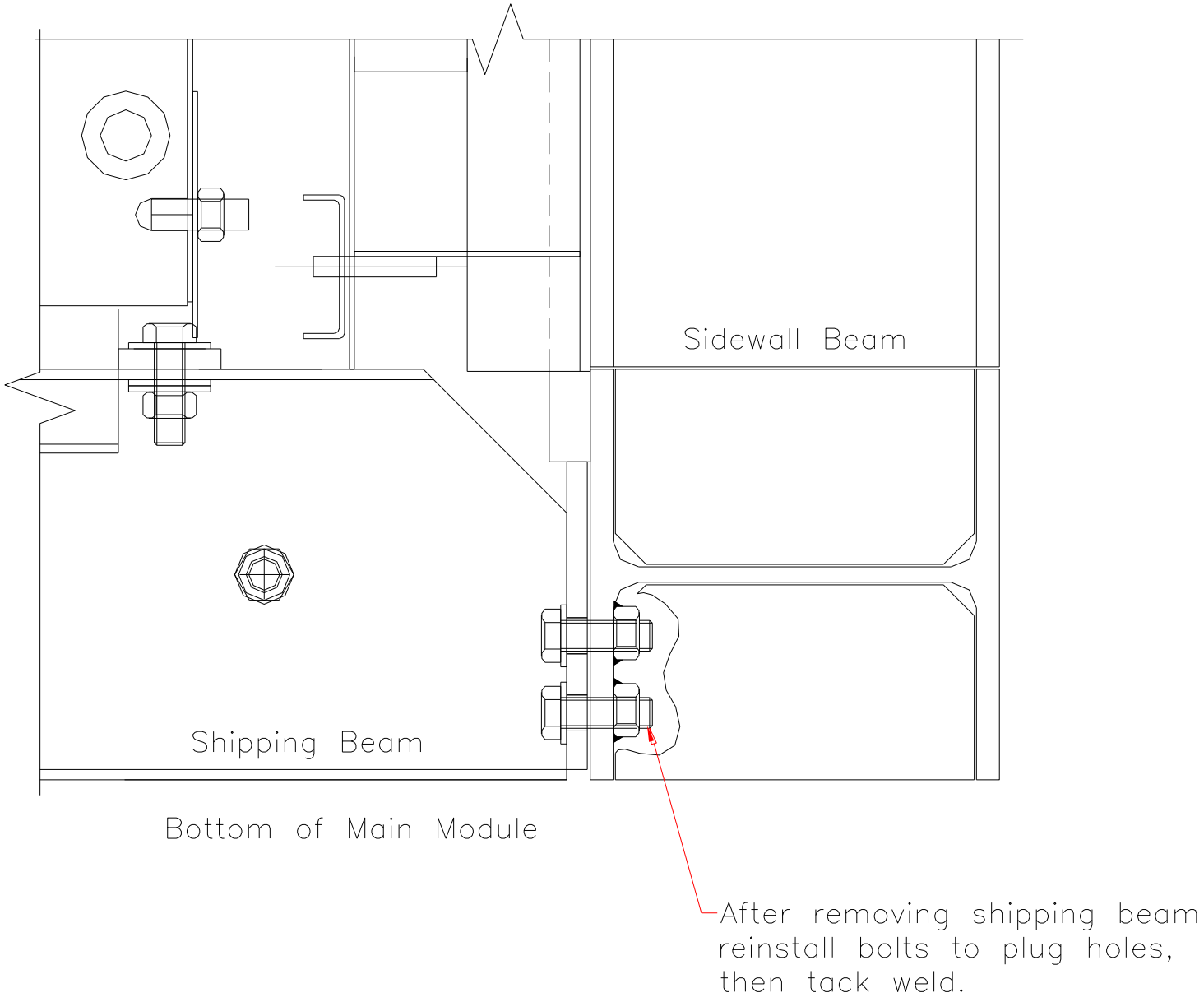
• At all locations where the shipping angles have been removed, reinsert the bolts into their respective holes, cut heads off with a grinder and seal weld.



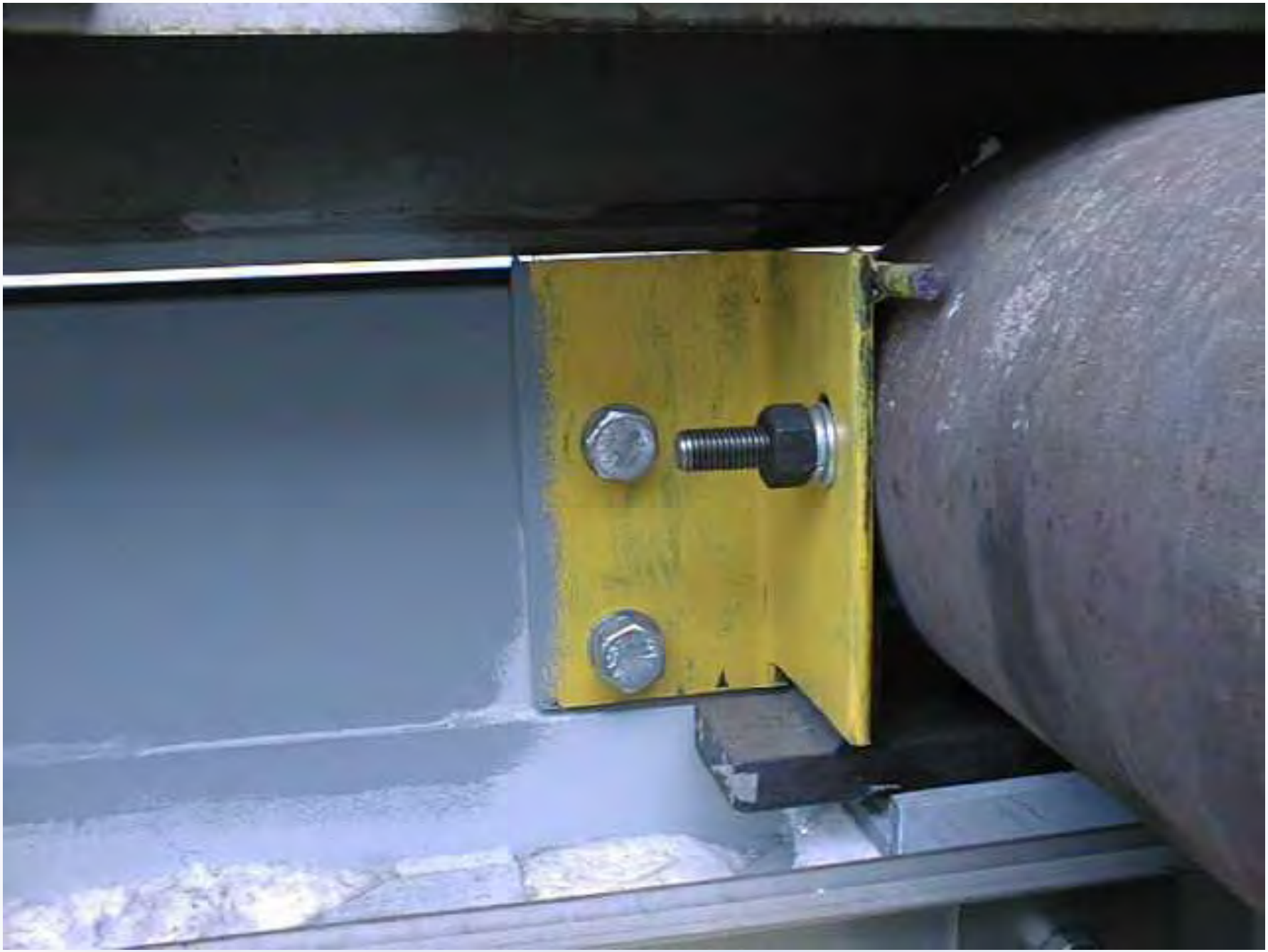
Typical Cross Section - Lower Module



Top Support Beam Restraint Hardware Removal



Shipping Beam Removal



Shipping Angle



Top Support Beam & Shipping Angles

Internal Perimeter Joint Welding and Joint Insulation Kits

NOTE: These instructions are typical for all ducting-to-ducting, ducting-to-module and module-to-module joints. JAK – Joint assembly kits

•Remove all remaining shipping beams from the ducting / module and close the bolt-holes at these shipping beam locations by reinstalling the removed bolts and seal welding them into place.

• Seal weld the internal perimeter joint between the two components.

• Remove existing internal liner hardware (channels, nuts, and washers) all around the perimeter on either side of the joint for JAK kit Installations

• Install 3 layers of ceramic fiber insulation into the joint. Ensure insulation ends are tight against one another and that seams are overlapping.

• Install Joint Assembly Kit (JAK) liner panels in correct sequence. Nuts are to be installed “snug” tight, backed off 1/4 turn then tack welded in place.



Inlet Plenum & Lower Module



Insulation between Module & Exhaust Hood



Insulation between Module & Exhaust Hood



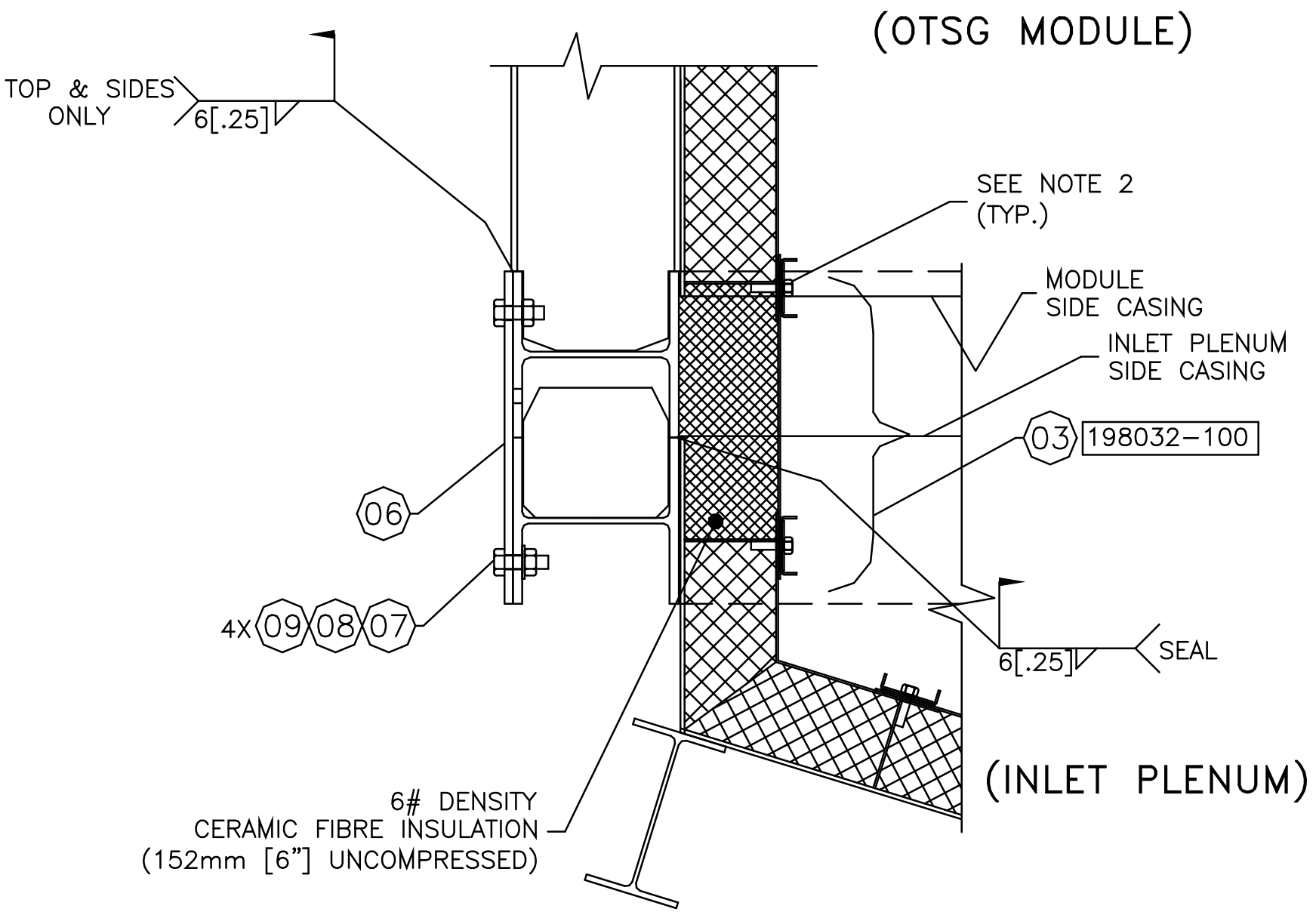
Joint Assembly Kit (JAK) Liner Panels



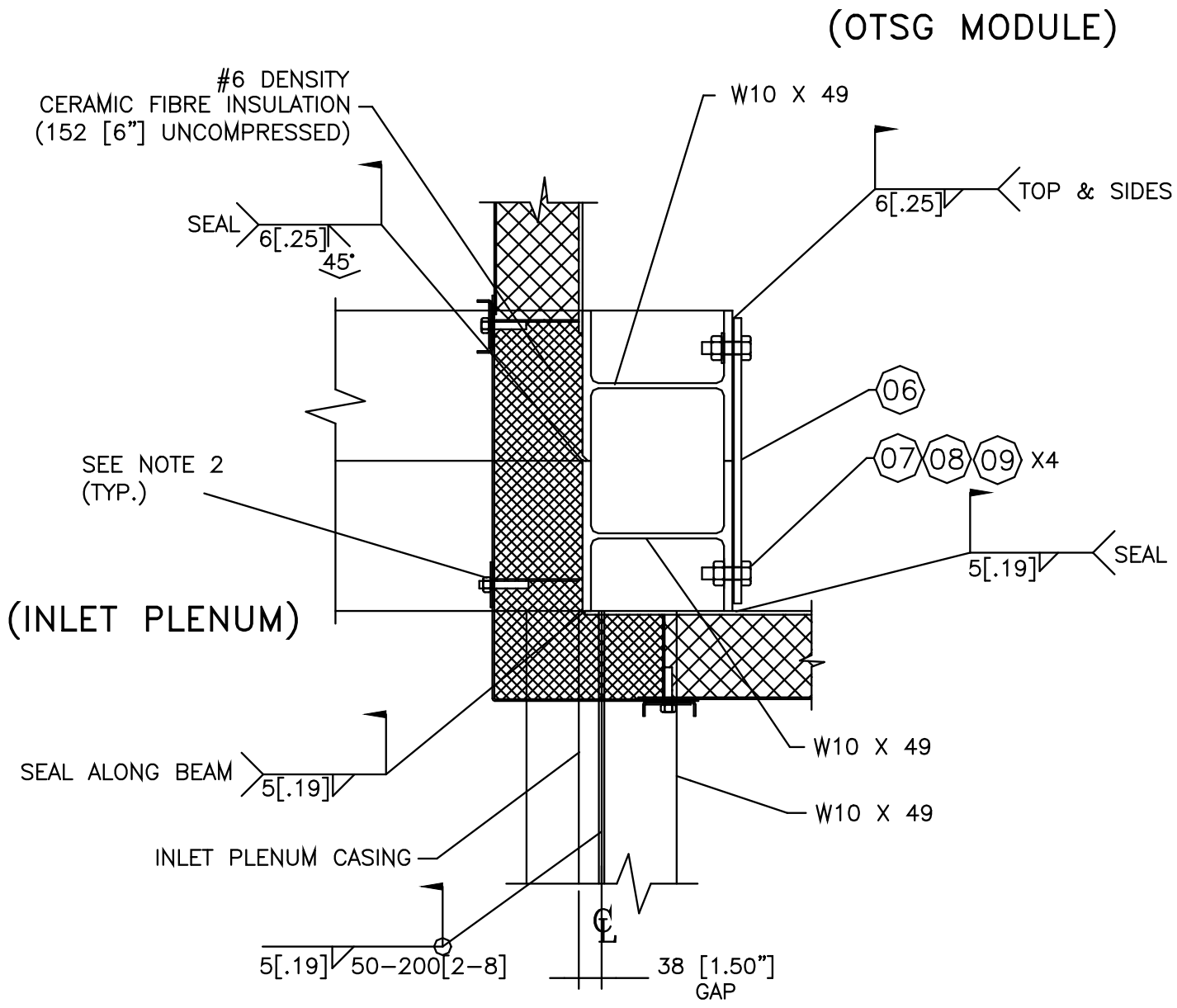
Picture 91: JAK Liner Panel



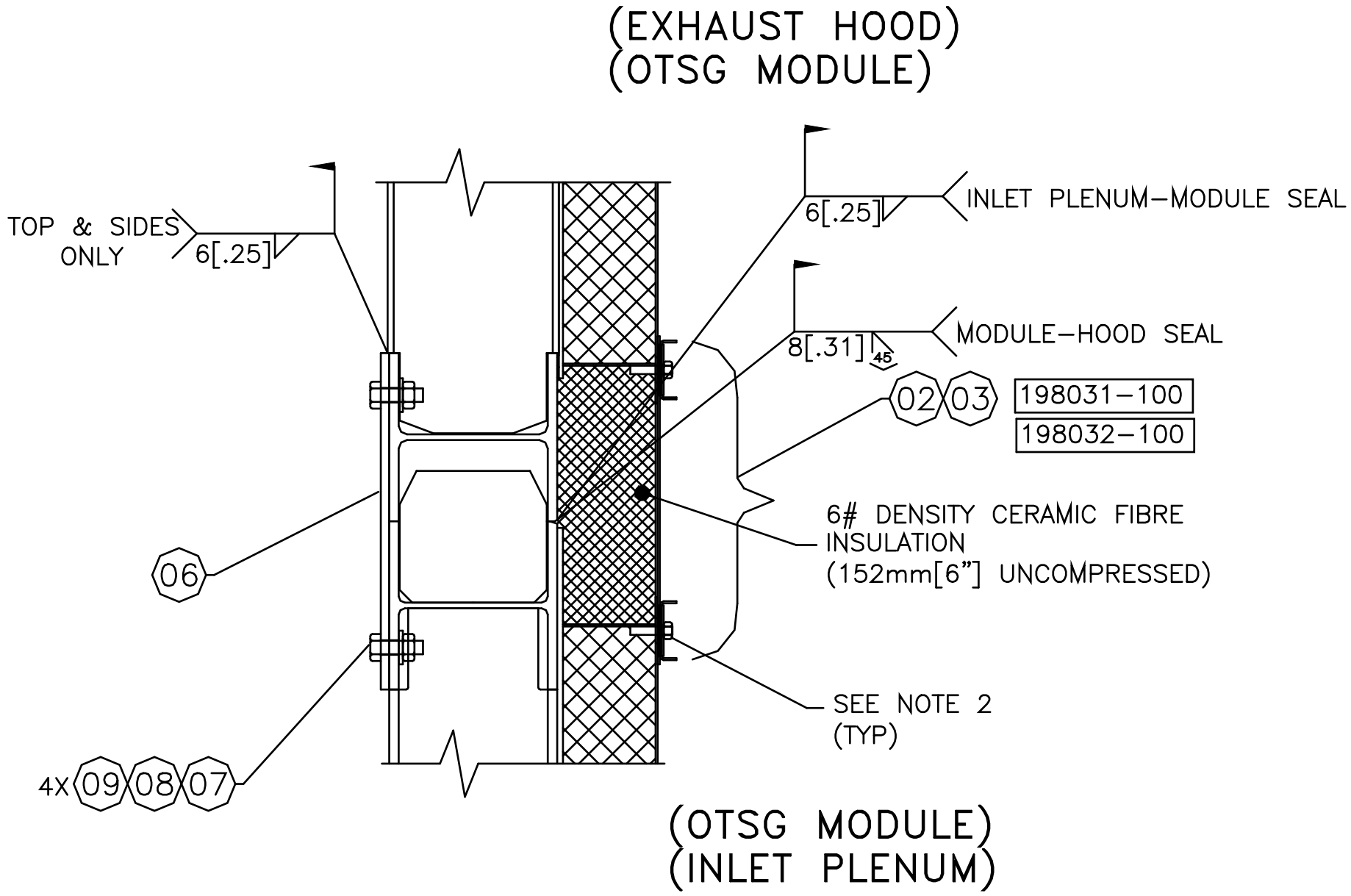
Installed JAK



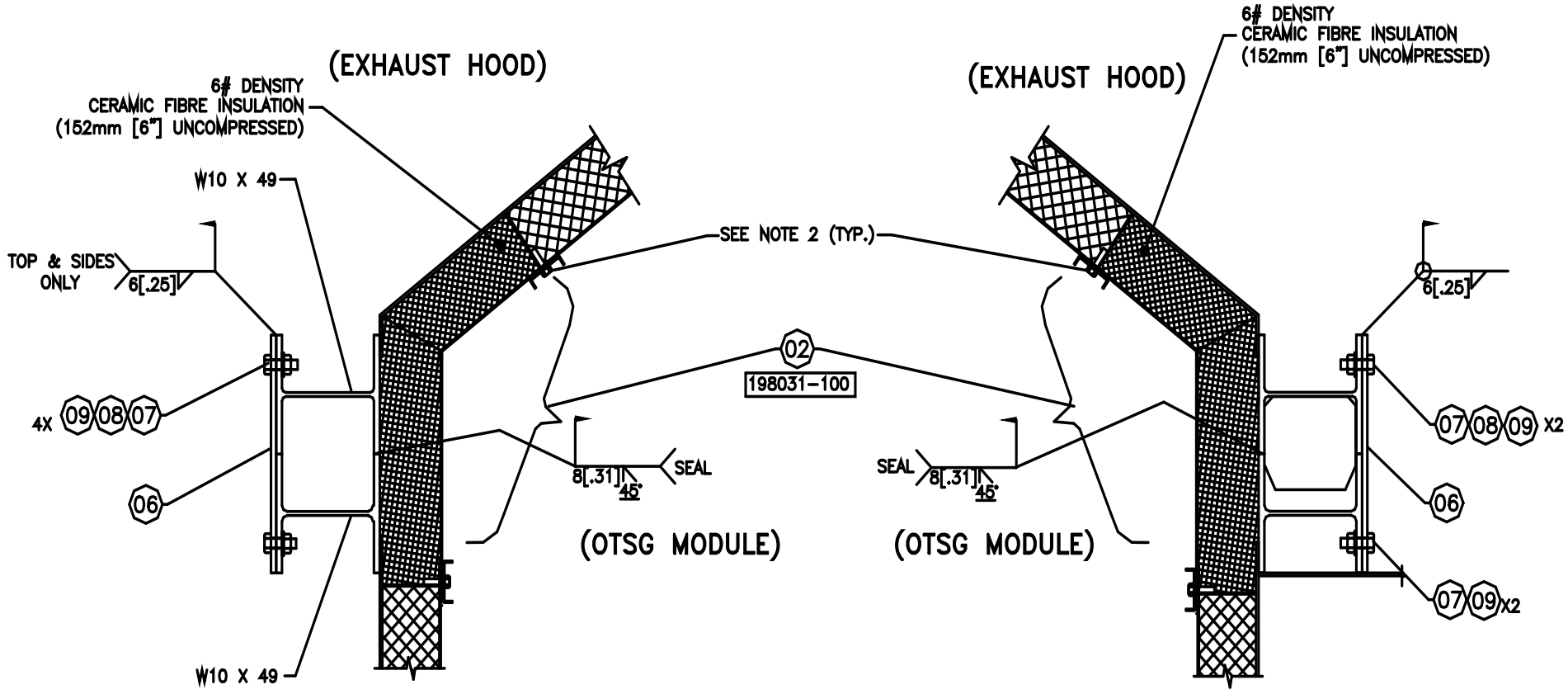
Rear Inlet Plenum & OTSG Module



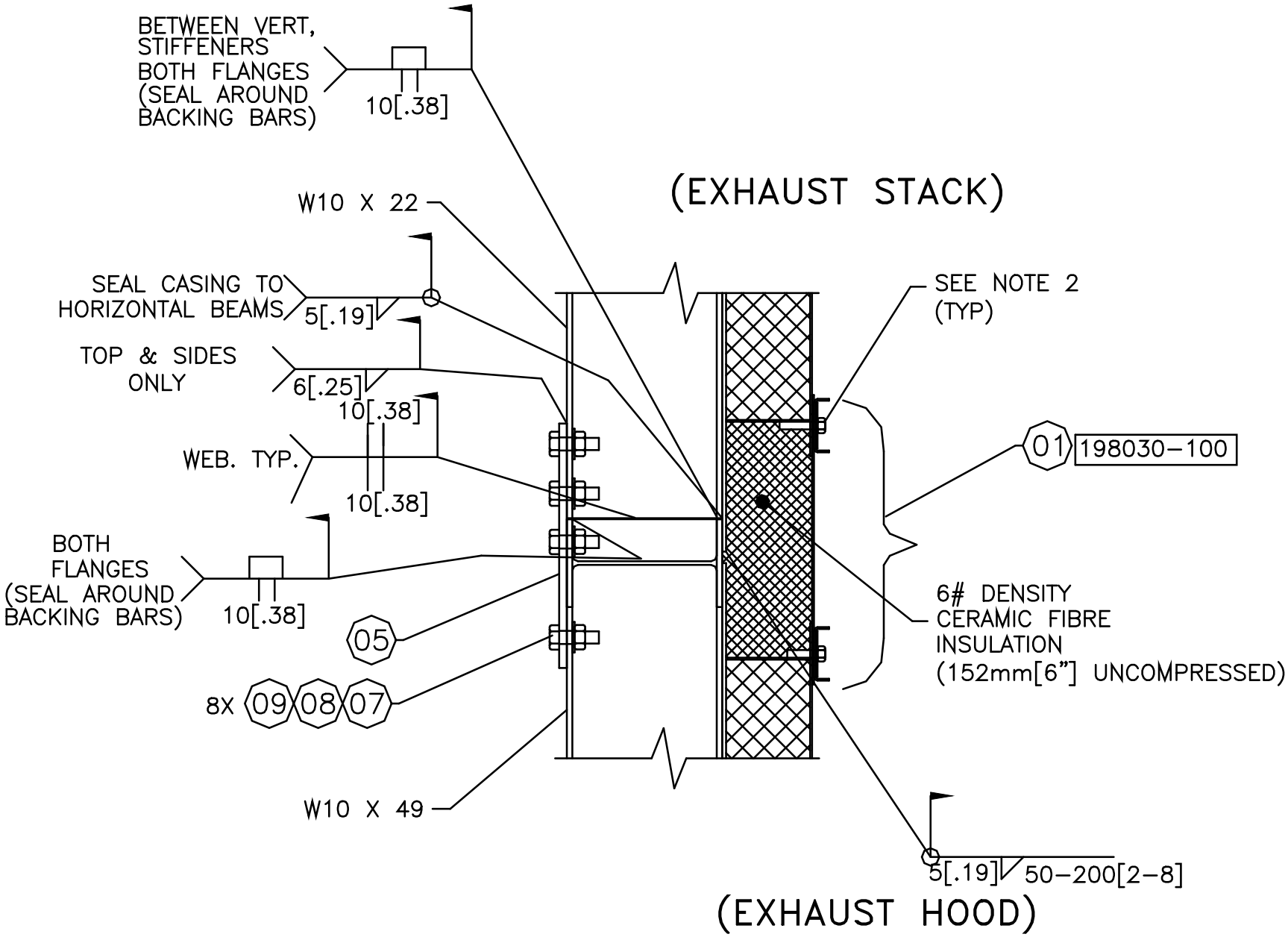
Cross Section - Front Inlet Plenum & OTSG Module



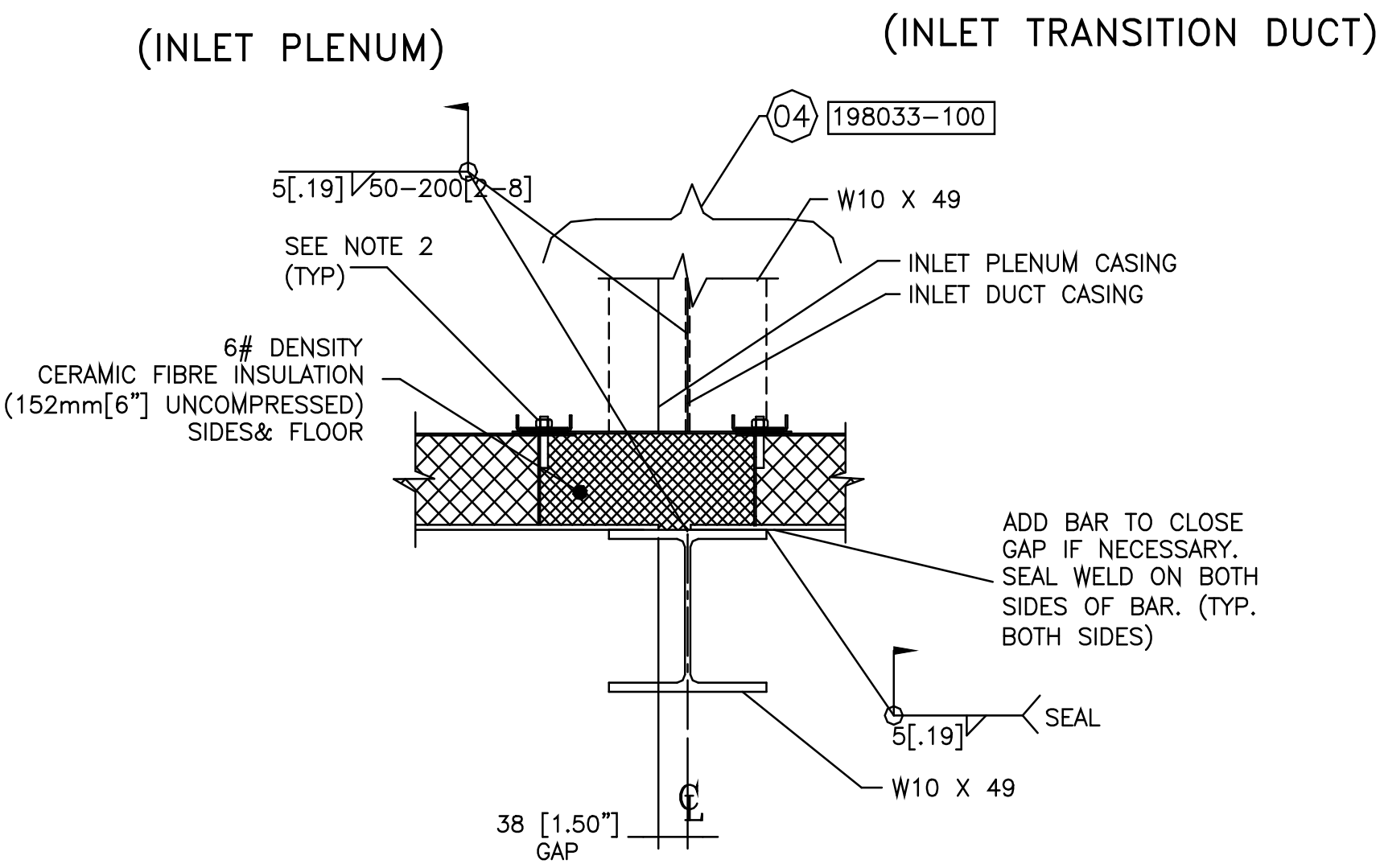
Typical Cross Section - Left & Right Side OTSG Module & Exhaust Hood



Typical Cross Section - OTSG Module & Exhaust Hood



Typical Cross Section - Exhaust Hood & Exhaust Stack



Joint Cross Section - Inlet Plenum & Inlet Duct

Pressure Part Restraint Adjustment

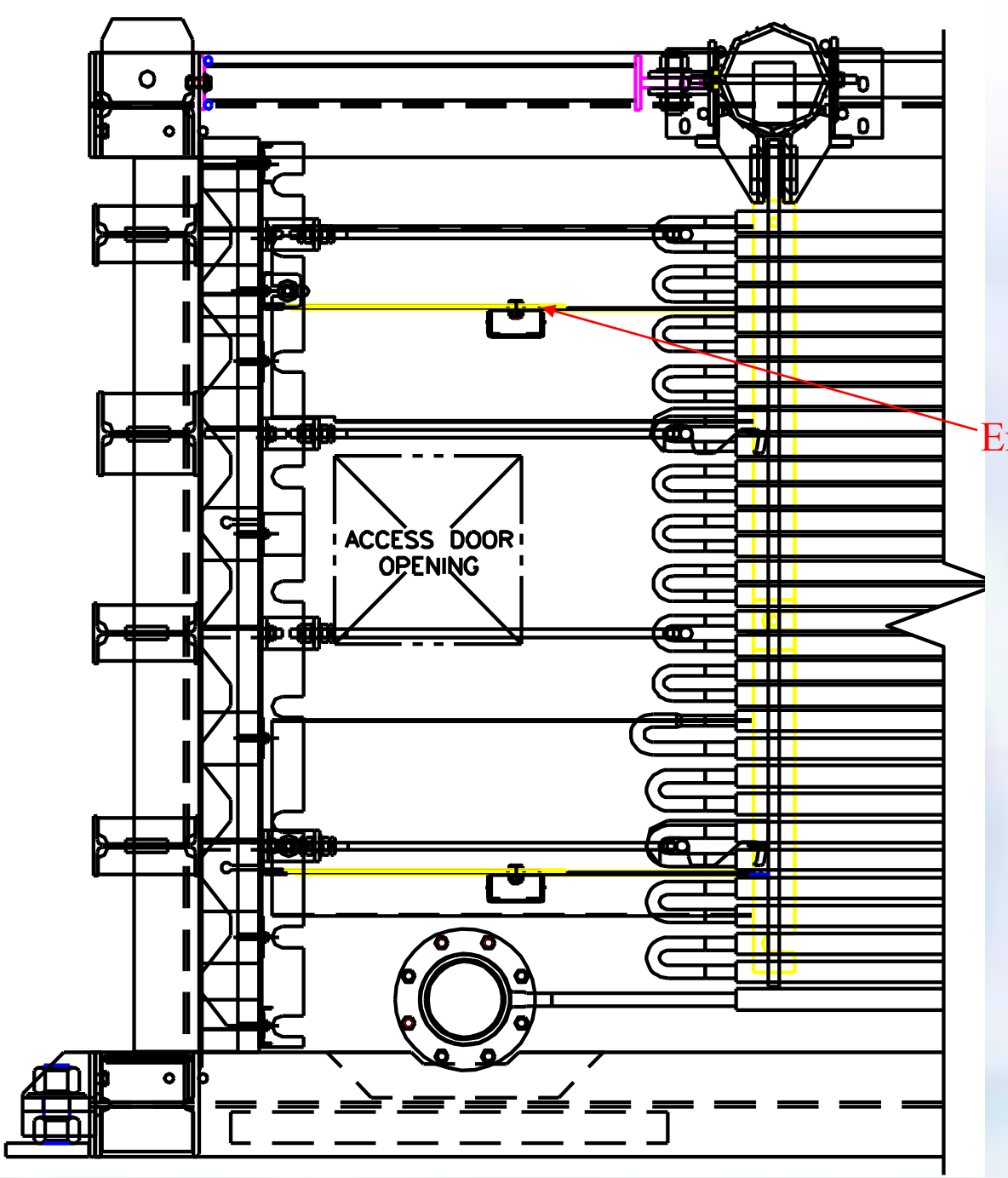
•After internal seal welding is complete and JAKs installed, the OTSG module tube bundles have restraint hardware that require adjustment.

• To protect the tubes during shipping, rubber has been installed on the inside radius of the return bends at all restraint rod levels and must be removed at all levels, both front and rear of each module.

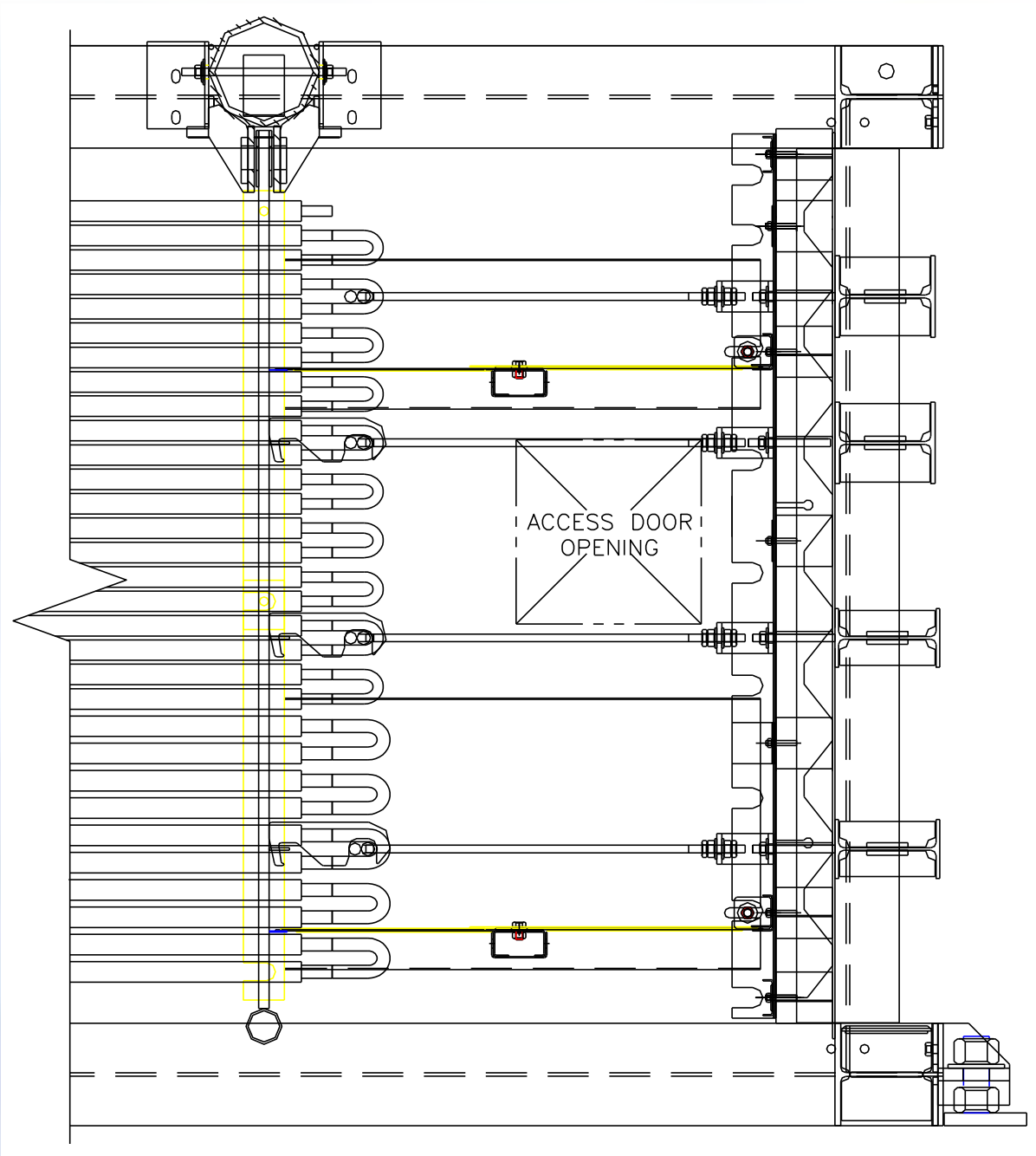
• When the protective rubber is removed, all restraint rods will require adjustment according to the erection instructions.

•It is critical not to over tighten and to maintain the required gaps. Refer to the erection instructions to obtain the required gap for restraint rod adjustment.

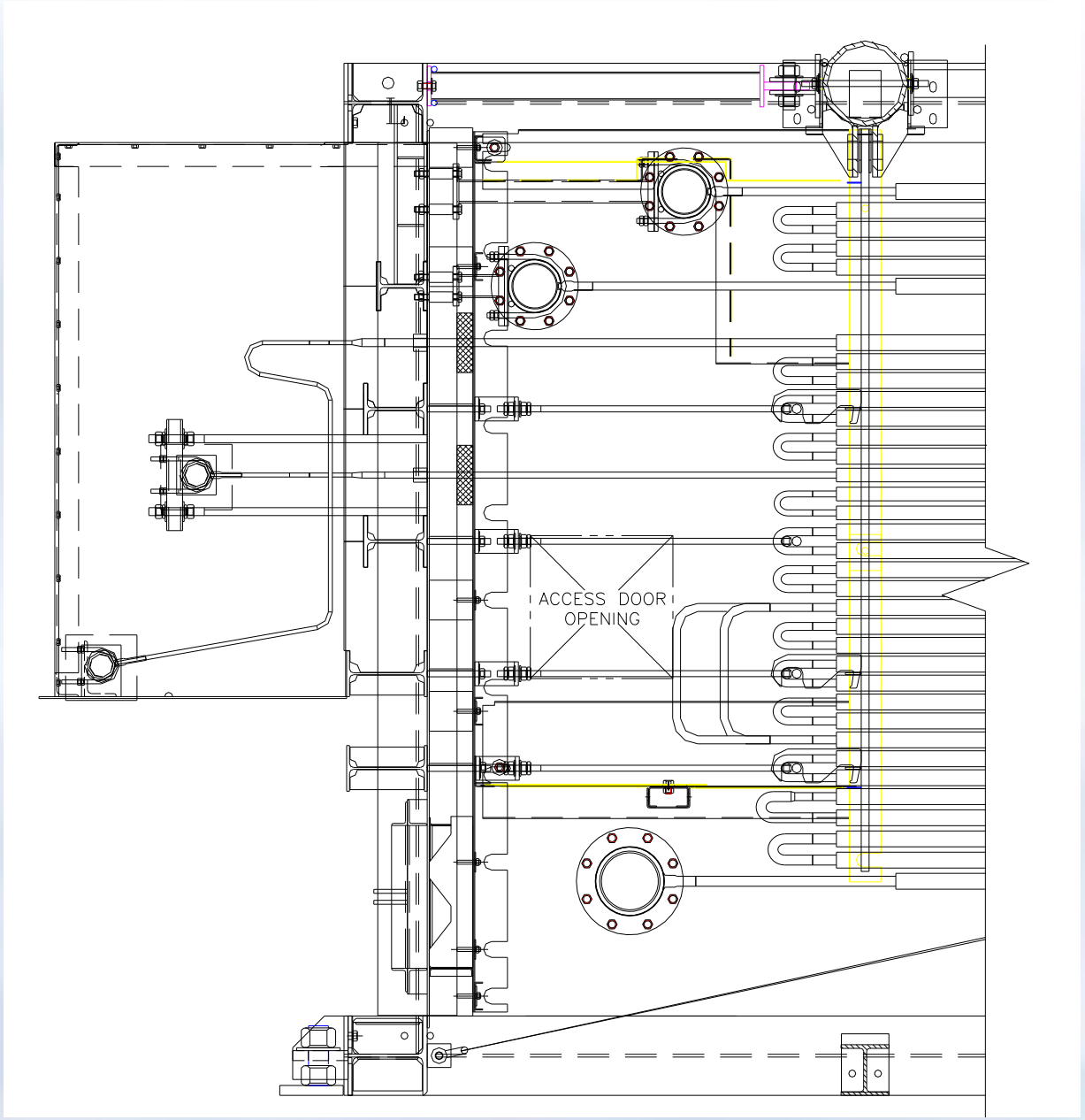
• In order to access all levels of restraints, some endseal panels will need to be removed. Ensure all panels are reinstalled immediately after the restraint is adjusted.



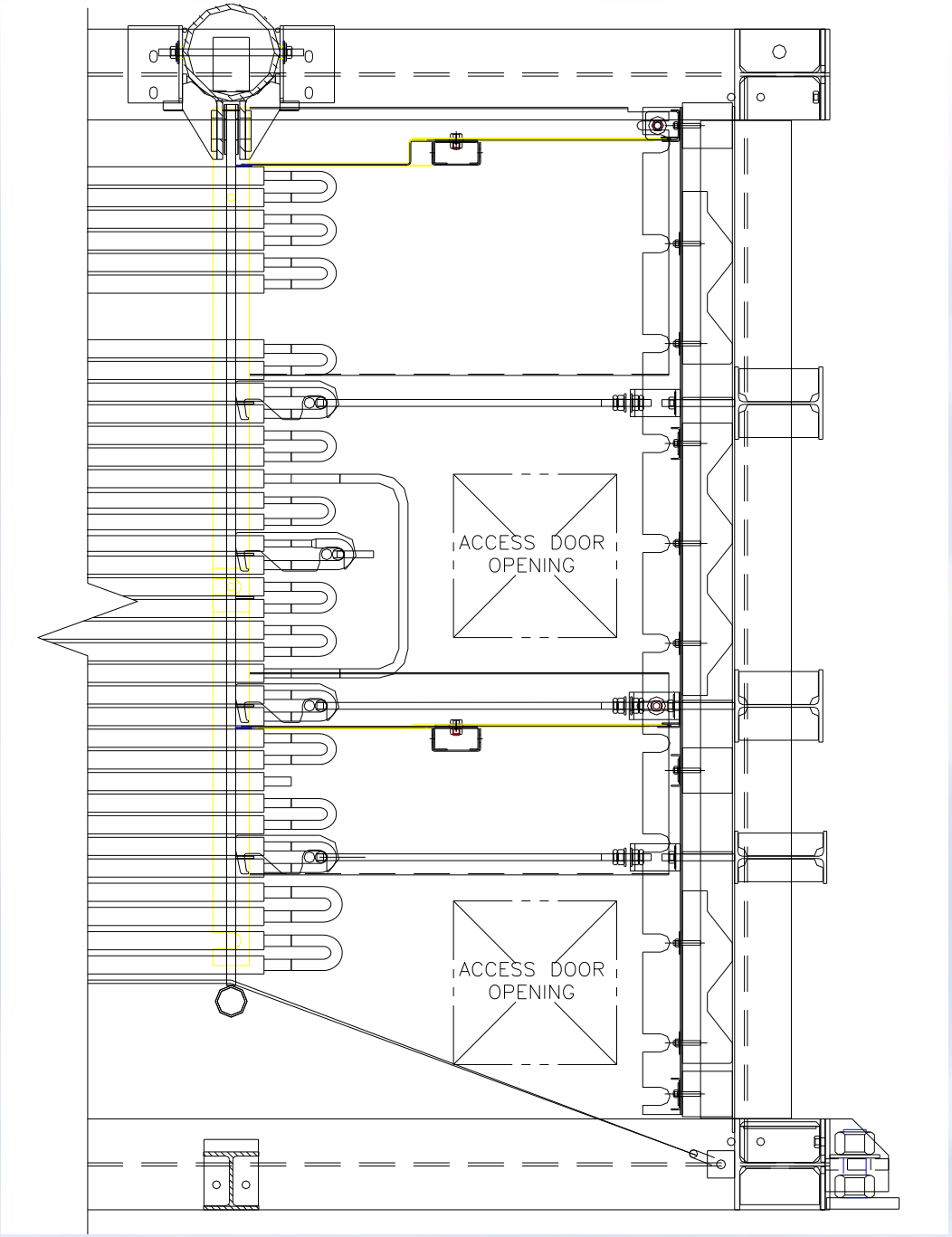
Restraint Rods & End Seals; Module Front End



Restraint Rods & End Seals; Module Rear End



Restraint Rods & End Seals; Module Front End



Restraint Rods & End Seals; Module Rear End



Module Cabling Restraint Inserted rubber protection



Typical Restraint System

Platform Steel Installation

•Typically, platform steel is installed after major components are in place.
    •Occasionally in high seismic zones, the platform steel must be installed before the hood and stack are in place.

•Clips are welded to the platform beams and the platforms are support off the OTSG vertical beams and columns.

• Pre-assembly of structural steel columns and beams should commence on the ground.

• Stair stringers, treads and small platform sections should be pre-assembled in the lay-down area to reduce installation time.

• Install grating. In the case of piping/conduit penetrations though grating, the contractor is responsible for cutting the grating and installing any kick plate protection.



Platform Columns & Horizontal Support Members



Platform Structural Members



Platform Steel Installation



Platform Steel Installation



Ladder to Grating Connection Detail

Rail Car Tie Down Lug Removal

The OTSG modules have large shipping lugs attached to the end wall casing to facilitate rail transportation to site.

One, or more, of these shipping lugs may require removal to allow installation of the front platform section. Removal can be done using a torch and the lug can be removed either when the module is on the ground or once it has been installed into position.



Module Shipping Lugs

SRV Vent Silencer Installation

•Ensure that the SRV vent silencer support steel is installed completely and secure.

• Prior to installation confirm measure the distance between holes on the silencer support pads and the support structure.

• Check orientation of the SRV vent silencer against drawing.



SRV Silencer Lift (using 2 cranes)



SRV Silencer Lift (using 2 cranes)



SRV Silencer vertical Lift



SRV Silencer Support

Piping Installation

• Piping installation cannot proceed until the platform steel is in place.

• Check to ensure that piping, valves, supports and hardware are available. Inspect all equipment prior to installation for damage.

• Do not remove protective end caps any piping until necessary.

• Ensure that the safety relief valves hydrostatic test plugs have been installed prior to hydrostatic testing and that all drain connections have been properly piped.

• Check that the SRV vent pipes are secure and check that sufficient clearance exists, between the safety valve discharge elbow and the inside of the vent pipe, to allow for thermal expansion.

• Ensure valves are installed in the correct flow direction. Motorised and pneumatic valves should be checked for proper operation. Operate the valves to ensure the linkages do not bind.

Piping Installation

•Check that pipe orifices and/or flow devices are properly installed.

• Ensure that all flange bolts are tight and that proper gaskets have been installed.

•Check that all drains and vents are free of obstructions and that the lines have been properly supported. Ensure all vent piping has been properly routed and is pointing safely away from access platforms.

• Check all pipe supports. Ensure that guides act only as guides and that any spring hangers are properly set in the "cold" position and shipping blocks removed. Refer to IST piping drawings.

• All temporary supports and bracing, installed for erection, must be removed before OTSG operation. Note: Do not weld temporary supports to steam piping as it will create internal stresses. This is a stress relieved vessel!

• All sampling ports off the OTSG casing and the drain connection on the bottom of the inlet plenum should be capped.

Piping Installation

•All blanking plates used for hydro testing or cleaning should be removed.

• Ensure in-line strainers are installed in the feedwater piping. Strainers will prevent plugging of flow orifices and damage to control valves by foreign matter.

• Ensure all necessary post weld heat treatment and non-destructive examination has been completed as necessary.

• Conduct a successful hydrostatic test as required.



Steam Outlet Piping Assembly



Steam Outlet Piping Assembly Installed



Steam Outlet Piping Installation



Steam Outlet Piping Connection to Header



Vent Stack - U-bolt Connection Detail



Typical Feedwater Piping

“Jumper” Tube Installation

Where the complete OTSG pressure tubing is contained in two or more modules, a connection must be made between these modules to complete the tubing circuitry from the inlet header to the outlet header. This activity is to be done by IST orbital welding technicians using a specialised automatic TIG welding process.

Orbital welding process...

- Prepare ends, on both “jumper” tubes and OTSG module tubes, for welding.
- Fill the inside of the tubing circuit/bundle with argon.
- Fit-up and weld “jumper” tubes to OTSG module tubes.

During this process, the construction contractor will be responsible for providing the following...

- Electrical junction and uninterrupted power source and hook-up service for IST tool crib container and transformer for orbital welding and 110 V power tools.
- Designated lay-down area local to OTSG for IST tool crib container.
- Compressed air.
- Scaffolding, if platform steel and grating is not complete.
- Tarps for scaffold areas at feedwater inlet box, in case of inclement weather.
- Site safety induction of IST personnel prior to commencement of site activities.

(Cont’d)

“Jumper” Tube Installation (con’t)

• Provision of two personnel for assistance with general support labour duties and requirements of IST welding technicians / supervisor.

• Designated lunch, smoking area and toilette facilities.

• Arrangement of any on site permit requirements.

• Supply of ample demineralized water and pressurizing equipment to perform a hydrostatic test of each OTSG circuit once “jumper” tube welding is complete and piping tie-ins are made.

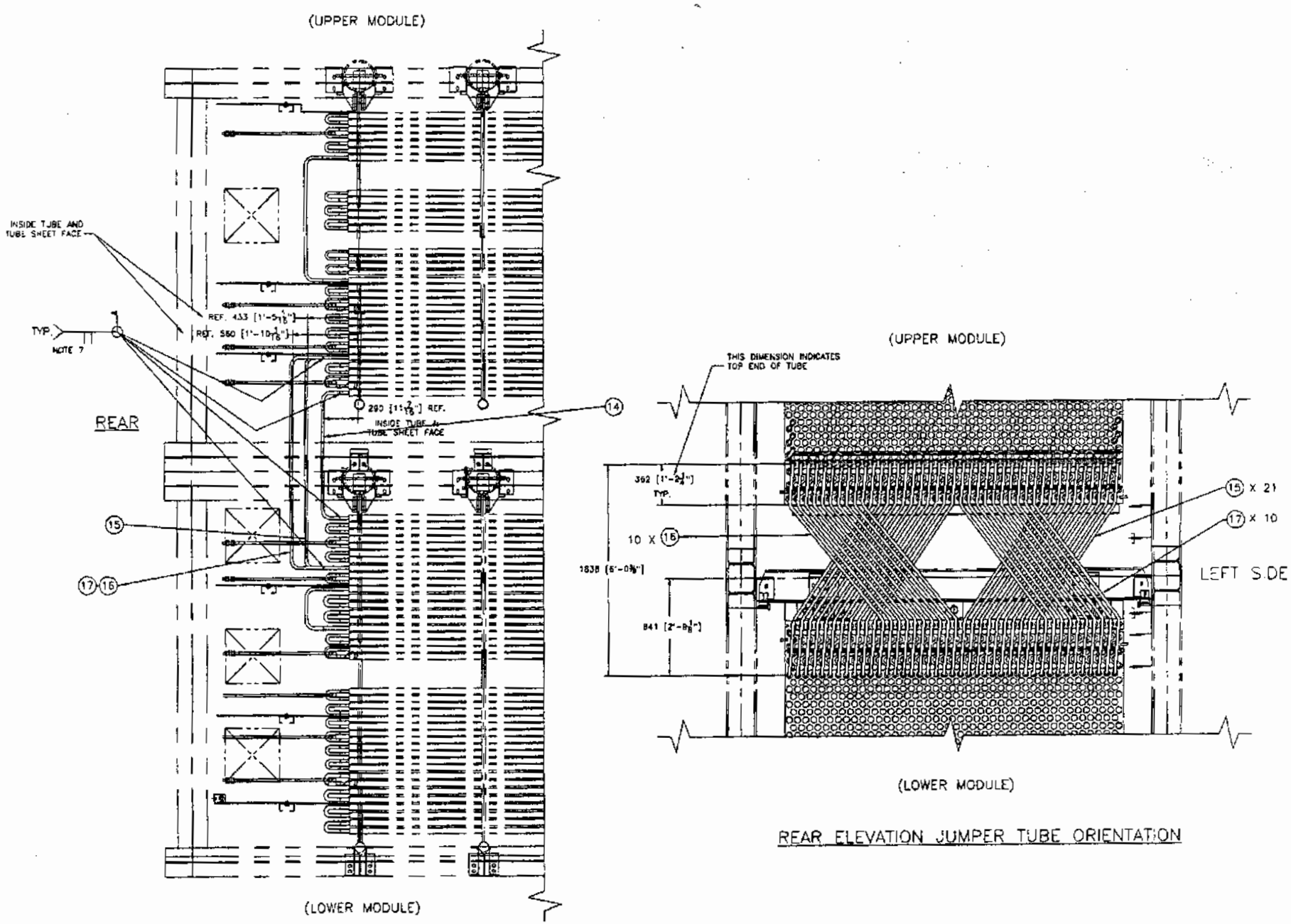


Figure 24: Typical "Jumper" Tube Arrangement

Instrumentation and Thermocouple Installation

- Check that all instrumentation, thermocouples and associated components are available. Inspect for damage.

- During installation ensure that the correct fittings are utilised for the application.

- Check inside all thermowells to ensure that they are void of any obstructions or deformities.

- Ensure that all gas side temperature probes install easily into the connection pipes.

- Ensure that any installed instrumentation does not interfere with platform access or walkways.

- Ensure that tubesheet thermocouples are installed per IST drawing.



Gas Side Thermocouple Installation Detail



Tubesheet Thermocouple Head Installation Detail

OTSG Installations



Triple Module OTSG with SCR



Double Module OTSGs with SCR and Duct Burner



Single Module OTSG (narrow) with Duct Burner



Single Module OTSG



Triple Module OTSG, SCR Module, AIG module and Duct Burner



Single Module OTSG - Barge Mounted



Single Module OTSG

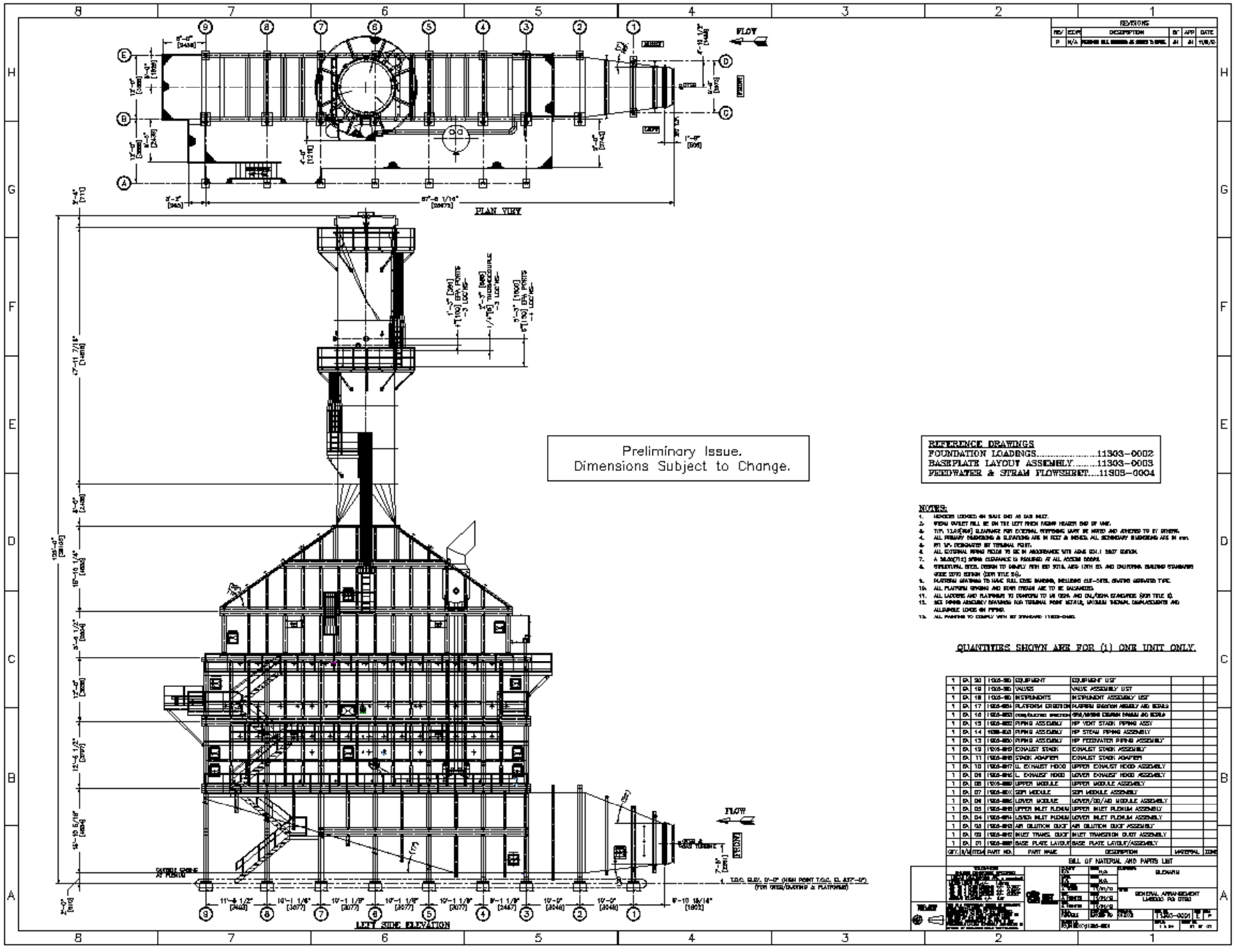
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Glenarm Repowering Project OTSG Design

Landon Tessmer
November 15, 2013

Preliminary General Arrangement / Shipping Pieces



OTSG Details

OTSG Mechanical Data: LM6000 PG

For Information Only. May be changed during contract stage

Overall Length, ft	88.60	
Overall Width, ft	12.95	
Overall Height, ft	125.00	
Overall Weight, lbs	884,149	
Number of pressure part modules per OTSG	2	
	Upper Module	Lower Module
OTSG Module Length, ft	54.74	61.47
OTSG Module Width, ft	12.95	12.95
OTSG Module Height, ft	8.53	9.56
OTSG Module Weight, lbs	301,291	194,422
Effective Net Surface Area, ft^2	231,436	
Number of Circuits per Module	41	
Tubes per Circuit	38	
Total Number of Tubes	1,558	
Transverse Pitch, inches	2.75	
Longitudinal Pitch, inches	2.38	
Effective Finned Tube Length, ft	42.73	
Tube Diameter, inches	0.75 / 1.0 / 1.25	
Tube Wall Thickness, inches	As req'd	
Fin Material	As req'd	
Fin Pitch, fins per inch	As req'd	
Fin Height, inches	As req'd	
Fin Thickness, inches	As req'd	

Approximate Exterior Dimensions & Weights (Please refer to attached drawing for referenced dimensions)

	Length	Width	Height	Weight
Inlet Duct Inlet, ft .		7.98	7.98 ' **A** '	
Inlet Duct, ft & lbs	15.14 ' **B** '			17,755
Inlet Duct Outlet, ft		12.86	15.49	
Air Dilution Duct, ft & lbs	10.00 ' **D** '	12.86	15.49	15,494
Burner Duct Outlet, ft		12.86	15.49	
Inlet Plenum, ft & lbs	61.47 ' **E** '	12.95	15.86 ' **F** '	95,229
OTSG Lower Module, ft & lbs	61.47	12.95	9.56	194,422
SCR Module, ft & lbs	61.47	12.95	16.50 ' **G** '	77,617
OTSG Upper Modules, ft & lbs	54.74	12.95	8.53	301,291
Exhaust Hood, ft & lbs	54.74	12.95	15.95 ' **H** '	52,090
Exhaust Stack, ft & lbs	12.85 ' **K** '	12.85	56.82 ' **J** '	65,250
Ladders & Platforms. lot, lbs				65,000
			Total	**884,149**

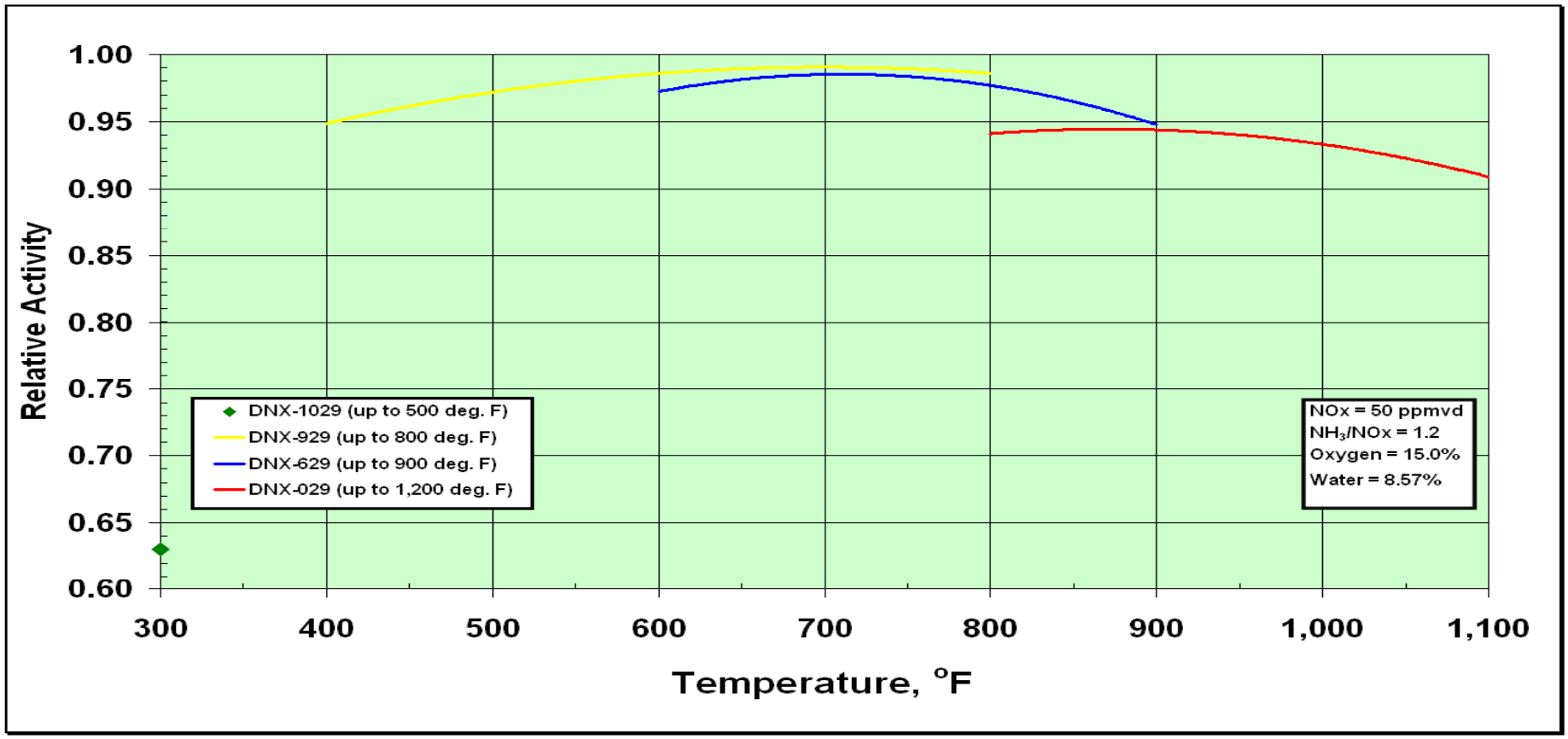


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3D View of a Similar OTSG

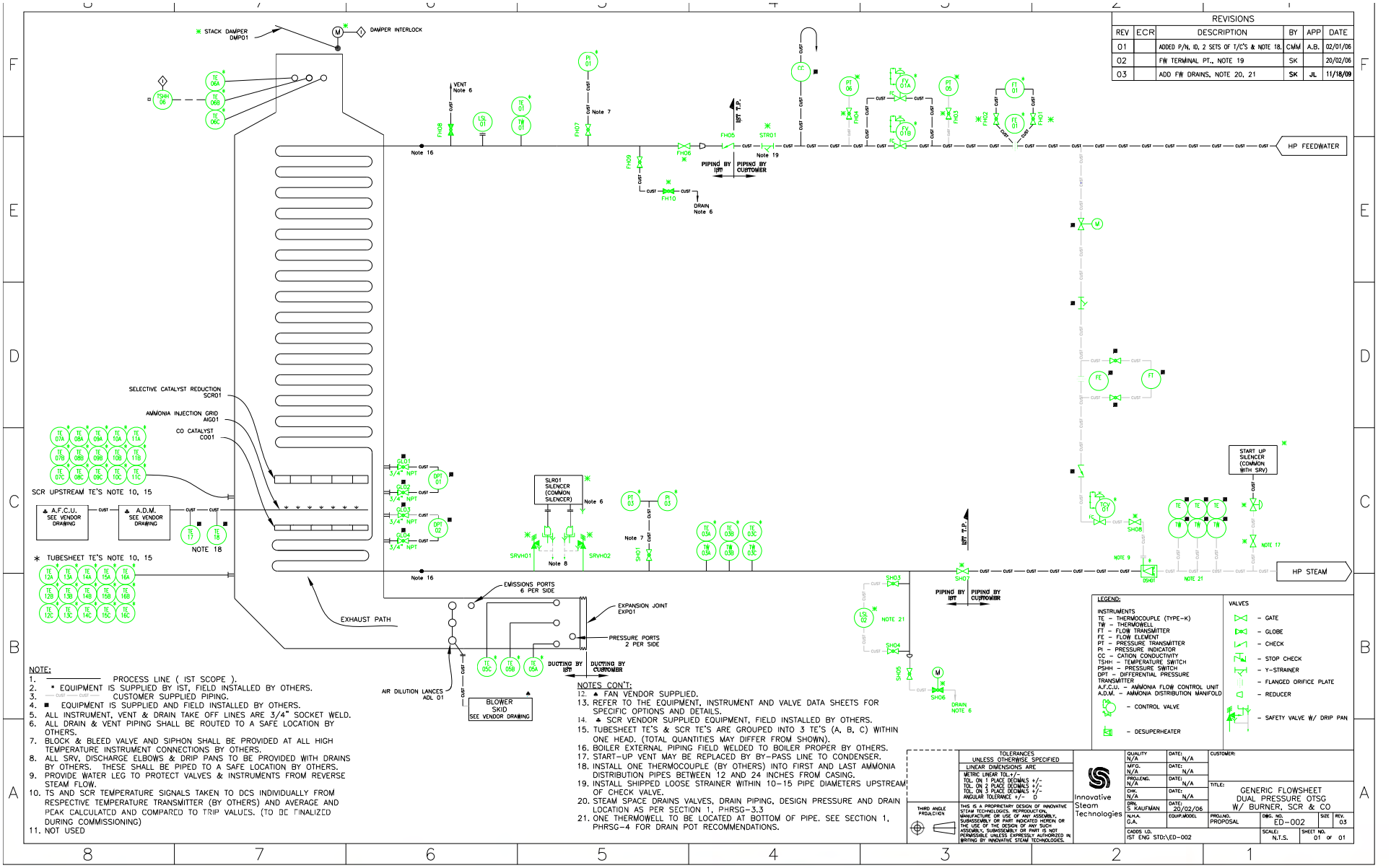


SCR Catalyst Performance

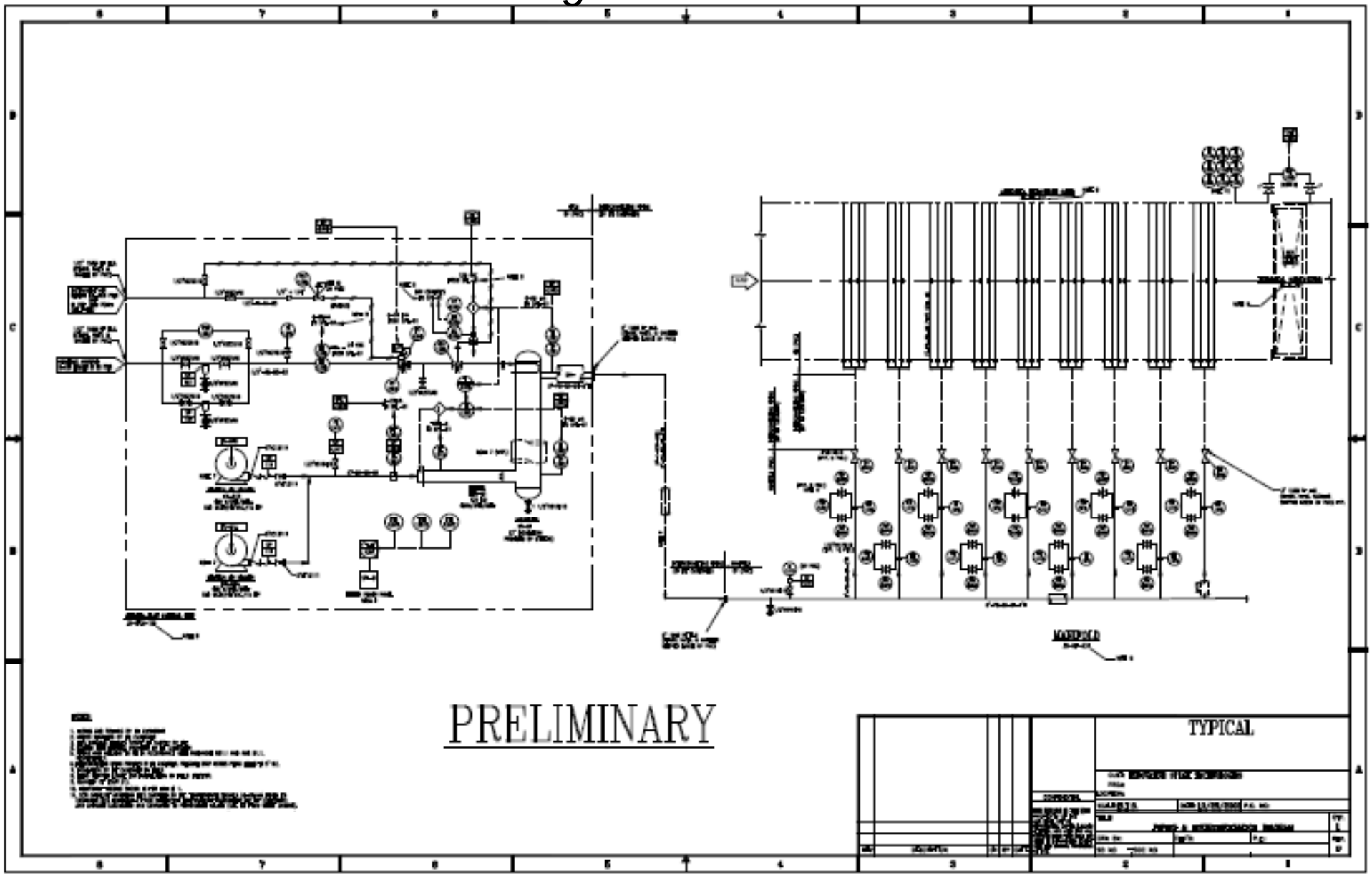


- The Glenarm OTSG has a DNX-629 (GT-301) SCR catalyst integrated. This change allows for the fastest OTSG start and fastest heating of the SCR bed from the cold condition.
- Air dilution is only required in extended/intentional simple cycle operation to cool the catalysts to 850 F max (~108,000 lbs/hr of fresh air).

Glenarm GE OTSG Flowsheet



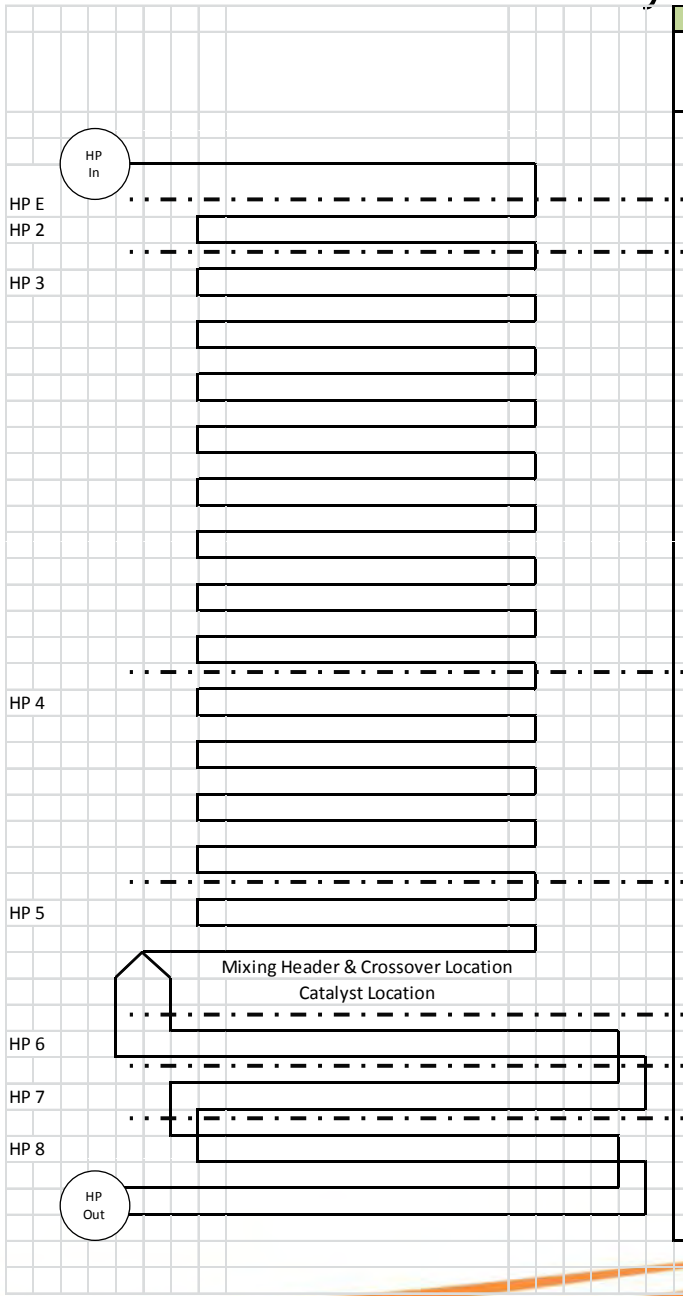
Glenarm Ammonia Handling Flowsheet



Glenarm OTSG Advanced Metallurgy

- Tube materials:
  - Incoloy Alloy 800 & 825
    - SB407 NO8800 (35%+ Nickel Content)
    - SB423 NO8825 (42%+ Nickel Content)
- Fin materials:
  - 409SS, 316SS, and Carbon Steel
- Ducting Liner materials:
  - 409 SS

Glenarm OTSG Tube Bundle Layout

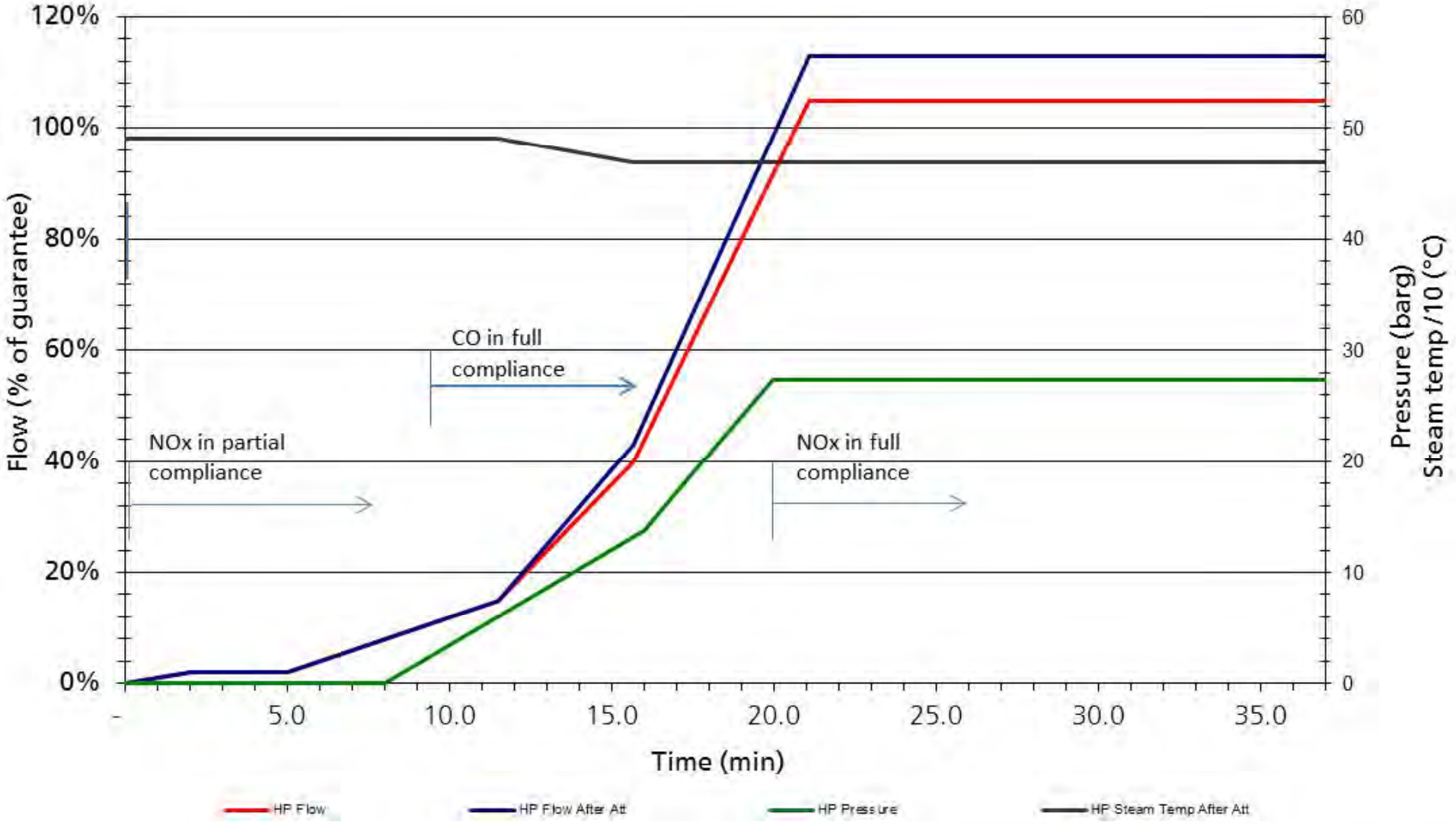


	Tube				Fins			
	Outer Diameter (in)	Rows	Material	Min Wall Thickness (in)	Height	Thickness	Material	FPI
HP E	1	1	825	0.092	0.5	0.035	316ss	5
HP 2	1	2	825	0.054	0.5	0.035	316ss	7
HP 3	1	16	800	0.049	0.5	0.04	Carbon Steel	9
HP 4	1.25	8	800	0.054	0.375	0.04	Carbon Steel	9.5
HP 5	1.25	3	800	0.054	0.375	0.04	Carbon Steel	9
HP 6	1.25	2	800	0.054	0.375	0.04	Carbon Steel	9
HP 7	1.25	2	800	0.054	0.375	0.04	409ss	8
HP 8	1.25	4	800	0.054	0.375	0.04	409ss	5

LM6000PG

OTSG Start-Up Curve

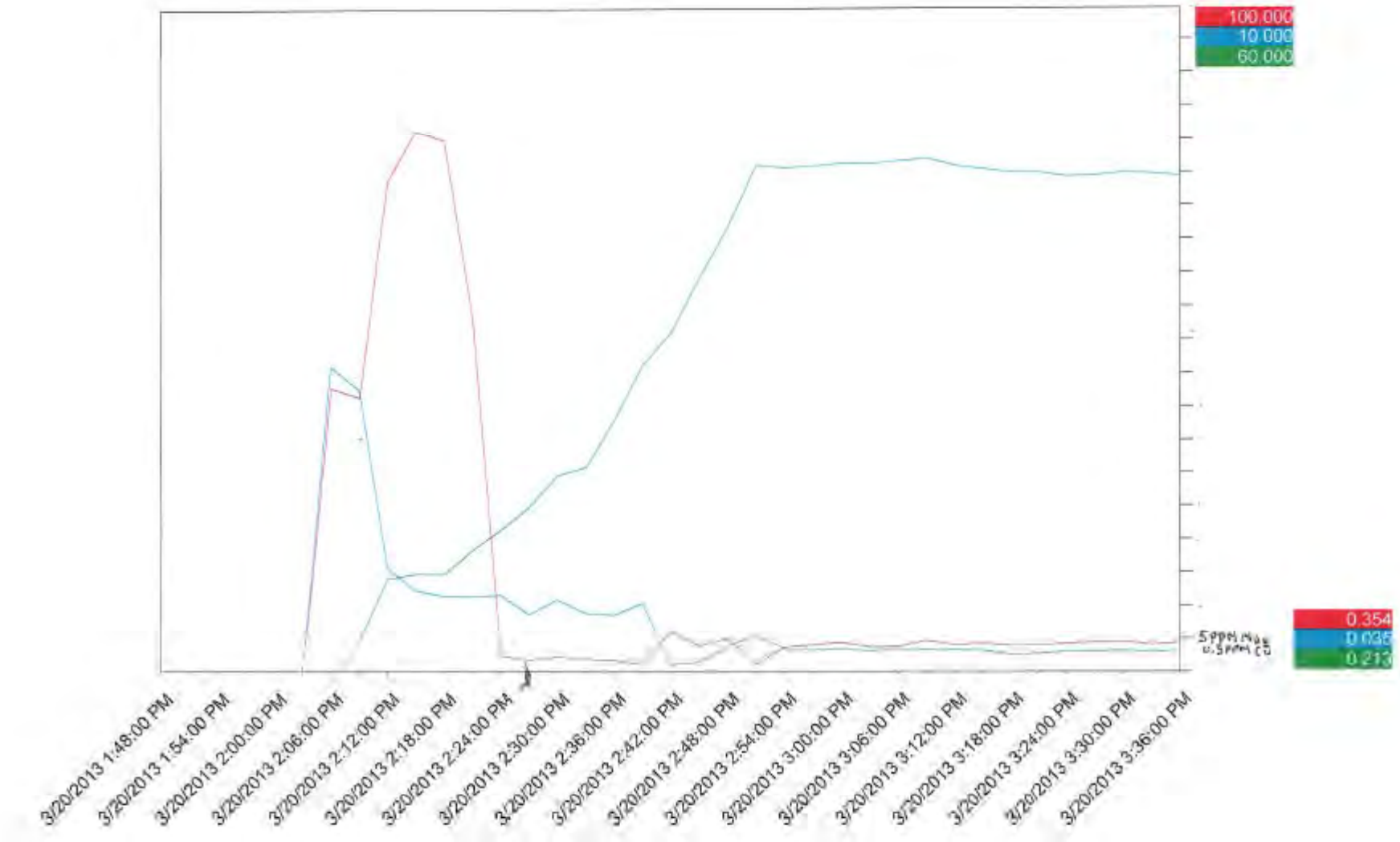
(OTSG Start Permissive approx 15 min from GT ignition with SCR/CO)
TIme zero refers to first FW introduction into OTSG



Trend4 - Live 30 hours

3/20/2013 2:03:00 PM

13CEM-AI6652.UNIT1@NE	OTSG STACK NOx@15% O2 CO COR	0.000	PP	Scale:	100	0.000
13CEM-AI6650.UNIT1@NE	OTSG STACK CO @15% O2 CO CORR	0.000	PP	Scale:	10.000	0.000
13CTG-JT8024.UNIT1@NE	13CTG 734-GEN3 NET MW	-0.89	MW	Scale:	60.000	0.000

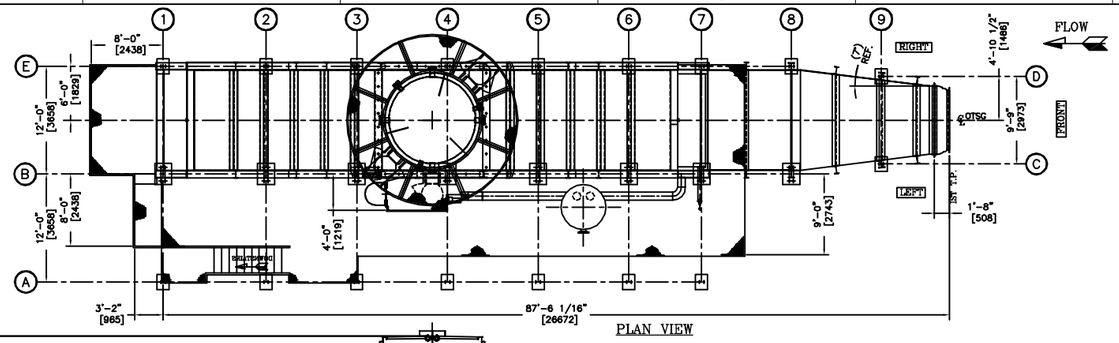


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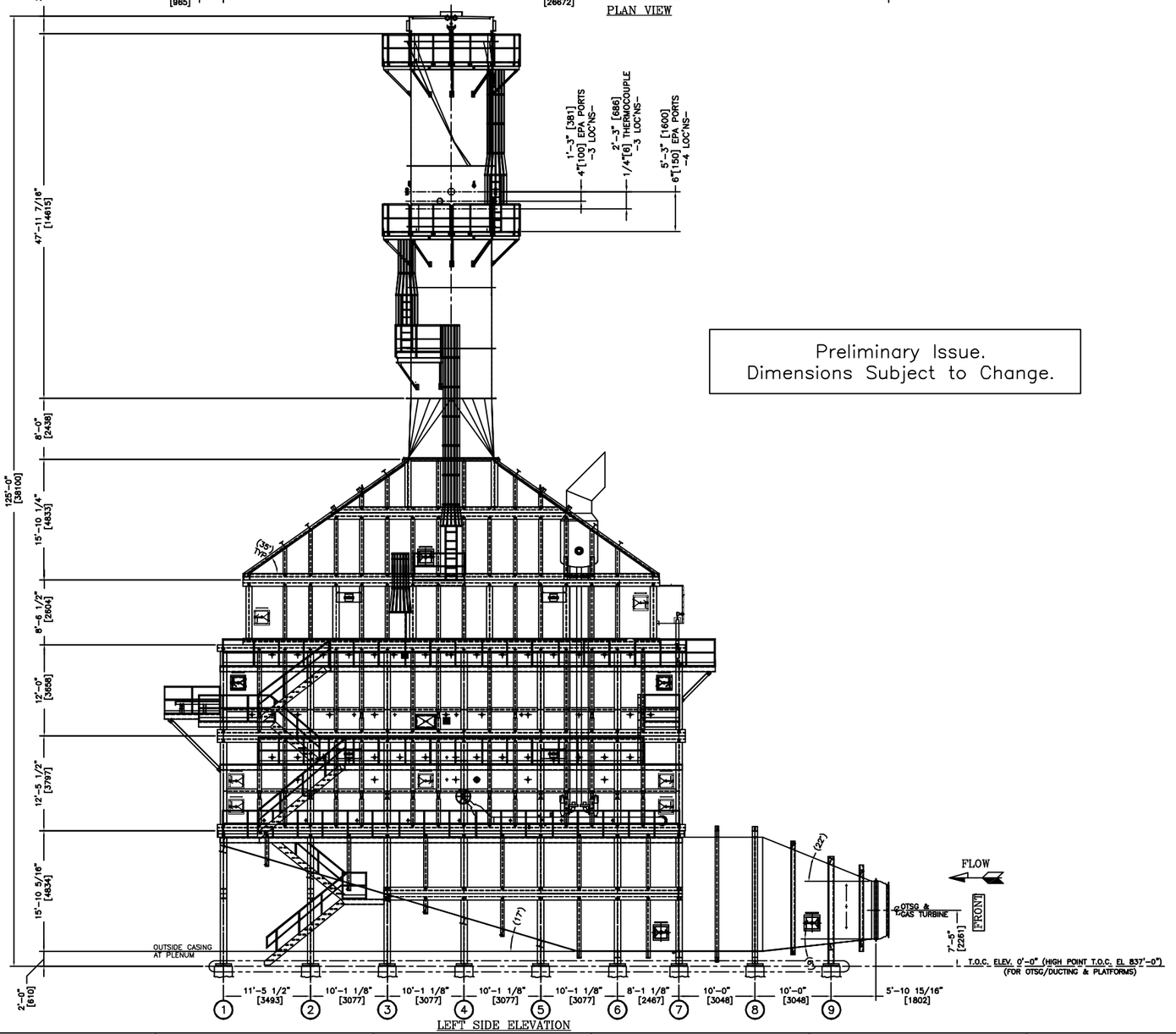
we find a better way

Questions/Discussion

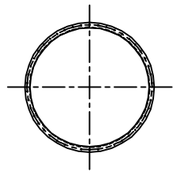
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
P	N/A	PRELIMINARY ISSUE. DIMENSIONS ARE SUBJECT TO CHANGE.	JH		11/01/13



PLAN VIEW



LEFT SIDE ELEVATION



Preliminary Issue.
Dimensions Subject to Change.

REFERENCE DRAWINGS
FOUNDATION LOADINGS.....11303-0002
BASEPLATE LAYOUT ASSEMBLY.....11303-0003
FEEDWATER & STEAM FLOWSHEET....11303-0004

NOTES:
1. HEADERS LOCATED ON SAME END AS GAS INLET.
2. STEAM OUTLET WILL BE ON THE LEFT WHEN FACING HEADER END OF UNIT.
3. TYP. 12.00[305] CLEARANCE FOR EXTERNAL STIFFENING MUST BE NOTED AND ADHERED TO BY OTHERS.
4. ALL PRIMARY DIMENSIONS & ELEVATIONS ARE IN FEET & INCHES. ALL SECONDARY DIMENSIONS ARE IN mm.
5. IST T.P. DESIGNATES IST TERMINAL POINT.
6. ALL EXTERNAL PIPING WELDS TO BE IN ACCORDANCE WITH ASME B31.1 2007 EDITION.
7. A 28.00[712] SWING CLEARANCE IS REQUIRED AT ALL ACCESS DOORS.
8. STRUCTURAL STEEL DESIGN TO COMPLY WITH IBC 2010, AISC 13TH ED, AND CALIFORNIA BUILDING STANDARDS CODE 2010 EDITION (CCR TITLE 24).
9. PLATFORM GRATINGS TO HAVE FULL EDGE BANDING, INCLUDING CUT-OUTS. GRATING SERRATED TYPE.
10. ALL PLATFORM GRATING AND STAIR TREADS ARE TO BE GALVANIZED.
11. ALL LADDERS AND PLATFORMS TO CONFORM TO US OSHA AND CAL/OSHA STANDARDS (CCR TITLE 8).
12. SEE PIPING ASSEMBLY DRAWINGS FOR TERMINAL POINT DETAILS, MAXIMUM THERMAL DISPLACEMENTS AND ALLOWABLE LOADS ON PIPING.
13. ALL PAINTING TO COMPLY WITH IST STANDARD 11303-0450.

QUANTITIES SHOWN ARE FOR (1) ONE UNIT ONLY.

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	20	11303-300	EQUIPMENT	EQUIPMENT LIST		
1	EA	19	11303-200	VALVES	VALVE ASSEMBLY LIST		
1	EA	18	11303-100	INSTRUMENTS	INSTRUMENT ASSEMBLY LIST		
1	EA	17	11303-0024	PLATFORM ERECTION	PLATFORM ERECTION ASEMBLY AND DETAILS		
1	EA	16	11303-0023	OTSG/DUCTING ERECTION	OTSG/DUCTING ERECTION DIAGRAM AND DETAILS		
1	EA	15	11303-0022	PIPING ASSEMBLY	HP VENT STACK PIPING ASSY		
1	EA	14	11303-0021	PIPING ASSEMBLY	HP STEAM PIPING ASSEMBLY		
1	EA	13	11303-0020	PIPING ASSEMBLY	HP FEEDWATER PIPING ASSEMBLY		
1	EA	12	11303-0019	EXHAUST STACK	EXHAUST STACK ASSEMBLY		
1	EA	11	11303-0018	STACK ADAPTER	EXHAUST STACK ADAPTER		
1	EA	10	11303-0017	U. EXHAUST HOOD	UPPER EXHAUST HOOD ASSEMBLY		
1	EA	09	11303-0016	L. EXHAUST HOOD	LOWER EXHAUST HOOD ASSEMBLY		
1	EA	08	11303-0009	UPPER MODULE	UPPER MODULE ASSEMBLY		
1	EA	07	11303-XXXX	SCR MODULE	SCR MODULE ASSEMBLY		
1	EA	06	11303-0006	LOWER MODULE	LOWER/CO/AIG MODULE ASSEMBLY		
1	EA	05	11303-0015	UPPER INLET PLENUM	UPPER INLET PLENUM ASSEMBLY		
1	EA	04	11303-0014	LOWER INLET PLENUM	LOWER INLET PLENUM ASSEMBLY		
1	EA	03	11303-0013	AIR DILUTION DUCT	AIR DILUTION DUCT ASSEMBLY		
1	EA	02	11303-0012	INLET TRANS. DUCT	INLET TRANSITION DUCT ASSEMBLY		
1	EA	01	11303-0003	BASE PLATE LAYOUT	BASE PLATE LAYOUT/ASSEMBLY		

BILL OF MATERIAL AND PARTS LIST

TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE in mm[inch]
METRIC LINEAR TOL +/- 1.0mm
TOL ON 1 PLACE DECIMALS +/- 0.100"
TOL ON 2 PLACE DECIMALS +/- 0.030"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°

THIRD ANGLE PROJECTION

THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. NEITHER RECEIPT OR USE OF ANY INFORMATION, SUBASSEMBLY OR PART IMPORTED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT AUTHORIZED EXCEPT BY A WRITTEN AGREEMENT WITH INNOVATIVE STEAM TECHNOLOGIES.

QUALITY N/A DATED: N/A
APPR. N/A DATED: N/A
DRAWN A. TONG DATED: 11/01/13
CHK. J. HUNTER DATED: 11/01/13
ENG. J. HUNTER DATED: 11/01/13
N.A.A. VARIABLE
EQUIP. MODEL LM6000 PG
PREL/ENG. C13XXX

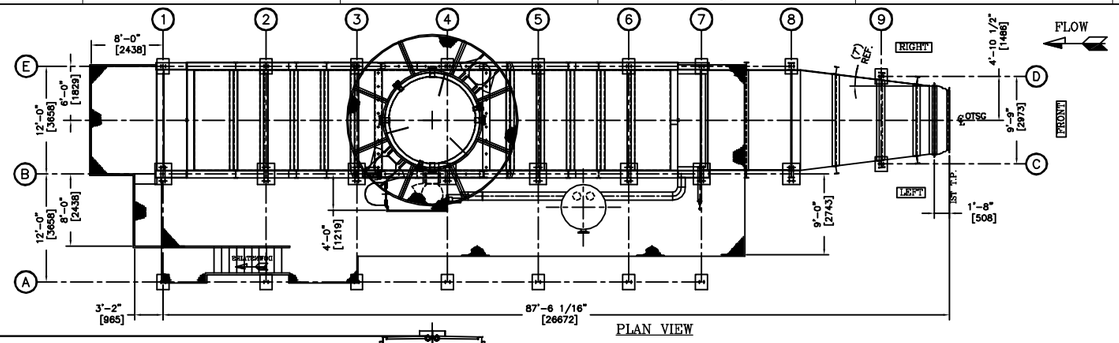
CUSTOMER: GLENARM

TITLE: GENERAL ARRANGEMENT LM6000 PG OTSG

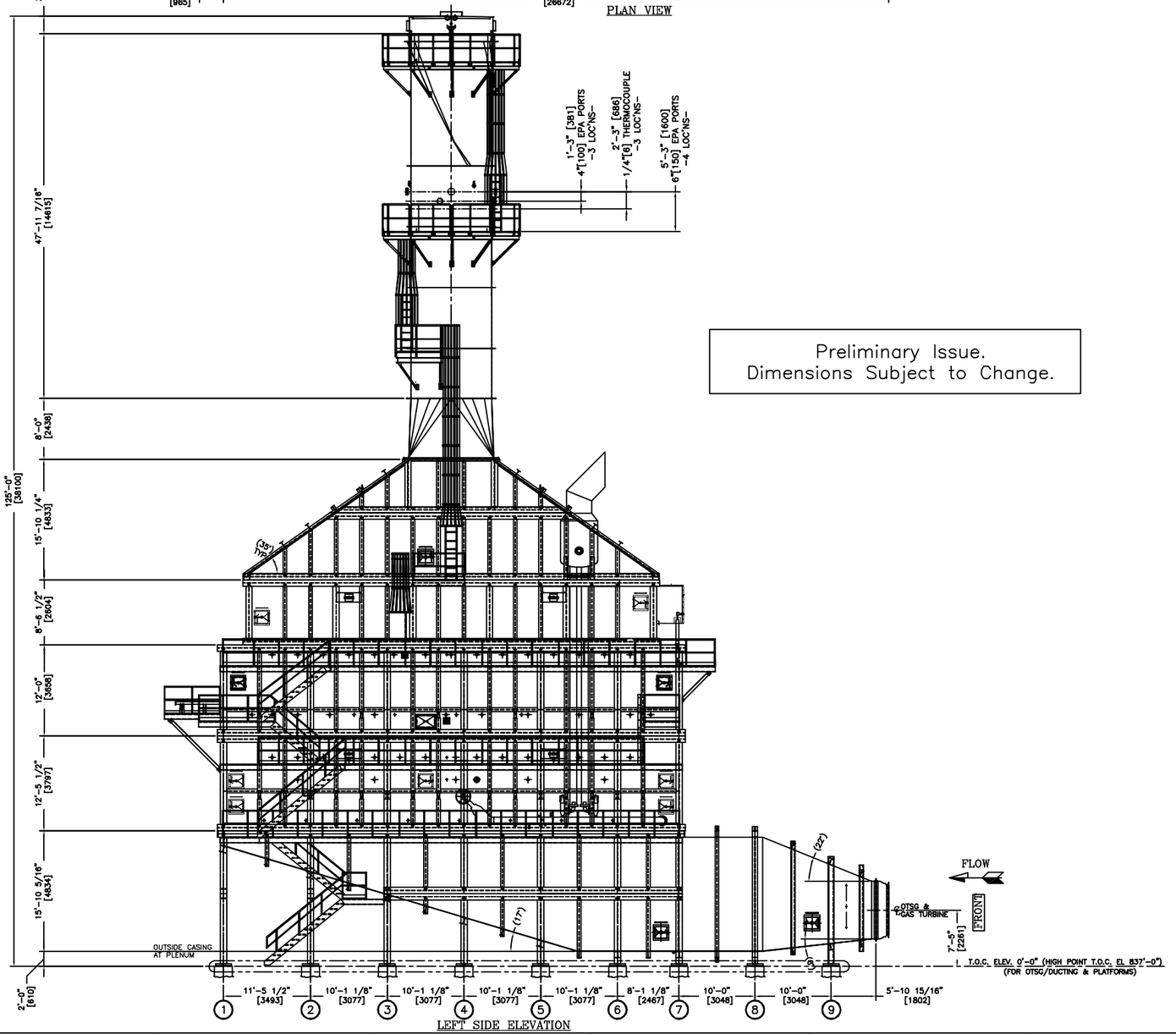
DWG. NO. 11303-0001 SIZE E REV. P
SCALE: 1 : 64 SHEET NO. 01 OF 01

DRIVE LE P:\C13XXX\11303-0001

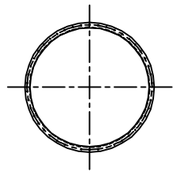
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
P	N/A	PRELIMINARY ISSUE. DIMENSIONS ARE SUBJECT TO CHANGE.	JH		11/01/13



PLAN VIEW



LEFT SIDE ELEVATION



Preliminary Issue.
Dimensions Subject to Change.

REFERENCE DRAWINGS
FOUNDATION LOADINGS.....11303-0002
BASEPLATE LAYOUT ASSEMBLY.....11303-0003
FEEDWATER & STEAM FLOWSHEET....11303-0004

NOTES:
1. HEADERS LOCATED ON SAME END AS GAS INLET.
2. STEAM OUTLET WILL BE ON THE LEFT WHEN FACING HEADER END OF UNIT.
3. TYP. 12.00[305] CLEARANCE FOR EXTERNAL STIFFENING MUST BE NOTED AND ADHERED TO BY OTHERS.
4. ALL PRIMARY DIMENSIONS & ELEVATIONS ARE IN FEET & INCHES. ALL SECONDARY DIMENSIONS ARE IN mm.
5. IST T.P. DESIGNATES IST TERMINAL POINT.
6. ALL EXTERNAL PIPING WELDS TO BE IN ACCORDANCE WITH ASME B31.1 2007 EDITION.
7. A 28.00[712] SWING CLEARANCE IS REQUIRED AT ALL ACCESS DOORS.
8. STRUCTURAL STEEL DESIGN TO COMPLY WITH IBC 2010, AISC 13TH ED, AND CALIFORNIA BUILDING STANDARDS CODE 2010 EDITION (CCR TITLE 24).
9. PLATFORM GRATINGS TO HAVE FULL EDGE BANDING, INCLUDING CUT-OUTS. GRATING SERRATED TYPE.
10. ALL PLATFORM GRATING AND STAIR TREADS ARE TO BE GALVANIZED.
11. ALL LADDERS AND PLATFORMS TO CONFORM TO US OSHA AND CAL/OSHA STANDARDS (CCR TITLE 8).
12. SEE PIPING ASSEMBLY DRAWINGS FOR TERMINAL POINT DETAILS, MAXIMUM THERMAL DISPLACEMENTS AND ALLOWABLE LOADS ON PIPING.
13. ALL PAINTING TO COMPLY WITH IST STANDARD 11303-0450.

QUANTITIES SHOWN ARE FOR (1) ONE UNIT ONLY.

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	20	11303-300	EQUIPMENT	EQUIPMENT LIST		
1	EA	19	11303-200	VALVES	VALVE ASSEMBLY LIST		
1	EA	18	11303-100	INSTRUMENTS	INSTRUMENT ASSEMBLY LIST		
1	EA	17	11303-0024	PLATFORM ERECTION	PLATFORM ERECTION ASEMBLY AND DETAILS		
1	EA	16	11303-0023	OTSG/DUCTING ERECTION	OTSG/DUCTING ERECTION DIAGRAM AND DETAILS		
1	EA	15	11303-0022	PIPING ASSEMBLY	HP VENT STACK PIPING ASSY		
1	EA	14	11303-0021	PIPING ASSEMBLY	HP STEAM PIPING ASSEMBLY		
1	EA	13	11303-0020	PIPING ASSEMBLY	HP FEEDWATER PIPING ASSEMBLY		
1	EA	12	11303-0019	EXHAUST STACK	EXHAUST STACK ASSEMBLY		
1	EA	11	11303-0018	STACK ADAPTER	EXHAUST STACK ADAPTER		
1	EA	10	11303-0017	U. EXHAUST HOOD	UPPER EXHAUST HOOD ASSEMBLY		
1	EA	09	11303-0016	L. EXHAUST HOOD	LOWER EXHAUST HOOD ASSEMBLY		
1	EA	08	11303-0009	UPPER MODULE	UPPER MODULE ASSEMBLY		
1	EA	07	11303-XXXX	SCR MODULE	SCR MODULE ASSEMBLY		
1	EA	06	11303-0006	LOWER MODULE	LOWER/CO/AIG MODULE ASSEMBLY		
1	EA	05	11303-0015	UPPER INLET PLENUM	UPPER INLET PLENUM ASSEMBLY		
1	EA	04	11303-0014	LOWER INLET PLENUM	LOWER INLET PLENUM ASSEMBLY		
1	EA	03	11303-0013	AIR DILUTION DUCT	AIR DILUTION DUCT ASSEMBLY		
1	EA	02	11303-0012	INLET TRANS. DUCT	INLET TRANSITION DUCT ASSEMBLY		
1	EA	01	11303-0003	BASE PLATE LAYOUT	BASE PLATE LAYOUT/ASSEMBLY		

BILL OF MATERIAL AND PARTS LIST

TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE in mm[inch]
METRIC LINEAR TOL +/- 1.0mm
TOL ON 1 PLACE DECIMALS +/- 0.100"
TOL ON 2 PLACE DECIMALS +/- 0.030"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°

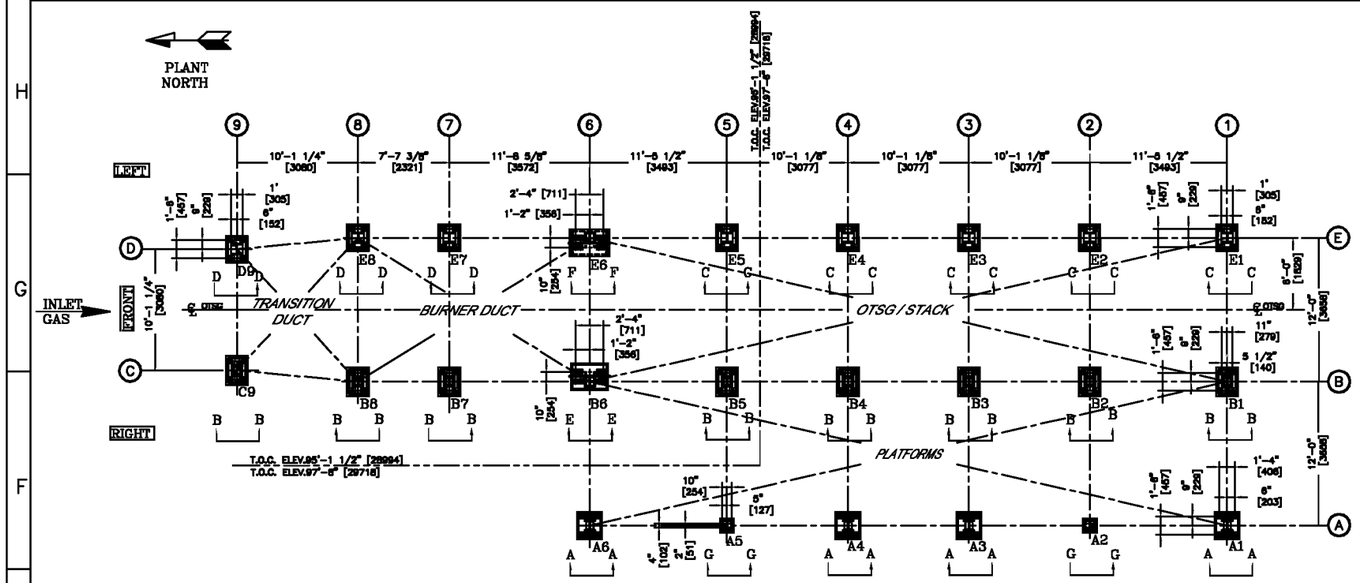
THIRD ANGLE PROJECTION

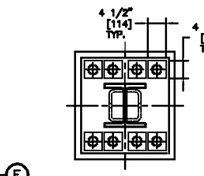
THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. NEITHER RECEIPT OR USE OF ANY INFORMATION, SUBASSEMBLY OR PART IMPORTED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT AUTHORIZED EXCEPT BY A WRITTEN AGREEMENT WITH INNOVATIVE STEAM TECHNOLOGIES.

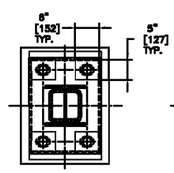
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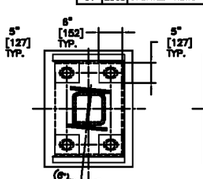
QUALITY	DATE:	CUSTOMER: GLENARM
N/A	N/A	
APPR.	DATE:	
N/A	N/A	
DRAWN: A. TONG	DATE: 11/01/13	TITLE: GENERAL ARRANGEMENT LM6000 PG OTSG
CHK. J. HUNTER	DATE: 11/01/13	
ENG. J. HUNTER	DATE: 11/01/13	
N.M.A. VARIABLE	EQUIP. MODEL: LM6000 PG	PROJ. NO. C13XXX
DWG. NO. 11303-0001	SIZE E	REV. P
SCALE: 1 : 64	SHEET NO. 01 OF 01	
DWG LOC. P:\C13XXX\11303-0001		

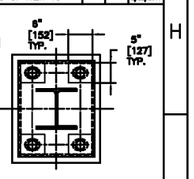
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	MZ	JH	10/27/2010
01	2363	UPDATED VIEWS OF ITEM 18	JT	DH	6/28/2011

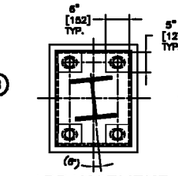


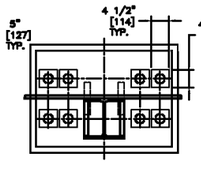

ARRANGEMENT A1,A3,A4,A6
SCALE 1:12

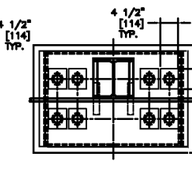

ARRANGEMENT B1–B5,B7,B8
SCALE 1:12

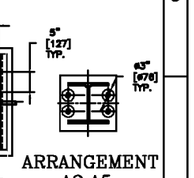

ARRANGEMENT C9
SCALE 1:12


ARRANGEMENT E1–E5,E7,E8
SCALE 1:12


ARRANGEMENT D9
SCALE 1:12

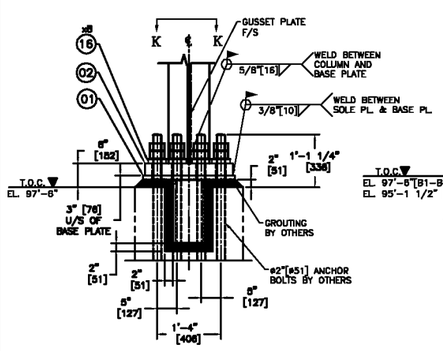

ARRANGEMENT B6
SCALE 1:12

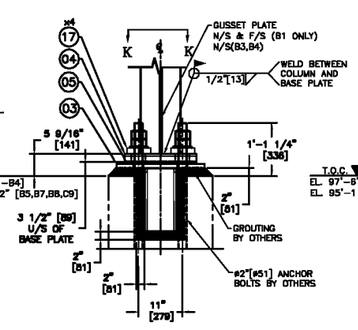

ARRANGEMENT E6
SCALE 1:12 △1

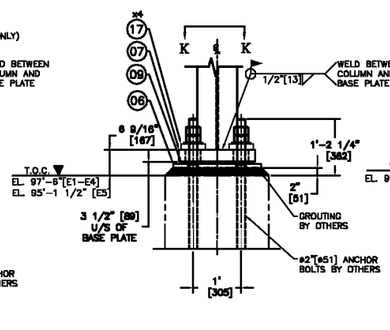

ARRANGEMENT A2,A5
SCALE 1:12

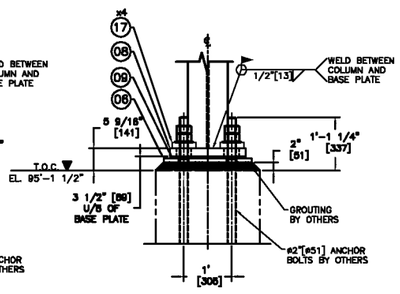
SPECIAL WASHERS PLATE ARRANGEMENT

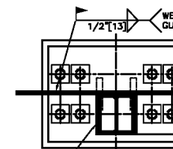
NOTE: INSTALL SPECIAL WASHERS PRIOR TO ANCHOR BOLT STANDARD WASHERS AND NUTS GUSSET PLATES NOT SHOWN

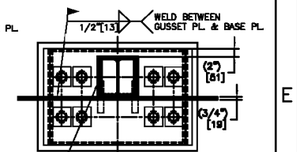

VIEW A–A
SCALE 1:12
ARRANGEMENT A1,A3,A4,A6


VIEW B–B
SCALE 1:12
ARRANGEMENT B1–B5,B7,B8,C9


VIEW C–C
SCALE 1:12
ARRANGEMENT E1–E5

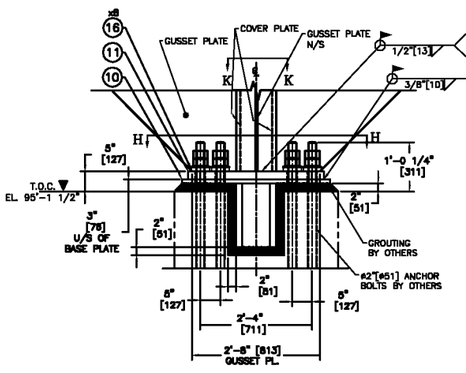

VIEW D–D
SCALE 1:12
ARRANGEMENT E7,E8,D9

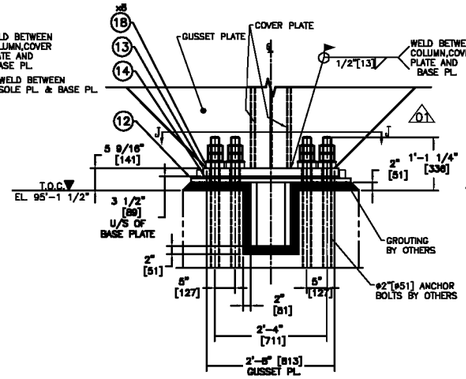

SECTION H–H
B6
SCALE 1:12

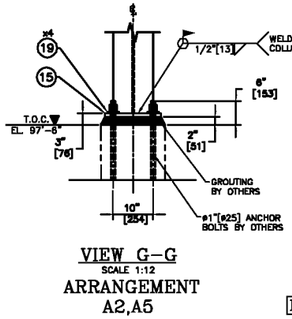

SECTION J–J
E6
SCALE 1:12 △1

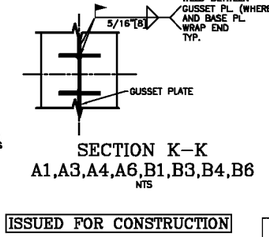
NOTES:

1. 2.00" [51mm] MINIMUM CLEARANCE FROM EACH SIDE OF SHEAR KEY TO EACH FACE OF PEDESTAL POCKET. CIVIL CONTRACTOR SHALL DETERMINE SHEAR KEY POCKET BASED ON SOLE PLATE DESIGN.
2. TIGHTEN ALL ANCHOR BOLTS WITH FIRST NUT UNTIL THERE IS NO CLEARANCE ABOVE WASHER. THEN LOCK FIRST NUT IN POSITION WITH SECOND NUT ON ALL SUPPORTS EXCEPT FIXED LOCATIONS B6, A1 TO A5 WHERE NUTS ARE TO BE RETIGHTENED AND THEN LOCKED WITH SECOND NUT.
3. BUFFED SIDE OF BASE PLATE TO FACE FABREEKA TEFLON FACE. REMOVE PAPER BACKING BEFORE INSTALLING.
4. BASE PLATES ARE TO BE CENTERED ON SOLE PLATES PRIOR TO BEING WELDED TO COLUMNS BY OTHERS.
5. FOUNDATIONS AND GROUTING SHALL BE SUPPLIED BY OTHERS.
6. DO NOT SCALE DRAWING, WORK WITH DIMENSIONS GIVEN.
7. PRIMARY DIMENSIONS ARE IN FEET & INCHES, SECONDARY DIMENSIONS ARE IN MILLIMETERS.
8. F/S=FARSIDE, N/S=NEARSIDE, U/S=UNDERSIDE, T.O.C.=TOP OF CONCRETE.
9. GRIND PAINT WHERE REQUIRED TO MAKE FIELD WELDS. REPAINT AFTER WELDING PER IST STANDARD #ES-010.
10. ALL STRUCTURAL STEEL WELDING AND INSPECTION SHALL BE ACCORDING TO AWS D1.1 AND APPLICABLE LOCAL CODES.
11. WELD NOT TO EXCEED SPECIFIED LEG DIMENSION LOCAL TO WASHERS TO ENSURE FREE MOVEMENT OF THE WASHER. WELD TO BE GROUND DOWN TO MEET SPECIFIED LEG DIMENSION LOCAL TO WASHERS AS REQUIRED.
12. ALL ANCHOR BOLTS (BY OTHERS) TO BE ASTM A307 OR BETTER. THE CIVIL CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE FINAL ANCHOR BOLT MATERIAL AND LENGTH BASED ON THE NOMINAL BOLT DIAMETER AND FOUNDATION LOADING PROVIDED.


VIEW E–E
SCALE 1:12
ARRANGEMENT B6


VIEW F–F
SCALE 1:12
ARRANGEMENT E6


VIEW G–G
SCALE 1:12
ARRANGEMENT A2,A5


SECTION K–K
A1,A3,A4,A6,B1,B3,B4,B6
NTS

ISSUED FOR CONSTRUCTION

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
8	EA	19	261043-04	SPECIAL WASHER	PLATE 0.38"[10]		
8	EA	18	261043-03	SPECIAL WASHER	PLATE 1.50"[38]		
84	EA	17	261043-02	SPECIAL WASHER	PLATE 1.50"[38]		
40	EA	16	261043-01	SPECIAL WASHER	PLATE 1.00"[25]		
2	EA	15	261042	BASE PLATE	BASE PLATE		
1	EA	14	261041	FABREEKA PAD	FABREEKA PAD		
1	EA	13	261040	BASE PLATE	BASE PLATE ASSEMBLY		
1	EA	12	261039	SOLE PLATE	SOLE PLATE ASSEMBLY		
1	EA	11	261038	BASE PLATE	BASE PLATE		
1	EA	10	261037	SOLE PLATE	SOLE PLATE ASSEMBLY		
8	EA	09	261036	FABREEKA PAD	FABREEKA PAD		
3	EA	08	261035	BASE PLATE	BASE PLATE ASSEMBLY		
5	EA	07	261034	BASE PLATE	BASE PLATE ASSEMBLY		
8	EA	06	261033	SOLE PLATE	SOLE PLATE		
8	EA	05	261032	FABREEKA PAD	FABREEKA PAD		
8	EA	04	261031	BASE PLATE	BASE PLATE ASSEMBLY		
8	EA	03	261030	SOLE PLATE	SOLE PLATE ASSEMBLY		
4	EA	02	261029	BASE PLATE	BASE PLATE		
4	EA	01	261028	SOLE PLATE	SOLE PLATE ASSEMBLY		

BILL OF MATERIAL AND PARTS LIST

CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT

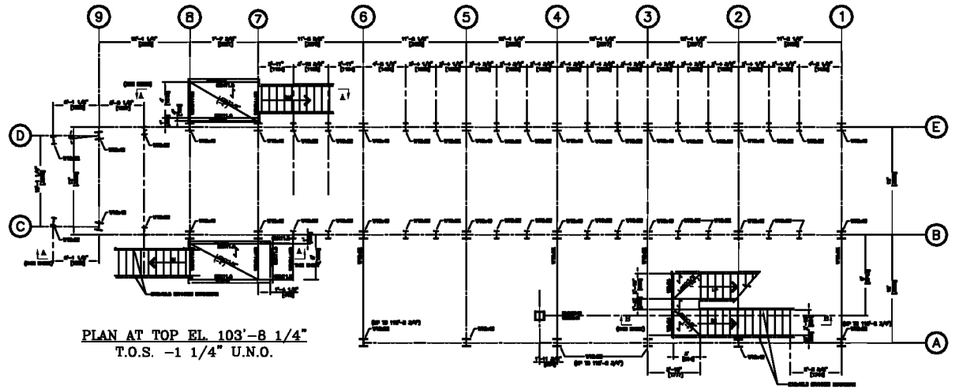
BASE PLATE LAYOUT ASSEMBLY

261001 | C10003 | 261003 | E | 01

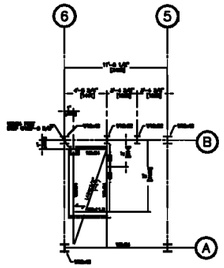
SCALE 1:1.48 | SHEET NO. 01 OF 01

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
D0	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	1/09/11
01	N/A	UPDATED T.O.P. EL. 129'-6 7/8" AND T.O.P. EL. 201'-7 3/4" AND BURNER PLATFORM STAIRS T.O.P. EL. 149'-7 1/4" PLAN ADDED/MODIFIED. T.O.P. EL. 116'-4", T.O.P. EL. 123'-11 1/4" AND T.O.P. EL. 137'-4 1/2" FRAMING ADDED.	A.T.	B.H.	2/08/11
02	N/A	T.O.S. EL. 129'-11" HOLD REMOVED AND PANDRL MODIFIED T.O.P. EL. 116'-4", 123'-11 1/4" AND T.O.P. EL. 137'-4 1/4"	A.T.	B.H.	2/28/11
03	N/A	T.O.S. EL. 150'-11" PLATFORM DETAIL MODIFIED	A.T.	B.H.	3/10/11
04	N/A	T.O.P. EL. 129'-9 3/4" AND PLATFORM AT T.O.P. EL. 130'-7 1/4" REVISED AS SHOWN	A.T.	B.H.	3/21/11
05	N/A	T.O.P. EL. 116'-7, EL. 129'-6 3/8" T.O.P. EL. 216'-5 3/4" AND T.O.P. EL. 203'-7 3/4" REVISED AS SHOWN EXTRA BRACING ADDED AT T.O.P. EL. 137'-4 1/2" T.O.P. EL. 149'-7" WAS 149'-7 1/4" SUPPORT CLIPS HOLES PATTERNS ADDED.	A.T.	B.H.	4/11/11
06	N/A	T.O.P. EL. 137'-7 REVISED AS PER DELTA (SHEET 1); REFERENCE GT SIGNS DOC REVISIONS ADDED (SHEET 2); VIEWS FF-FF, DD-DD, BB-BB ADDED (SHEET 3); FOR BOLT SHEET AND AB CONNECTION ADDED IN SECTION 1-1 (SHEET 4); SECTION AAA-AAA WAS AAA-AAA (SHEET 5); NOTE AT SECTIONS FF-FF,DD-DD,-LLBB-BB ADDED (SHEET 6); HDG MATERIAL ADDED IN GENERAL NOTES (SHEET 1); TYPICAL BEAM & AB CONNECTION IN STAIRS HDG ADDED (SHEET 6); TYPICAL BEAM CONNECTION IN HDG FRAMES & HDG ADDED (SHEET 6); SECTIONS SS-SS, TT-TT, UU-UU, VV-VV ADDED (SHEET 5);	F.T.	F.T.	4/24/11

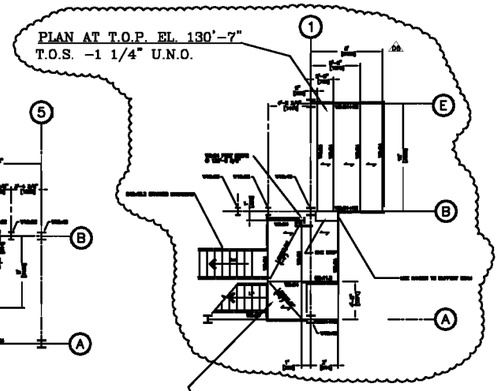
PLAN AT TOP EL. 103'-8 1/4"
T.O.S. -1 1/4" U.N.O.



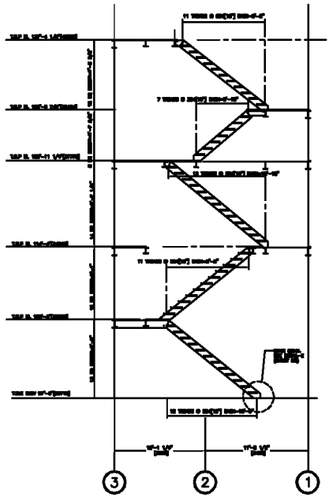
PLAN AT T/LANDING EL. 106'-3"
T.O.S. -1 1/4" U.N.O.



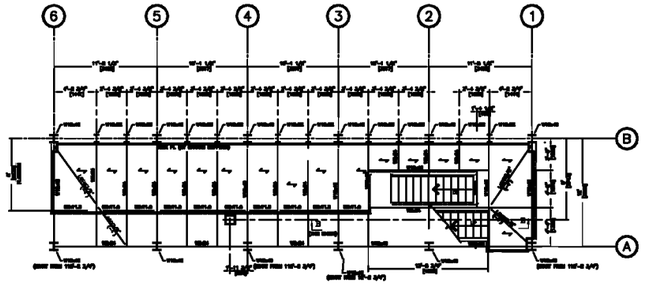
PLAN AT T.O.P. EL. 129'-6 7/8"
T.O.S. -1 1/4" U.N.O.



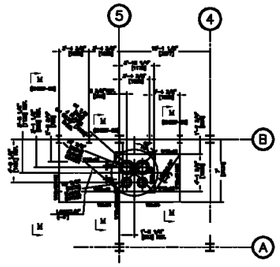
PLAN AT T.O.P. EL. 129'-6 7/8"
T.O.S. -1 1/4" U.N.O.



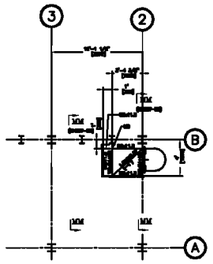
SECTION B-B



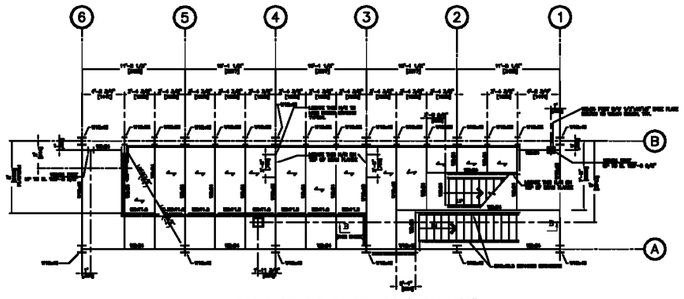
PLAN AT T.O.P. EL. 114'-4"
T.O.S. -1 1/4" U.N.O.



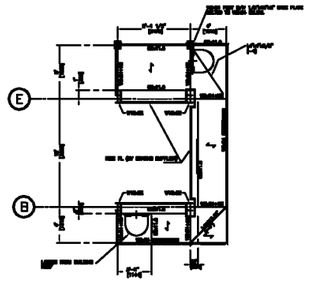
PLAN AT T.O.S. EL. 150'-9 3/4" (45968)
T.O.S. -0" U.N.O.



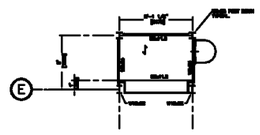
PLAN AT T.O.P. EL. 149'-7"
T.O.S. -1 1/4" U.N.O.



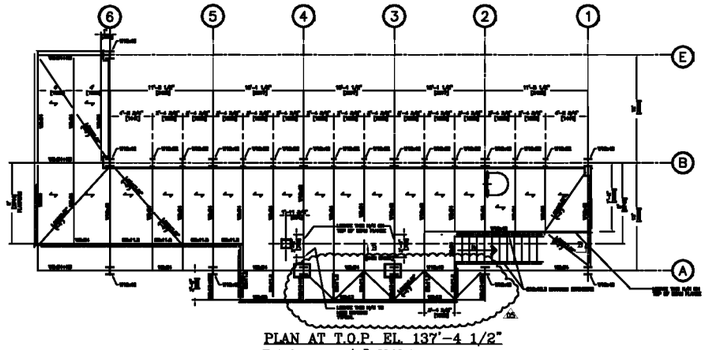
PLAN AT T.O.P. EL. 123'-11 1/4"
T.O.S. -1 1/4" U.N.O.



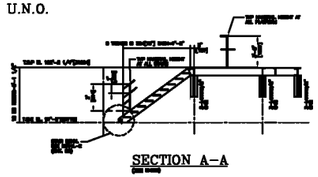
PLAN AT T.O.P. EL. 203'-7 3/4"
T.O.S. -1 1/4" U.N.O.



PLAN AT T.O.P. EL. 216'-5 3/4"
T.O.S. -1 1/4" U.N.O.



PLAN AT T.O.P. EL. 137'-4 1/2"
T.O.S. -1 1/4" U.N.O.



SECTION A-A

ISSUED FOR CONSTRUCTION

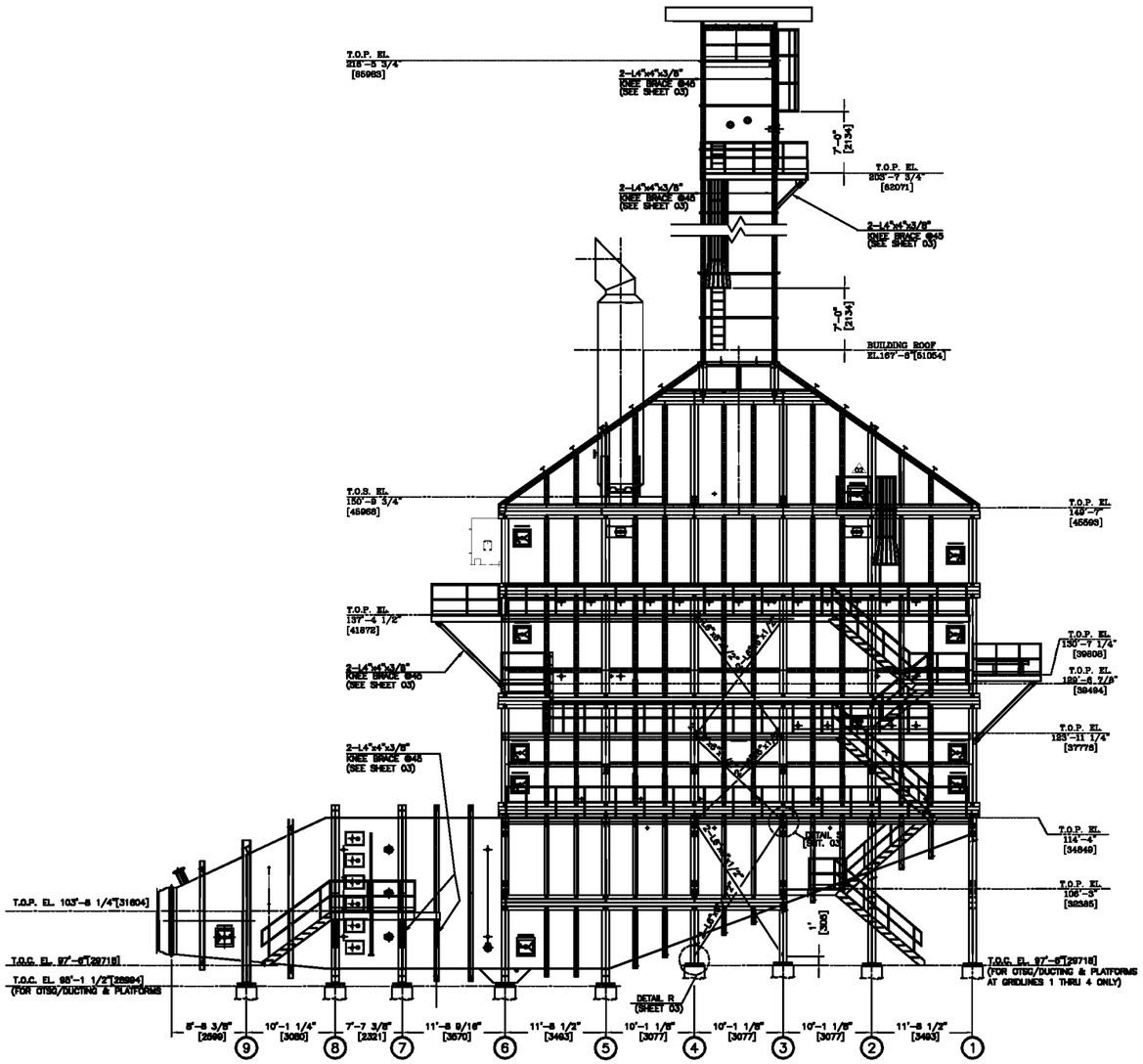
SLCI CONTRACT No.	0689
CONTRACT No.	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT
PLATFORM ERECTION DIAGRAM
LM6000PF OTSG

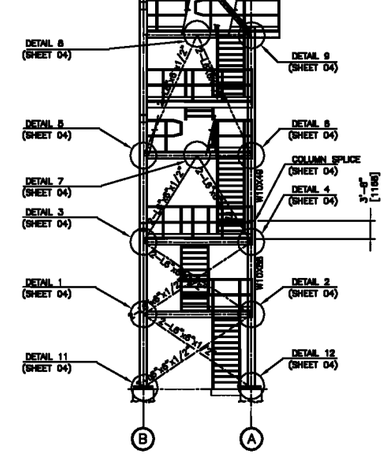
IST

DWG. NO. 281021 REV. E 05
SCALE 1:1.84 SHEET NO. 01 OF 05

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	1/9/11
01	N/A	ADDED NOTE,DETAIL 12, UPDATED BURNER STAIRS PLATFORM AT EL. 149'-7 1/4" ADDED	A.T.	B.H.	2/9/11
02	N/A	SEE DRAWING T&P. ELEV[illegible] 1/4" [illegible] ADDED.	A.T.	B.H.	2/28/11
03	N/A	MODIFICATIONS AS SHOWN	A.T.	B.H.	3/11/11
04	N/A	MODIFICATIONS AS SHOWN	A.T.	B.H.	3/21/11
05	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	4/11/11
06	N/A	SEE SHEET 1	F.T.	F.T.	4/21/11



SIDE ELEVATION



PLATFORM BRACING AT GRID LINES 1,3,4, AND 6

NOTE:

REFER TO DRAWING 281003 FOR BASEPLATE AND TOP OF CONCRETE ELEVATION AT COLUMN LINES A AND B.

REFER TO IST DRAWINGS 140961 THRU 140969 FOR SWING GATE ASSEMBLIES.

ISSUED FOR CONSTRUCTION

SLCI CONTRACT No.	0689
CONTRACT No.	81041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

IST

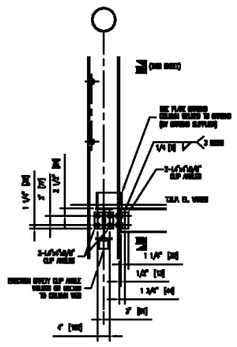
CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT

PLATFORM ERECTION DIAGRAM LM6000PF OTSG

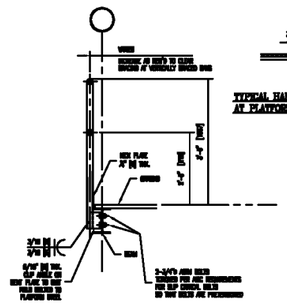
DWG. NO. 281021 REV. E

SCALE 1 : 64 SHEET NO. 02 OF 05

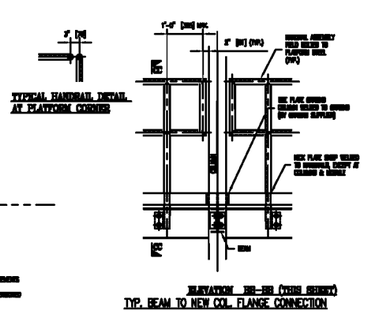
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	1/9/11
01	N/A	ADDED SECTIONS, VIEWS HH, JJ, KK. SECTIONAL VIEWS MM MODIFIED	A.T.	B.H.	2/9/11
02	N/A	SECTION M-M HOLD REMOVED	A.T.	B.H.	2/28/11
03	N/A	SECTION M-M MODIFIED	A.T.	B.H.	3/10/11
04	N/A	SECTION M-M MODIFIED AND COMMENCED	A.T.	B.H.	3/21/11
05	N/A	DETAILS MODIFIED AS SHOWN	A.T.	B.H.	4/11/11
06	N/A	SEE SHEET 1	F.T.	F.T.	4/21/11



TYPICAL BEAM TO NEW COLUMN WEB CONNECTION

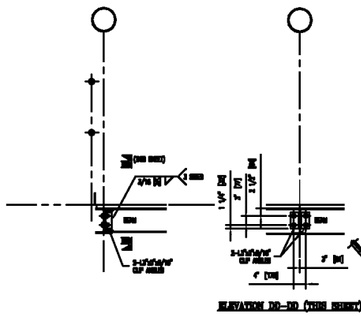


ELEVATION CC-CC (THIS SHEET)
TYPICAL HANDRAIL CONNECTION TO PLATFORM STEEL

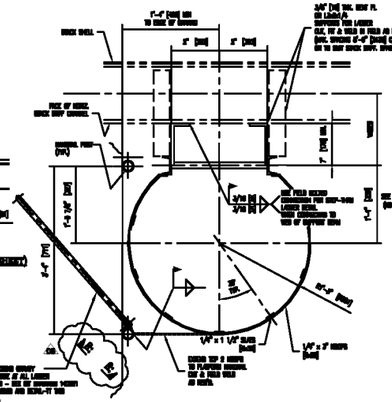


TYPICAL HANDRAIL DETAIL AT PLATFORM CORNER

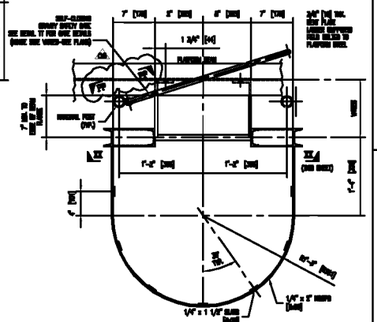
ELEVATION HH-HH (THIS SHEET)
TYP. BEAM TO NEW COL. FLANGE CONNECTION



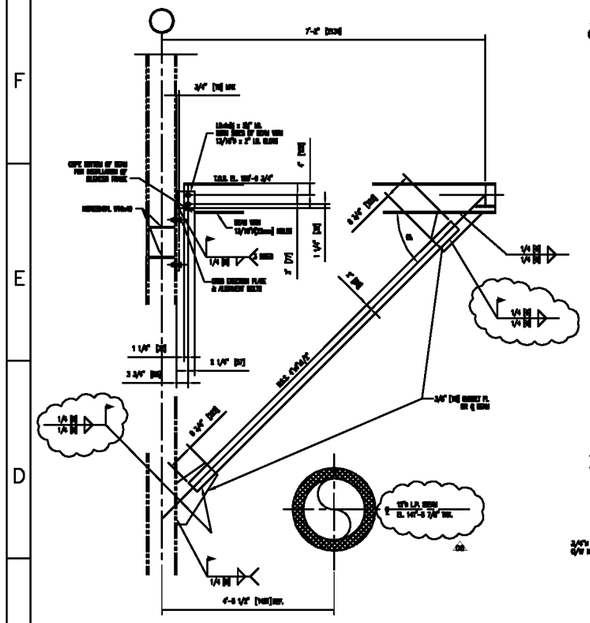
ELEVATION DD-DD (THIS SHEET)
TYPICAL BEAM TO BEAM CONNECTION



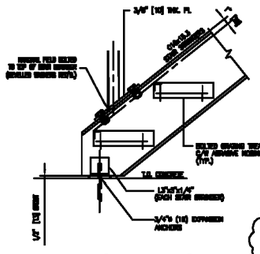
TYPICAL SIDE-STEP LADDER ARRANGEMENT



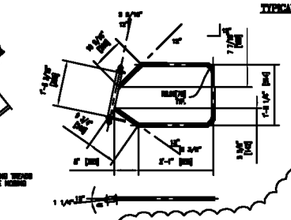
TYPICAL STEP-THRU LADDER ARRANGEMENT



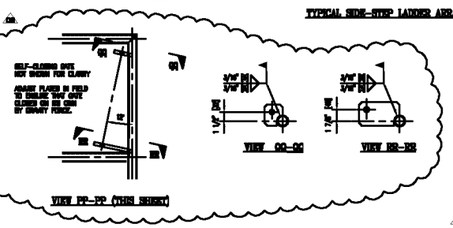
VENT STANCHION SUPPORT BEAM CONNECTION TO MODULE
SECTION M-M (SHEET 01)



DETAIL-X (SHEET 01 AND 02)



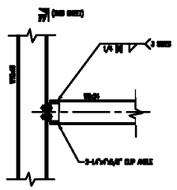
TYPICAL SELF-CLOSING GRAVITY GATE
DETAIL-TT (THIS SHEET)
(SEE SVY DRAWINGS 140981 THRU 140989 FOR REFERENCE)



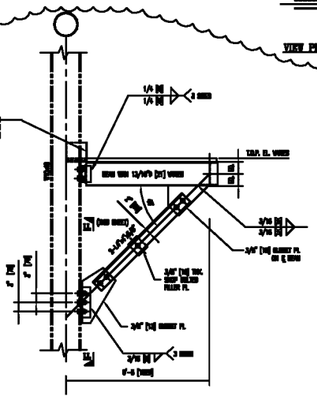
VIEW PP-PP (THIS SHEET)

VIEW QQ-QQ

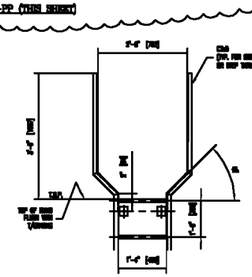
VIEW RR-RR



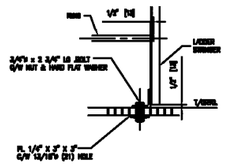
TYPICAL BEAM TO OTSG CONNECTION
AT GRID LINE 2 AND 5



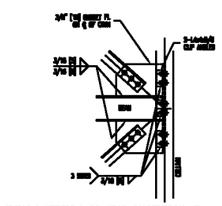
TYPICAL KNEE BRACE CONNECTION (0'-0" SPAN OR LESS)
TO W10x49 FLANGE



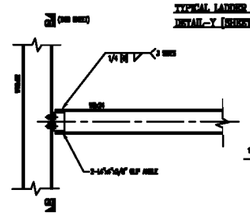
TYPICAL STEP-THRU LADDER STRINGERS
SECTION XX-XX (THIS SHEET)



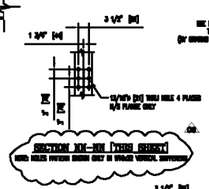
TYPICAL LADDER BASE CONNECTION TO GRATING
DETAIL-Y (SHEET 02)



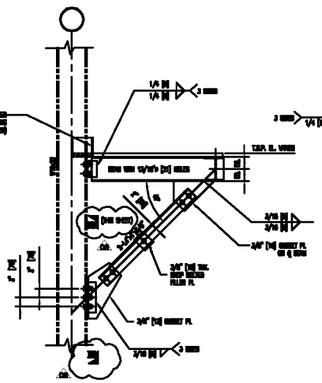
TYPICAL VERTICAL BRACING CONNECTION AT
NEW COLUMNS (LINE "A" ONLY)
DETAIL-S (SHEET 02)



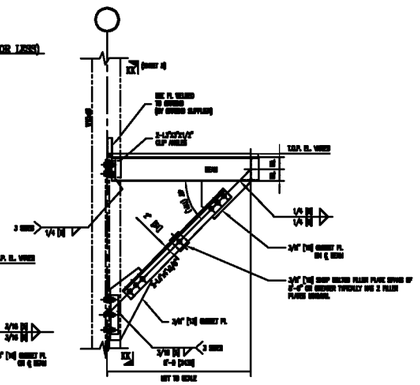
TYPICAL BEAM TO OTSG CONNECTION
AT OTSG W10x88 VERTICAL STIFFENERS



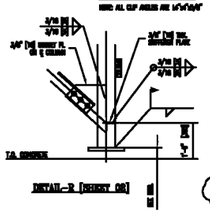
SECTION MM-MM (THIS SHEET)



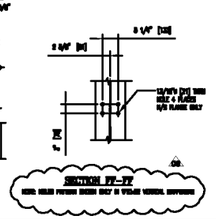
TYPICAL KNEE BRACE CONNECTION (0'-0" SPAN OR LESS)
TO W10x88 WEB



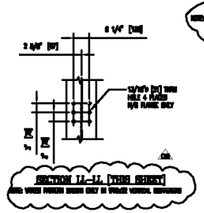
TYPICAL KNEE BRACE CONNECTION (0'-0" SPAN OR GREATER)
TO W10x88 WEB



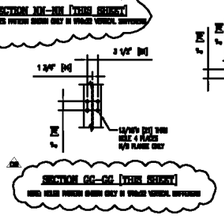
DETAIL-R (SHEET 02)



SECTION FF-FF



SECTION LL-LL (THIS SHEET)



SECTION QQ-QQ (THIS SHEET)

GENERAL NOTES:

1. ALL PRIMARY DIMENSIONS ARE IN FEET & INCHES, ALL SECONDARY DIMENSIONS ARE IN mm.
   ALL EL. SHOWN ARE PER OTSG DATUM.
2. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LATEST EDITION OF THE AISC AMERICAN OF STEEL CONSTRUCTION, U.S.A. OSHA REGULATIONS ALASKA OSHA REGULATIONS AND ANCE
3. ALL STEEL MATERIALS SHALL CONFORM TO THE FOLLOWING SPECIFICATIONS.
   STRUCTURAL 'S' SHAPES — G40.21M-300W/ASTM A992 GR.50
   HOLLOW STRUCTURAL SECTION (HSS) — G40.21M-350W/ASTM A500 GR.C
   ALL OTHER STRUCTURAL SHAPES AND PLATES — G40.21M-300W/ASTM A572
   BOLTS — ASTM A325
   NO FIELD WELDED CONNECTIONS AND/OR SPLICES (FULL STRENGTH) OF MEMBERS ARE ALLOWED, UNLESS AS SHOWN OR DRAWING OR APPROVED BY SIL.
4. PAINTING & GALVANIZING
   ALL STEEL OTHER THAN GRATING & SCAR TREADS SHALL BE PREPARED AS FOLLOWS.
   SURFACE PREPARATION — COMMERCIAL BLAST CLEANING SSPC-6 OR EQUAL.
   PAINTING — REFER TO SIT SPECIFICATION 09-010
   H.D. GALVANIZING — GRATING & SCAR TREADS ONLY

   DO NOT PAINT 3" AT BOTTOM OF PLATFORM COLUMNS.
5. CONNECTIONS
   ALL FIELD CONNECTIONS SHALL BE WITH 3/4 INCH HIGH STRENGTH BEARING TYPE BOLTS (HOT-DIPPED GALVANIZED) TIGHTENED AND INSPECTED IN ACCORDANCE WITH ASTM A325 UNLESS NOTED OTHERWISE.
   NON-HIGH STRENGTH BOLTS FOR STAIRS, LADDERS ETC. SHALL BE ASTM A307 GRADE A.
   ALL BOLT HOLES ARE 13/16" U.N.O.
6. WELDING: ALL WELDING SHALL BE IN ACCERANCE WITH CSA W59
   ALL WELDS SHALL BE CONTINUOUS UNLESS NOTED OTHERWISE. MINIMUM SIZE OF FILLET WELD TO BE 3/16" OR AS REQUIRED BY MATERIAL THICKNESS OR PARTS JOINTED.
   WELDING MATERIALS CSA# W-H SERIES E48018 OR E7XXX/E80XX LOW HYDROGEN TYPE.
7. GRATING: ALL PLATFORM GRATING SHALL BE SERRATED IRS SERIES TYPE W/S OR APPROVED EQUAL 1 1/4"x3/16" BEARING BARS AT 1 3/16" SPACIAL CENTERS OF GRATING TO BE SWAGED.
   ALL SCAR TREADS GRATING SHALL BE SERRATED IRS SERIES TYPE W/S OR APPROVED EQUAL WITH ABRASIVE TYPE NOSING
   CROSS BARS SHALL BE AT 4" SPACING, LONGITUDINAL BARS ONLY SHALL SPAN SUPPORTING BEAMS
   ABRASIVE NOSING SHALL BE SHOP BOLTED. GRATING HOLD DOWN CLIPS AS PER SIT STANDARD 03-018.
   ALL GRATING PANELS TO BE FULLY BANDED ALL AROUND.
   ALL GRATING TO BE H.D GALVANIZED.
8. HANDRAIL: UNLESS NOTED OTHERWISE, ALL HANDRAILS SHALL BE 1.05"O.D. x 0.15" WALL ASCO SR. C. SHOP WELDED MODULAR UNITS COMBINED WITH RAILS AND BOLTS AND FIELD BOLTED TO STRUCTURAL MEMBERS.
   MAXIMUM SPACING OF POSTS IS 4'-6" O.C.
   TOP OF HAND RAIL FOR PLATFORM TO BE 42" AND CENTERLINE OF MIDRAIL TO BE 24" ABOVE PLATFORM ELEVATION.
   FOR STAIRS TOP OF TOP RAIL TO BE 36" AND CENTERLINE OF MIDRAIL TO BE 18" ABOVE THE SURFACE OF THE TREAD, IN LINE WITH THE FACE OF THE RISER AT THE FORWARD EDGE OF THE TREAD.
9. TOE PLATES: ALL TOE PLATES SHALL BE 4"x1/4" AND EXTEND A MIN. OF 4 1/4" ABOVE GRATING ELEVATION AND BE SHOP WELDED TO HANDRAIL POSTS U.N.O/NOTED OTHERWISE.
10. * DENOTES EXISTING MEMBER OF OTSG.
11. DESIGN LOADS ARE PER SIT SPECIFICATIONS AS FOLLOWS:
    PLATFORM AND WALKWAYS — 100 PSF LIVE LOAD + 20 PSF SERVICE LOAD
    STAIRS — 100 PSF OR 1000 LB CONCENTRATED LIVE LOAD
    STRUCTURAL FRAMEWORK — PIPING LOADS OF 5 KIPS ON MAJOR BEAMS
12. ALL STAIRS AND LADDERS SHALL BE SHOP ASSEMBLED WITH TREADS AND RUNGS INSTALLED. HANDRAILS SHALL BE SHOP INSTALLED ON STRUCTURAL STEEL TO THE FULLEST EXTENT POSSIBLE.
13. NOTE TO ERECTOR:
    FIELD CUT OPENINGS IN GRATING FOR PIPES & OTHER PENETRATIONS OR OTHER OBSTRUCTIONS AS REQ'D. TO SUIT ALL SITE CONDITIONS. FIELD CUT, FIELD FIT & FIELD WELD TOE PLATES & GRATING AS REQ'D. (TYP. ALL GRATING AREAS AT ALL PLATFORM LEVELS). OPENINGS IN GRATING TO BE BANDED.
14. H.D. DENOTES HOOK GRADE BELOW
15. ⟷ DENOTES DIRECTION OF GRATING BEARING BARS
16. U.N.O. = UNLESS NOTED OTHERWISE
17. ERECTOR TO SUPPLY AND INSTALL PIPE PENETRATION TOE PLATES AS REQUIRED.
18. PLATFORM FABRICATION TO MEET SIT SPECIFICATION 03-017.
19. T.O.S. = TOP OF STEEL.
20. T.O.G. = TOP OF PLATFORM GRATING

ISSUED FOR CONSTRUCTION

SLC CONTRACT No. 0659
CONTRACT No. 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

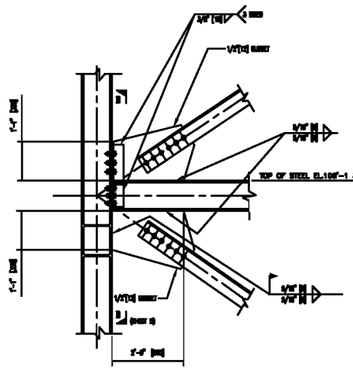
TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN mm [in]
+/- 0.5 [+/- 1/64]
+/- 1 [+/- 1/32]
+/- 2 [+/- 1/16]
+/- 5 [+/- 3/16]
+/- 10 [+/- 3/8]
+/- 20 [+/- 3/4]
+/- 50 [+/- 2]
+/- 100 [+/- 4]
+/- 200 [+/- 8]
+/- 500 [+/- 20]
+/- 1000 [+/- 40]
ANGULAR DIMENSIONS +/- 1°

THIS DRAWING IS THE PROPERTY OF SIT AND IS LOANED SUBJECT TO RETURN UPON DEMAND AND WITH THE UNDERSTANDING THAT IT SHALL NOT BE REPRODUCED, COPIED OR USED IN WHOLE OR IN PART AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS OR APPLIANCES WITHOUT WRITTEN PERMISSION OF SIT.

IST

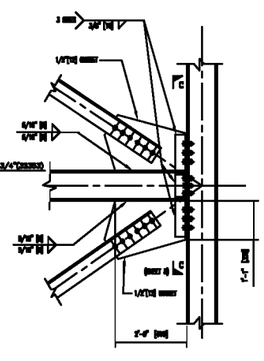
N/A/QUALITY	DATE: N/A	ENGINEER: CHUGACH ELECTRIC ASSOCIATION INC SOUTHCENTRAL POWER PROJECT	
N/A/PM	DATE: N/A		
N/A/ENGINEER	DATE: 1/9/11	TITLE: PLATFORM ERECTION DIAGRAM LM6000PF OTSG	
N/A/CHECKED	DATE: 1/9/11		
N/A/A.T.	DATE: 10/20/10		
N/A/A.T.	DRAWING NO: LM6000PF	PROJECT NO: 281021	SIZE: E REV: 06
SHEET 1/2: PA\210001\281001-03		SCALE: 1 : 10	SHEET NO: 03 OF 08

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	1/9/11
01	N/A	ADDED SECTION B,C,D,E,F,G,H,I, T.O.S. EL. NOTES AND DETAIL 12	A.T.	B.H.	2/9/11
02	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	3/18/11
03	N/A	DETAIL 8 MODIFIED	A.T.	B.H.	3/18/11
04	N/A	DETAIL 8 MODIFIED	A.T.	B.H.	3/21/11
05	N/A	ISSUED FOR CONSTRUCTION	A.T.	B.H.	4/11/11
06	N/A	SEE SHEET 1	F.T.	F.T.	4/21/11



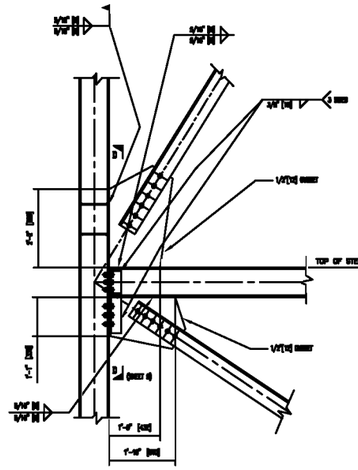
DETAIL-1

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL BOLTS ARE 3/4"Ø A325
ALL FIELD WELD ARE 5/16"[8]
ALL FIELD WELDS TO BE CONDUCTED DURING FINAL WELD OUT OF DUCT INTERFACE SEAMS AND ERECTION PLATES.



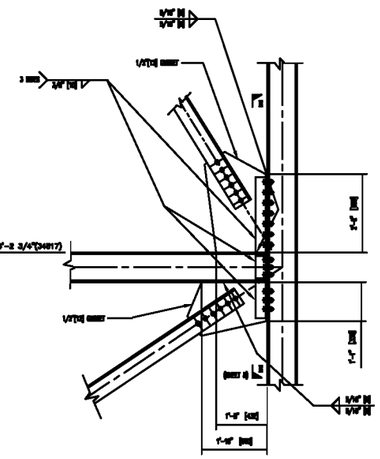
DETAIL-2

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL FIELD WELD ARE 5/16"[8]
ALL BOLTS ARE 3/4"Ø A325



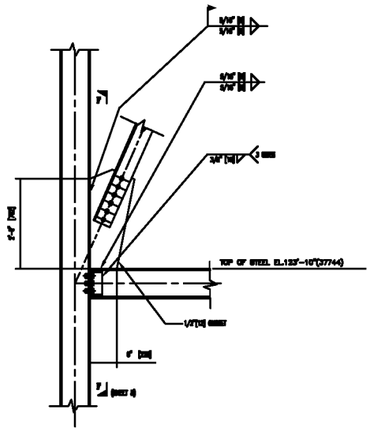
DETAIL-3

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL BOLTS ARE 3/4"Ø A325
ALL FIELD WELD ARE 5/16"[8]
ALL FIELD WELDS TO BE CONDUCTED DURING FINAL WELD OUT OF DUCT INTERFACE SEAMS AND ERECTION PLATES.



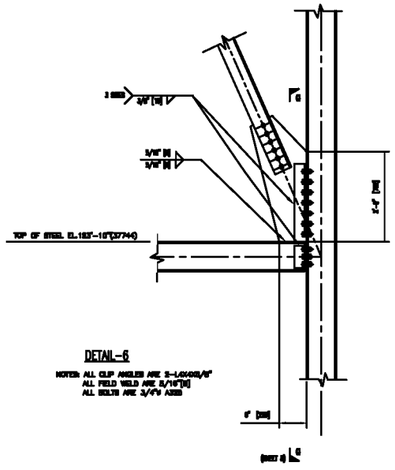
DETAIL-4

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL FIELD WELD ARE 5/16"[8]
ALL BOLTS ARE 3/4"Ø A325



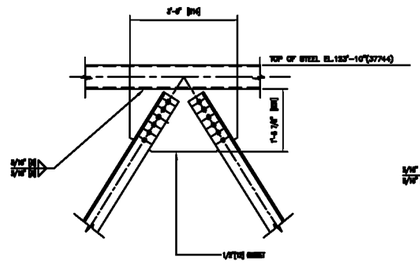
DETAIL-5

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL BOLTS ARE 3/4"Ø A325
ALL FIELD WELD ARE 5/16"[8]
ALL FIELD WELDS TO BE CONDUCTED DURING FINAL WELD OUT OF DUCT INTERFACE SEAMS AND ERECTION PLATES.



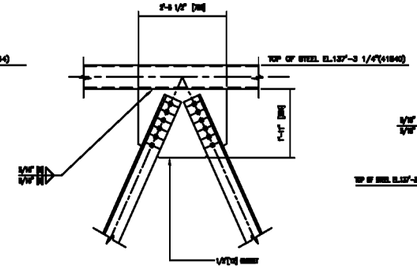
DETAIL-6

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL FIELD WELD ARE 5/16"[8]
ALL BOLTS ARE 3/4"Ø A325



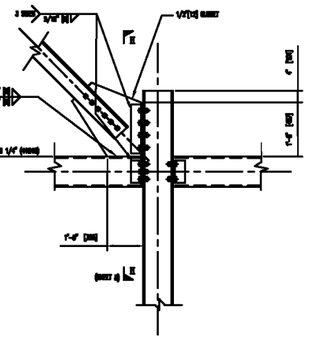
DETAIL-7

NOTES: ALL BOLTS ARE 3/4"Ø A325



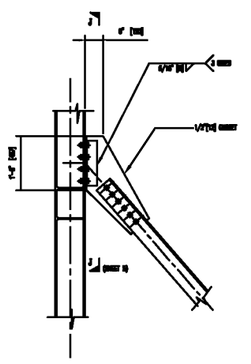
DETAIL-8

NOTES: ALL BOLTS ARE 3/4"Ø A325



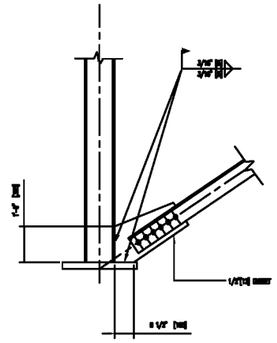
DETAIL-9

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL FIELD WELD ARE 5/16"[8]
ALL BOLTS ARE 3/4"Ø A325



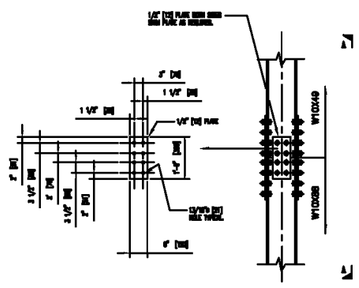
DETAIL-10

NOTES: ALL CLIP ANGLES ARE 2-L4X4X5/8"
ALL FIELD WELD ARE 5/16"[8]
ALL BOLTS ARE 3/4"Ø A325



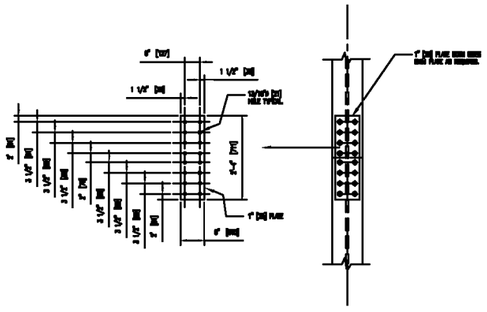
DETAIL-11

NOTES: ALL BOLTS ARE 3/4"Ø A325
FIELD WELD TO BE CONDUCTED DURING INSTALLATION OF CROSS BRACE.

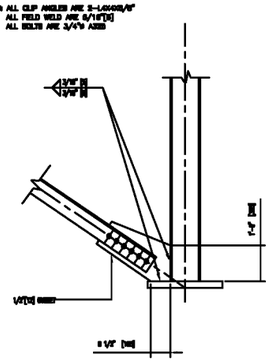


COLUMN SPLICE DETAIL
W10x68 TO W10x49 COLUMNS

NOTES: ALL BOLTS ARE 3/4"Ø A325



ELEVATION A-A



DETAIL-12

NOTES: ALL BOLTS ARE 3/4"Ø A325

ISSUED FOR CONSTRUCTION

SLC CONTRACT No.	0659
CONTRACT No.	61041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

QUALITY	N/A
CIVIL	N/A
STRUCTURAL	T/S/11
MECH.	T/S/11
ELEC.	T/S/10
P/C, A.T.	
N/A	
N/A	

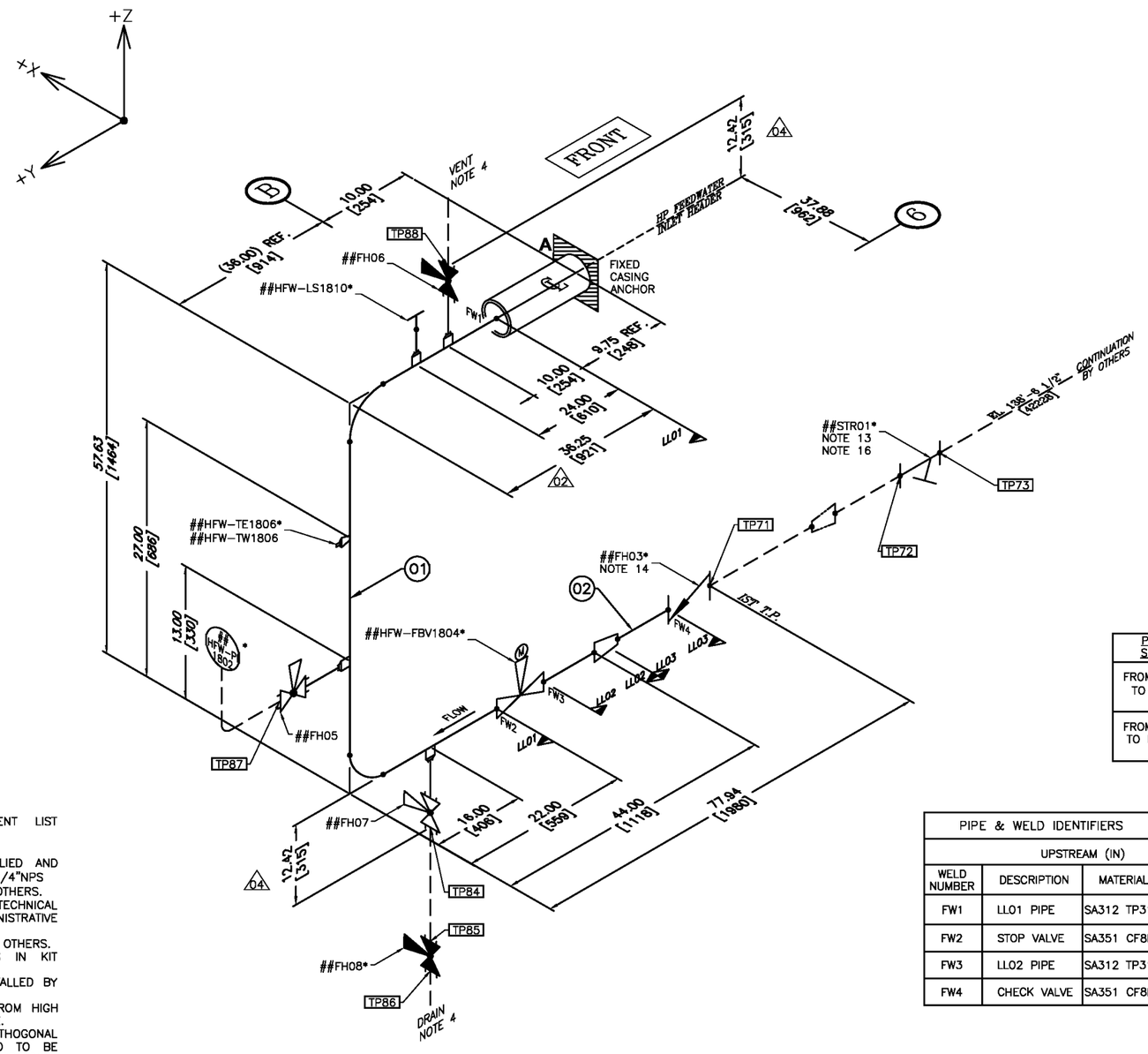
CHUGACH ELECTRIC ASSOCIATION INC
SOUTHCENTRAL POWER PROJECT

PLATFORM ERECTION DIAGRAM
LM6000PF OTSG

DRAWING NO. 261021 REV. E SHT. 05

SCALE: 1 : 10 SHEET NO. 04 OF 05

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	–	FIRST ISSUE	GB	JH	12/02/10
01	–	ISSUED FOR CONSTRUCTION	GB	JH	01/06/10
02	–	PIPING DIMS UPDATED; MAX. ANCHOR THERMAL DISPLACEMENT UPDATED	MZ	JH	02/25/11
03	–	HYDROTEST MAX TEMP. CHANGED FROM 200°F TO 100°F	DH	FT	04/25/11
04	–	ADDED DIMENSION TO TP84 AND TP88.	JT	JH	07/13/11



HP FEEDWATER PIPING
261022

ALLOWABLE ANCHOR LOADS						
LOCATION	F_x	F_y	F_z	M_x	M_y	M_z
A	650 LBF	650 LBF	650 LBF	950 FT–LBF	950 FT–LBF	950 FT–LBF

NOTE 10

MAX ANCHOR THERMAL DISPLACEMENT			
LOCATION	X	Y	Z
A	+0.032 in [+0.821mm]	–0.009 in [–0.229mm]	+0.494 in [+12.548mm]

LINE ITEM TABLE		MATERIAL (SEAMLESS)		
LINE ITEM	DESCRIPTION	PIPE	FITTINGS	FORGINGS / CASTINGS
LL01	4" NPS SCH.80	SA312 TP316	SA403 WP316	SA182 F316/ SA351 CF8M
LL02	4" NPS SCH.120	SA312 TP316	SA403 WP316	SA351 CF8M
LL03	3" NPS SCH.80	SA312 TP316	SA403 WP316	SA351 CF8M

PIPE ** SECTION	DESIGN CONDITION 1		DESIGN CONDITION 2		HYDROTEST	
FROM "FW1" TO "FW2"	PRESSURE	TEMPERATURE	PRESSURE	TEMPERATURE	PRESSURE	TEMPERATURE
	900 psig [6.205 MPag]	926°F [497°C]	1479 psig [10.200 MPag]	161°F [72°C]	1849 psig [12.750 MPag]	70°FMin–100°FMax [21°CMin–38°CMax]
FROM "FW3" TO IST T.P.	PRESSURE	TEMPERATURE	PRESSURE	TEMPERATURE	PRESSURE	TEMPERATURE
	1950 psig [13.445 MPag]	161°F [72°C]	–	–	2925 psig [20.167 MPag]	70°FMin–100°FMax [21°CMin–38°CMax]

** ALSO APPLICABLE TO ALL BRANCHES WITHIN SPECIFIED RUN PIPE SECTION UP TO OUTLET OF SECOND ISOLATION VALVE WHERE EXISTS.
▲ PUMP SHUT–OFF HEAD AS ADVISED BY SLCI.

PIPE & WELD IDENTIFIERS							
	UPSTREAM (IN)			DOWNSTREAM (OUT)			
WELD NUMBER	DESCRIPTION	MATERIAL	WELD PREP	DESCRIPTION	MATERIAL	WELD PREP	WELD
FW1	LL01 PIPE	SA312 TP316	SCH.80	INLET HEADER SPOOL	SA312 TP316	SCH.80	FULL PEN BUTT WELD
FW2	STOP VALVE	SA351 CF8M	SCH.80	LL01 PIPE	SA312 TP316	SCH.80	FULL PEN BUTT WELD
FW3	LL02 PIPE	SA312 TP316	SCH.120	STOP VALVE	SA351 CF8M	SCH.120	FULL PEN BUTT WELD
FW4	CHECK VALVE	SA351 CF8M	SCH.80	LL03 PIPE	SA312 TP316	SCH.80	FULL PEN BUTT WELD

NOTE:

1. PIPE TO BE CLEANED PER IST SPEC. ES–021.
2. SEE APPROPRIATE VALVE LIST (261000–200) AND INSTRUMENT LIST (261000–100) FOR SPECIFICATIONS.
3. FW INDICATES FIELD WELD.
4. ALL DRAIN & VENT PIPING, 3/4"NPS [DN20] SHALL BE SUPPLIED AND ROUTED TO A SAFE LOCATION BY OTHERS. ALL INSTRUMENT PIPING 3/4"NPS [DN20] SHALL BE SUPPLIED AND ROUTED TO A SAFE LOCATION BY OTHERS.
5. PIPING TO BE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL REQUIREMENTS OF ASME–B31.1 2007 EDITION AND THE ADMINISTRATIVE REQUIREMENTS OF ASME–SECTION I 2007 EDITION 2009 ADDENDA,
6. ON BRANCHES, ALL WELDS AFTER FIRST VALVE ARE FIELD WELDS BY OTHERS.
7. IST SUPPLIED AND SHIPPED LOOSE INSTRUMENTS AND VALVES IN KIT 261000–100 AND 261000–200, INDICATED WITH * IN TAG LINE.
8. EQUIPMENT IDENTIFIED WITH * IS SUPPLIED BY IST AND FIELD INSTALLED BY OTHERS.
9. INSTRUMENTATION INSTALLED ONTO PIPING SHALL BE PROTECTED FROM HIGH OPERATING TEMPERATURES BY A SIPHON AND BLOCK & BLEED VALVE.
10. FORCES AND MOMENTS ARE ASSUMED TO ACT IN EACH ORTHOGONAL DIRECTION CONCURRENTLY. FORCES AND MOMENTS ARE ASSUMED TO BE EITHER PLUS OR MINUS. ANCHORS ARE DESIGNED TO ACCEPT AN ADDITIONAL 50% INCREASE IN THE STATED LOADS FOR OCCASIONAL LOADS. PIPING ANALYSIS AND REQUIRED PIPE SUPPORTS BY OTHERS.
11. PIPING BY OTHERS ARE MARKED WITH DASHED LINE (– – – – – – –).
12. PIPING BETWEEN CHECK & STOP VALVES REQUIRES FREEZE PROTECTION BY OTHERS.
13. STRAINER ORIENTATION SHOWN AS EXAMPLE ONLY. INSTALLED ORIENTATION & LOCATION BY OTHERS.
14. CHECK VALVE TO HAVE A MINIMUM OF 10 PIPE DIAMETERS STRAIGHT LENGTH UPSTREAM TO ENSURE PROPER PERFORMANCE.
15. PIPE SUPPORTS TO BE DESIGNED, LOCATED & INSTALLED BY OTHERS. SUPPORT FROM OTSG STRUCTURAL STEEL ACCEPTABLE IF APPROVED BY IST.
16. INSTALL STRAINER NO MORE THAN 15 PIPE DIAMETERS UPSTREAM OF CHECK VALVE.
17. EQUIPMENT IS SUPPLIED AND FIELD INSTALLED BY OTHERS.
18. PRIMARY DIMENSIONS ARE IN INCHES, SECONDARY [BRACKETED] ARE IN MILLIMETERS.
19. REPLACE ## IN TAG FOR OTSG UNIT NUMBER.

REFERENCE DRAWINGS/DOCUMENTS:

GENERAL ARRANGEMENT (IST)	261001
FLOWSHEET (IST)	261004
INSTRUMENT LIST (IST)	261000–100
VALVE LIST (IST)	261000–200

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

ISSUED FOR CONSTRUCTION

QTY	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	02	261093–100	HP FEEDWATER PIPING	HP FEEDWATER PIPING SPOOL		
1	EA	01	261092–100	HP FEEDWATER PIPING	HP FEEDWATER PIPING SPOOL		

BILL OF MATERIAL AND PARTS LIST

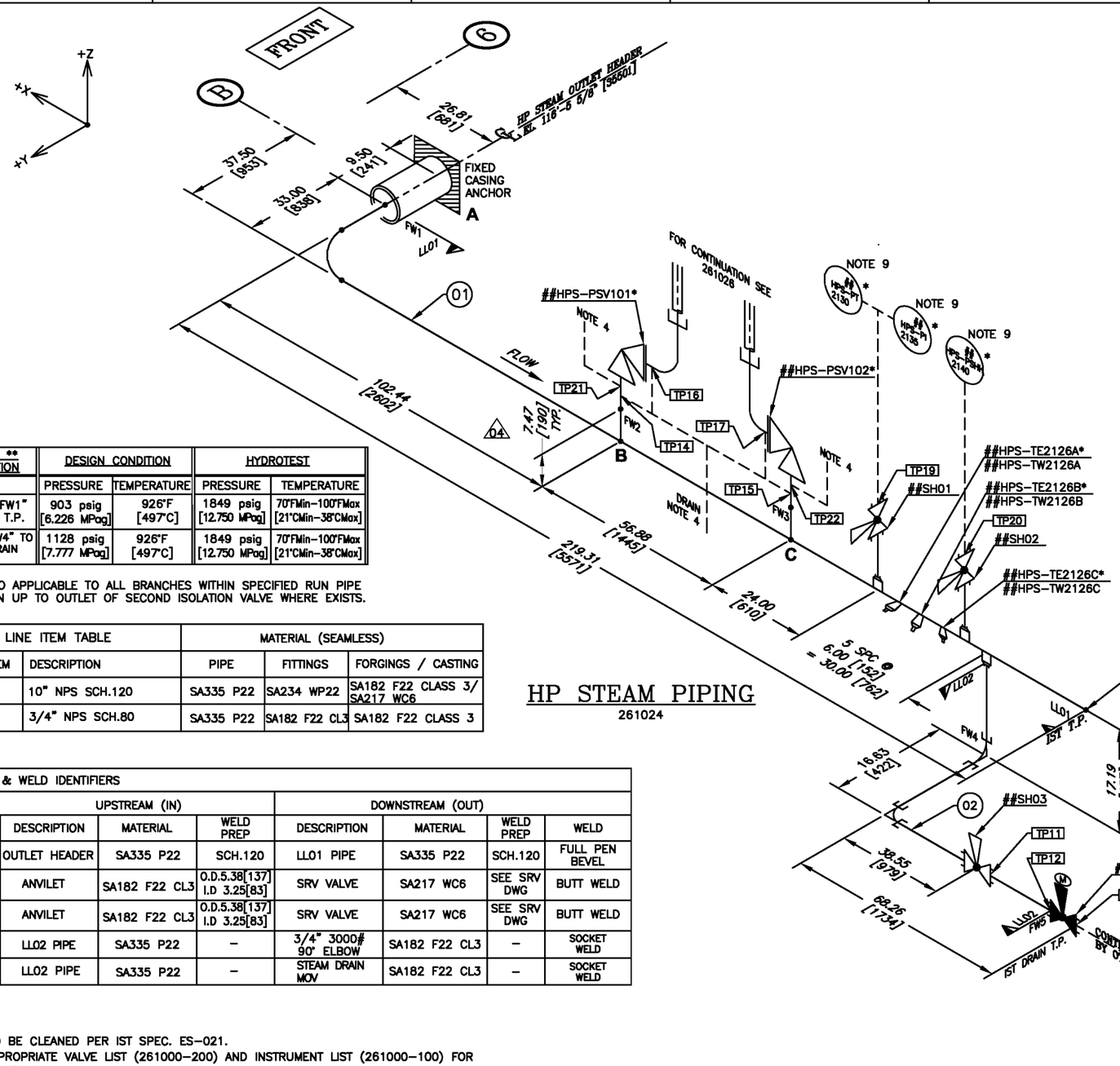
TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN in [mm]
METRIC LINEAR TOL+/– 1.5mm
TOL ON 1 PLACE DECIMALS +/– .120
TOL ON 2 PLACE DECIMALS +/– .060
TOL ON 3 PLACE DECIMALS +/– .030
ANGULAR TOLERANCE +/– 0.5°

THIRD ANGLE PROJECTION

THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.

IST

QUALITY A. RIVERS	DATE: 03/12/10	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFG. M. HUNTER	DATE: 03/12/10	TITLE: HP FEEDWATER PIPING ISOMETRIC	
PROJ.ENG. J.TONG	DATE: 03/12/10		
CHK. J. HUNTER	DATE: 01/12/10		
DRN. G. BELL	DATE: 03/12/10		
N.H.A. 261001	EQUIP.MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261022 SIZE D REV. 04
CADDS I.D. P:\C10082\261022		SCALE: NTS	SHEET NO. 01 OF 01



HP STEAM PIPING
261024

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	–	FIRST ISSUE	GB	JH	12/03/10
01	–	ISSUED FOR CONSTRUCTION	GB	JH	01/05/10
02	–	REVISED STEAM DRAIN PIPING, ADDED ITEM 02	MZ	JH	02/25/11
03	–	HYDROTEST MAX TEMP. CHANGED FROM 200°F TO 100°F	DH	FT	04/25/11
04	–	ADDED DIMENSION TO FW2 AND FW3.	JT	JH	07/13/11

SRV REACTION LOADS		
LOCATION	F_Z (lbf)	M_Y (ft–lbf)
B	–3171	–4741
C	–3152	+4713

REACTION LOADS DO NOT INCLUDE A DYNAMIC LOAD FACTOR PER ASME B31.1.

MAX ANCHOR THERMAL DISPLACEMENT			
LOCATION	X	Y	Z
A	–0.023 in [–0.584mm]	–0.004 in [–0.102mm]	+0.219 in [+5.558mm]

ALLOWABLE ANCHOR LOADS						
LOCATION	F_x	F_y	F_z	M_x	M_y	M_z
A	2400 LBF	2400 LBF	2400 LBF	7500 FT-LBF	7500 FT-LBF	7500 FT-LBF

NOTE 10

PIPE ** SECTION	DESIGN CONDITION		HYDROTEST	
	PRESSURE	TEMPERATURE	PRESSURE	TEMPERATURE
FROM "FW1" TO IST T.P.	903 psig [6.226 MPag]	926°F [497°C]	1849 psig [12.750 MPag]	70°FMin–100°FMax [21°CMin–38°CMax]
FROM "FW4" TO STEAM DRAIN MOV	1128 psig [7.777 MPag]	926°F [497°C]	1849 psig [12.750 MPag]	70°FMin–100°FMax [21°CMin–38°CMax]

** ALSO APPLICABLE TO ALL BRANCHES WITHIN SPECIFIED RUN PIPE SECTION UP TO OUTLET OF SECOND ISOLATION VALVE WHERE EXISTS.

LINE ITEM TABLE		MATERIAL (SEAMLESS)		
LINE ITEM	DESCRIPTION	PIPE	FITTINGS	FORGINGS / CASTING
LL01	10" NPS SCH.120	SA335 P22	SA234 WP22	SA182 F22 CLASS 3/ SA217 WC6
LL02	3/4" NPS SCH.80	SA335 P22	SA182 F22 CL3	SA182 F22 CLASS 3

PIPE & WELD IDENTIFIERS							
	UPSTREAM (IN)			DOWNSTREAM (OUT)			
WELD NUMBER	DESCRIPTION	MATERIAL	WELD PREP	DESCRIPTION	MATERIAL	WELD PREP	WELD
FW1	OUTLET HEADER	SA335 P22	SCH.120	LL01 PIPE	SA335 P22	SCH.120	FULL PEN BEVEL
FW2	ANVILET	SA182 F22 CL3	O.D.5.38[137] I.D 3.25[83]	SRV VALVE	SA217 WC6	SEE SRV DWG	BUTT WELD
FW3	ANVILET	SA182 F22 CL3	O.D.5.38[137] I.D 3.25[83]	SRV VALVE	SA217 WC6	SEE SRV DWG	BUTT WELD
FW4	LL02 PIPE	SA335 P22	–	3/4" 3000# 90° ELBOW	SA182 F22 CL3	–	SOCKET WELD
FW5	LL02 PIPE	SA335 P22	–	STEAM DRAIN MOV	SA182 F22 CL3	–	SOCKET WELD

NOTE:

1. PIPE TO BE CLEANED PER IST SPEC. ES–021.
2. SEE APPROPRIATE VALVE LIST (261000–200) AND INSTRUMENT LIST (261000–100) FOR SPECIFICATIONS.
3. FW# INDICATES FIELD WELD.
4. ALL DRAIN & VENT PIPING, 3/4" NPS [DN20], SHALL BE SUPPLIED AND ROUTED TO A SAFE LOCATION BY OTHERS. ALL INSTRUMENT PIPING, 3/4" NPS [DN20], SHALL BE SUPPLIED AND ROUTED BY OTHERS.
5. PIPING TO BE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL REQUIREMENTS OF ASME – B31.1 2007 EDITION AND THE ADMINISTRATIVE REQUIREMENTS OF ASME – SECTION I 2007 EDITION 2009 ADDENDA.
6. ON BRANCHES, ALL WELDS AFTER FIRST VALVE ARE FIELD WELDS BY OTHERS.
7. IST SUPPLIED AND SHIPPED LOOSE INSTRUMENTS AND VALVES IN KIT 261000–100 AND 261000–200, INDICATED WITH * IN TAG LINE.
8. EQUIPMENT IDENTIFIED WITH * IS SUPPLIED BY IST, AND FIELD INSTALLED BY OTHERS. EQUIPMENT IDENTIFIED WITH ■ IS SUPPLIED AND FIELD INSTALLED BY OTHERS.
9. INSTRUMENTATION INSTALLED ONTO PIPING SHALL BE PROTECTED FROM HIGH OPERATING TEMPERATURES BY A SIPHON AND BLOCK & BLEED VALVE (PROVIDED & ROUTED BY OTHERS).
10. FORCES AND MOMENTS ARE ASSUMED TO ACT IN EACH ORTHOGONAL DIRECTION CONCURRENTLY. FORCES AND MOMENTS ARE ASSUMED TO BE EITHER PLUS OR MINUS. ANCHORS ARE DESIGNED TO ACCEPT AN ADDITIONAL 50% INCREASE IN THE STATED LOADS FOR OCCASIONAL LOADS. PIPING ANALYSIS BY OTHERS.
11. PIPING BY OTHERS ARE MARKED WITH DASH LINE (_ _ _ _ _).
12. PIPE SUPPORTS TO BE DESIGNED, SUPPLIED, LOCATED, & INSTALLED BY OTHERS. SUPPORT OFF OTSG STRUCTURAL STEEL IS ALLOWABLE IF APPROVED BY IST.
13. PRIMARY DIMENSIONS ARE IN INCHES, SECONDARY [BRACKETED] ARE IN MILLIMETERS.
14. REPLACE ## IN TAG FOR OTSG UNIT NUMBER.

ISSUED FOR CONSTRUCTION

REFERENCE DRAWINGS/DOCUMENTS:

GENERAL ARRANGEMENT (IST)	261001
FLOWSHEET (IST)	261004
INSTRUMENT LIST (IST)	261000–100
VALVE LIST (IST)	261000–200

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	02	261700	HP STEAM PIPING	HP STEAM PIPING SPOOL		
1	EA	01	261096	HP STEAM PIPING	HP STEAM PIPING SPOOL		

BILL OF MATERIAL AND PARTS LIST

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN in [mm]
METRIC LINEAR TOL.+/– 1.5mm
TOL. ON 1 PLACE DECIMALS +/– 0.120"
TOL. ON 2 PLACE DECIMALS +/– 0.060"
TOL. ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

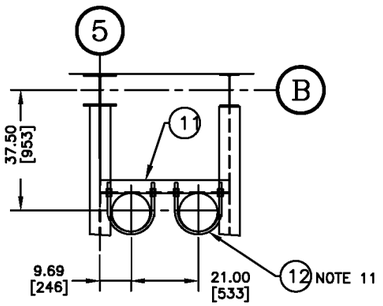
THIRD ANGLE PROJECTION

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IST

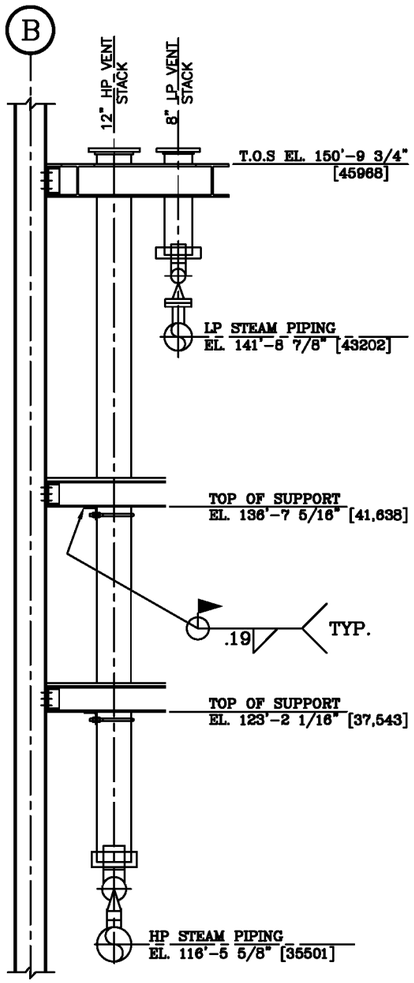
QUALITY A. RIVERS	DATE: 03/12/10	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFG. M. HUNTER	DATE: 03/12/10		
PROJ.ENG. J. TONG	DATE: 03/12/10	TITLE: HP STEAM PIPING ISOMETRIC	
CHK. J. HUNTER	DATE: 01/12/10		
DRN. G. BELL	DATE: 03/12/10		
N.H.A. 261001	EQUIP.MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261024 SIZE D REV. 04
CADDS I.D. P:\C10082\261024			SCALE: N.T.S. SHEET NO. 01 OF 01

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	–	FIRST ISSUE	GB	JH	12/03/10
01	–	ISSUED FOR CONSTRUCTION	GB	JT	01/20/10
02	–	PIPING DIMS UPDATED; TEMPERATURE UPDATED	MZ	JH	02/25/11



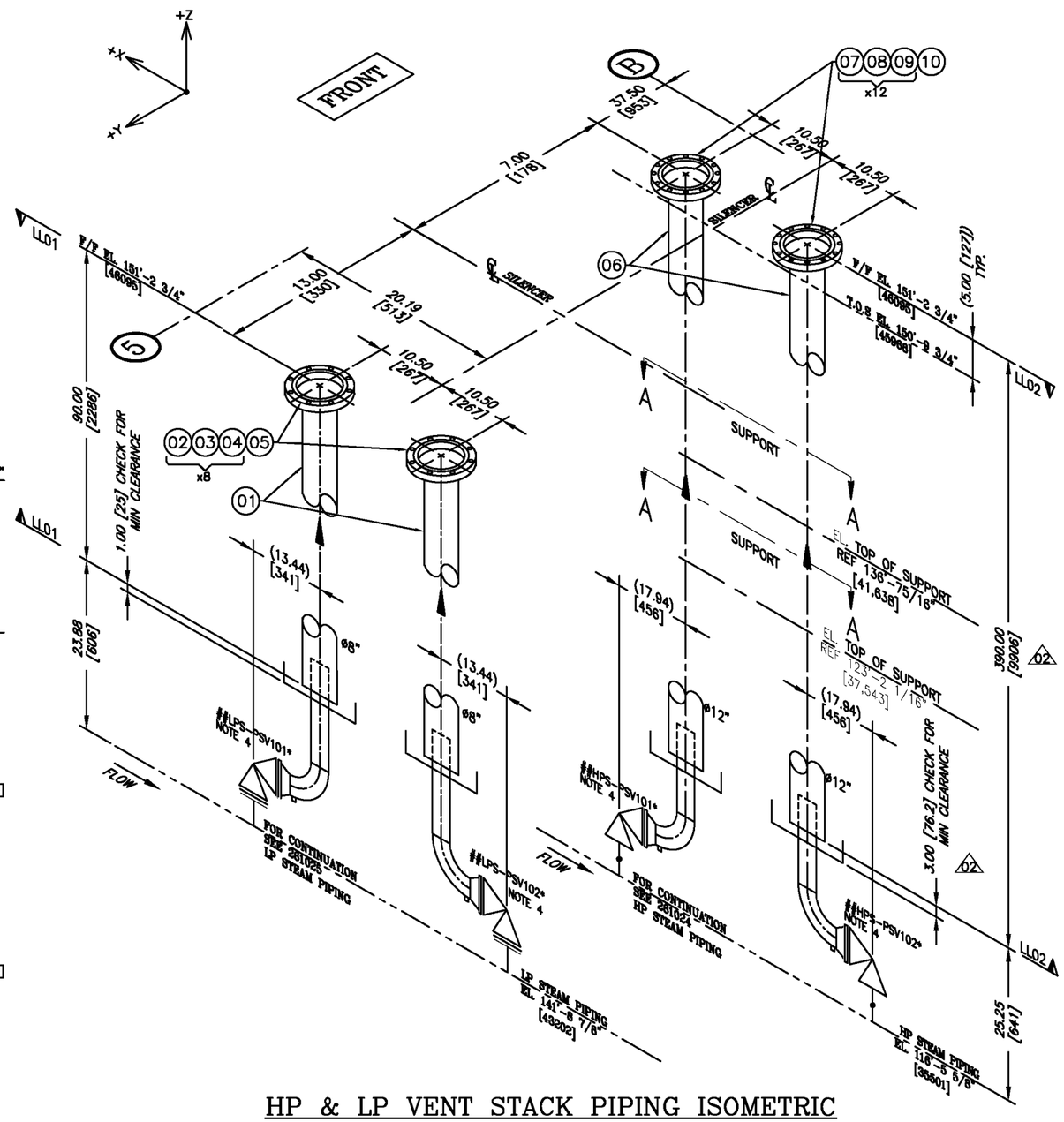
SECTION A–A

TYP. 2 PLCS
SCALE: NTS



FRONT VIEW

NTS



HP & LP VENT STACK PIPING ISOMETRIC

261026
NTS

LINE ITEM TABLE		MATERIAL	
LINE ITEM	DESCRIPTION	PIPE	FLANGE
LL01	8" NPS SCH.20	SA-53B ERW	SA105
LL02	12" NPS SCH.20	SA-53B ERW	SA105

PIPE SECTION	DESIGN CONDITION	
	PRESSURE	TEMPERATURE
HP VENT	100 psig [0.69 MPag]	788°F [420°C]
LP VENT	100 psig [0.69 MPag]	406°F [208°C]

.02

NOTES:

1. PREPARE AND PAINT EXTERNAL SURFACE PER IST SPECIFICATION ES-010.
2. ALL OPENINGS TO BE CLOSED WITH PLASTIC PROTECTORS AND SECURELY FASTENED IMMEDIATELY FOLLOWING PIPE CLEANING.
3. SAFETY VALVE, DRIP PAN ELBOW, DRIP PAN, GASKETS AND HARDWARE SUPPLIED BY SAFETY VALVE VENDOR. INSTALLED AT SITE BY OTHERS.
4. SEE APPROPRIATE VALVE LIST 261000-200 FOR VALVE SPECIFICATIONS.
5. FINAL LOCATION OF VENT PIPE SUPPORT ITEMS TO BE DETERMINED BY ACTUAL LOCATION OF VENT PIPES MEASURED IN FIELD. ALL DIMENSIONS TO BE CONFIRMED BY ERECTOR.
6. PIPING TO BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ASME B31.1, 2007, 2009 ADDENDUM.
7. ALL WELDING SHALL BE PERFORMED IN ACCORDANCE WITH ASME SECTION IX REQUIREMENTS, USING APPROPRIATELY QUALIFIED PROCEDURES AND PERSONNEL.
8. PRIMARY DIMENSIONS AND ELEVATIONS ARE IN INCHES AND FEET, SECONDARY [BRACKETED] DIMENSIONS AND ELEVATIONS ARE IN mm.
9. SITE ERECTOR TO TRIM PIPES TO MEET CLEARANCE IF REQUIRED.
10. REPLACE ## IN TAG FOR OTSG UNIT NUMBER.
11. U-BOLTS ACT AS GUIDES. TIGHTEN TO REMOVE ALL CLEARANCE ONLY. DO NOT CLAMP PIPES.

REFERENCE DRAWINGS/DOCUMENTS:

GENERAL ARRANGEMENT (IST)	261001
FLOWSHEET (IST)	261004
VALVE LIST (IST)	261000-200

QTY	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
4	EA	12	261026-09	U-BOLT	STD. 12" C/W NUTS AND WASHERS	GALV. A36	
2	EA	11	261263	ANGLE BRACKET	ANGLE 4" x 4" x .38"	G40.21M 300W	
2	EA	10	261026-08	GASKET	GASKET 12" 150# SPIRAL WOUND	316/GRAPHITE	
24	EA	09	261026-07	WASHER	WASHER CIRC. 0.88" NOM.	F436 TYPE1	
24	EA	08	261026-06	NUT	NUT-HY HEX 0.88"-9UNC-2B	A194-GR7	
24	EA	07	261026-05	BOLT	BOLT-HY HEX 0.88"-9UNC-2A x 4.00 [102]	A193 B7	
2	EA	06	261262	HP VENT PIPE	HP VENT PIPING SPOOL		
2	EA	05	261026-04	GASKET	GASKET 8" 150# SPIRAL WOUND	316/GRAPHITE	
16	EA	04	261026-03	WASHER	WASHER CIRC 0.75" NOM.	F436 TYPE1	
16	EA	03	261026-02	NUT	NUT-HY HEX 0.75"-10UNC-2B	A194-GR7	
16	EA	02	261026-01	BOLT	BOLT-HY HEX 0.75"-10UNC-2A X 3.50 [89]	A193 B7	
2	EA	01	261261	LP VENT PIPE	LP VENT PIPING SPOOL		

BILL OF MATERIAL AND PARTS LIST

ISSUED FOR CONSTRUCTION

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN in [mm]
METRIC LINEAR TOL +/- 1.5
TOL ON 1 PLACE DECIMALS +/- 0.120"
TOL ON 2 PLACE DECIMALS +/- 0.060"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°

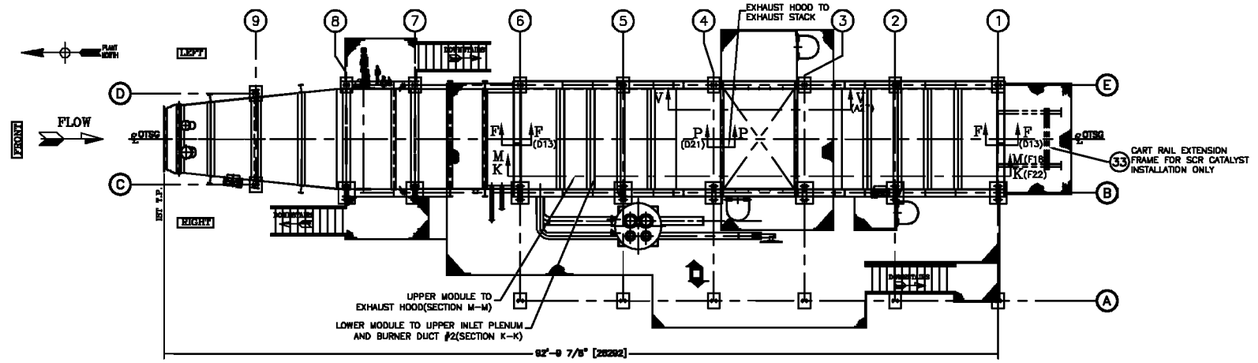
THIRD ANGLE PROJECTION

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QUALITY A. RIVERS	DATE: 24/12/10	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT
MFG. B. NIELSEN	DATE: 17/12/10	
PROJ.ENG. J. TONG	DATE: 17/12/10	TITLE: VENT STACK OUTLET PIPING ISOMETRIC
CHK. J. HUNTER	DATE: 17/12/10	
DRN. G. BELL	DATE: 17/12/10	
N.H.A. 261001	EQUIP.MODEL LM6000PF	PROJ.NO. C10082
CADDS I.D. P:\C10082\261026		SCALE: NTS

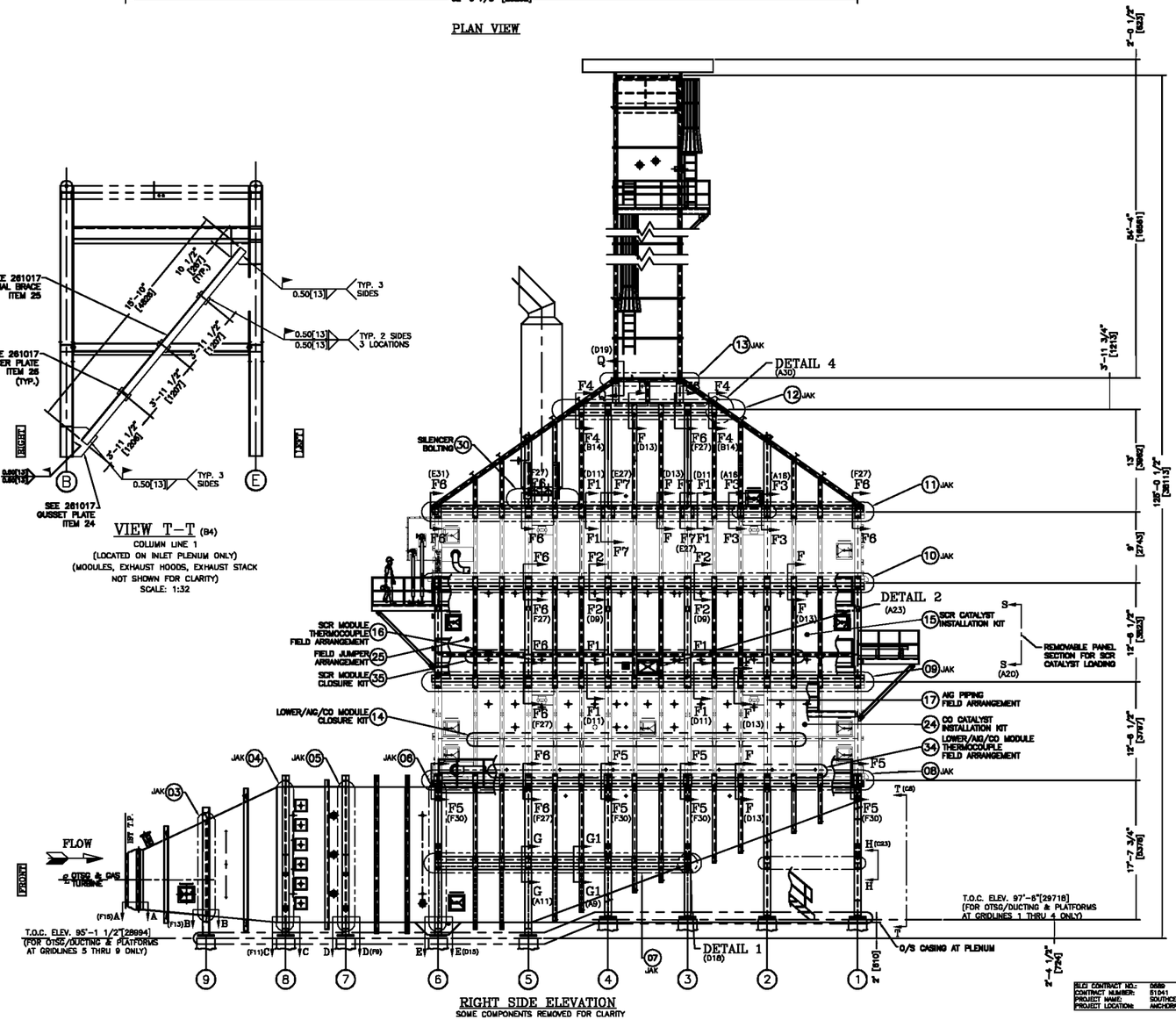
DWG. NO. 261026 | SIZE D | REV. 02
SHEET NO. 01 OF 01

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	RG	JH	03/11/2011
01	N/A	ADDED ITEMS 37-39 (UPPER INLET PLENUM TO LOWER MODULE), ITEM 34 (LOWER/AIG/CO MODULE THERMOCOUPLE FIELD ARRANGEMENT) AND ITEM 35 (SCR MODULE CLOSURE KIT). UPDATED QUANTITIES.	JH	JT	03/18/2011
02	N/A	REMOVED ITEM 30 ON HOLD. UPDATED QUANTITIES.	JH	FT	03/23/2011
03	2578	UPDATED DESCRIPTION FOR ITEM 22	JT	JH	05/06/2011



PLAN VIEW

VIEW T-T (B4)
COLUMN LINE 1
(LOCATED ON INLET PLENUM ONLY)
(MODULES, EXHAUST HOODS, EXHAUST STACK NOT SHOWN FOR CLARITY)
SCALE: 1:32



RIGHT SIDE ELEVATION
SOME COMPONENTS REMOVED FOR CLARITY

NOTES:

1. ALL PRIMARY DIMENSIONS & ELEVATIONS ARE IN FEET & INCHES. ALL SECONDARY [IN BRACKETS] DIMENSIONS ARE IN MILLIMETRES.
2. TACK WELD ALL INTERNAL THREADED CONNECTIONS TO PREVENT NUT FROM TURNING OFF AFTER ASSEMBLY UNLESS OTHERWISE NOTED. (EXCLUDE ALL DOUBLE NUTS)
3. JOINT ASSEMBLY KIT ITEM NO. 09 TO BE PLACED ON LOWER AIC/CO MODULE SUPPORT BEAMS PRIOR TO PLACEMENT OF SCR MODULE.
4. JOINT ASSEMBLY KIT ITEM NO. 10 TO BE PLACED ON SCR MODULE SUPPORT BEAMS PRIOR TO PLACEMENT OF UPPER MODULE.
5. JOINT ASSEMBLY KITS ITEM NO. 11 TO BE PLACED ON OTSG UPPER MODULE TOP SUPPORT BEAMS PRIOR TO HOOD INSTALLATION.
6. JOINT ASSEMBLY KITS ITEM NO. 12 & 13 TO BE PLACED ON LOWER EXHAUST HOOD BAFFLES PRIOR TO PLACEMENT OF UPPER EXHAUST HOOD.
7. JOINT ASSEMBLY KITS ITEM NO. 05, 06, 07 & 08 TO BE PLACED IN INLET PLENUM PRIOR TO PLACEMENT OF BURNER DUCT #1.
8. JOINT ASSEMBLY KITS ITEM NO. 03 & 04 AND EXPANSION JOINT LAP PLATES TO BE PLACED IN INLET TRANSITION DUCT PRIOR TO PLACEMENT OF EXPANSION JOINT.
9. HEX BOLTS (ITEMS #28 & 29) TO BE INSTALLED WITH HEADS ON EXTERIOR OF ERECTION PLATES. BOLTS SHALL BE INSTALLED IN ALL HOLES OF THE CONNECTION AND BROUGHT TO A SNUG-TIGHT CONDITION. SNUG-TIGHT IS DEFINED AS THE TIGHTNESS THAT EXISTS WHEN THE PLIES OF THE JOINT ARE IN FIRM CONTACT. THIS MAY BE ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A WORKER USING AN ORDINARY SPUD WRENCH. SNUG TIGHTENING SHALL PROGRESS SYSTEMATICALLY FROM THE MOST RIGID PART OF THE CONNECTION TO THE FREE EDGES AND THEN THE BOLTS OF THE CONNECTION SHALL BE RE-TIGHTENED IN A SIMILAR SYSTEMATIC MANNER AS NECESSARY UNTIL ALL BOLTS ARE SIMULTANEOUSLY SNUG-TIGHT AND THE CONNECTION IS FULLY COMPACTED. FOLLOWING THIS INITIAL OPERATION, ALL BOLTS IN THE CONNECTION SHALL BE TIGHTENED FURTHER BY THE APPLICABLE AMOUNT OF ROTATION (1/3 TURN). DURING THE TIGHTENING OPERATION THERE SHALL BE NO ROTATION OF THE PART NOT TURNED BY THE WRENCH. TIGHTENING SHALL PROGRESS SYSTEMATICALLY FROM THE MOST RIGID PART OF THE JOINT TO ITS FREE EDGES.
10. REMOVE ALL YELLOW PAINTED SHIPPING COMPONENTS PRIOR TO FINAL INSTALLATION. SEE ERECTION INSTRUCTIONS. FOR DETAILS (SHEETS 2 & 3).
11. INSULATION TO BE COMPRESSED TO 5.50" THK.
12. ABBREVIATION JAK = JOINT ASSEMBLY KIT.
13. ALL TUBE WELDS ARE FULL PENETRATION BUTT WELDS IN ACCORDANCE WITH ASME SECTIONS I & IX.
14. MODULE LIFTING AS PER IST ENGINEERING SPEC. ES-024.
15. INSTALL AIG LANCE ASSEMBLIES (ITEM #17) BEFORE ERECTING SCR MODULE, AS A MIN., PLACE THE TWO AIG LANCE SECTIONS IN THE LOWER MODULE FOR LATER INSTALLATION.

QUANTITIES SHOWN ARE FOR (1) ONE UNIT ONLY.

REFERENCE DRAWINGS:
GENERAL ARRANGEMENT.....261001
ERECTION INSTRUCTION PACKAGE.....C10082-B

	QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
	2	EA	39	182808-01	IST CAUTION PLATE	SHEET 11 GA.		B22
	1	EA	38	261741	GUSSET PLATE	PLATE .75"		B18
	1	EA	37	261740	GUSSET PLATE	PLATE .75"		B18
	2	EA	36	261732	FILLER PLATE	PLATE .25"		D26
1		EA	35	261737	SCR CLOSURE KIT	SCR MODULE CLOSURE KIT ASSEMBLY		C7
	1	EA	34	261602	THERMOCOUPLE ARR.	LOWER/AIG/CO MODULE THERMOCOUPLE ARRANGEMENT		B4
1		EA	33	261736	CART RAIL	CART RAIL EXTENSION FRAME ASSY.		H4
	43	EA	32	140730-03	ERECTION PLATE	PLATE .75"		B17
	2	EA	31	261733	ERECTION PLATE	ERECTION PLATE ASSEMBLY		B15
	4	EA	30	300430	HVY HEX BOLT SET	1.00"-8UNC-2A x 2.75" LG	A325 TYPE 1 GALV.	D8
	35	EA	29	300058	HEX BOLT	HEX BOLT 0.75"-10UNC-2A x 2.75" LG	A490 TYPE 1	B10
	818	EA	28	300038	CIRCULAR WASHER	#0.75" WASHER HARDENED	F436 TYPE 1	B15
	818	EA	27	300036	HEAVY HEX NUT	HVY HEX NUT 0.75"-10UNC-2B	A563 DH3	B15
	783	EA	26	300459	HEX BOLT	HEX BOLT 0.75"-10UNC-2A x 2.50" LG	A490 TYPE 1	B15
	1	EA	25	261650	JUMPER TUBES	FIELD JUMPER ARRANGEMENT		C7
	1	EA	24	261735	CO CATALYST	CO CATALYST INSTALLATION KIT		B4
	8	EA	23	140730-05	ERECTION PLATE	PLATE 0.50"		C23
03	12	EA	22	261739	ERECTION PLATE	PLATE 0.50"		D29
	4	EA	21	261731	ERECTION PLATE	PLATE 0.50"		B14
	4	EA	20	140730-06	ERECTION PLATE	PLATE 0.50"		D20
	103	EA	19	140730-01	ERECTION PLATE	PLATE 0.50"		D13
	8	EA	18	140730-04	ERECTION PLATE	PLATE 1.00"		B11
	1	EA	17	261718	AIG PIPING	AIG PIPING FIELD ARRANGEMENT		B4
	1	EA	16	261728	THERMOCOUPLE ARR.	SCR MODULE THERMOCOUPLE ARRANGEMENT		C7
	1	EA	15	261734	SCR CATALYST	SCR CATALYST LOADING ARRANGEMENT		C4
	1	EA	14	261601	CLOSURE KIT	LOWER MODULE CLOSURE KIT ASSEMBLY		B7
1		EA	13	261513	JOINT ASSEMBLY KIT	UPPER EXHAUST HOOD TO STACK		D5
1		EA	12	261512	JOINT ASSEMBLY KIT	LOWER EXHAUST HOOD TO UPPER EXHAUST HOOD		D5
	1	EA	11	261511	JOINT ASSEMBLY KIT	UPPER MODULE TO LOWER EXHAUST HOOD		D4
	1	EA	10	261510	JOINT ASSEMBLY KIT	SCR MODULE TO UPPER MODULE		C4
	1	EA	09	261509	JOINT ASSEMBLY KIT	LOWER MODULE TO SCR MODULE		B4
	1	EA	08	261508	JOINT ASSEMBLY KIT	UPPER INLET PLENUM TO LOWER MODULE		B4
1		EA	07	261507	JOINT ASSEMBLY KIT	LOWER INLET PLENUM TO UPPER INLET PLENUM		A5
1		EA	06	261506	JOINT ASSEMBLY KIT	BURNER DUCT #2 TO INLET PLENUM		B8
1		EA	05	261505	JOINT ASSEMBLY KIT	BURNER DUCT #1 TO BURNER DUCT #2		B7
1		EA	04	261504	JOINT ASSEMBLY KIT	INLET TRANS. DUCT #2 TO BURNER DUCT #1		B7
1		EA	03	261503	JOINT ASSEMBLY KIT	INLET TRANS. DUCT #1 TO INLET TRANS. DUCT #2		B7
92		CF	02	900283	INSULATION	10# DENSITY PER ES-028	SOLUBLE FIBRE	
455		CF	01	900259	INSULATION	6# DENSITY PER ES-028	SOLUBLE FIBRE	

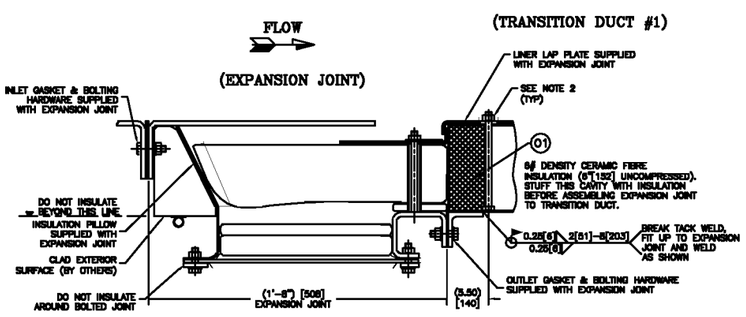
BILL OF MATERIAL AND PARTS LIST

BLG CONTRACT NO.:	0488
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

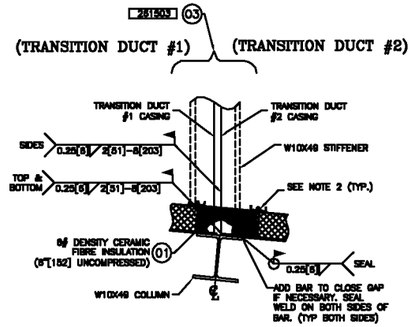
CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT
OTSG, DUCTING AND EQUIPMENT ERECTION DIAGRAM

DRAWN	N/A
CHECKED	03/11/2011
PROJ. ENG.	03/11/2011
APPROVED	03/11/2011
QA/QC	03/11/2011
SUPERVISOR	03/11/2011
DES. ENG.	03/11/2011
PROJ. MGR.	03/11/2011
DWG. NO.	261001
PROJECT	LM6000PF
PROJECT NO.	C10082
DRWG. NO.	261027
SIZE / REV.	E 03
SCALE	1:64
SHEET NO.	01 OF 04
PART NUMBER	261027-01

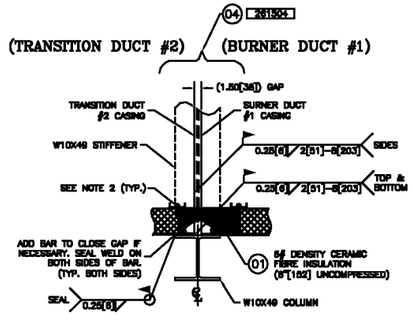
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	RG	JH	09/11/2011
01	N/A	ADDED SECTION H-H TO SECTION E-E	JH	JT	09/19/2011
02	N/A	SEE SHT 1	JH	FT	09/23/2011
03	ERR	SEE SHT 1	JT	JH	09/28/2011



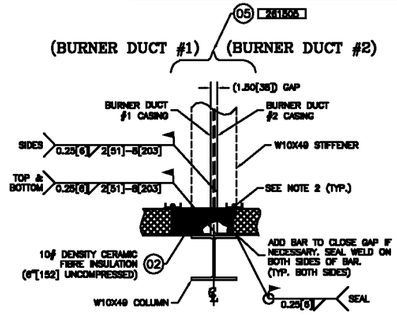
SECTION A–A (A6)
SCALE: NTS
SOME HATCH LINES REMOVED FOR CLARITY. REFER TO SUDBURY EXPANSION JOINT DWG # 825744-1 FOR INSTALLATION INSTRUCTIONS



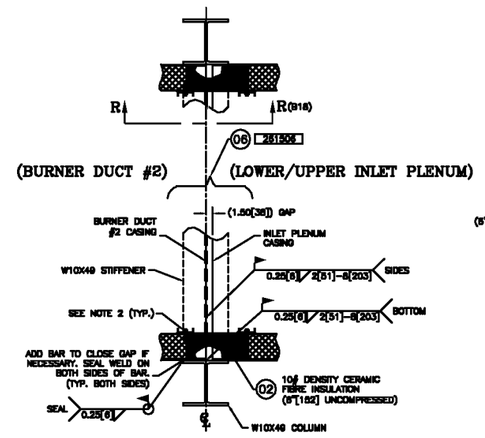
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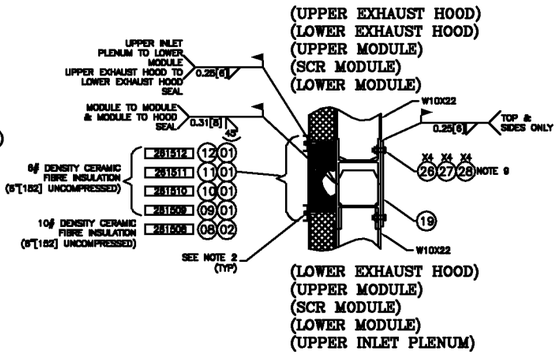
SECTION C–C (A7)
SCALE: NTS



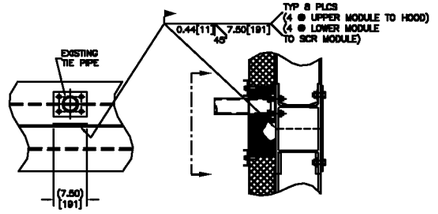
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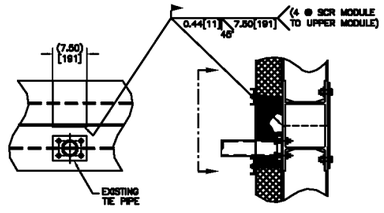
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SCALE: NTS



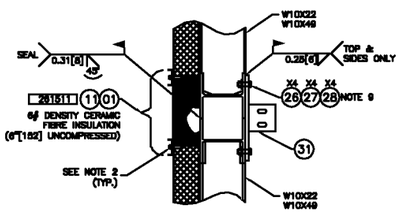
SECTION F–F (D5)
SCALE: NTS
(TYP ● INT. VER. STIFFENERS)
TYP. 87 PLCS.



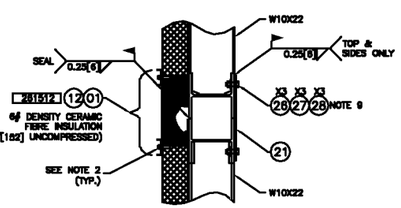
SECTION F1–F1 (C5)
AT TIE ROD LOCATIONS ONLY. (8 PLCS.)
FOR ADDITIONAL DETAIL AND INFORMATION SEE SECTION F–F
SCALE: NTS



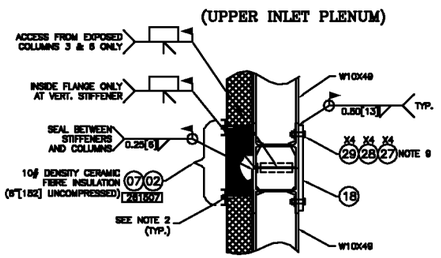
SECTION F2–F2 (C5)
AT TIE ROD LOCATIONS ONLY. (4 PLCS.)
FOR ADDITIONAL DETAIL AND INFORMATION SEE SECTION F–F
SCALE: NTS



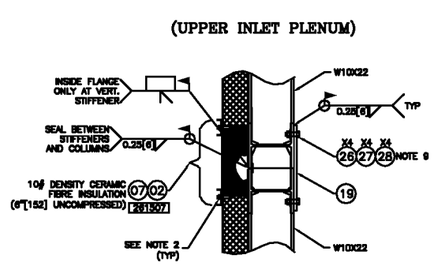
SECTION F3–F3 (D5)
SCALE: NTS
RIGHT SIDE ONLY
TYP. 2 PLCS



SECTION F4–F4 (D5)
SCALE: NTS
TYP. 4 PLCS



SECTION G–G (A6)
SCALE: NTS
(TYP ● COLUMNS 3, 4, 5 & 6)
TYP. 8 PLCS.



SECTION G1–G1 (A6)
SCALE: NTS
(TYP ● VERTICAL STIFFENERS)
TYP. 12 PLCS.

NOTES:

METALLIC COMPONENT SECTIONS NOT HATCHED FOR CLARITY.

GLI CONTRACT NO.:	DWG.
CONTRACT NUMBER:	61241
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN MILLIMETERS
ANGULAR TOLERANCE +/- 0.5°

THIRD ANGLE PROJECTION

THIS IS A PROPRIETARY DRAWING OF ENGINEERING DESIGN, THE USE OF WHICH, WITHOUT THE WRITTEN PERMISSION OF IST, IS STRICTLY PROHIBITED. IT IS LOANED SUBJECT TO THE AGREEMENT THAT IT SHALL NOT BE COPIED OR REPRODUCED IN WHOLE OR IN PART, NOR USED IN THE MANUFACTURE OF ANY ARTICLE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY LOANED.

IST

QUALITY	DATE	N/A
M.E.	DATE	09/11/2011
CHECKED	DATE	09/11/2011
PROJECT MGR.	DATE	09/11/2011
ENGINEER	DATE	09/11/2011
DRAWN	DATE	09/11/2011
CAD FILE NO.	PROJECT NO.	
281001	136000PP	
CAD FILE NO.	PROJECT NO.	
C10002		

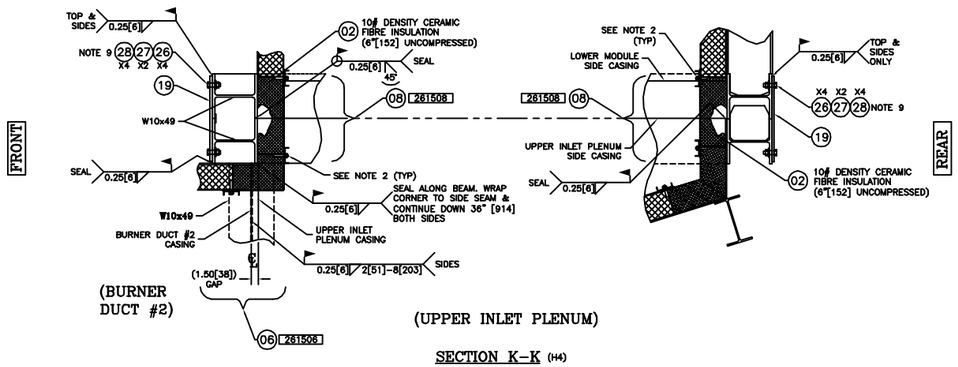
CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT
TITLE
DTSG, DUCTING AND EQUIPMENT ERECTION DIAGRAM

DWG. NO.	REV.	
281027	E	08
SCALE	SHEET NO.	
1:64	03 OF 04	

CAD FILE NO.
PV2010\281027-03

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	RC	JH	03/11/2011
01	N/A	ADDED SECTION R-R & T-T, UPDATED DETAIL 2,3 AND VIEW S-S	JH	JT	03/15/2011
02	N/A	SEE SHT 1	JH	FT	03/23/2011
03	2379	SEE SHT 1	JT	JH	06/08/2011

(LOWER MODULE)



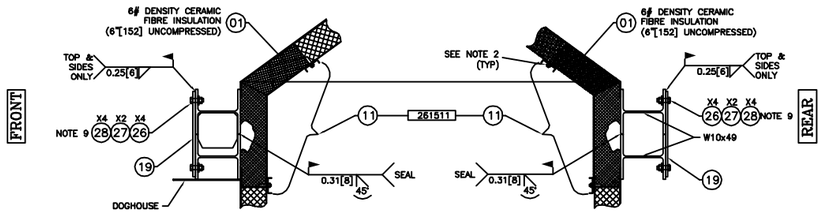
(BURNER DUCT #2)

(UPPER INLET PLENUM)

SECTION K-K (H4)

SCALE: NTS

(LOWER EXHAUST HOOD)

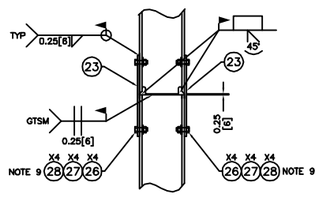


(UPPER MODULE)

SECTION M-M (H4)

SCALE: NTS

(UPPER COLUMN)

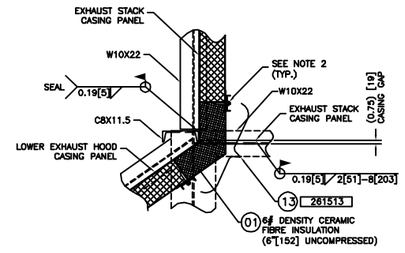


(LOWER LOOSE COLUMN)

VIEW H-H (B4)

SCALE: NTS
TYP. AT COLUMNS 1 & 2 (4 PLCS)

(EXHAUST STACK)

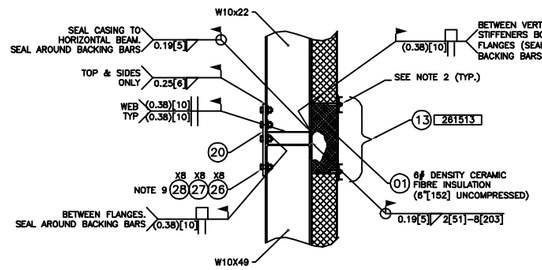


(UPPER EXHAUST HOOD)

SECTION P-P (H5)

SCALE: NTS
FRONT & REAR

(EXHAUST STACK)

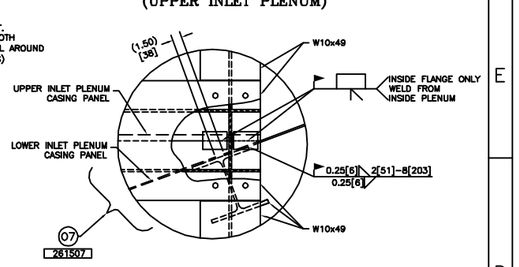


(UPPER EXHAUST HOOD)

SECTION Q-Q (D5)

SCALE: NTS
LEFT & RIGHT
4 PLACES

(UPPER INLET PLENUM)

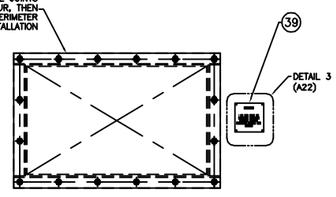


(LOWER INLET PLENUM)

DETAIL 1 (A5)

SCALE: NTS

IF GAS LEAKAGE AT THE JOINTS IS FOUND TO OCCUR, THEN SEAL WELD AROUND PERIMETER AFTER CO CATALYST INSTALLATION



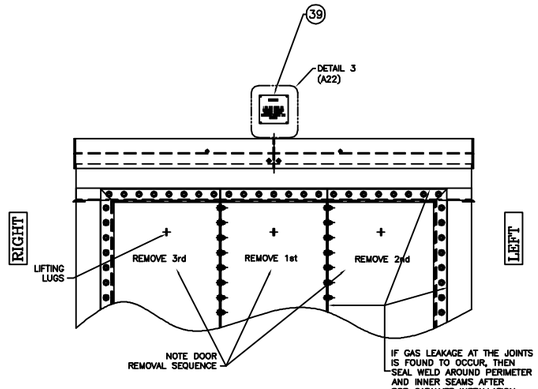
DETAIL 2 (C4)

CO CATALYST LOADING DOOR



DETAIL 3 (C20)(B23)

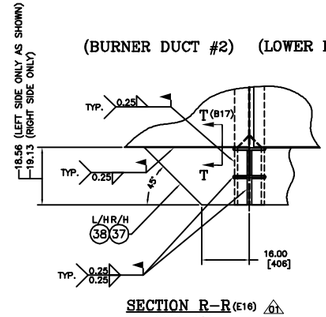
INSTALL OVER SCR LOADING DOOR AND/OR BESIDE C/O CATALYST LOADING DOOR. IF THERE IS NO SIGN OR IF ONE HAS BEEN DAMAGED OR REMOVED AT THESE DOOR OPENINGS ADVISE IST.



VIEW S-S (C4)

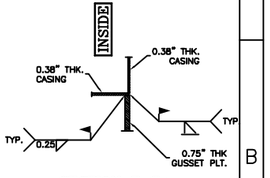
SCALE: NTS
SCR LOADING DOORS

(BURNER DUCT #2) (LOWER INLET PLENUM)



SECTION R-R (E16) 01

SCALE : NTS
TYP. LEFT(SHOWN) AND RIGHT SIDES
(SEE DRAWING 261003 FOR GUSSET PLATE TO BASEPLATE WELD)



SECTION T-T (C18)

SCALE : NTS

NOTES:

METALLIC COMPONENT SECTIONS NOT HATCHED FOR CLARITY.

SILCI CONTRACT NO.:	DEBB
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES [mm]
METRIC LINEAR TOL +/- 1.0 mm
TOL ON 1 PLACE DECIMALS +/- 0.100"
TOL ON 2 PLACE DECIMALS +/- 0.030"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°

THIRD ANGLE PROJECTION

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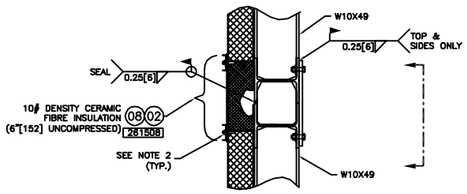
QUALITY	N/A	DATE: N/A
MFG.	J.CABRAL	DATE: 03/11/2011
ENGR.	F.TRAPSA	DATE: 03/11/2011
CHK.	J.HUNTER	DATE: 03/11/2011
APP.	R.DU	DATE: 03/11/2011
N.A.A.	261001	DRAWING NUMBER: LM6000PF
PROJ.NO.	C10082	DWG. NO. 261027 SIZE E REV. 03
DWG I.D.	P:\C10082\261027-S3	SCALE: 1:64 SHEET NO. 03 of 04

CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT

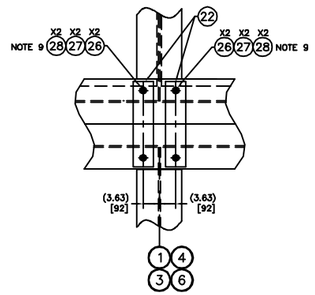
TITLE: OTSG, DUCTING AND EQUIPMENT ERECTION DIAGRAM

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	N/A	ISSUED FOR CONSTRUCTION	RC	JH	03/11/2011
01	N/A	SEE SHT 1 & 3	JH	JT	03/15/2011
02	N/A	SEE SHT 1	JH	FT	03/23/2011
03	N/A	SEE SHT 1	JT	JH	06/08/2011

(LOWER MODULE)

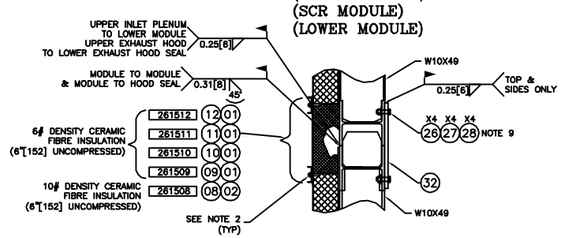


(UPPER INLET PLENUM)



SECTION F5–F5 (B6)
SCALE: NTS
(RH SIDE ONLY @ COLUMNS 1, 3, 4, & 6)
TYP. 4 PLCS

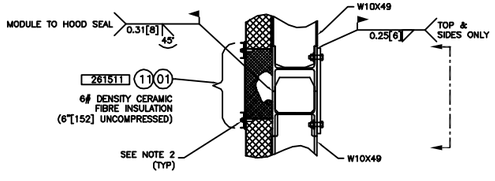
(UPPER EXHAUST HOOD)
(LOWER EXHAUST HOOD)
(UPPER MODULE)
(SCR MODULE)
(LOWER MODULE)



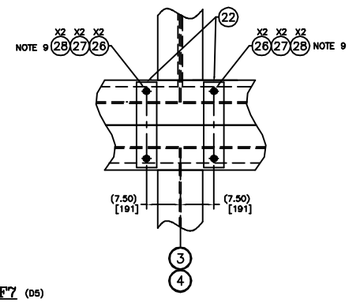
(LOWER EXHAUST HOOD)
(UPPER MODULE)
(SCR MODULE)
(LOWER MODULE)
(UPPER INLET PLENUM)

SECTION F6–F6 (D6)
SCALE: NTS
(TYP @ COLUMNS UNLESS OTHERWISE NOTED)

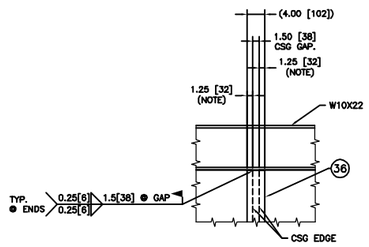
(LOWER EXHAUST HOOD)



(UPPER MODULE)

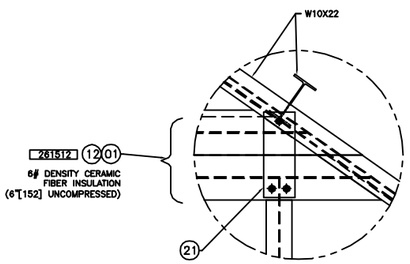


SECTION F7–F7 (D5)
SCALE: NTS
(RH SIDE ONLY @ COLUMNS 3 & 4)
TYP. 2 PLCS.

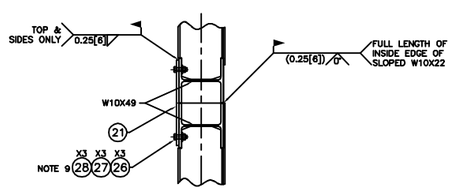


VIEW W–W (C25) (C28)
NOTE: GRIND EXISTING FILLET WELD 1.25" (TYP. BOTH ENDS)
SCALE: NTS

(UPPER EXHAUST HOOD)

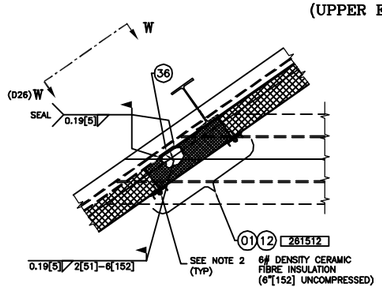


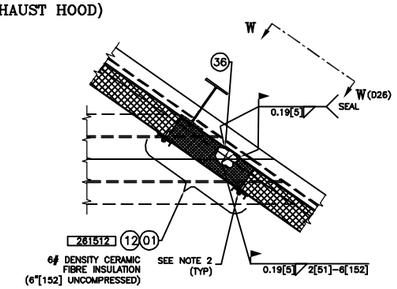
(LOWER EXHAUST HOOD)



DETAIL 4 (D5)
SCALE: NTS
(LWR EXHAUST HOOD TO UPR EXHAUST HOOD)
TYP. 4 PLCS

(UPPER EXHAUST HOOD)





(LOWER EXHAUST HOOD)

SECTION V–V (H5)
SCALE: NTS

NOTES:

METALLIC COMPONENT SECTIONS NOT HATCHED FOR CLARITY.

SLD CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

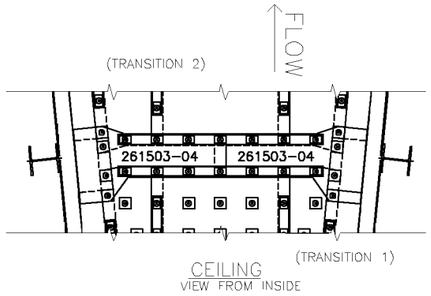
TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES [mm]
METRIC UNLESS SPECIFIED
TOL ON 1 PLACE DECIMALS +/- 1.0 mm
TOL ON 1 PLACE DECIMALS +/- 0.125"
TOL ON 2 PLACE DECIMALS +/- 0.060"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°
THIRD ANGLE PROJECTION

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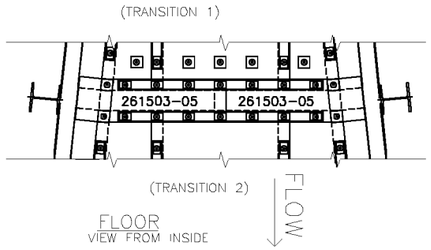
IST

DRAWN BY:	N/A	DATE:	N/A
APPD.	J.CABRAL	DATE:	03/11/2011
CHECKED	F.TRUJILLO	DATE:	03/11/2011
ENG. APPR.	J.HUNTER	DATE:	03/11/2011
CUST. APPR.		DATE:	
R.S.O.	R.SU	DATE:	03/11/2011
S.A.O.	261001	CAD FILE:	L:\MODOPS\C100\262\C100262

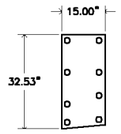
CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT
TITLE: OTSG, DUCTING AND EQUIPMENT ERECTION DIAGRAM
DWG. NO. 261027 REV. E 03
SCALE: 1:64
SHEET NO. 04 OF 04
ORDER I.D. P:\C100\262\261027-S4



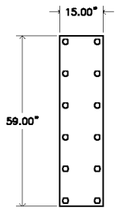
CEILING
VIEW FROM INSIDE



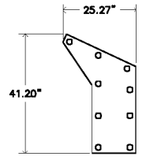
FLOOR
VIEW FROM INSIDE



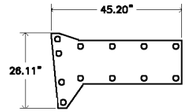
261503-01
11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



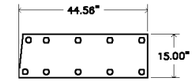
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11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



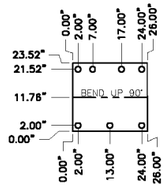
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11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



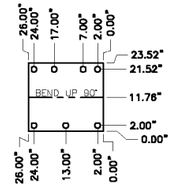
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11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



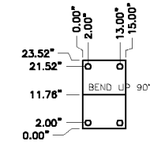
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11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



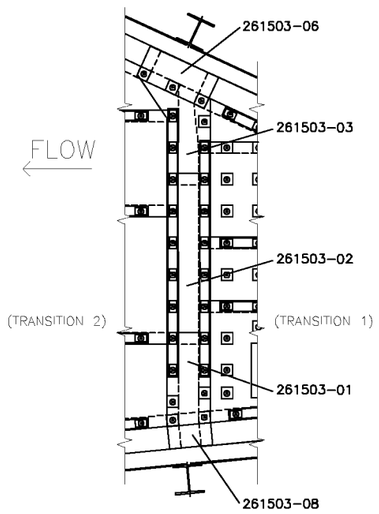
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11GA 40930 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



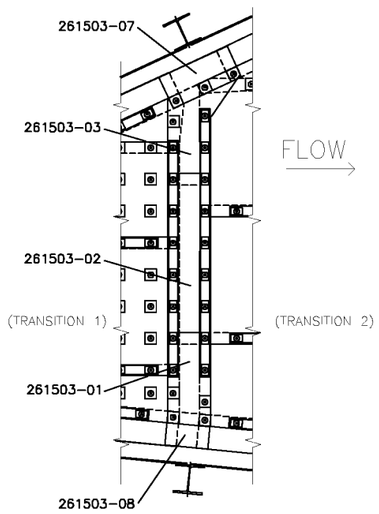
261503-07
11GA 40930 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261503-08
11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



RIGHT SIDE
VIEW FROM INSIDE



LEFT SIDE
VIEW FROM INSIDE

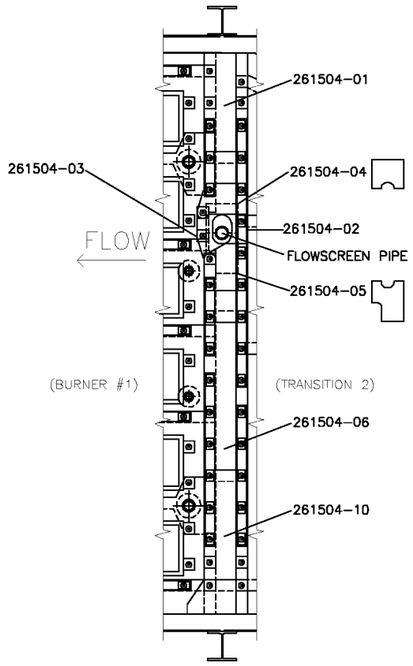
THESE PARTS SHIP LOOSE QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM (3) SYSTEMS TOTAL REQ'D		
PART NO.	QTY	DESCRIPTION
261503-01	2	JAK PANEL (40930 SS)
261503-02	2	JAK PANEL (40930 SS)
261503-03	2	JAK PANEL (40930 SS)
261503-04	2	JAK PANEL (40930 SS)
261503-05	2	JAK PANEL (40930 SS)
261503-06	1	JAK PANEL (40930 SS)
261503-07	1	JAK PANEL (40930 SS)
261503-08	2	JAK PANEL (40930 SS)
(REF ES-026)	7 ROLLS	6# INSULATION (2"X24"X150" ROLL)

REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS. UPDATED B.O.M.	RWB	14MAR11

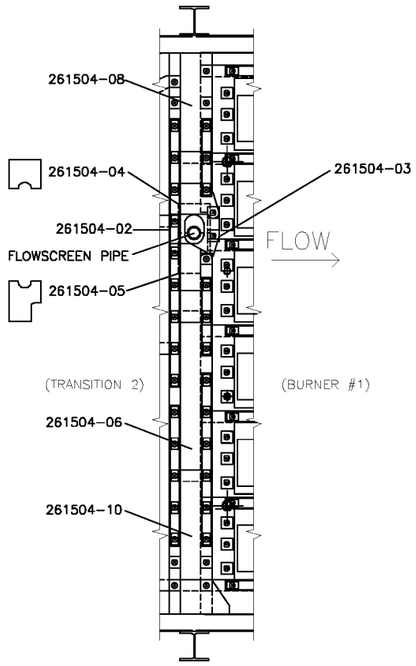
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

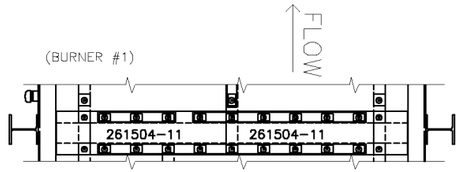
1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE, AK JOB
RWB DRAFTER	JAK KIT TRANSITION 1 TO TRANSITION 2	
10 MAR 11 DATE		
P.O. NUMBER	261503 DRAWING NO.	1 SHEET / REV.



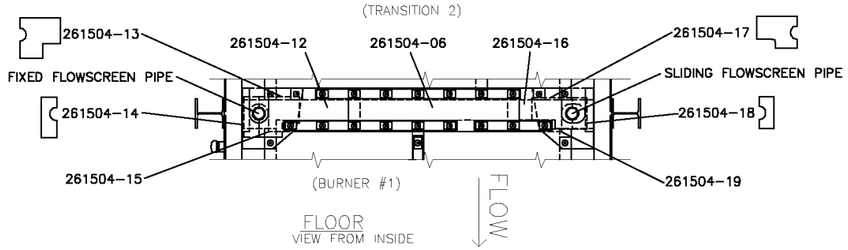
RIGHT SIDE
VIEW FROM INSIDE



LEFT SIDE
VIEW FROM INSIDE



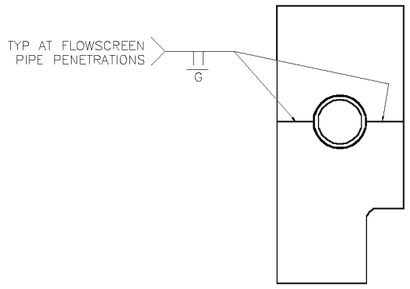
CEILING
VIEW FROM INSIDE



FLOOR
VIEW FROM INSIDE

THESE PARTS SHIP LOOSE
QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM
(3) SYSTEMS TOTAL REQ'D

PART NO.	QTY	DESCRIPTION
261504-01	1	JAK PANEL (316 SS)
261504-02	2	JAK PANEL (316 SS)
261504-03	2	JAK PANEL (316 SS)
261504-04	2	JAK PANEL (316 SS)
261504-05	2	JAK PANEL (316 SS)
261504-06	3	JAK PANEL (316 SS)
261504-07		
261504-08	1	JAK PANEL (316 SS)
261504-09		
261504-10	2	JAK PANEL (316 SS)
261504-11	2	JAK PANEL (316 SS)
261504-12	1	JAK PANEL (316 SS)
261504-13	1	JAK PANEL (316 SS)
261504-14	1	JAK PANEL (316 SS)
261504-15	1	JAK PANEL (316 SS)
261504-16	1	JAK PANEL (316 SS)
261504-17	1	JAK PANEL (316 SS)
261504-18	1	JAK PANEL (316 SS)
261504-19	1	JAK PANEL (316 SS)
(REF ES-026)	8 ROLLS	10# INSULATION (2"X24"X150" ROLL)

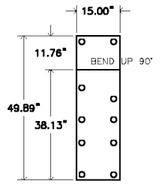


REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS. UPDATED B.O.M.	RWB	14MAR11

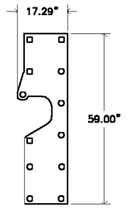
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

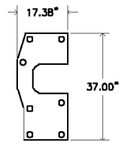
1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT TRANSITION 2 TO BURNER 1	
10 MAR 11 DATE		
P.O. NUMBER	261504 DRAWING NO.	1 SHEET / A REV.



261504-01
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261504-02
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



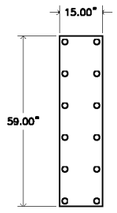
261504-03
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



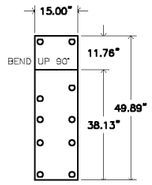
261504-04
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



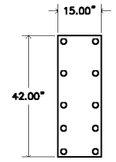
261504-05
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



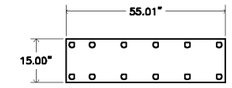
261504-06
11GA 316 SS
(3) REQ'D PER SYSTEM
(9) REQ'D TOTAL



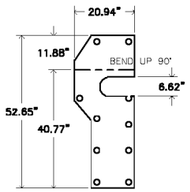
261504-08
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



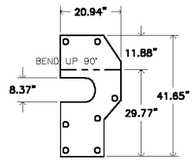
261504-10
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



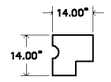
261504-11
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



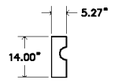
261504-12
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



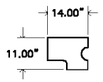
261504-16
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261504-13
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



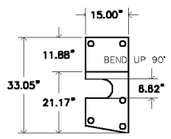
261504-14
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



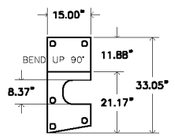
261504-17
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261504-18
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261504-15
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



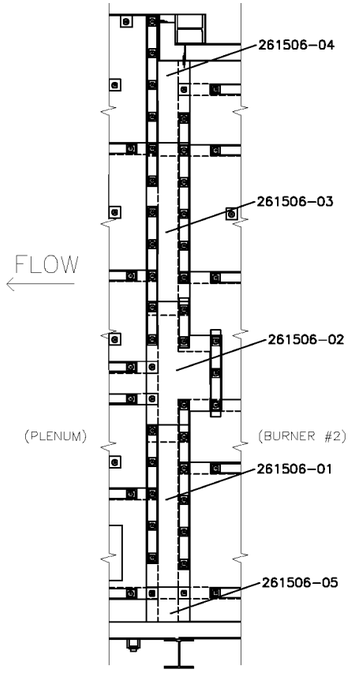
261504-19
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL

REV	DESCRIPTION	BY	DATE

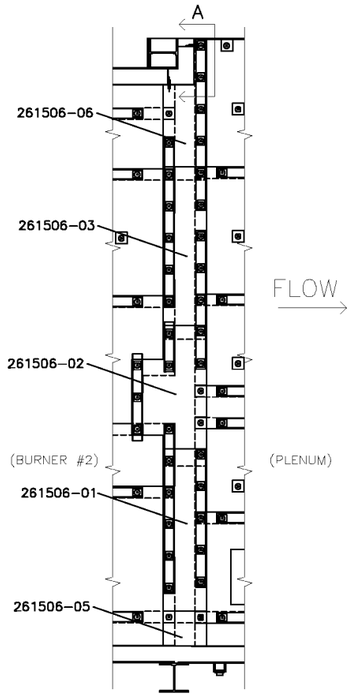
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

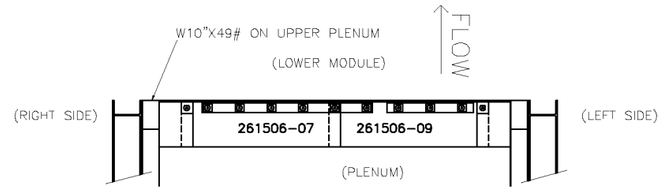
1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT TRANSITION 2 TO BURNER 1	
10 MAR 11 DATE		
P.O. NUMBER	261504 DRAWING NO.	2 SHEET / REV.



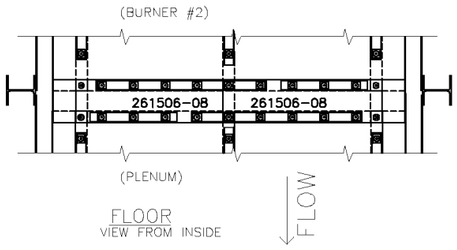
RIGHT SIDE
VIEW FROM INSIDE



LEFT SIDE
VIEW FROM INSIDE



SECTION A–A
VIEW FROM INSIDE FACING UPSTREAM



FLOOR
VIEW FROM INSIDE

THESE PARTS SHIP LOOSE
QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM
(3) SYSTEMS TOTAL REQ'D

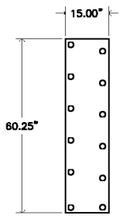
PART NO.	QTY	DESCRIPTION
261506-01	2	JAK PANEL (316 SS)
261506-02	2	JAK PANEL (316 SS)
261506-03	2	JAK PANEL (316 SS)
261506-04	1	JAK PANEL (316 SS)
261506-05	2	JAK PANEL (316 SS)
261506-06	1	JAK PANEL (316 SS)
261506-07	1	JAK PANEL (316 SS)
261506-08	2	JAK PANEL (316 SS)
261506-09	1	JAK PANEL (316 SS)
(REF ES-026)	10 ROLLS	10# INSULATION (2"X24"X150" ROLL)

REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS. UPDATED B.O.M.	RWB	14MAR11

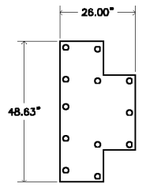
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

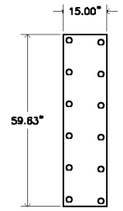
1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT BURNER 2 TO PLENUM	
10 MAR 11 DATE		
P.O. NUMBER	261506 DRAWING NO.	1 SHEET / A REV.



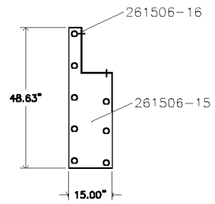
261506-01
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



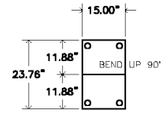
261506-02
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



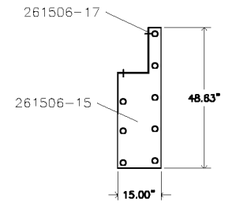
261506-03
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



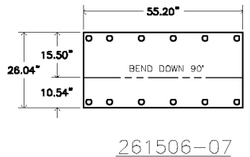
261506-04
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



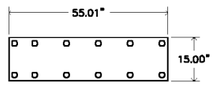
261506-05
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



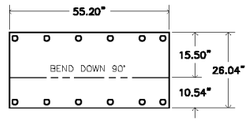
261506-06
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



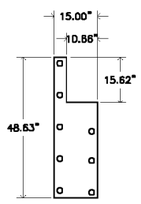
261506-07
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



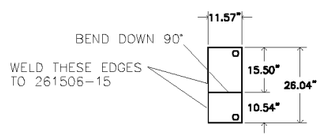
261506-08
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



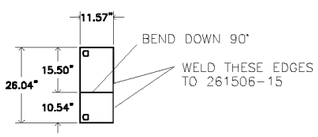
261506-09
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261506-15
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261506-16
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



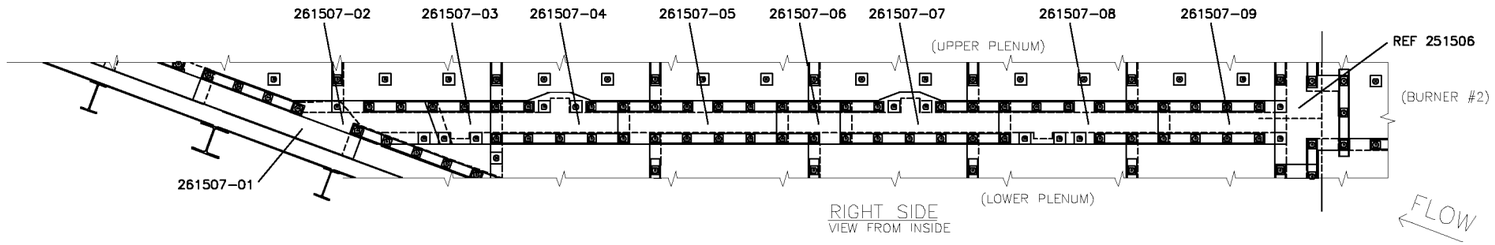
261506-17
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL

REV	DESCRIPTION	BY	DATE

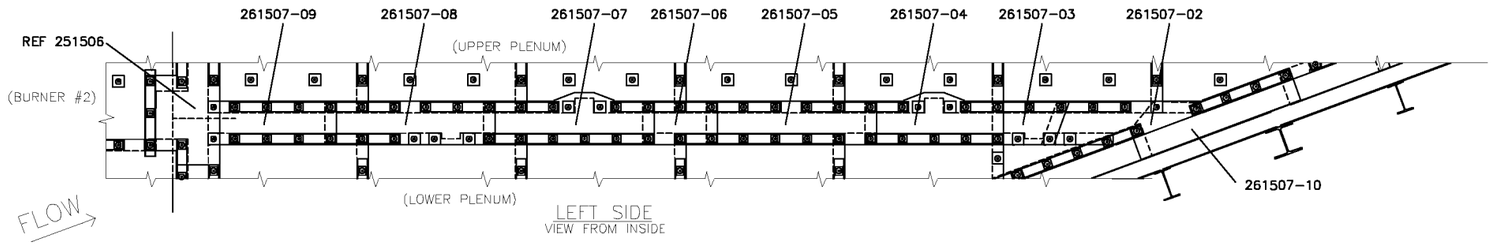
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

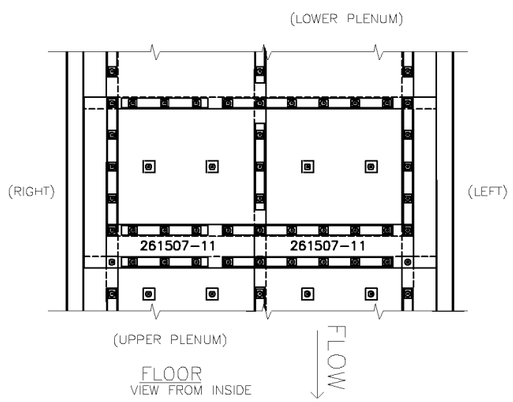
1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT BURNER 2 TO PLENUM	
10 MAR 11 DATE		
P.O. NUMBER	261506 DRAWING NO.	2 SHEET / REV.



RIGHT SIDE
VIEW FROM INSIDE



LEFT SIDE
VIEW FROM INSIDE



FLOOR
VIEW FROM INSIDE

THESE PARTS SHIP LOOSE
QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM
(3) SYSTEMS TOTAL REQ'D

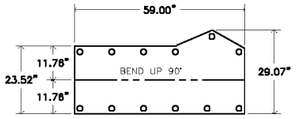
PART NO.	QTY	DESCRIPTION
261507-01	1	JAK PANEL (316 SS)
261507-02	2	JAK PANEL (316 SS)
261507-03	2	JAK PANEL (316 SS)
261507-04	2	JAK PANEL (316 SS)
261507-05	2	JAK PANEL (316 SS)
261507-06	2	JAK PANEL (316 SS)
261507-07	2	JAK PANEL (316 SS)
261507-08	2	JAK PANEL (316 SS)
261507-09	2	JAK PANEL (316 SS)
261507-10	1	JAK PANEL (316 SS)
261507-11	2	JAK PANEL (316 SS)
(REF ES-026)	12 ROLLS	10# INSULATION (2"X24"X150" ROLL)

REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS. UPDATED B.O.M.	RWB	14MAR11

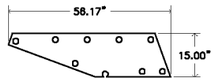
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

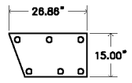
1=24 PLOT SCALE	MEDFORD FABRICATION
1/2"=1' DRAWING SCALE	
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER / CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT LOWER PLENUM TO UPPER PLENUM
10 MAR 11 DATE	
P.O. NUMBER	261507 DRAWING NO. / 1 SHEET / REV.



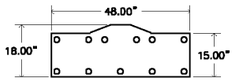
261507-01
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



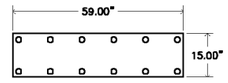
261507-02
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



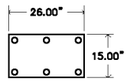
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11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



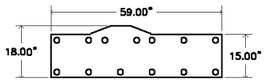
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11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



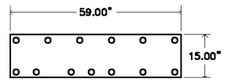
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(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



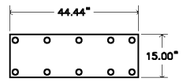
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11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



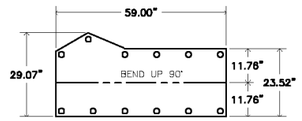
261507-07
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



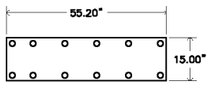
261507-08
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261507-09
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261507-10
11GA 316 SS
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL



261507-11
11GA 316 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL

REV	DESCRIPTION	BY	DATE

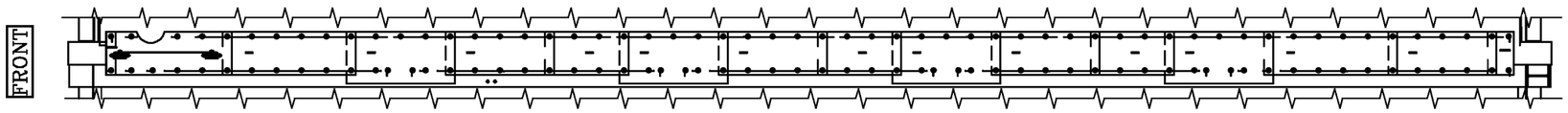
NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT LOWER PLENUM TO UPPER PLENUM	
10 MAR 11 DATE		
P.O. NUMBER	261507 DRAWING NO.	2 SHEET / A REV.

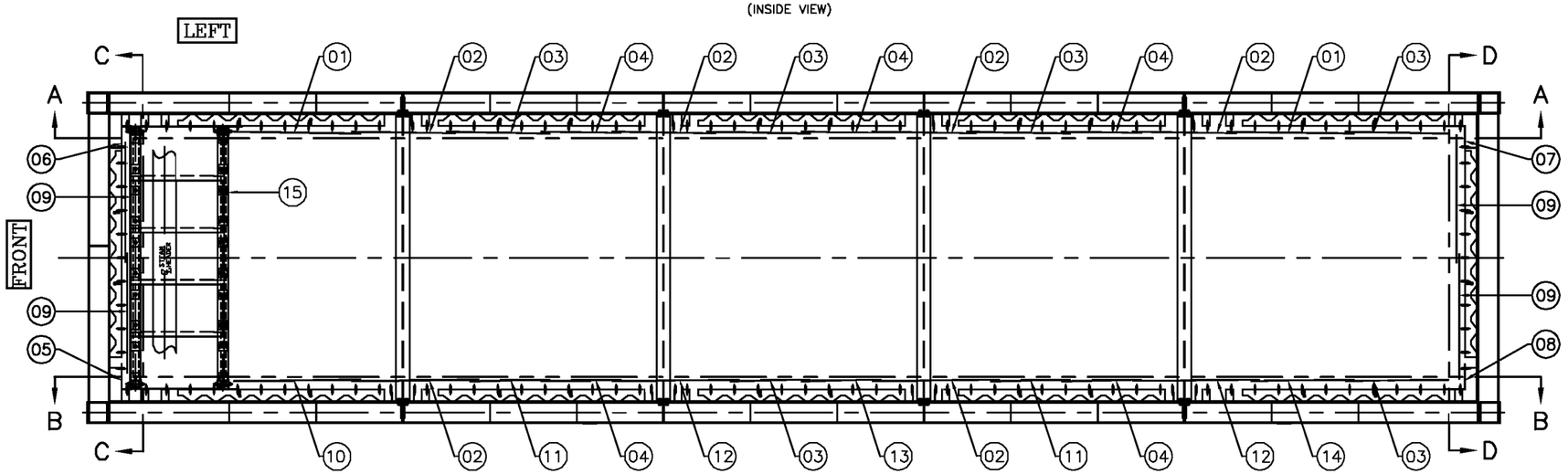
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
01	2391	CHANGED QUANTITY OF ITEM 11 FROM 1 TO 2	BJ	JT	10/9/12

LOWER MODULE

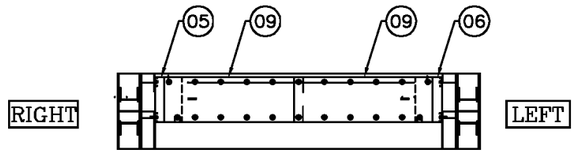


UPPER INLET PLENUM

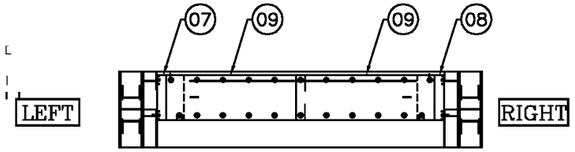
SECTION A–A
LEFT SIDE WALL
(INSIDE VIEW)



KEY PLAN LAYOUT JOINT ASSEMBLY KIT
(TOP VIEW)
261508

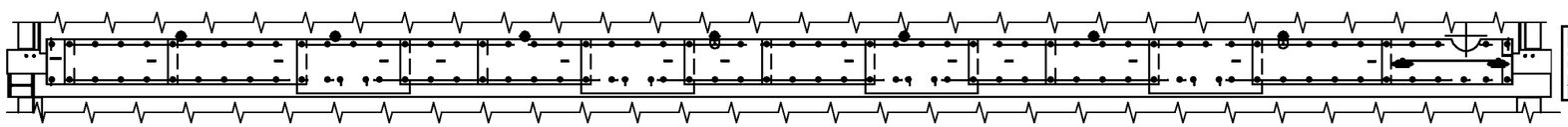


SECTION C–C
(INSIDE VIEW)
ROTATED –90°



SECTION D–D
(INSIDE VIEW)
ROTATED 90°

LOWER MODULE



UPPER INLET PLENUM

SECTION B–B
(ROTATED 180°)
RIGHT SIDE WALL
(INSIDE VIEW)

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	15	261717	HEADER SHIELD KIT	HEADER SHIELD KIT ARRANGEMENT		
1	EA	14	261508–14	LINER PLATE	SHEET 11GA X 19.00 X 59.00	SA240 316	
1	EA	13	261508–13	LINER PLATE	SHEET 11GA X 19.00 X 37.00	SA240 316	
2	EA	12	261508–12	LINER PLATE	SHEET 11GA X 23.00 X 48.00	SA240 316	
2	EA	11	261508–11	LINER PLATE	SHEET 11GA X 19.00 X 48.00	SA240 316	
1	EA	10	261508–10	LINER PLATE	SHEET 11GA X 19.00 X 59.00	SA240 316	
4	EA	09	261508–09	LINER PLATE	SHEET 11GA X 19.00 X 59.00	SA240 316	
1	EA	08	261508–08	CORNER LINER	SHEET 11GA X 19.00 X 26.63 DL	SA240 316	
1	EA	07	261508–07	CORNER LINER	SHEET 11GA X 19.00 X 26.63 DL	SA240 316	
1	EA	06	261508–06	CORNER LINER	SHEET 11GA X 19.00 X 19.50 DL	SA240 316	
1	EA	05	261508–05	CORNER LINER	SHEET 11GA X 19.00 X 19.50 DL	SA240 316	
5	EA	04	261508–04	LINER PLATE	SHEET 11GA X 19.00 X 37.00	SA240 316	
6	EA	03	261508–03	LINER PLATE	SHEET 11GA X 19.00 X 48.00	SA240 316	
6	EA	02	261508–02	LINER PLATE	SHEET 11GA X 23.00 X 48.00	SA240 316	
2	EA	01	261508–01	LINER PLATE	SHEET 11GA X 19.00 X 59.00	SA240 316	

BILL OF MATERIAL AND PARTS LIST

NOTES:

1. INSTALLATION SEQUENCE:
   – REMOVE APPLICABLE CHANNELS AND WASHERS.
   – INSTALL INSULATION AS REQUIRED.
   – PLACE CORNER LINERS (ITEMS #07 & 08) IN CORNERS AT REAR.
   – PLACE LINER PLATES AT REAR END (ITEMS #09).
   – PLACE CORNER LINERS (ITEMS #05 & 06) IN CORNERS AT FRONT.
   – PLACE LINER PLATES AT FRONT END (ITEM #09).
   – PLACE LINER PLATES (ITEMS #01 THRU 04, #09 THRU 14) AS SHOWN AND RESECURE CHANNELS.
   – PLACE HEADER SHIELD (ITEM #15) BELOW HEADER AS SHOWN.
2. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED, SO ALL PANELS OF THE JOINT ARE IN FIRM CONTACT, USING AN ORDINARY WRENCH THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN WHEN HIT ON THE CORNER WITH A HAMMER, USING A NORMAL HAMMER SWING, BUT NOT TURN FREELY). TACK WELD NUT TO BOLT.

NOTE:

83 CU. FT. OF 10# INSULATION REQUIRED FOR UPPER INLET PLENUM TO LOWER MODULET JOINT ASSEMBLY KIT. REFER TO ERECTION DIAGRAM #261027.

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES
UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL.+/– 1.5mm
TOL. ON 1 PLACE DECIMALS +/– 0.120"
TOL. ON 2 PLACE DECIMALS +/– 0.060"
TOL. ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

THIRD ANGLE PROJECTION

THIS IS A PRELIMINARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.

IST

QUALITY N/A	DATE: N/A
MFGR. M.HUNTER	DATE: 03/02/2011
PROJENGR. N/A	DATE: N/A
CHK. J.HUNTER	DATE: 03/02/2011
DRN. R.GU	DATE: 03/02/2011
N.H.A. 261027	EQUIP.MODEL LM6000PF
CADDS I.D. P:\C10082\261508–S1	

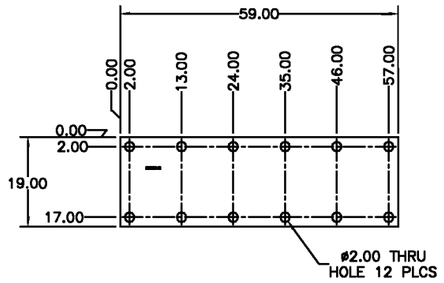
CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT

TITLE: JOINT ASSEMBLY KIT UPPER INLET PLENUM TO LOWER MODULE ASSEMBLY & DETAILS

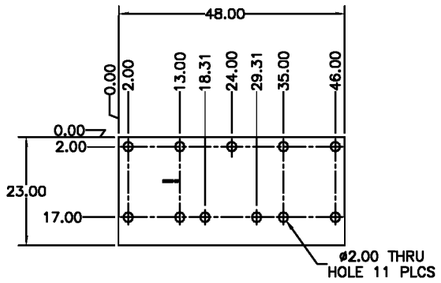
PROJ.NO. C10082 | DWG. NO. 261508 | SIZE D | REV. 01

SCALE: 1 : 32 | SHEET NO. 01 OF 02

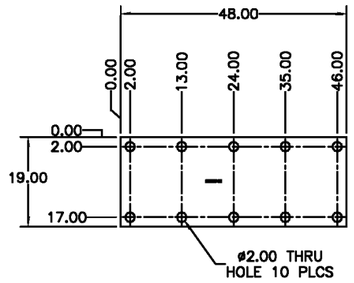
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
01	2391	SEE SHEET 1	BJ	JT	10/09/12



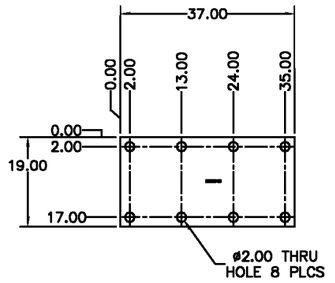
LINER PLATE
261508-01



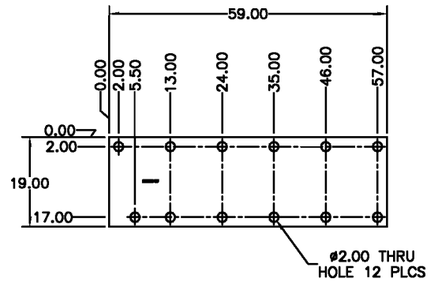
LINER PLATE
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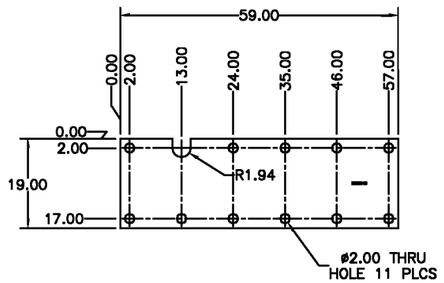
LINER PLATE
261508-03



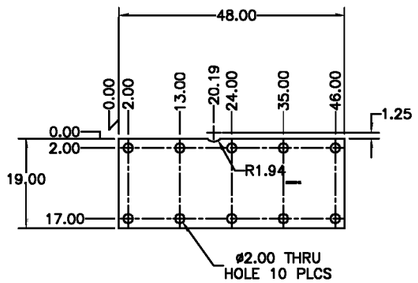
LINER PLATE
261508-04



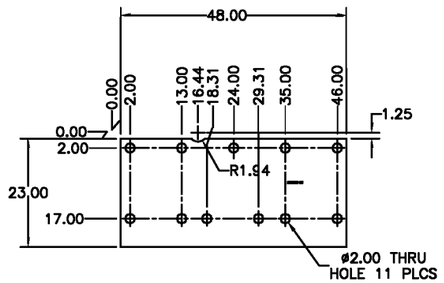
LINER PLATE
261508-09



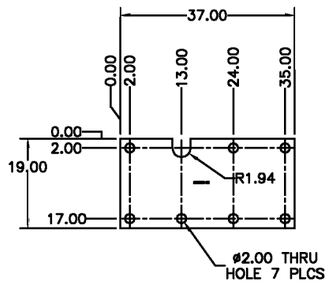
LINER PLATE
261508-10



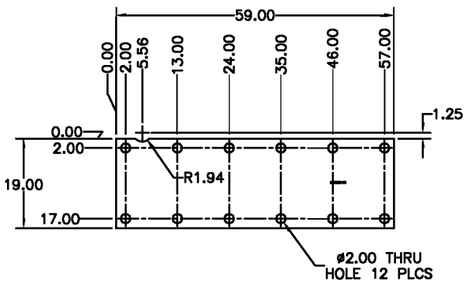
LINER PLATE
261508-11



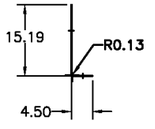
LINER PLATE
261508-12



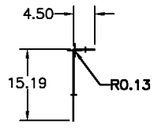
LINER PLATE
261508-13



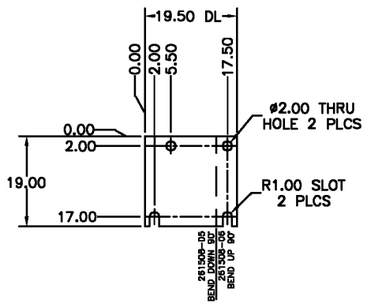
LINER PLATE
261508-14



BEND PROFILE
(261508-05)

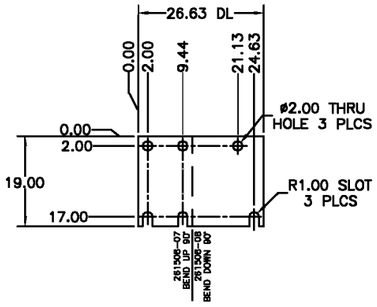


BEND PROFILE
(2615D8-06)

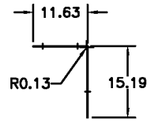


FLAT DEVELOPMENT

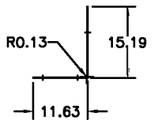
CORNER LINER
261508-05 BEND DOWN 90°
261508-06 BEND UP 90°



FLAT DEVELOPMENT



BEND PROFILE
(261508-07)



BEND PROFILE
(261508-08)

CORNER LINER
261508-07 BEND UP 90°
261508-08 BEND DOWN 90°

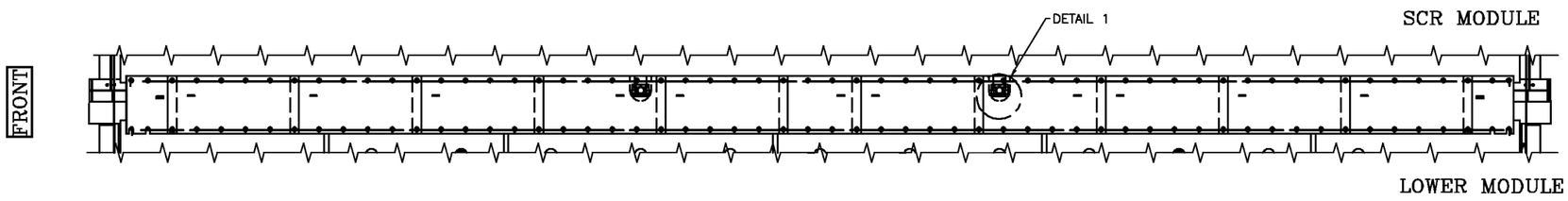
TOLERANCES UNLESS OTHERWISE SPECIFIED	
LINEAR DIMENSIONS ARE IN INCHES	
METRIC LINEAR TOL+/-	1.5mm
TOL ON 1 PLACE DECIMALS +/-	0.120"
TOL ON 2 PLACE DECIMALS +/-	0.060"
TOL ON 3 PLACE DECIMALS +/-	0.030"
ANGULAR TOLERANCE +/-	0.5°

THIRD ANGLE PROJECTION

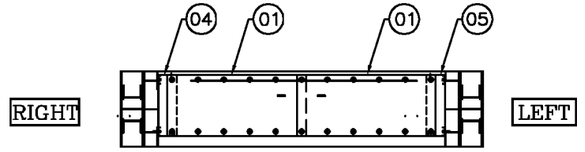
THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.

IST

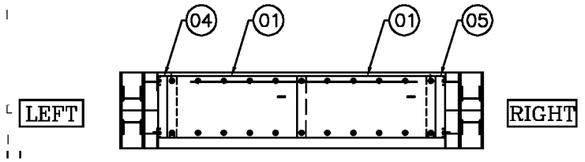
QUALITY: N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFG. M.HUNTER	DATE: 03/02/2011		
ENGINEERING: N/A	DATE: N/A	TITLE: JOINT ASSEMBLY KIT UPPER INLET PLENUM TO LOWER MODULE ASSEMBLY & DETAILS	
CHK. J.HUNTER	DATE: 03/02/2011		
DRN. R.GU	DATE: 03/02/2011		
N.H.A. 261027	EQUIP.MODEL: LM6000PF	PROJ.NO. C10082	DWG. NO. 261508 SIZE D REV. 01
CADDS I.D. P:\C10082\261508-S2		SCALE: 1 : 16	SHEET NO. 02 OF 02



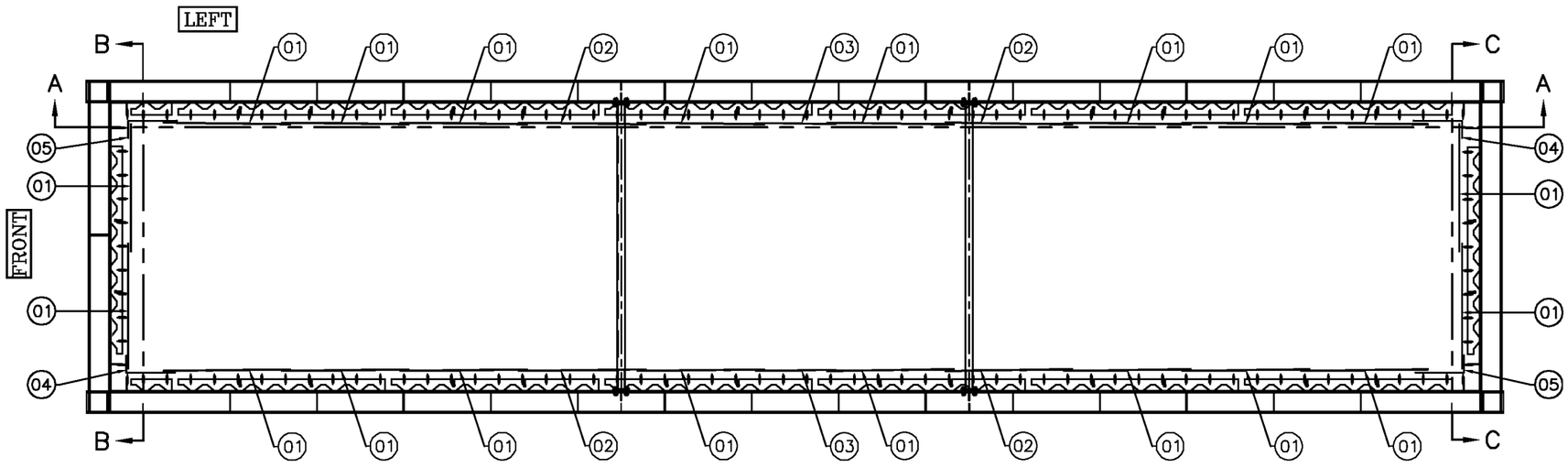
SECTION A–A



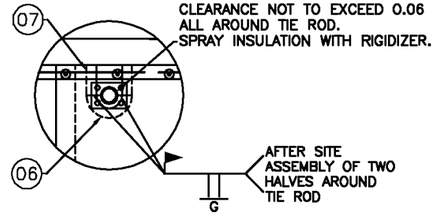
SECTION B–B
(INSIDE VIEW)
ROTATED 90°



SECTION C–C
(INSIDE VIEW)
ROTATED 90°



KEY PLAN LAYOUT JOINT ASSEMBLY KIT
(TOP VIEW)
261509



DETAIL 1
(SCALE 1:16)
TYP. 4 PLCS

NOTES:

1. INSTALLATION SEQUENCE:
   - REMOVE APPLICABLE CHANNELS AND WASHERS.
   - INSTALL INSULATION AS REQUIRED.
   - PLACE CORNER LINERS (ITEMS #04 & 05) IN CORNERS AT REAR.
   - PLACE LINER PLATES AT REAR END (ITEMS #01).
   - PLACE CORNER LINERS (ITEMS #04 & 05) IN CORNERS AT FRONT.
   - PLACE LINER PLATES AT FRONT END (ITEM #01).
   - PLACE COVER PLATES (ITEM #06 & 07) AROUND TIE RODS.
   - PLACE LINER PLATES (ITEMS #01 THRU 03) AS SHOWN AND RESECURE CHANNELS.
2. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED, SO ALL PANELS OF THE JOINT ARE IN FIRM CONTACT, USING AN ORDINARY WRENCH THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN WHEN HIT ON THE CORNER WITH A HAMMER, USING A NORMAL HAMMER SWING, BUT NOT TURN FREELY). TACK WELD NUT TO BOLT.
3. MATERIAL DESIGNATED ON AN MTR AS A240 S40900 IS ACCEPTABLE PROVIDED THE CHEMISTRY MATCHES THAT OF A240 S40930 INCLUDING THE TITANIUM + COLUMBIUM (NIOBIUM) REQUIREMENT.

NOTE:

116 CU. FT. OF 6# INSULATION REQUIRED FOR LOWER MODULE TO SCR MODULE JOINT ASSEMBLY KIT. REFER TO ERECTION DIAGRAM #261027.

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

REVISIONS

REV	ECR	DESCRIPTION	BY	APP	DATE

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
4	EA	07	261509-07	COVER PLATE	11GA X 6.50 X 9.63	A240 S40930 (SEE NOTE 3)	
4	EA	06	261509-06	COVER PLATE	11GA X 4.81 X 9.63	A240 S40930 (SEE NOTE 3)	
2	EA	05	261509-05	CORNER LINER	11GA X 26.00 X 30.50 DL	A240 S40930 (SEE NOTE 3)	
2	EA	04	261509-04	CORNER LINER	11GA X 26.00 X 30.50 DL	A240 S40930 (SEE NOTE 3)	
2	EA	03	261509-03	LINER PLATE	11GA X 26.00 X 37.00	A240 S40930 (SEE NOTE 3)	
4	EA	02	261509-02	LINER PLATE	11GA X 26.00 X 59.00	A240 S40930 (SEE NOTE 3)	
20	EA	01	261509-01	LINER PLATE	11GA X 26.00 X 59.00	A240 S40930 (SEE NOTE 3)	*
-100	ASSY			BILL OF MATERIAL AND PARTS LIST			

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL.+/– 1.5mm
TOL. ON 1 PLACE DECIMALS +/– 0.120"
TOL. ON 2 PLACE DECIMALS +/– 0.060"
TOL. ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

THIRD ANGLE PROJECTION

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QUALITY: N/A	DATE: N/A
MFG.: M.HUNTER	DATE: 03/02/2011
PROJ.ENG.: N/A	DATE: N/A
CHK.: J.HUNTER	DATE: 03/02/2011
DRN.: R.GU	DATE: 03/02/2011
N.H.A.: 261027	EQUIP.MODEL: LM6000PF
CHDIR I.D.: P:\C10082\261509-S1	

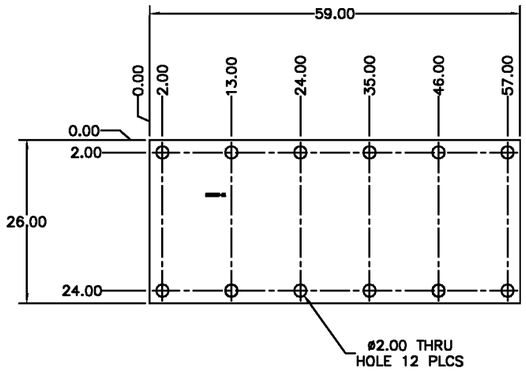
CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT

TITLE: JOINT ASSEMBLY KIT LOWER MODULE TO SCR MODULE ASSEMBLY & DETAILS

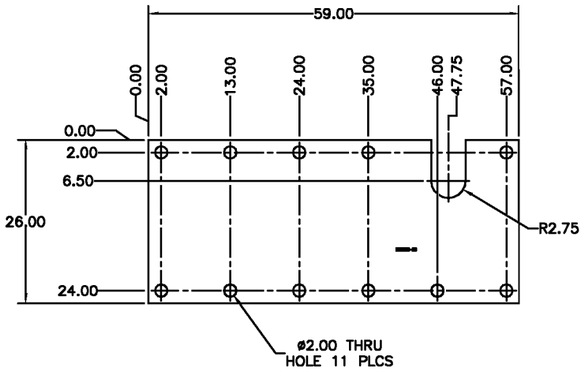
PROJ.NO.	DWG. NO.	SIZE	REV.
C10082	261509	D	00

SCALE: 1 : 32 | SHEET NO.: 01 OF 02

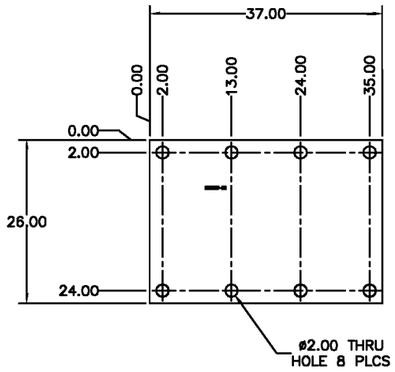
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



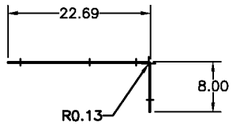
LINER PLATE
261509-01



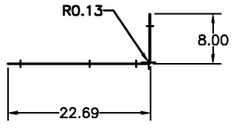
LINER PLATE
261509-02



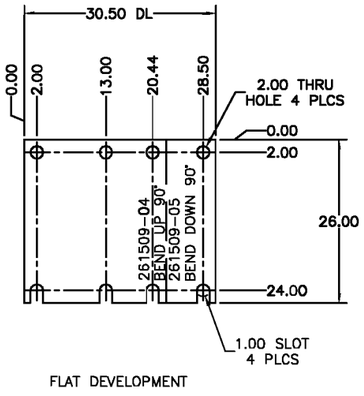
LINER PLATE
261509-03



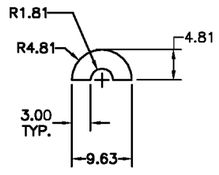
BEND PROFILE
(261509-04)



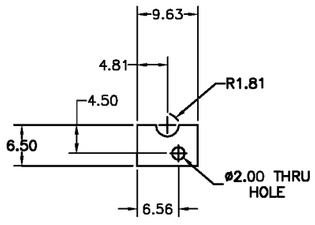
BEND PROFILE
(261509-05)



FLAT DEVELOPMENT



COVER PLATE
261509-06



COVER PLATE
261509-07

CORNER LINER
261509-04 BEND UP 90°
261509-05 BEND DOWN 90°

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL+/- 1.5mm
TOL ON 1 PLACE DECIMALS +/- 0.120"
TOL ON 2 PLACE DECIMALS +/- 0.060"
TOL ON 3 PLACE DECIMALS +/- 0.030"
ANGULAR TOLERANCE +/- 0.5°

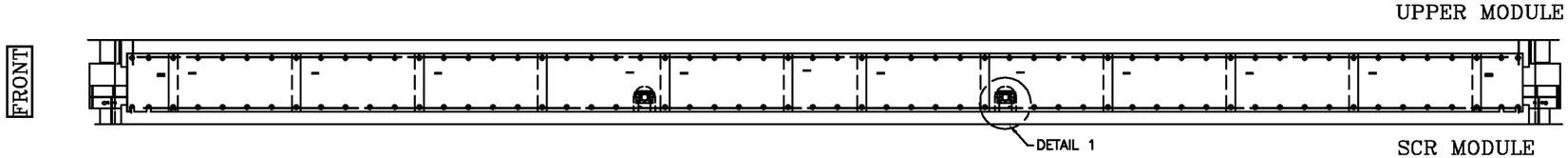
THIRD ANGLE PROJECTION

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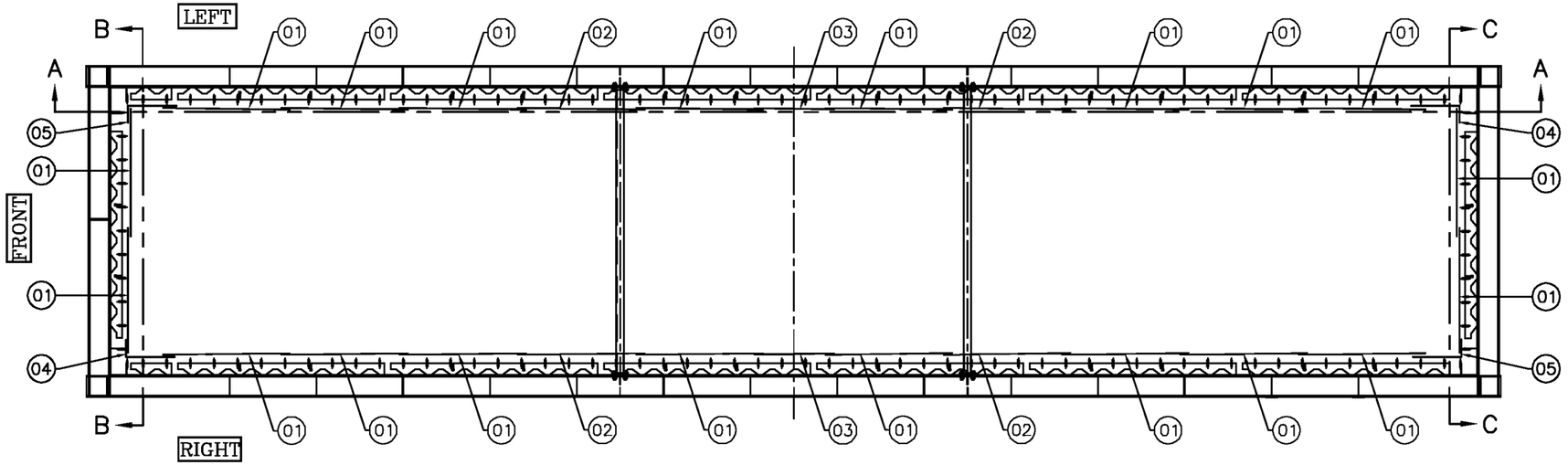
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QUALITY: N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFGL: M.HUNTER	DATE: 03/02/2011		
PROJ.ENG.: N/A	DATE: N/A	TITLE: JOINT ASSEMBLY KIT LOWER MODULE TO SCR MODULE ASSEMBLY & DETAILS	
CHK: J.HUNTER	DATE: 03/02/2011		
DRN: R.GU	DATE: 03/02/2011		
N.H.A. 261027	EQUIP.MODEL: LM6000PF	PROJ.NO.: C10082	DWG. NO.: 261509 / SIZE: D / REV.: 00
CADDS I.D.: P:\C10082\261509-S2		SCALE: 1 : 12	SHEET NO.: 02 OF 02

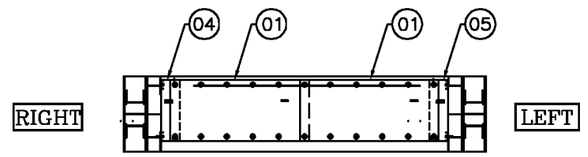
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



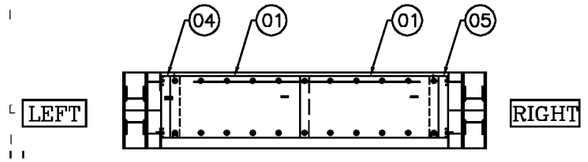
SECTION A–A



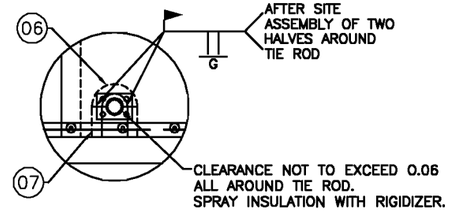
KEY PLAN LAYOUT JOINT ASSEMBLY KIT
261510



SECTION B–B
(INSIDE VIEW)
ROTATED 90°



SECTION C–C
(INSIDE VIEW)
ROTATED 90°



DETAIL 1
(SCALE 1:16)
TYP. 4 PLCS

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
4	EA	07	261510–07	COVER PLATE	11GA X 4.81 X 9.63	A240 S40930 (SEE NOTE 3)	
4	EA	06	261510–06	COVER PLATE	11GA X 6.50 X 9.63	A240 S40930 (SEE NOTE 3)	
2	EA	05	261510–05	CORNER LINER	11GA X 26.00 X 30.50 DL	A240 S40930 (SEE NOTE 3)	
2	EA	04	261510–04	CORNER LINER	11GA X 26.00 X 30.50 DL	A240 S40930 (SEE NOTE 3)	
2	EA	03	261510–03	LINER PLATE	11GA X 26.00 X 37.00	A240 S40930 (SEE NOTE 3)	
4	EA	02	261510–02	LINER PLATE	11GA X 26.00 X 59.00	A240 S40930 (SEE NOTE 3)	
20	EA	01	261510–01	LINER PLATE	11GA X 26.00 X 59.00	A240 S40930 (SEE NOTE 3)	*

BILL OF MATERIAL AND PARTS LIST

NOTES:

1. INSTALLATION SEQUENCE:
   - REMOVE APPLICABLE CHANNELS AND WASHERS.
   - INSTALL INSULATION AS REQUIRED.
   - PLACE CORNER LINERS (ITEMS #04 & 05) IN CORNERS AT REAR.
   - PLACE LINER PLATES AT REAR END (ITEMS #01).
   - PLACE CORNER LINERS (ITEMS #04 & 05) IN CORNERS AT FRONT.
   - PLACE LINER PLATES AT FRONT END (ITEM #01).
   - PLACE COVER PLATES (ITEM #06 & 07) AROUND TIE RODS.
   - PLACE LINER PLATES (ITEMS #01 THRU 03) AS SHOWN AND RESECURE CHANNELS.
2. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED, SO ALL PANELS OF THE JOINT ARE IN FIRM CONTACT, USING AN ORDINARY WRENCH THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN WHEN HIT ON THE CORNER WITH A HAMMER, USING A NORMAL HAMMER SWING, BUT NOT TURN FREELY). TACK WELD NUT TO BOLT.
3. MATERIAL DESIGNATED ON AN MTR AS A240 S40900 IS ACCEPTABLE PROVIDED THE CHEMISTRY MATCHES THAT OF A240 S40930 INCLUDING THE TITANIUM + COLUMBIUM (NIOBIUM) REQUIREMENT.

NOTE:

116 CU. FT. OF 6# INSULATION REQUIRED FOR SCR MODULE TO UPPER MODULE JOINT ASSEMBLY KIT. REFER TO ERECTION DIAGRAM #261027.

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

THIRD ANGLE PROJECTION

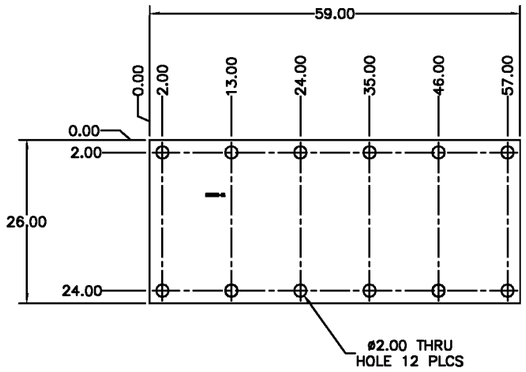
TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL+/– 1.5mm
TOL. ON 1 PLACE DECIMALS +/– 0.120"
TOL. ON 2 PLACE DECIMALS +/– 0.060"
TOL. ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

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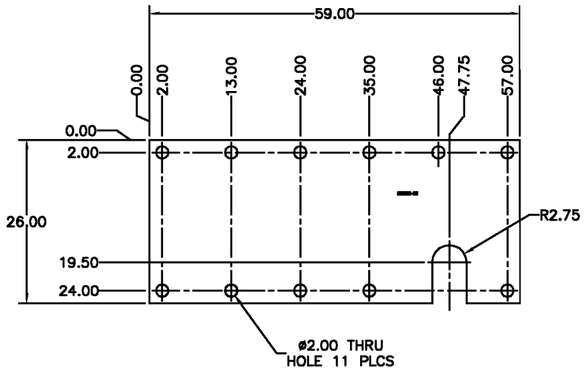
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QUALITY N/A	DATE: N/A	CUSTOMER:	CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT
MFG. M.HUNTER	DATE: 03/02/2011		
PROJ.ENG. N/A	DATE: N/A	TITLE:	JOINT ASSEMBLY KIT SCR MODULE TO UPPER MODULE ASSEMBLY & DETAILS
CHK. J.HUNTER	DATE: 03/02/2011		
DRN. R.CU	DATE: 03/02/2011		
N.U.A. 261027	DRAWN MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261510 SIZE D REV. 00
CADDS I.D. P:\C10082\261510–S1			SCALE: 1 : 32 SHEET NO. 01 OF 02

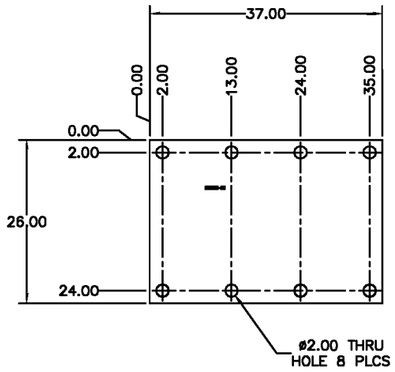
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



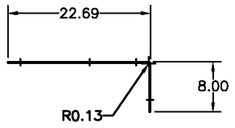
LINER PLATE
261510-01



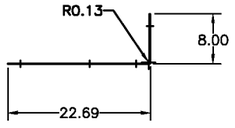
LINER PLATE
261510-02



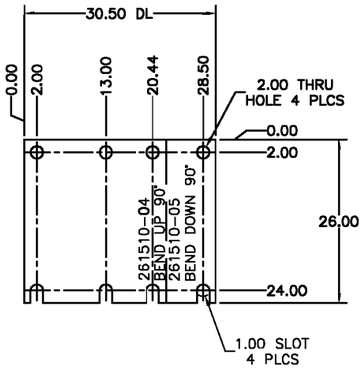
LINER PLATE
261510-03



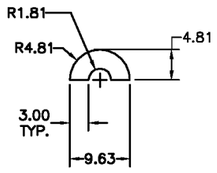
BEND PROFILE
(261510-04)



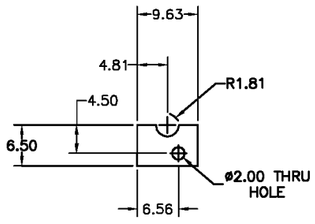
BEND PROFILE
(261510-05)



FLAT DEVELOPMENT



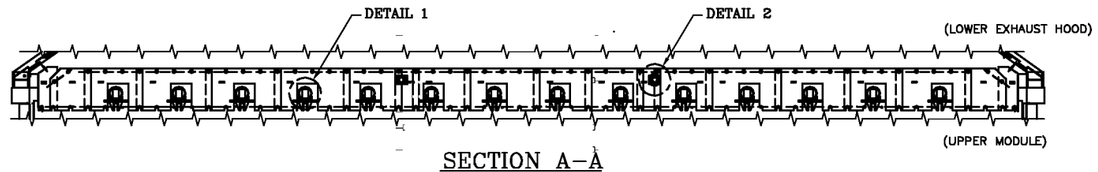
COVER PLATE
261510-06



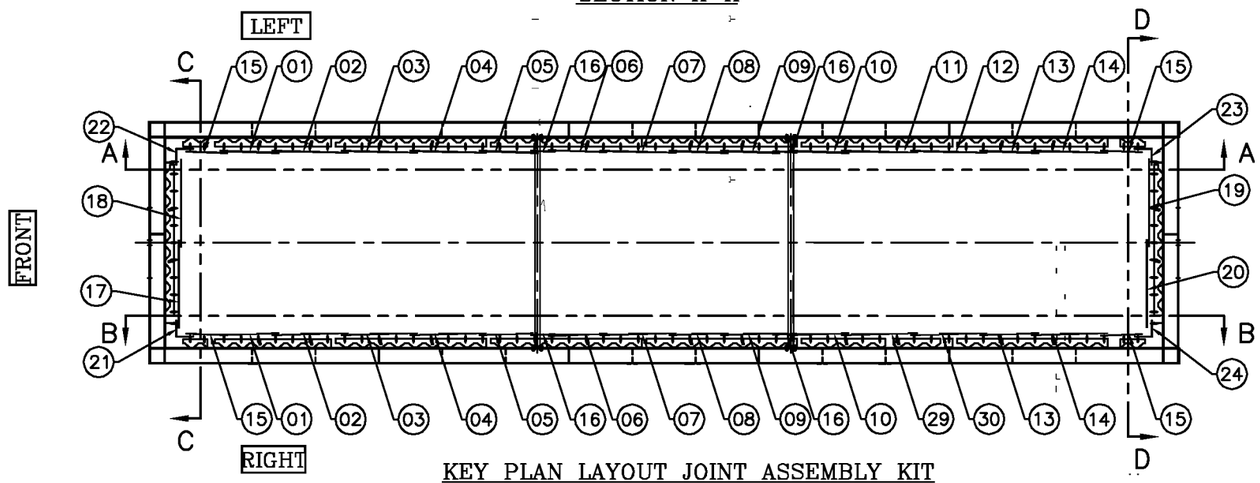
COVER PLATE
261510-07

CORNER LINER
261510-04 BEND UP 90°
261510-05 BEND DOWN 90°

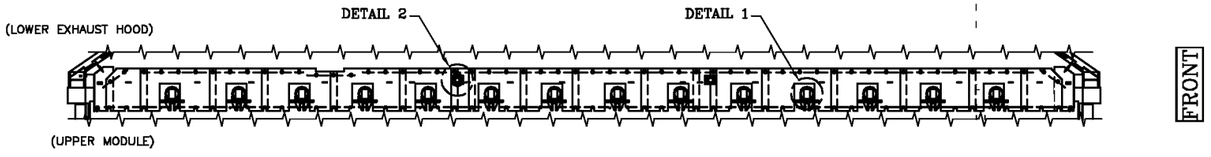
THIRD ANGLE PROJECTION	TOLERANCES UNLESS OTHERWISE SPECIFIED LINEAR DIMENSIONS ARE IN INCHES METRIC LINEAR TOL+/- 1.5mm TOL ON 1 PLACE DECIMALS +/- 0.120" TOL ON 2 PLACE DECIMALS +/- 0.060" TOL ON 3 PLACE DECIMALS +/- 0.030" ANGULAR TOLERANCE +/- 0.5°	QUALITY: N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
	THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.	MFG. M.HUNTER	DATE: 03/02/2011		
		PROJ.ENG. N/A	DATE: N/A	TITLE: JOINT ASSEMBLY KIT SCR MODULE TO UPPER MODULE ASSEMBLY & DETAILS	
		CHK. J.HUNTER	DATE: 03/02/2011		
		DRN. R.GU	DATE: 03/02/2011		
		N.H.A. 261027	EQUIP.MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261510 SIZE D REV. 00
		CADDS I.D. P:\C10082\261510-S2		SCALE: 1 : 12	SHEET NO. 02 OF 02



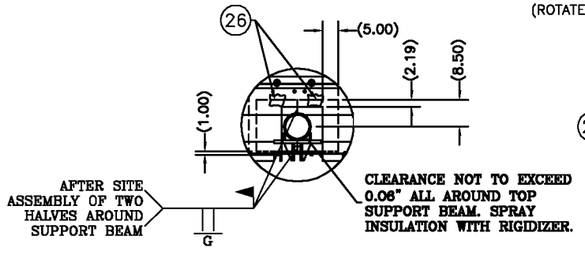
SECTION A–A



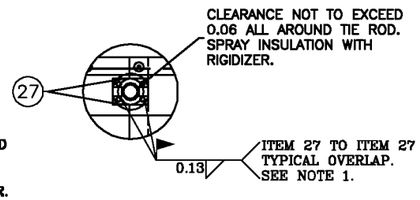
KEY PLAN LAYOUT JOINT ASSEMBLY KIT
261511
(TOP VIEW)
SOME COMPONENTS REMOVED FOR CLARITY



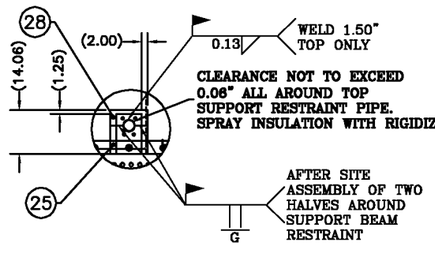
SECTION B–B
(ROTATED 180°)



DETAIL 1
SOME COMPONENTS REMOVED FOR CLARITY.
(SCALE 1:12)
TYP. 28 PLACES



DETAIL 2
SOME COMPONENTS REMOVED FOR CLARITY.
(SCALE 1:16)
TYP. 4 PLCS



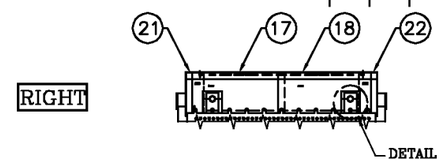
DETAIL 3
SOME COMPONENTS REMOVED FOR CLARITY.
(SCALE 1:16)
TYP. 2 PLACES

NOTES:
1. INSTALLATION SEQUENCE:
   - REMOVE APPLICABLE CHANNELS AND WASHERS.
   - INSTALL INSULATION AS REQUIRED.
   - PLACE CORNER LINERS (ITEMS #21 & 22) IN CORNERS AT REAR.
   - PLACE LINER PLATES AT REAR ENDS. (ITEMS #19 & 20)
   - PLACE CORNER LINERS (ITEMS #23 & 24) IN CORNERS AT FRONT.
   - PLACE COVER PLATES (ITEM #25 & 28) AROUND TOP SUPPORT RESTRAINT PIPE.
   - PLACE LINER PLATES AT FRONT (ITEM #17 & 18).
   - PLACE COVER PLATES (ITEM #26) AROUND TOP SUPPORT BEAMS.
   - PLACE COVER PLATES (ITEM #27) AROUND TIE RODS.
   - PLACE LINER PLATES (ITEMS #01 THRU 16, 29, 30) AS SHOWN AND RESECURE CHANNELS.
2. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED, SO ALL PANELS OF THE JOINT ARE IN FIRM CONTACT, USING AN ORDINARY WRENCH THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN WHEN HIT ON THE CORNER WITH A HAMMER, USING A NORMAL HAMMER SWING, BUT NOT TURN FREELY). TACK WELD NUT TO BOLT.
3. MATERIAL DESIGNATED ON AN MTR AS A240 S40900 IS ACCEPTABLE PROVIDED THE CHEMISTRY MATCHES THAT OF A240 S40930 INCLUDING THE TITANIUM + COLUMBIUM (NIOBIUM) REQUIREMENT.

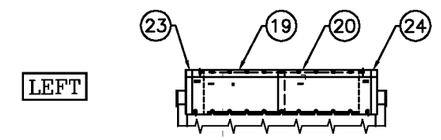
NOTE:
121 CU. FT. OF 6# INSULATION REQUIRED FOR UPPER MODULE TO LOWER HOOD JOINT ASSEMBLY KIT. REFER TO ERECTION DIAGRAM #261027.

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



SECTION C–C
(INSIDE VIEW)
SOME COMPONENTS REMOVED FOR CLARITY
ROTATED –90°



SECTION D–D
(INSIDE VIEW)
SOME COMPONENTS REMOVED FOR CLARITY
ROTATED 90°

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
1	EA	30	261511–24	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
1	EA	29	261511–23	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	28	140027–01	COVER PLATE	SHEET 11 GA.		
8	EA	27	140466–01	CLOSURE LINER	SHEET 11 GA.		
56	EA	26	261511–22	COVER PLATE	SHEET 11 GA. x 13.00 x 16.50	A240 S40930 (SEE NOTE 3)	
2	EA	25	261511–21	COVER PLATE	SHEET 11GA X 9.06 X 12.00	A240 S40930 (SEE NOTE 3)	
1	EA	24	261726	CORNER LINER	CORNER LINER ASSEMBLY		
1	EA	23	261725	CORNER LINER	CORNER LINER ASSEMBLY		
1	EA	22	261724	CORNER LINER	CORNER LINER ASSEMBLY		
1	EA	21	261723	CORNER LINER	CORNER LINER ASSEMBLY		
1	EA	20	261511–20	LINER PLATE	SHEET 11GA X 31.50 X 59.00	A240 S40930 (SEE NOTE 3)	
1	EA	19	261511–19	LINER PLATE	SHEET 11GA X 31.50 X 59.00	A240 S40930 (SEE NOTE 3)	
1	EA	18	261511–18	LINER PLATE	SHEET 11GA X 27.13 X 59.00	A240 S40930 (SEE NOTE 3)	
1	EA	17	261511–17	LINER PLATE	SHEET 11GA X 27.13 X 59.00	A240 S40930 (SEE NOTE 3)	
4	EA	16	261511–16	LINER PLATE	SHEET 11GA X 15.00 X 26.88	A240 S40930 (SEE NOTE 3)	
4	EA	15	261511–15	LINER PLATE	SHEET 11GA X 26.00 X 26.88	A240 S40930 (SEE NOTE 3)	
2	EA	14	261511–14	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	13	261511–13	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
1	EA	12	261511–12	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
1	EA	11	261511–11	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	10	261511–10	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
2	EA	09	261511–09	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
2	EA	08	261511–08	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
2	EA	07	261511–07	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	06	261511–06	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
2	EA	05	261511–05	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	
2	EA	04	261511–04	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	03	261511–03	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	02	261511–02	LINER PLATE	SHEET 11GA X 26.88 X 48.00	A240 S40930 (SEE NOTE 3)	
2	EA	01	261511–01	LINER PLATE	SHEET 11GA X 26.88 X 37.00	A240 S40930 (SEE NOTE 3)	*

BILL OF MATERIAL AND PARTS LIST

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL.+/– 1.5mm
TOL. ON 1 PLACE DECIMALS +/– 0.120"
TOL. ON 2 PLACE DECIMALS +/– 0.060"
TOL. ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

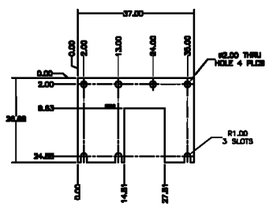
THIRD ANGLE PROJECTION

THIS IS A PREPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.

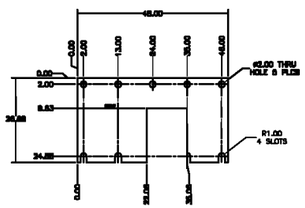
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QUALITY: N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFG. M.HUNTER	DATE: 03/08/2011		
ENGINEERING: N/A	DATE: N/A	TITLE: JOINT ASSEMBLY KIT UPPER MODULE TO LOWER HOOD ASSEMBLY & DETAILS	
CHK. J.HUNTER	DATE: 03/08/2011		
DRN. R.GU	DATE: 03/08/2011		
N.H.A. 261027	EQUIP.MODEL: LM6000PF	PROJ.NO. C10082	DWG. NO. 261511 SIZE D REV. 00
CADDS I.D. P:\C10082\261511–S1		SCALE: 1 : 48	SHEET NO. 01 OF 02

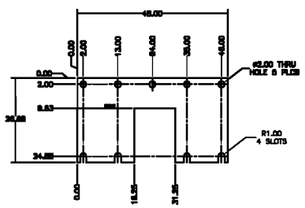
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



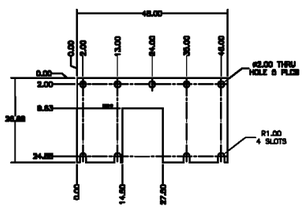
LINER PLATE
281511-01



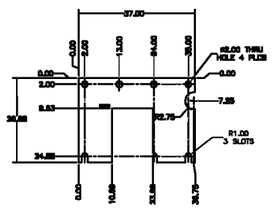
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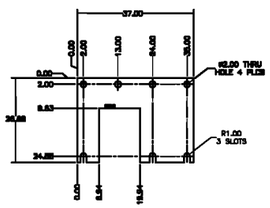
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281511-03



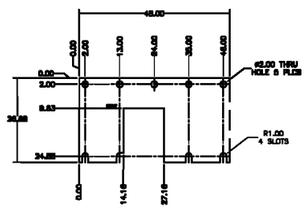
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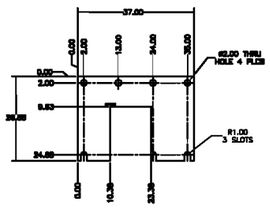
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281511-05



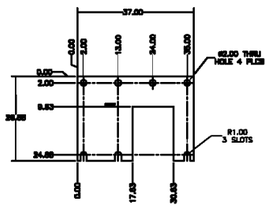
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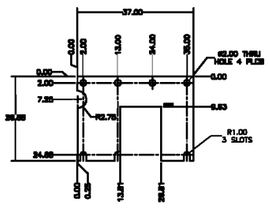
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281511-07



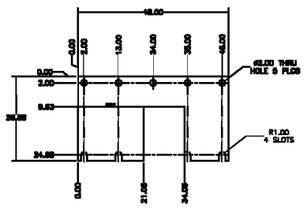
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281511-08



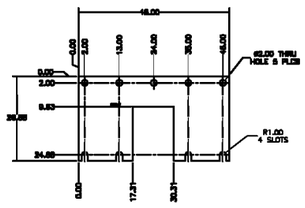
LINER PLATE
281511-09



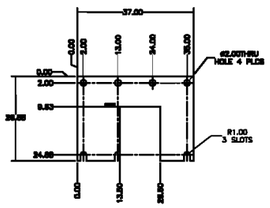
LINER PLATE
281511-10



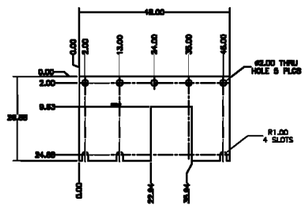
LINER PLATE
281511-11



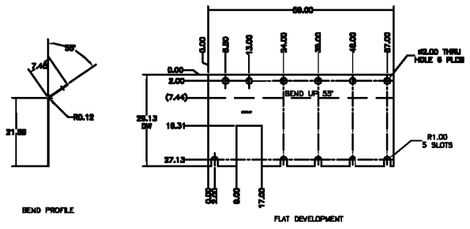
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281511-12



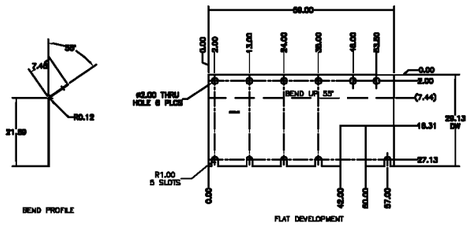
LINER PLATE
281511-13



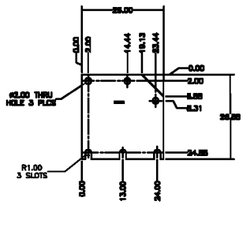
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281511-14



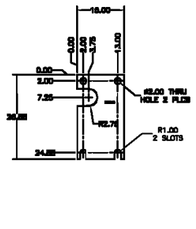
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281511-17



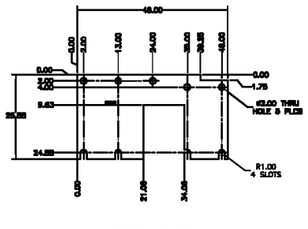
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281511-18



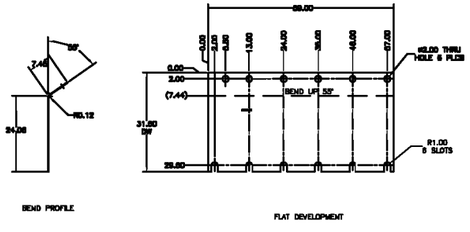
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281511-15



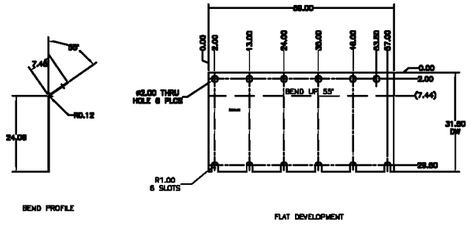
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281511-16



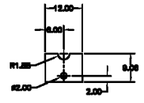
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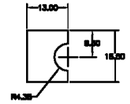
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281511-19



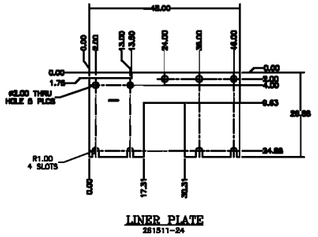
LINER PLATE
281511-20



COVER PLATE
281511-21



COVER PLATE
281511-22



LINER PLATE
281511-24

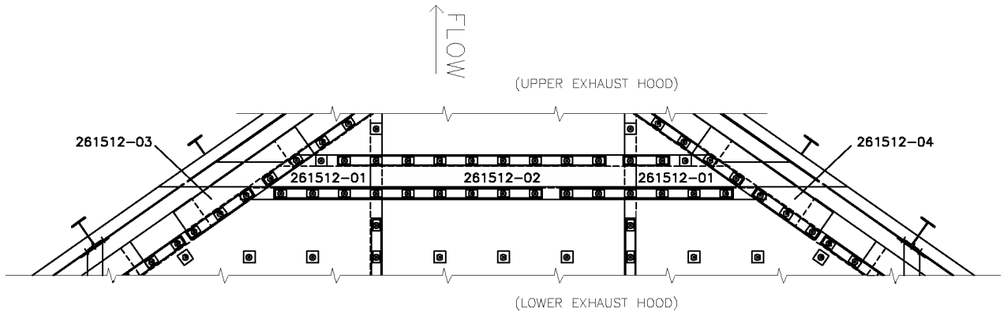
TOLERANCES UNLESS OTHERWISE SPECIFIED	
LINEAR DIMENSIONS ARE IN INCHES	
METRIC LINEAR TOL+/-	1.5mm
TOL ON 1 PLACE DECIMALS +/-	0.120"
TOL ON 2 PLACE DECIMALS +/-	0.060"
TOL ON 3 PLACE DECIMALS +/-	0.030"
ANGULAR TOLERANCE +/-	0.5°

THIRD ANGLE PROJECTION

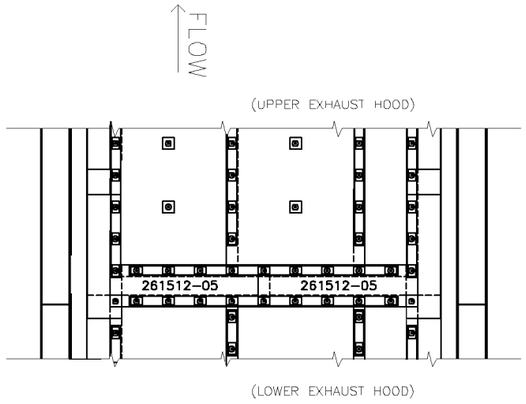
THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES. REPRODUCTION, MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THE DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART IS NOT PERMISSIBLE UNLESS EXPRESSLY AUTHORIZED IN WRITING BY INNOVATIVE STEAM TECHNOLOGIES.

IST

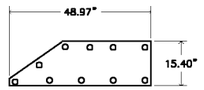
QUALITY: N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFGR. M.HUNTER	DATE: 03/08/2011		
PROJ.ENG. N/A	DATE: N/A	TITLE: JOINT ASSEMBLY KIT UPPER MODULE TO LOWER HOOD ASSEMBLY & DETAILS	
CHK. J.HUNTER	DATE: 03/08/2011		
DRN. R.GU	DATE: 03/08/2011		
N.H.A. 261027	EQUIP.MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261511 / SIZE D / REV. 00
CADDS I.D. P:\C10082\261511-S2		SCALE: 1 : 24	SHEET NO. 02 OF 02



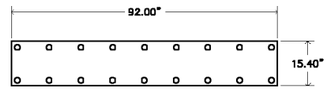
TYP RIGHT & LEFT SIDE
VIEW FROM INSIDE



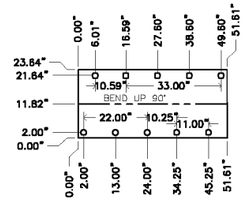
TYP FRONT AND REAR SIDE
VIEW FROM INSIDE



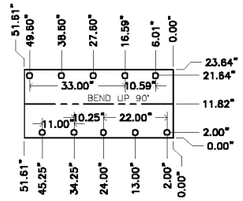
261512-01
11GA 409.30 SS
(4) REQ'D PER SYSTEM
(12) REQ'D TOTAL



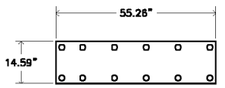
261512-02
11GA 409.30 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261512-03
11GA 409.30 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261512-04
11GA 409.30 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261512-05
11GA 409.30 SS
(4) REQ'D PER SYSTEM
(12) REQ'D TOTAL

THESE PARTS SHIP LOOSE
QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM
(3) SYSTEMS TOTAL REQ'D

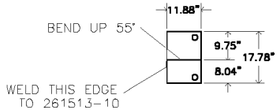
PART NO.	QTY	DESCRIPTION
261512-01	4	JAK PANEL (40930 SS)
261512-02	2	JAK PANEL (40930 SS)
261512-03	2	JAK PANEL (40930 SS)
261512-04	2	JAK PANEL (40930 SS)
261512-05	4	JAK PANEL (40930 SS)
(REF ES-026)	8 ROLLS	6# INSULATION (2"X24"X150" ROLL)

REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS. UPDATED B.O.M.	RWB	14MAR11

NOTES:

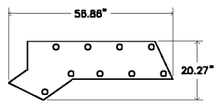
SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT LOWER EXHAUST HOOD TO UPPER EXHAUST HOOD	
10 MAR 11 DATE		
P.O. NUMBER	261512 DRAWING NO.	1 SHEET / REV.



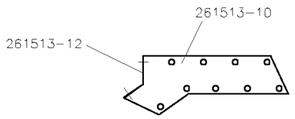
261513-12

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



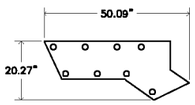
261513-10

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



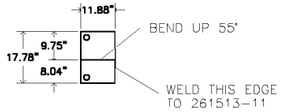
261513-01

(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



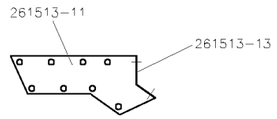
261513-11

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



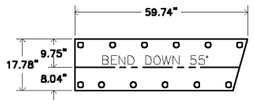
261513-13

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



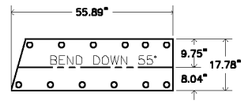
261513-02

(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



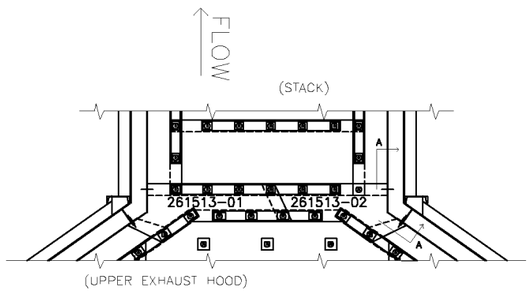
261513-03

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL

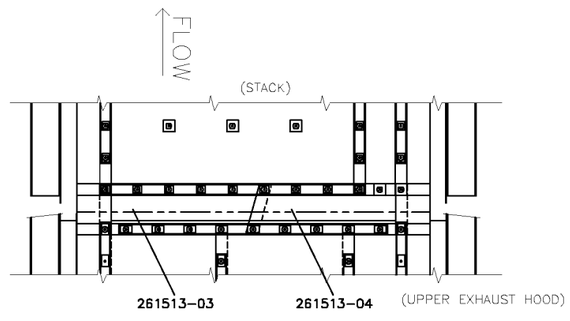


261513-04

11GA 40930 SS
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



TYP RIGHT & LEFT SIDE
VIEW FROM INSIDE



TYP FRONT AND REAR SIDE
VIEW FROM INSIDE

THESE PARTS SHIP LOOSE QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM (3) SYSTEMS TOTAL REQ'D		
PART NO.	QTY	DESCRIPTION
261513-01	2	JAK PANEL (40930 SS)
261513-02	2	JAK PANEL (40930 SS)
261513-03	2	JAK PANEL (40930 SS)
261513-04	2	JAK PANEL (40930 SS)
(REF ES-026)	6 ROLLS	6# INSULATION (2"X24"X150" ROLL)

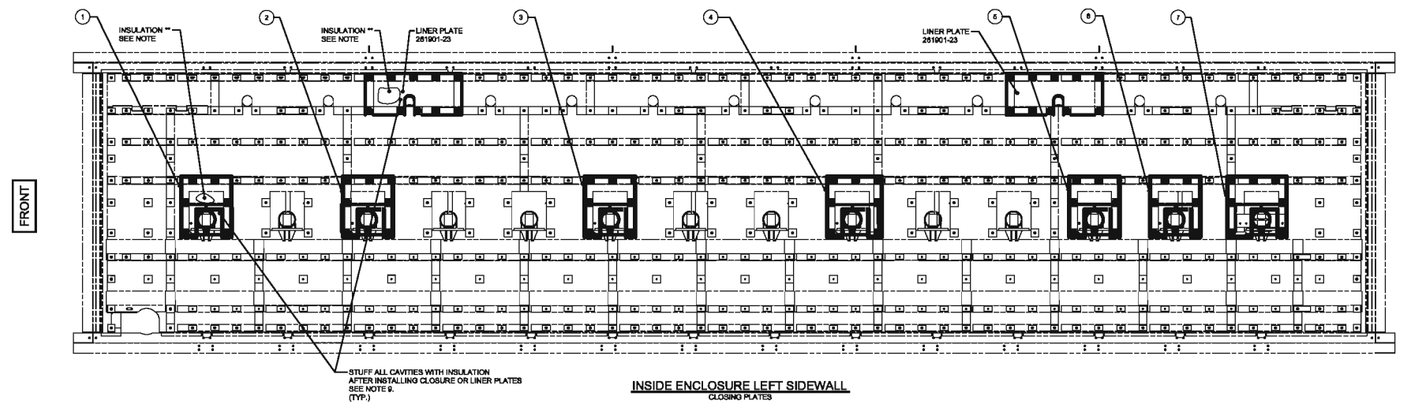
REV	DESCRIPTION	BY	DATE
A	ADDED LINER DETAILS, UPDATED B.O.M.	RWB	14MAR11

NOTES:

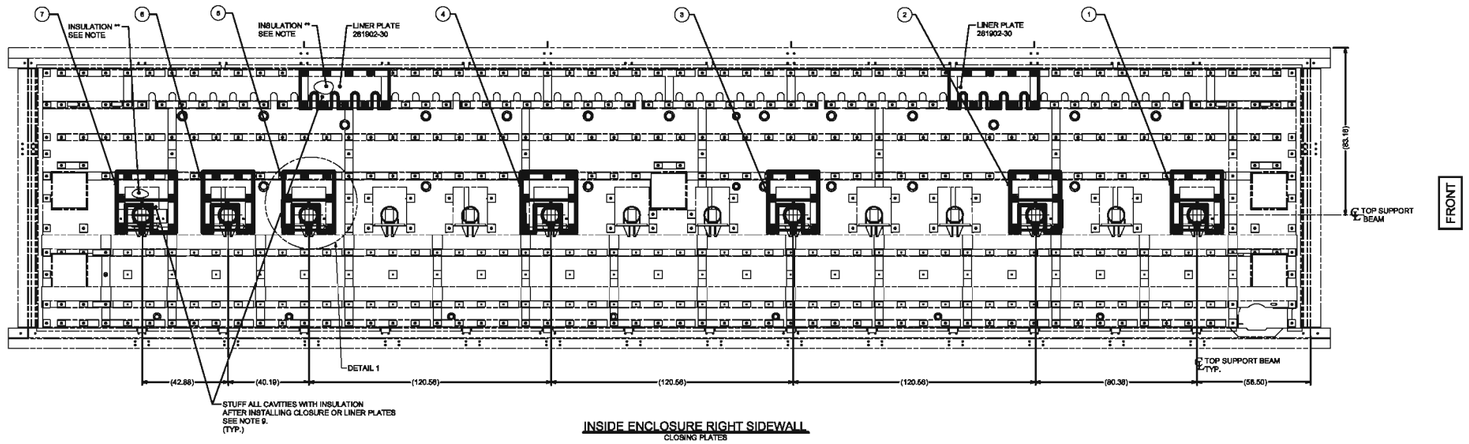
SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
RW CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
RWB DRAFTER	JAK KIT UPPER EXHAUST HOOD TO EXHAUST STACK	
10 MAR 11 DATE		
P.O. NUMBER	261513 DRAWING NO.	1 SHEET / REV.

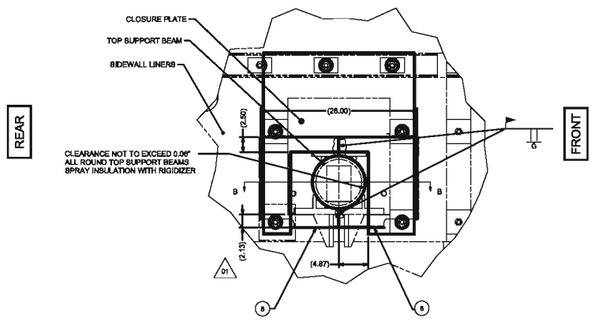
REVISION HISTORY					
REV	ECR	DESCRIPTION	BY	APP	DATE
01	2256	UPDATED DETAIL 1, ADDED ITEM # TO INSULATION NOTE	JH	FT	3/23/2011



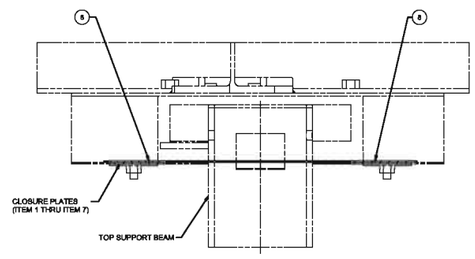
INSIDE ENCLOSURE LEFT SIDEWALL
CLOSING PLATES



INSIDE ENCLOSURE RIGHT SIDEWALL
CLOSING PLATES



DETAIL 1
CLOSURE PLATE INSTALLATION
TYP. 14 PLCS
SCALE 1:8



SECTION B-B
SCALE 1:4

NOTES:

1. REMOVE APPLICABLE CHANNELS AND HARDWARE.
2. REMOVE SUPPORT BEAM STUDS THAT SECURE SUPPORT BEAM TO ANGLE BRACKETS. (ALL LOCATIONS)
3. REMOVE SUPPORT BEAM ANGLE BRACKETS PAINTED YELLOW AND HARDWARE (ALL BUT REAR) PLUG AND SEAL HOLES.
4. INSTALL 6# DENSITY INSULATION (COMPRESSED TO 5.50") TYP. ALL CAVITIES.
5. INSTALL CLOSURE PLATES (ITEM 8) WELD AS SHOWN PER VIEW) INSTALL CLOSURE PLATES (ITEM 1 THRU ITEM 7 INCL.)
6. INSTALL LINER PLATES (261901-23, 261902-30)
7. REPLACE CHANNELS AND HARDWARE.
8. TRIM WASHERS, CHANNELS & SCALLOP PLATES WHERE REQUIRED.
9. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED, USING THE FULL EFFORT OF A MAN USING AN ORDINARY WRENCH, THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN, WHEN HIT ON THE CORNER WITH A HAMMER, USING A NORMAL HAMMER SWING, BUT NOT TURN FREELY) DEFORM THREADS.

NOTE
60 CU. FT. OF 6# INSULATION REQ'D FOR LOWER MODULE CLOSING KIT
REFER TO ERECTION DIAGRAM #261027
ITEM 01 FOR SUPPLY

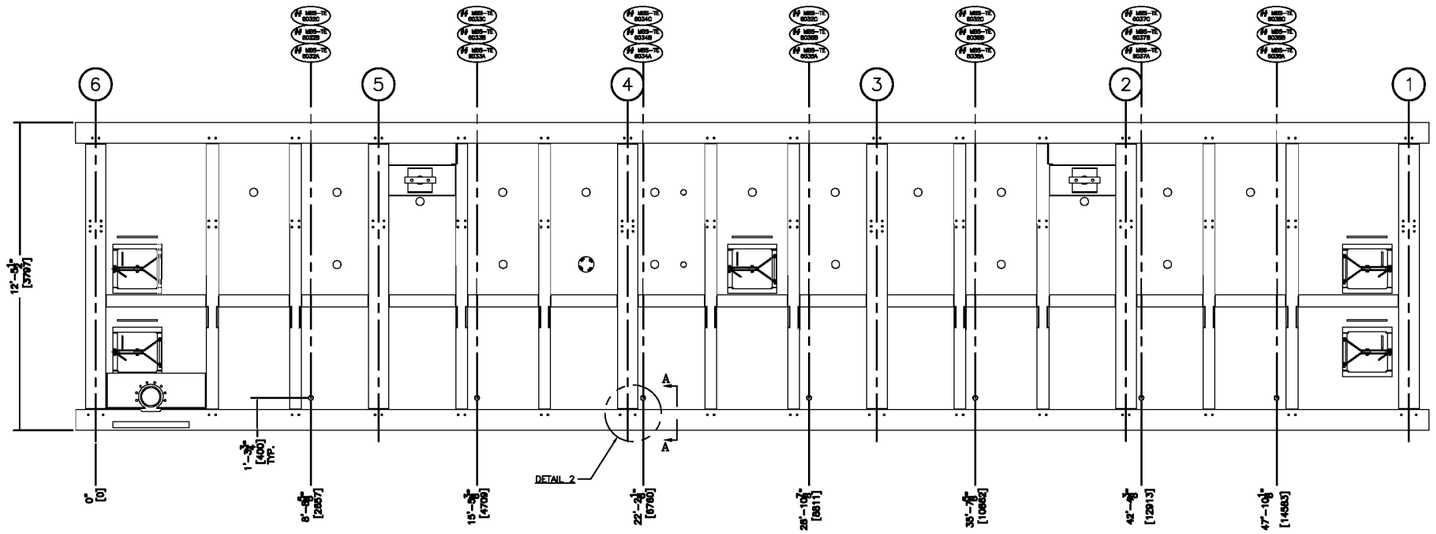
28	EA	8	261600-17	CLOSURE PLATE	A340 S40930	
2	EA	7	261600-14	CLOSURE PLATE	A340 S40930	
2	EA	6	261600-13	CLOSURE PLATE	A340 S40930	
2	EA	5	261600-12	CLOSURE PLATE	A340 S40930	
2	EA	4	261600-09	CLOSURE PLATE	A340 S40930	
2	EA	3	261600-05	CLOSURE PLATE	A340 S40930	
2	EA	2	261600-03	CLOSURE PLATE	A340 S40930	
2	EA	1	261600-01	CLOSURE PLATE	A340 S40930	
QTY	U/M	ITEM	PART NO.	TITLE	MATERIAL	ZONE

BILL of Material and Parts List

THIRD ANGLE PROJECTION	UNLESS OTHERWISE NOTED: TOLERANCE UNLESS NOTED 1 PLACE DECIMAL ± 0.125" 2 PLACE DECIMAL ± 0.060" 3 PLACE DECIMAL ± 0.030" ANGULAR ± 0.5°	DRAWN: JH 2/24/2011	CONTRACTOR: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT
THIS IS A PROPRIETARY DESIGN OF INNOVATIVE STEAM TECHNOLOGIES, INC. (ISTI). ANY MANUFACTURE OR USE OF ANY ASSEMBLY, SUBASSEMBLY OR PART INDICATED HEREIN OR THE USE OF THIS DESIGN OF ANY SUCH ASSEMBLY, SUBASSEMBLY OR PART WITHOUT THE EXPRESS WRITTEN AUTHORIZATION FROM ISTI IS STRICTLY FORBIDDEN. ALL PRODUCTS MADE FROM ISTI INNOVATIVE STEAM TECHNOLOGIES (IST).	CHECKED: J.HUNTER 2/24/2011	TITLE: LOWER MODULE CLOSURE KIT ASSEMBLY
	ENGINEER: J.HUNTER 2/24/2011	
	APPROVED: M.ZENG 2/24/2011	
	PROJECT: C10082	WEIGHT: N/A
	MFG. PLANT: 261027	SCALE: 1:24
	LOCATION: LM5000PF	SHEET NO.: 1 OF 1
		DRAWING: 261601
		REV: 01

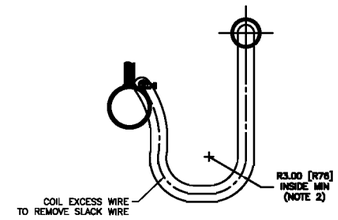
SLCI CONTRACT NO.:	0699
CONTRACT NUMBER:	31041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE
00	—	ISSUED FOR CONSTRUCTION	MZ	JH	09/25/11

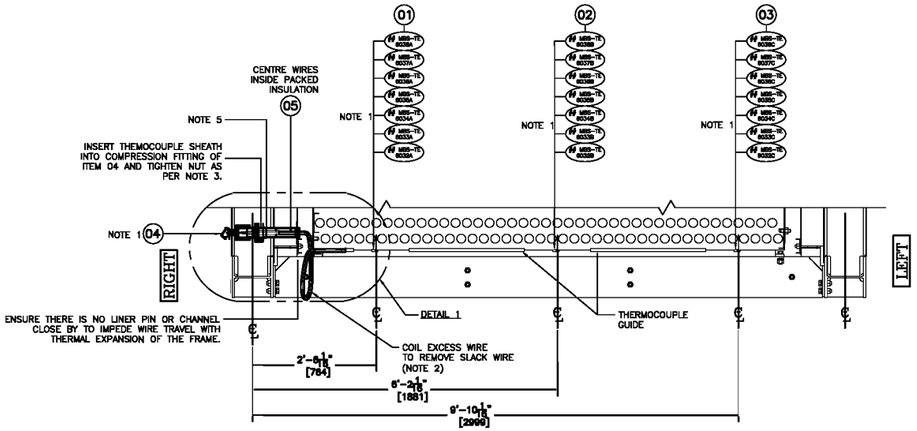


LOWER MODULE THERMOCOUPLE FIELD ARRANGEMENT

261602

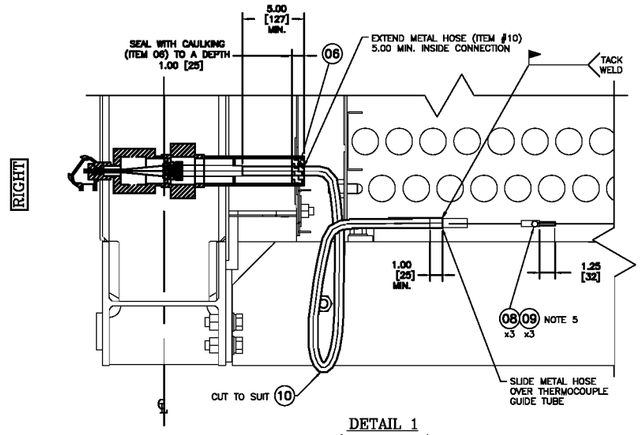


DETAIL 2
N.T.S.
(TYP.)



SECTION A–A

N.T.S.
TYP. 7 PLACES



DETAIL 1

(TYPICAL 7 PLACES)
N.T.S.

NOTES

1. EACH T/C IS TO BE IDENTIFIED WITH 316 SS TAG# WIRED (ITEM 07) TO T/C HOT END. ERECTOR TO ATTACH WEATHER RESISTANT TAGS TO T/C COLD END INSIDE THERMOCOUPLE HEAD (ITEM 04). (TAGS SUPPLIED BY ERECTOR)
2. MINIMUM BEND RADIUS OF ITEMS 01 THRU 03 IS 3.00. DO NOT KINK WIRES.
3. INSTALL THERMOCOUPLE END INTO COMPRESSION FITTING AND TIGHTEN NUT UNTIL THERMOCOUPLE END CAN NOT BE MOVED BY HAND. FURTHER TIGHTEN NUT WITH TOOL 1 1/4 TURNS.
4. APPLY HIGH TEMPERATURE SEALANT TO JOINT OF CASING PIPE NIPPLE AND ITEM D4. (BY OTHERS)
5. APPLY HIGH TEMPERATURE ANTI SEIZE AT THE THREADED FASTENER. (BY OTHERS)
6. INSTALLATION OF THERMOCOUPLES ONLY TAKES PLACE AFTER MODULE PLACEMENT AND THE REMOVAL OF SHIPPING BEAMS.
7. PRIMARY DIMENSIONS ARE IN FEET AND INCHES, SECONDARY (BRACKETED) DIMENSIONS ARE IN mm.

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
75	FT	10	900247	FLEXIBLE METAL HOSE	METAL HOSE 3/4" I.D. x 0.011" THK x AS NOTED McMASTER CARR P/N 5484K512 OR EQUAL	316 SS	
23	EA	09	300254	HEX JAM NUT	HEX JAM NUT .25–20UNC–2B	316 SS (MIN. 0.045 C)	
23	EA	08	300312	HEX BOLT	HEX BOLT .25 –20UNC–2A X .88 LG.	316 SS (MIN. 0.045 C)	
12	FT	07	900174	WIRE	WIRE 20 GA.	316 SS	
3	TUBE	06	900072	CAULKING	FIBREFRAX CAULKING TUBE		
2	FT	05	900263	INSULATION	10# DENSITY ES–026	SOLUBLE FIBER	
7	EA	04	140878–100	THERM. HEAD	THERMOCOUPLE HEAD CONNECTION ASSY.		
7	EA	03	261000–137	THERMOCOUPLE	TYPE "K" "L" = 150.00 S/S + 12.00" EXT. WIRE	NOTE 1	
7	EA	02	261000–136	THERMOCOUPLE	TYPE "K" "L" = 107.00 S/S + 12.00" EXT. WIRE	NOTE 1	
7	EA	01	261000–135	THERMOCOUPLE	TYPE "K" "L" = 63.80 S/S + 12.00" EXT. WIRE	NOTE 1	

BILL OF MATERIAL AND PARTS LIST

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN MILLIMETERS
MOLD LINE IN ± 1.5mm
DECIMAL ± ANGULAR ±
THIS IS A PROPRIETARY DESIGN OF PROPRIETARY INFORMATION OF LIQUID SOLIDIFICATION INTERNATIONAL, INC. AND IS THE PROPERTY OF LIQUID SOLIDIFICATION INTERNATIONAL, INC. IT IS NOT TO BE REPRODUCED OR USED IN WHOLE OR IN PART FOR ANY PURPOSE WITHOUT THE WRITTEN PERMISSION OF LIQUID SOLIDIFICATION INTERNATIONAL, INC. ANY REPRODUCTION OR USE WITHOUT PERMISSION IS PROHIBITED BY LIQUID SOLIDIFICATION INTERNATIONAL, INC.

LST

DRAWN	N/A
CHECKED	M. HUNTER 09/26/11
ENGINEER	P. TRAPP 09/24/11
QAC	J. HUNTER 09/24/11
APP.	M. ZEMKO 09/26/11
N.A.A.	261027
DRAWING NUMBER	L9850009
REVISED	C10088

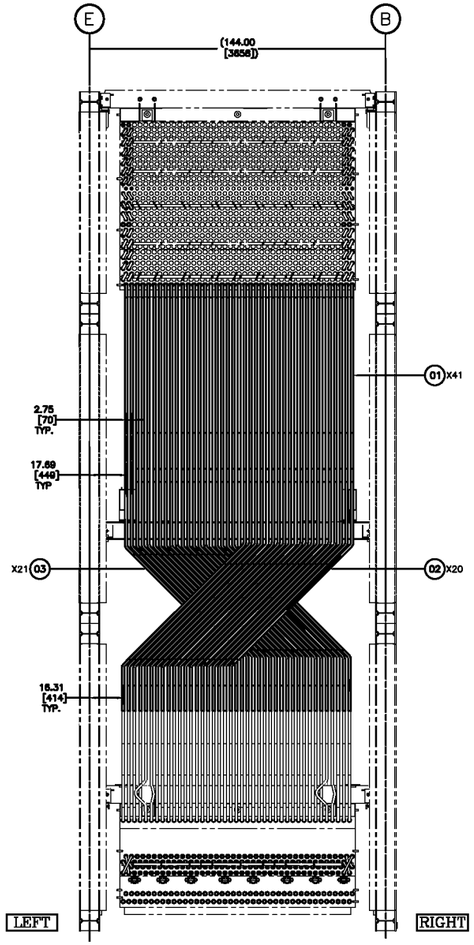
CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT

TITLE: LOWER MODULE THERMOCOUPLE FIELD ARRANGEMENT

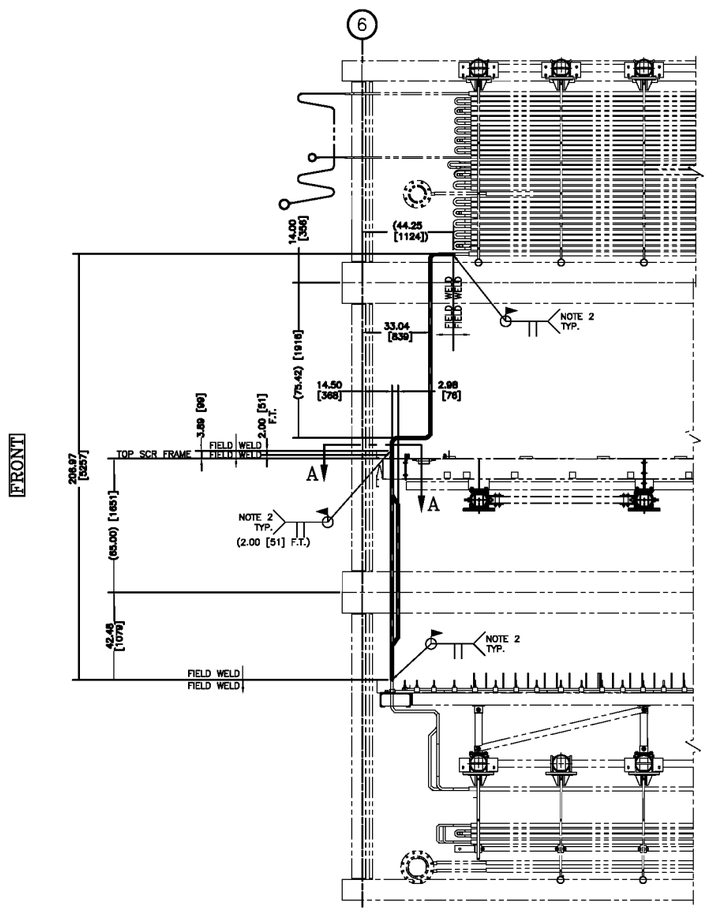
SIZE	E
DWG. NO.	261802
REV.	00
SCALE	1 : 24
SHEET NO.	01 OF 01

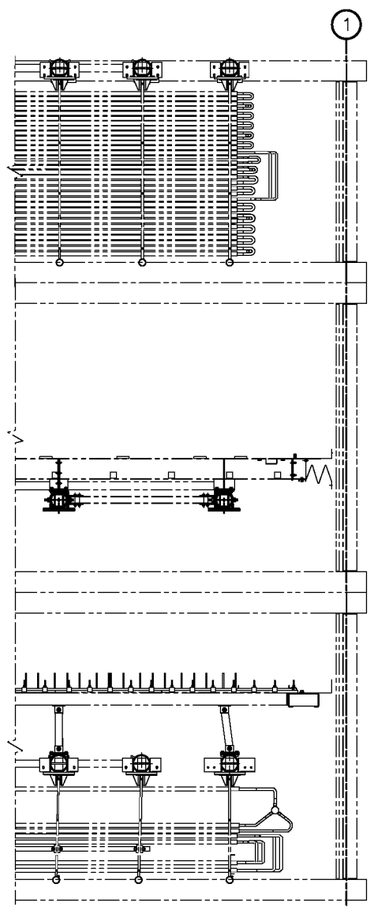
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REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE

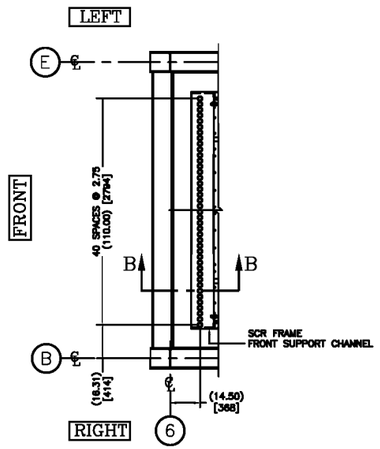


FRONT JUMPER ARRANGEMENT

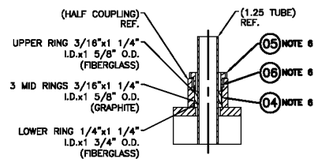




INTERNAL SIDE ELEVATION
(TUBING SHOWN ONLY)



SECTION A–A
(TYP. BUSHING ARRANGEMENT)



SECTION B–B
TYP. 41 PLCS
SCALE 1 : 2

NOTES:

1. ALL PRIMARY DIMENSIONS ARE IN INCHES. ALL SECONDARY DIMENSIONS ARE IN [mm]. ELEVATIONS ARE IN FEET & INCHES.
2. ALL TUBE WELDS ARE FULL PENETRATION BUTT WELDS IN ACCORDANCE WITH ASME SECTIONS I AND IX.
3. REMOVE ALL TEMPORARY SHIPPING PROTECTION & SPACERS WHERE EXISTING.
4. INSTALL ITEMS 04 & 05 BEFORE WELDING UPPER JUMPER SECTIONS (ITEMS 01).
5. F.T. INDICATES FIELD TRIM ALLOWANCE.
6. INSTALL PACKING (ITEM 04), APPLY A THIN LAYER OF SEALANT (ITEM 06) TO THREADS OF BUSHING (ITEM 05), THEN TIGHTENED DOWN TO COMPRESS PACKING AROUND THE TUBE. THE TUBE SHOULD BE ABLE TO SLIDE THROUGH EASILY (I.E. NOT CLAMPED TIGHT) AFTER TIGHTENING. DO NOT OVER TIGHTEN BUSHING.

REFERENCE DRAWINGS:

GENERAL ARRANGEMENT ----------261001
OTSG DUCTING & ERECTION DIAGRAM-----261027
ERECTION INSTRUCTION PACKAGE

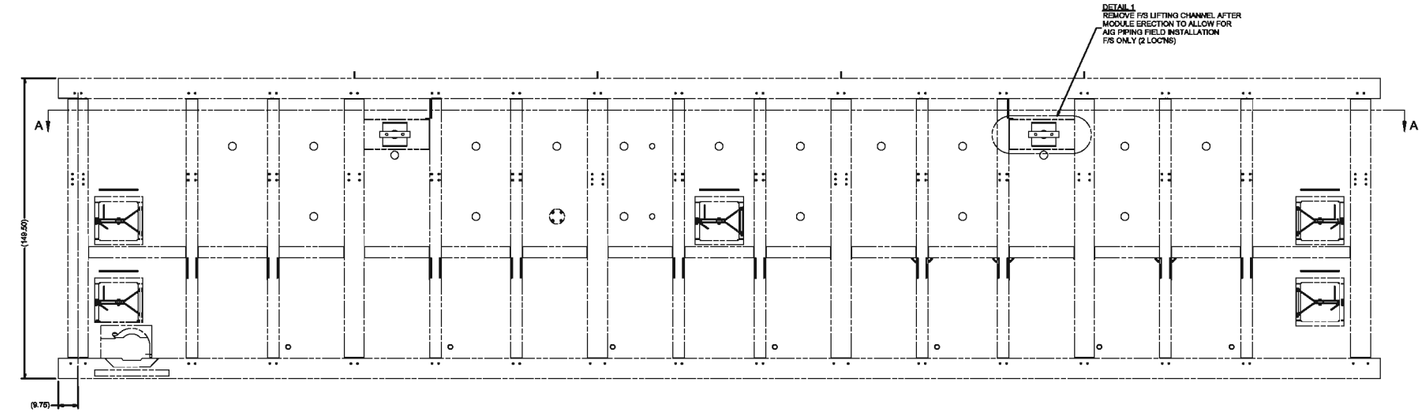
QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
4	EA	08	900246	SEALANT	SEALANT TUBE	LOCTITE HIGHEAT	
41	EA	05	140985	BUSHING	BUSHING 1.50" NPT HEX HEAD	SA182 F316	
41	EA	04	400041	PACKING	PACKING (GRAFOIL/FIBERGLASS 1.25" TUBE)		
21	EA	03	261661	JUMPER TUBE	FIELD JUMPER TUBE ASSEMBLY		
20	EA	02	261658	JUMPER TUBE	FIELD JUMPER TUBE ASSEMBLY		
41	EA	01	261664	JUMPER TUBE	FIELD JUMPER TUBE ASSEMBLY		

BILL OF MATERIAL AND PARTS LIST

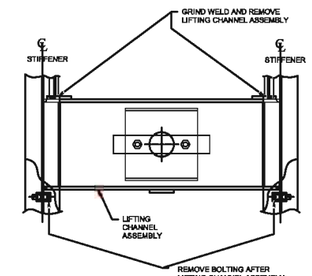
CUSTOMER	CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT
TITLE	FIELD JUMPER ARRANGEMENT
DWG. NO.	261650
REV	E
SHEET NO.	01 OF 01
SCALE	1:24
FILENAME	P:\A1C0282\261650

IST

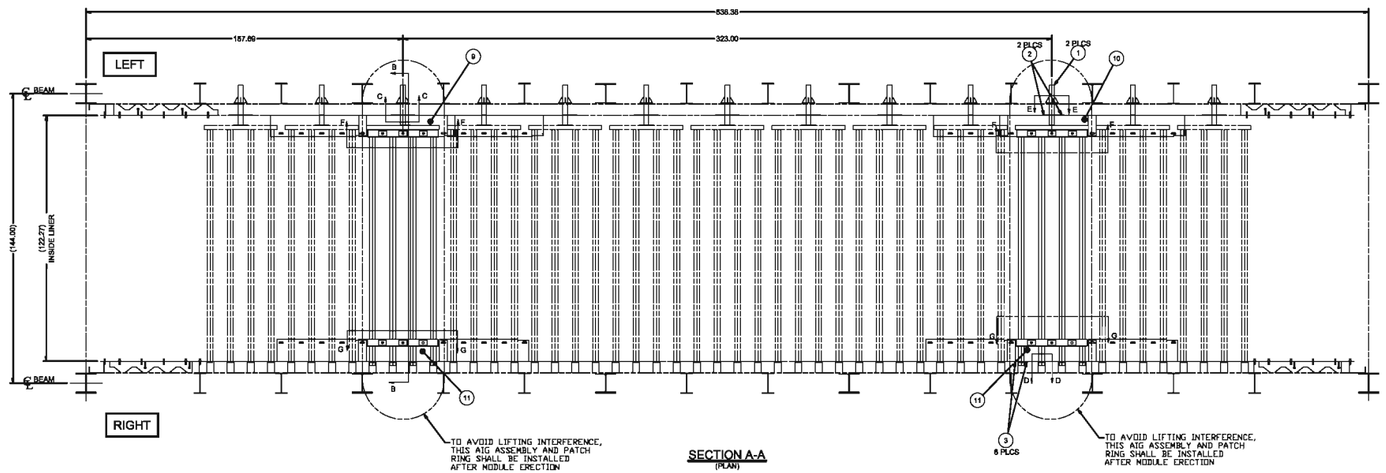
REVISION HISTORY						
REV	ECR	DESCRIPTION	BY	APP	DATE
01	2356	ITEMS 09, 10, 11 ADDED NOTES 4, 5 ADDED: SECTIONS F-F AND G-G UPDATED	GF	FT	06/23/11



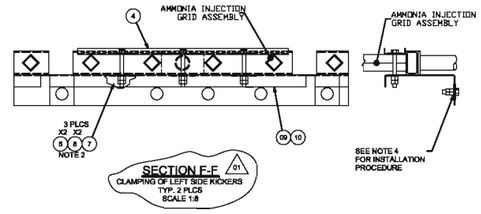
AIG PIPING FIELD ARRANGEMENT



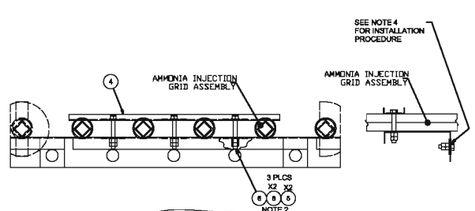
DETAIL 1
SCALE: NTS



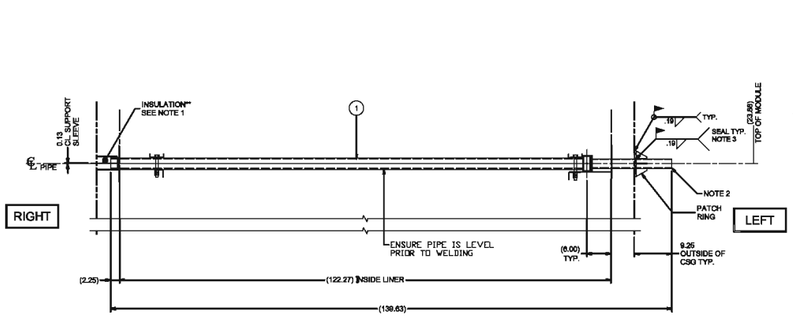
SECTION A-A
(PLAN)



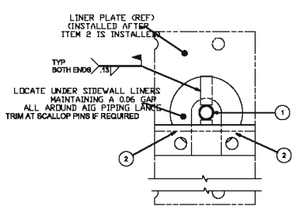
SECTION F-F
CLAMPING OF LEFT SIDE KICKERS
TYP. 2 PLCS
SCALE 1:8



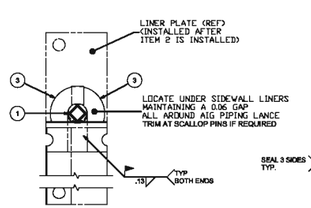
SECTION G-G
(ROTATED 180°)
CLAMPING OF RIGHT SIDE KICKERS
TYP. 2 PLCS
SCALE 1:8



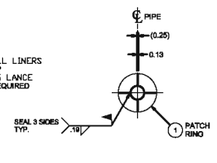
SECTION B-B
ROTATED 90°
TYP. 2 LOCNS
(SOME ITEMS REMOVED FOR CLARITY)
SCALE 1:12



SECTION C-C
TYP. 2 PLCS
SCALE 1:8



SECTION D-D
(ROTATED 180°)
TYP. 8 PLCS
SCALE 1:8



SECTION E-E
TYP. 2 PLCS
SCALE 1:8

** 0.5 CU. FT. OF 5# INSULATION REQUIRED FOR AIG PIPING ARRANGEMENT. REFER TO ERECTION DIAGRAM #261027 ITEM 01 FOR SUPPLY.

REFERENCE DRAWINGS

ERECTION DIAGRAM.....261027
PEERLESS MFG. CO. DRAWING.....D202-00055-02

NOTES

1. FILL AIG PIPE SUPPORT SLEEVES LOOSELY WITH INSULATION PRIOR TO INSTALLING AIG PIPING. (DO NOT OVERFILL)
2. UNLESS OTHERWISE SPECIFIED, NUTS ARE TO BE TIGHTENED USING THE FULL EFFORT OF A MAN USING AN ORDINARY WRENCH THEN BACKED OFF 1/4 TURN. (WASHERS MUST BE ABLE TO TURN WHEN HIT ON THE CORNER WITH A HAMMER USING A NORMAL HAMMER SWING BUT NOT TURN FREELY). DEFORM THREADS.
3. PIPING ATTACHMENT WELDS AS PER ASME SECTION IX.
4. REMOVE EXISTING NUTS & WASHERS AT SIDEWALL LOCATIONS, INSERT ITEMS 09, 10, 11 IN ORDER TO UNDERLAP THE EXISTING DIVERTERS RE-ATTACH THE HARDWARE AND FOLLOW NOTE 2 FOR TIGHTENING
5. ITEMS 09, 10, 11 TO BE INSTALLED PRIOR TO AIG PIPING INSERTION

ITEM	QTY	UM	PART NO.	TITLE	MATERIAL	ZONE
2	EA	11	281710-15	FLOW DIVERTER	A240 S40930	
1	EA	10	281710-11	FLOW DIVERTER	A240 S40930	
1	EA	9	281710-03	FLOW DIVERTER	A240 S40930	
24	EA	9	300478	NUT 0.63" - 11 UNC-2B	A194 8M	
6	EA	7	300808	BOLT 0.63" - 11 UNC-2A X 6.76" LG	A193 B8M	
6	EA	8	300805	BOLT 0.63" - 11 UNC-2A X 6.00" LG	A193 B8M	
24	EA	5	180270-51	LINER WASHER (2.50" X 4.00")	A240 S40930	
4	EA	4	281711	LINER CHANNEL	A240 S40930	
16	EA	3	281715	CLOSURE COLLAR (FOR 2 X 2 HSS)	A240 S40930	
4	EA	2	281714	CLOSURE COLLAR (FOR 2" NPS)	A240 S40930	
2	EA	1	AK2512PK0251	AIG ASSEMBLY W/ PATCH RING	A240 S40930	

BB of Materials and Parts List

DESIGN BY:	TOSONI	DATE: 2/24/2011	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT
DRAWN BY:	HUNTER	DATE: 2/24/2011	
CHECKED BY:	TRAPSA	DATE: 2/24/2011	TITLE: AIG PIPING FIELD ARRANGEMENT
APPROVED BY:	HUNTER	DATE: 2/24/2011	
PROJ. ENGR:	GU	DATE: 2/24/2011	
JOB NO:	C10082	SYSTEM: LNB500PF	SIZE: 22" D Arch
DWG. NO:	281027	SCALE: 1:24	SHEET NO: 1 OF 1

DRAWING NO: 261716
REV: 01

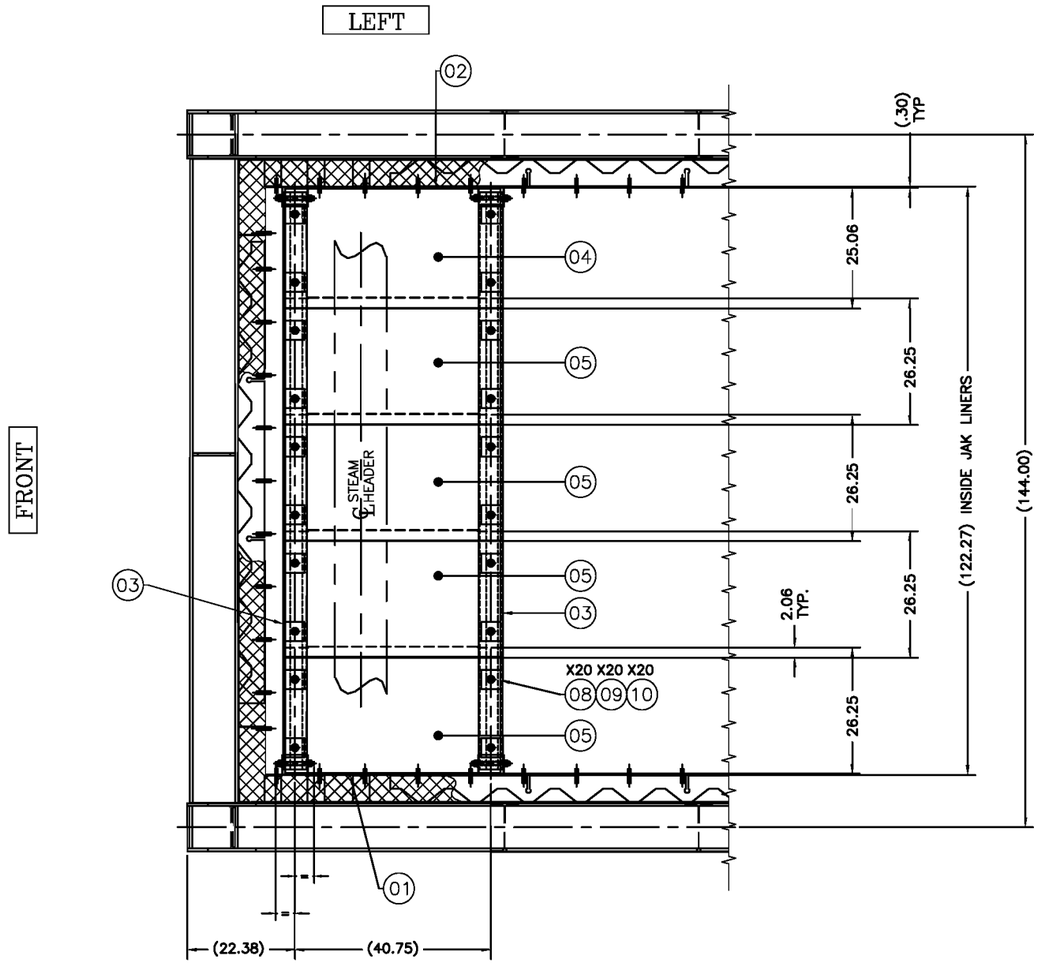
THIRD ANGLE PROJECTION

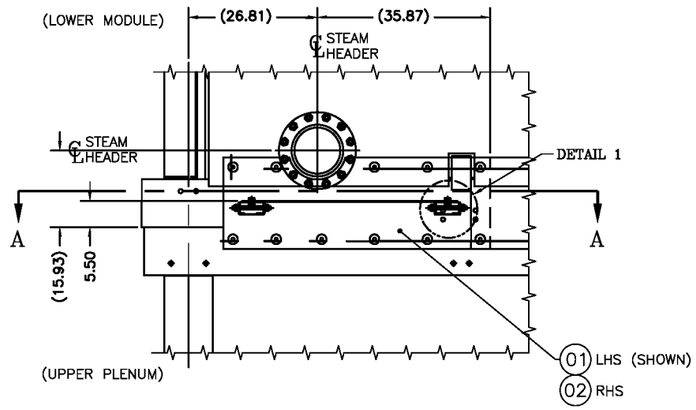
UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES
TOLERANCE UNLESS NOTED
1 PLACE DECIMALS ± 0.125"
2 PLACE DECIMALS ± 0.060"
3 PLACE DECIMALS ± 0.030"
ANGULAR ± 0.5°

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SLCI CONTRACT NO.:	0689	
CONTRACT NUMBER:	51041	
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT	
PROJECT LOCATION:	ANCHORAGE, ALASKA	

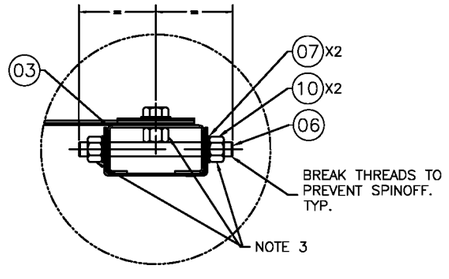
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE





HEADER SHIELD ASSEMBLY

261717
(UPPER PLENUM AND LOWER MODULE
RHS WALLS REMOVED FOR CLARITY)



SECTION A–A

DETAIL 1

TYP 4 PLACES
(SCALE 1:4)

NOTES:

1. APPLY ANTI–SEIZE TO ALL THREADED FASTENERS.
2. ERECTORS TO REMOVE SHIPPING BEAMS PRIOR TO HEADER SHIELD INSTALLATION.
3. ERECTORS TO TIGHTEN ALL NUTS UNTIL SNUG, BACK OFF 1/4 TURN, AND THEN BREAK THREAD.
4. TRIAL ASSEMBLY REQUIRED BEFORE SHIPPING.

28	EA	10	300303	HEAVY HEX NUT	HVY. HEX NUT 0.75–10UNC–2B	SA194 GR.8M MIN. 0.04% C	
20	EA	09	180270–39	WASHER	SHEET 11 GA. X 4.00 X 4.00	SA240 316	
20	EA	08	300543	HEAVY HEX BOLT	HVY. HEX BOLT 0.75–10UNC–2A x 1.25 LG	SA193 B8M MIN. 0.04% C	
8	EA	07	300032	WASHER	WASHER 0.75 NOM. CIRCULAR	18–8SS	
4	EA	06	300544	STUD	STUD 0.75–10UNC–2A x 8.00 LG	SA193 B8M MIN. 0.04% C	
4	EA	05	261722	HDR SHIELD PANEL	SHEET 11 GA.		
1	EA	04	261721	HDR SHIELD PANEL	SHEET 11 GA.		
2	EA	03	140096–03	SUPPORT CHANNEL	SHEET 11 GA.		
1	EA	02	261720	PANEL ASSEMBLY	ENDSEAL PANEL ASSEMBLY		
1	EA	01	261718	PANEL ASSEMBLY	ENDSEAL PANEL ASSEMBLY		
QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE

BILL OF MATERIAL AND PARTS LIST

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN INCHES
METRIC LINEAR TOL+/– 1.5mm
TOL ON 1 PLACE DECIMALS +/– 0.120"
TOL ON 2 PLACE DECIMALS +/– 0.060"
TOL ON 3 PLACE DECIMALS +/– 0.030"
ANGULAR TOLERANCE +/– 0.5°

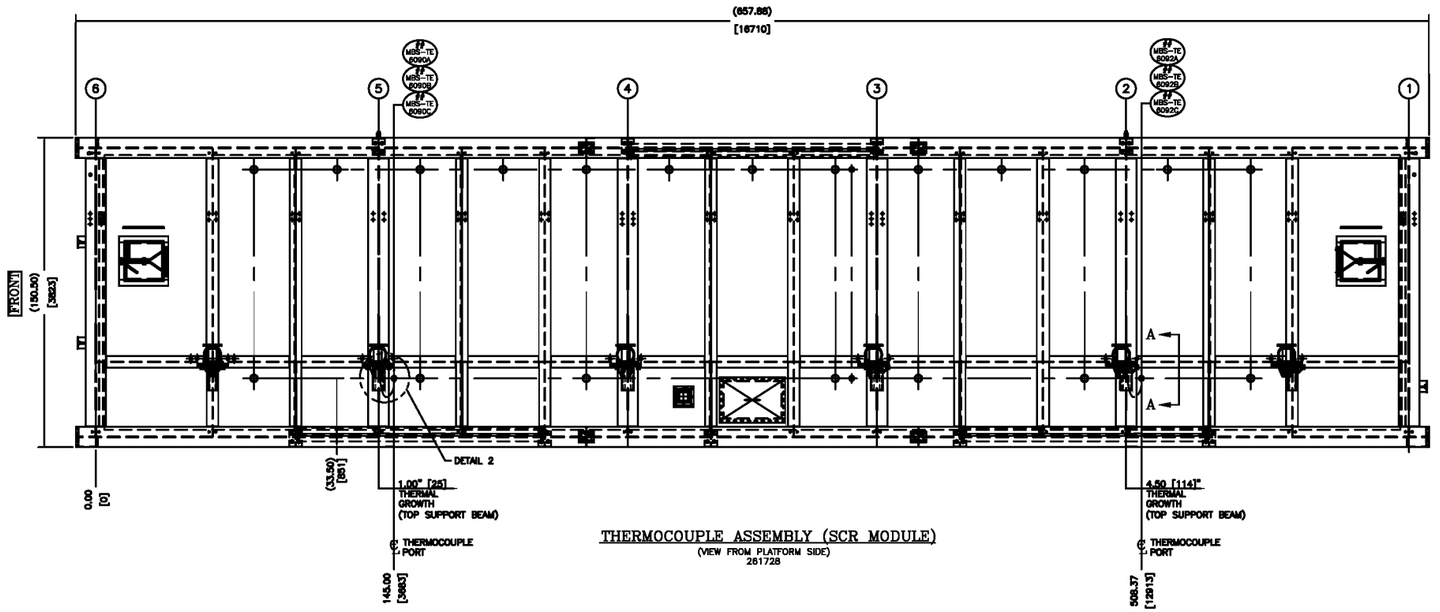
THIRD ANGLE PROJECTION

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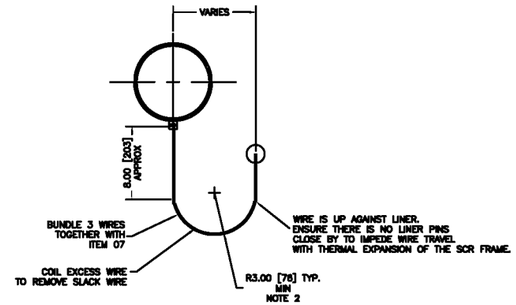
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QUALITY N/A	DATE: N/A	CUSTOMER: CHUGACH ELECTRIC ASSOCIATION INC. SOUTHCENTRAL POWER PROJECT	
MFG. M.HUNTER	DATE: 03/02/2011		
PROJ.ENG. N/A	DATE: N/A	TITLE: HEADER SHIELD KIT ARRANGEMENT	
CHK. J.HUNTER	DATE: 03/02/2011		
DRN. R.GU	DATE: 03/02/2011		
N.H.A. 261508	EQUIP.MODEL LM6000PF	PROJ.NO. C10082	DWG. NO. 261717 SIZE D REV. 00
CADDS I.D. P:\C10082\261717		SCALE: 1 : 16	SHEET NO. 01 OF 01

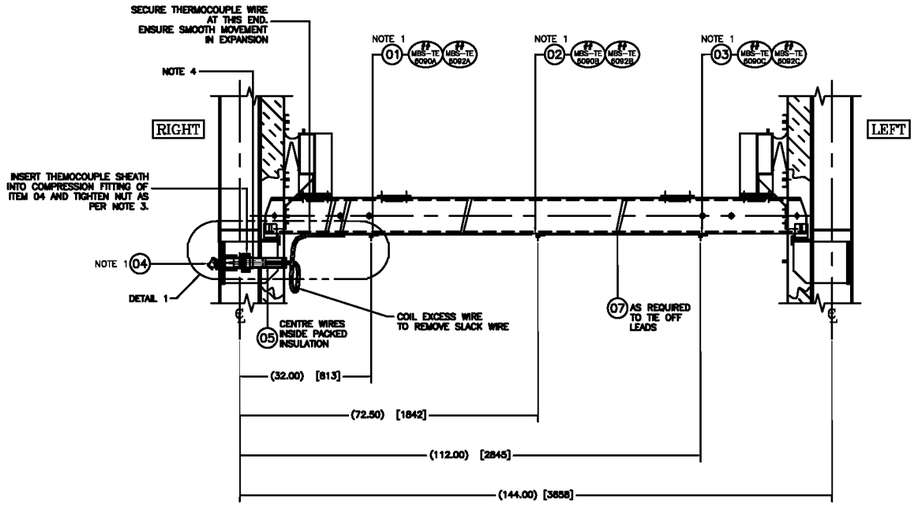
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



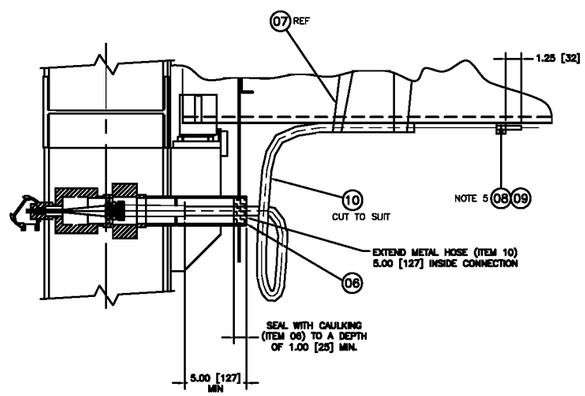
THERMOCOUPLE ASSEMBLY (SCR MODULE)
(VIEW FROM PLATFORM SIDE)
261728



DETAIL –2
TYP. 2 PLCS
SCALE: NTS



SECTION A–A
(TYP 2 LOC'NS)
SCALE: 1:12



DETAIL –1
TYP
SCALE: 1:4

NOTES

1. EACH T/C IS TO BE IDENTIFIED WITH 316 SS TAG# WIRED (ITEM 07) TO T/C HOT END. ERECTOR TO ATTACH WEATHER RESISTANT TAGS TO T/C COLD END INSIDE THERMOCOUPLE HEAD (ITEM 04). (TAGS SUPPLIED BY ERECTOR)
2. MINIMUM BEND RADIUS OF ITEMS 01, 02 & 03 IS 3.00 [76]. DO NOT KINK WIRES.
3. INSTALL THERMOCOUPLE END INTO COMPRESSION FITTING AND TIGHTEN NUT UNTIL THERMOCOUPLE END CAN NOT BE MOVED BY HAND. FURTHER TIGHTEN NUT WITH TOOL 1 1/4 TURNS.
4. APPLY HIGH TEMPERATURE SEALANT TO JOINT OF CASING PIPE NIPPLE AND ITEM 04. (BY OTHERS)
5. APPLY HIGH TEMPERATURE ANTI SEIZE AT THE THREADED FASTENER. (BY OTHERS)
6. INSTALLATION OF THERMOCOUPLES ONLY TAKES PLACE AFTER MODULE PLACEMENT AND THE REMOVAL OF SHIPPING BEAMS.
7. ALL PRIMARY DIMENSIONS ARE IN INCHES. ALL SECONDARY DIMENSIONS ARE IN mm.

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
8	FT	10	900247	FLEXIBLE METAL HOSE	METAL HOSE 3/4" I.D. x 0.011" THK x AS NOTED	316 SS	
7	EA	09	300254	HEX JAM NUT	HEX JAM NUT .25–20UNC–2B	316 SS (MIN. 0.04% C)	
7	EA	08	300312	HEX BOLT	HEX BOLT .25 –20UNC–2A X .88 LG.	316 SS (MIN. 0.04% C)	
30	FT	07	900174	WIRE	WIRE 20 GA.	316 SS	
1	TUBE	06	900072	CAULKING	FIBREFRAX CAULKING TUBE		
0.5	FT³	05	900259	INSULATION	6# DENSITY PER ES–026	SOLUBLE FIBER	
2	EA	04	140678–200	THERM. HEAD	THERMOCOUPLE HEAD CONNECTION ASSY.		
2	EA	03	261000–134	THERMOCOUPLE	TYPE "K" "L" = 150.00 S/S + 12.00" EXT. WIRE	NOTE 1	
2	EA	02	261000–133	THERMOCOUPLE	TYPE "K" "L" = 107.00 S/S + 12.00" EXT. WIRE	NOTE 1	
2	EA	01	261000–132	THERMOCOUPLE	TYPE "K" "L" = 63.80 S/S + 12.00" EXT. WIRE	NOTE 1	

BILL OF MATERIAL AND PARTS LIST

SLCI CONTRACT NO.:	0689
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN [mm]
MICRO LIGHT TOL +/– N/A
FRACTIONAL TOLERANCE +/– 1/64
ANGULAR TOLERANCE +/– 0.5°

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THIRD ANGLE PROJECTION

IST

DRAWN N/A
CHK'D N/A
APPR. 03/02/2011
MANUFACTURING 03/01/2011
QUALITY 03/01/2011
ENGINEERING 03/02/2011
N/A
261067
LM8000PF
PROJECT C100282

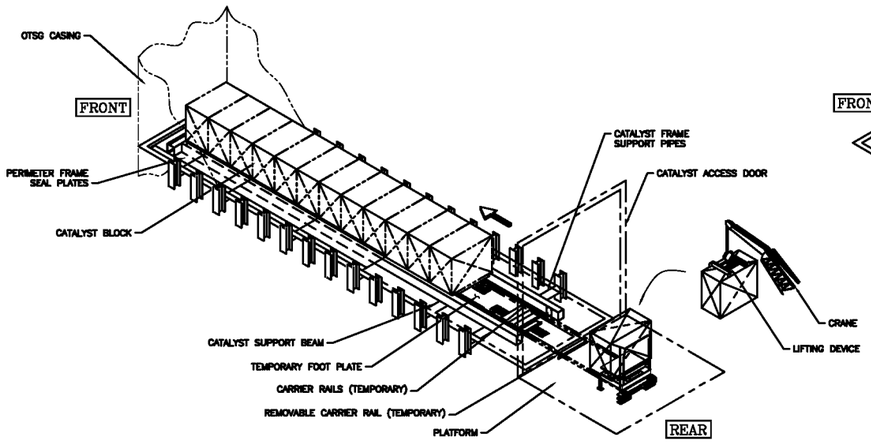
CUSTOMER
CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PLANT

TITLE
SCR MODULE THERMOCOUPLE, FIELD ARRANGEMENT/ASSEMBLY

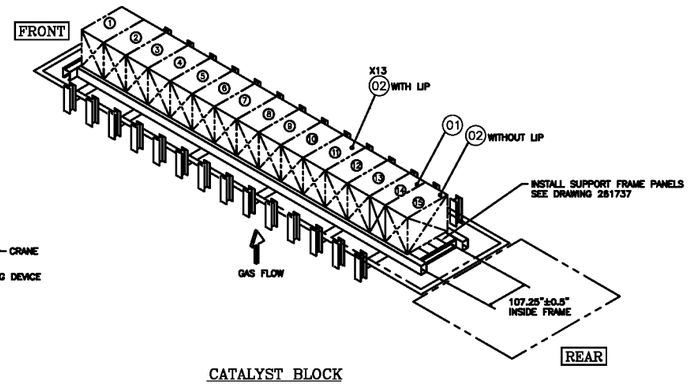
DWG. NO. 261728
SIZE E
REV. 00
SCALE 1:24
SHEET 01 OF 01

DWG LOC. P:\C100282\261728

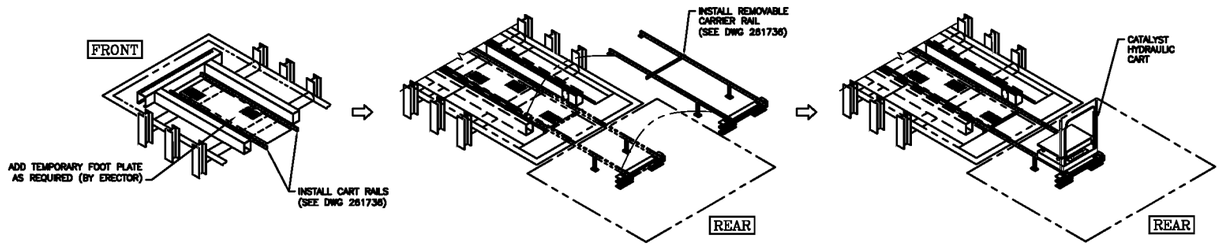
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



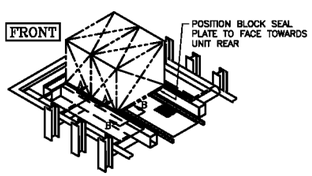
CATALYST CARRIER



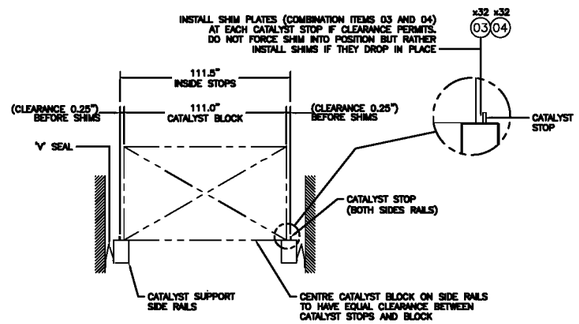
CATALYST BLOCK LOADING SEQUENCE



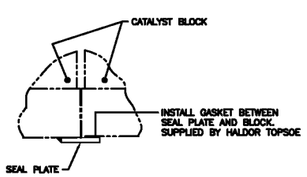
PREPARATION SEQUENCE



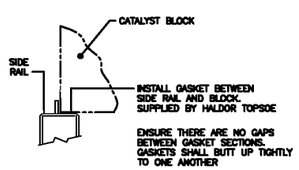
CATALYST BLOCK POSITIONING AND GASKET INSTALLATION



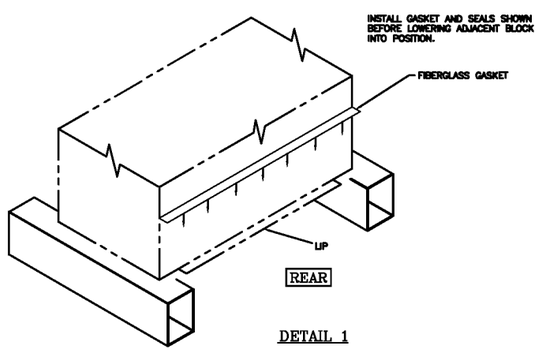
GAP BETWEEN CATALYST BLOCK AND SIDE RAIL STOPS AND SHIM INSTALLATION



VIEW A–A



VIEW B–B



DETAIL 1

CATALYST LOADING PROCEDURE

PREPARATION

1. REMOVE THE GAS SEALING PLATES BETWEEN THE SCR FRAME AND THE REAR WALL INTERNAL LINER.
2. REMOVE THE CATALYST LOADING DOORS LOCATED AT THE REAR END OF THE OTSG.
3. REMOVE THE SCR FRAME REAR CROSS CHANNEL ASSEMBLY.
4. INSTALL THE CART RAILS ACCORDING TO DRAWING 261736 WHICH WILL BE USED TO TRANSPORT THE CATALYST INTO THE UNIT.
5. POSITION THE CATALYST CART ONTO THE CART RAILS.
6. ADD ANY NECESSARY WOOD FOOTING UNDERNEATH THE SCR FRAME TO ALLOW PERSONNEL TO WALK DURING INSTALLATION.

CATALYST INSTALLATION SEQUENCE

1. LIFT THE CATALYST BLOCKS USING THE SUPPLIED LIFTING DEVICES AND PLACE ON THE CARRIER CART. TAKE SPECIAL CARE TO PROPERLY POSITION THE BLOCK ON THE CART AS IT WILL BE DIFFICULT TO MAKE ADJUSTMENTS INSIDE THE UNIT. REMOVE THE LIFTING DEVICE. ENSURE THE BLOCK SEALING LIP FACES TOWARDS THE REAR OF THE UNIT.
2. USING THE HYDRAULIC HANDLE ON THE CART, LIFT THE CART PLATFORM SO THAT THE CATALYST WILL CLEAR THE CATALYST SUPPORT SIDE RAILS.
3. PUSH THE CART/CATALYST BLOCK INTO THE UNIT AND POSITION ON THE FRAME AS INDICATED IN THIS DRAWING. LOWER THE CATALYST ONTO THE FRAME BY RELEASING THE HYDRAULIC PUMP. ENSURE THE SPACE DISTANCE BETWEEN BLOCKS IS MAINTAINED AS INDICATED IN THIS DRAWING.
4. PULL BACK THE CATALYST CARRIER TO THE OUTSIDE PLATFORM TO REPEAT THE PROCESS FOR THE OTHER BLOCKS. REPEAT PROCEDURES 1 TO 4 FOR THE REMAINING BLOCKS.
5. ONCE ALL THE CATALYST HAS BEEN LOADED, REMOVE THE TEMPORARY FOOT PLATES AND REMOVE ALL CART RAILS. REINSTALL THE SCR FRAME END CHANNEL ASSEMBLY, DOORS AND INTERNAL SEAL PLATES. A SPECIAL SCR FRAME CLOSURE ASSEMBLY WILL NEED TO BE INSTALLED. SEE DRAWING 261737.
6. CHECK FOR GAS LEAKAGE AT THE DOOR DURING OPERATION, AND TIGHTEN THE DOOR BOLTS TO REMOVE ANY LEAKAGE. IT MAY BE REQUIRED TO PERFORM A SEAL WELD AROUND THE PERIMETER OF THE DOOR SECTIONS IF A LEAK CANNOT BE STOPPED.

NOTES

1. EACH CATALYST BLOCK (EXCEPT ITEM 02) HAS A SEAL PLATE AT THE BOTTOM EDGE OF THE CATALYST BLOCK FRAME (ONE SIDE ONLY).
2. BLOCKS ARE TO BE INSTALLED WITH THE LIPS FACING THE REAR END (LOADING DOOR OPENING)
3. ENSURE THE BLOCKS ARE INSTALLED IN THE SEQUENCE SHOWN IN THIS DRAWING.

SLCI CONTRACT NO.:	0689						
CONTRACT NUMBER:	51041						
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT						
PROJECT LOCATION:	ANCHORAGE, ALASKA						

QTY.	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
32	EA	04	261734-02	SHIM	PLATE 0.19 x 1.50 x 10.00	A240 304	
32	EA	03	261734-01	SHIM	SHEET 11 GA x 1.50 x 10.00	A240 S40830	
14	EA	02	DWG-10-6037-02	CATALYST	CATALYST BLOCK 111" LG x 47.6" H x 37.3"W		
1	EA	01	DWG-10-6037-01	CATALYST	CATALYST BLOCK 111" LG x 47.6" H x 19"W		
-100		ASSY			BILL OF MATERIAL AND PARTS LIST		

UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN MILLIMETERS
MACHINED SURFACE "M.S." 1 DECIMAL
TOL. ON 1 PLACE DECIMALS +/- 0.100"
TOL. ON 2 PLACE DECIMALS +/- 0.050"
TOL. ON 3 PLACE DECIMALS +/- 0.010"
ANGULAR TOLERANCE +/- 0.5°

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QUALITY: N/A
DESIGN: N/A
CHECKED: M. HUNTER 04/05/12
PROJ. ENGR.: K. THOMPSON 04/05/12
DRAWN: M. HUNTER 04/05/12
CHK'D: M. HUNTER 04/05/12
S&L JOB NO. 251027
DRAWING NUMBER: LM0006FF
PREPARED: C10GEE

CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT

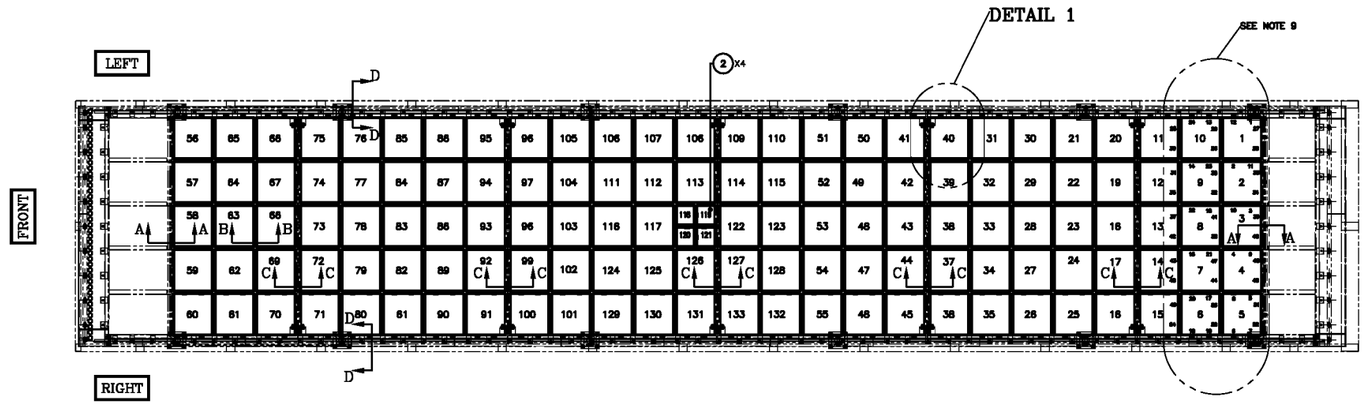
TITLE: SCR CATALYST LOADING ARRANGEMENT

DWG. NO. 261734
REV. E
SHEET NO. 01 OF 01
SCALE: N.T.S.

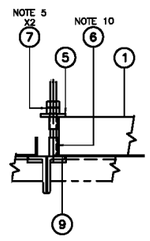
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LST

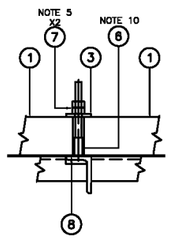
REVISIONS					
REV	ECR	DESCRIPTION	BY	APP	DATE



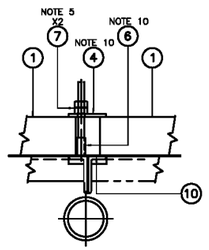
CO CATALYST INSTALLATION
261735



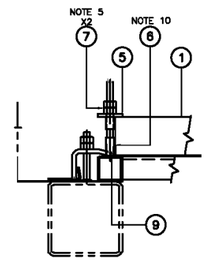
SECTION A–A
N.T.S.
TYP
(PERIMETER–END)



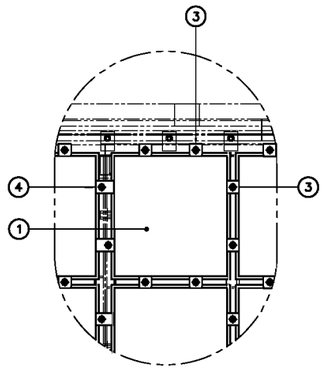
SECTION B–B
N.T.S.
TYP



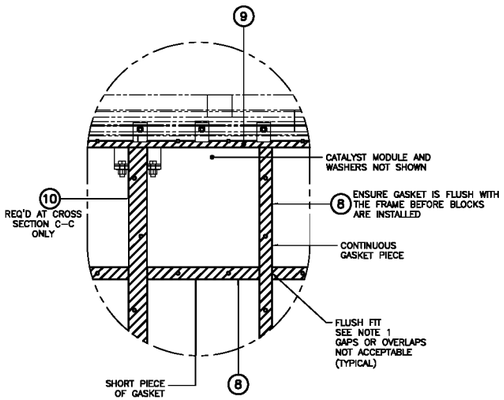
SECTION C–C
N.T.S.
TYP
(5 PLACES)



SECTION D–D
N.T.S.
TYP
(PERIMETER–SIDES)



DETAIL 1
SCALE 1 : 8
TYP.



DETAIL 1
GASKET INSTALLATION
SCALE 1 : 8
TYP.

CATALYST FIELD INSTALLATION NOTES:

1. BEGINNING AT THE REAR–LEFT SIDE, APPLY GASKET TO SHORT MEMBERS OF THE FRAME GRID, SLIDING THE CENTER–SLOTTED MATERIAL OVER THE WELD STUDS. AFTER TWO SHORT GRID MEMBERS HAVE BEEN COVERED, CUT AND APPLY GASKET TO ADJOINING CROSS MEMBERS, MAKING SURE THAT GASKETS DO NOT OVERLAP AND NO GAPS ARE LEFT BETWEEN THE GASKETS.
2. AFTER GASKET IS INSTALLED, SLIDE ONE SPACER ITEM 6 OVER EACH STUD.
3. INSTALL CATALYST MODULE BETWEEN SPACERS AND AGAINST GASKET.
4. AFTER TWO ADJOINING CATALYST MODULES ARE INSTALLED, ASSEMBLE ONE CATALYST HOLD DOWN CLIP OVER STUD AND SECURE WITH TWO HEX NUT.
5. FIRST NUT SHOULD BE TORQUED TO 10 ft/lbs FOR PERIMETER STUDS AND 20 ft/lbs FOR INTERIOR STUDS. LOCK WITH SECOND NUT.
8. CATALYST INSTALLATION SHOULD PROCEED PER THE NUMBERED SEQUENCE ABOVE. TO AVOID DAMAGING OR MARRING THE CATALYST FACE, DO NOT STAND ON OR SIT ITEMS ON CATALYST FACE.
7. REFER TO **EMERACHEM** OPERATION AND MAINTENANCE MANUAL FOR CATALYST DETAILS.
8. ITEMS 1 & 2 SUPPLIED BY **EMERACHEM**.
9. REFER TO ABOVE PLAN VIEW FOR TYPICAL TORQUING SEQUENCE. (REDUCED AS SHOWN)
10. IN THE EVENT CATALYST MODULES CANNOT FIT BETWEEN SPACERS (ITEM 6), ERECTOR MAY LEAVE OUT A MINIMUM QUANTITY OF SPACERS (ITEM 6) AND STILL ENSURE A RELATIVELY TIGHT FIT OF MODULES.

NOTE: ITEMS 3 THRU 10 QUANTITIES INCLUDE 10% EXTRA

QTY	U/M	ITEM	PART NO.	PART NAME	DESCRIPTION	MATERIAL	ZONE
48	LF	10	900888	FIBREGLASS GASKET	GASKET, 4.25" W, SPONGE SHOP STRIP 1/8" THK	NONE REQD.	
116	LF	9	900887	FIBREGLASS GASKET	GASKET, 3.25" W, SPONGE SHOP STRIP 1/8" THK	NONE REQD.	
369	LF	8	900886	FIBREGLASS GASKET	GASKET, 2.25" W, SPONGE SHOP STRIP 1/8" THK	NONE REQD.	
1269	EA	7	300949	HVY HEX NUT	HVY HEX NUT .50–13UNC–2B	A194 GR8M	
645	EA	6	900889–6928	PIPE	3/8 NPS SCH 10S x 1.50" LG	A312 TP316	
136	EA	5	261744	WASHER ASSEMBLY	WASHER TUBE ASSEMBLY		
55	EA	4	261745	WASHER	PLATE .25		
453	EA	3	261742	WASHER	PLATE .25		
4	EA	2	261000–304	TEST CATALYST MODULE	9 1/4" x 9 7/8" x 3 1/8" MODULE	CO CATALYST	
130	EA	1	261000–304	CATALYST MODULE	19 1/4" x 39 1/2" x 3 1/8" MODULE	CO CATALYST	

BILL OF MATERIAL AND PARTS LIST

SLCI CONTRACT NO.:	0669
CONTRACT NUMBER:	51041
PROJECT NAME:	SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION:	ANCHORAGE, ALASKA

TOLERANCES UNLESS OTHERWISE SPECIFIED: LINEAR DIMENSIONS ARE IN INCHES. METRIC LINEAR DIM. ±1mm. DECIMAL 2 PLACES ±0.01, 3 PLACES ±0.005, 4 PLACES ±0.0005. ANGULAR TOLERANCE +/– 0.5°

THIRD ANGLE PROJECTION

THIS IS A REPRESENTATION, ERRORS OF OMISSION OR COMMISSION IS THE RESPONSIBILITY OF THE USER. ALL USE OF THIS DRAWING IS AT THE USER'S OWN RISK. ALL RIGHTS RESERVED. NO PART OF THIS DRAWING MAY BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC, MECHANICAL, PHOTOCOPYING, RECORDING, OR OTHERWISE, WITHOUT THE PRIOR WRITTEN PERMISSION OF LST SYSTEMS, INC.

LST

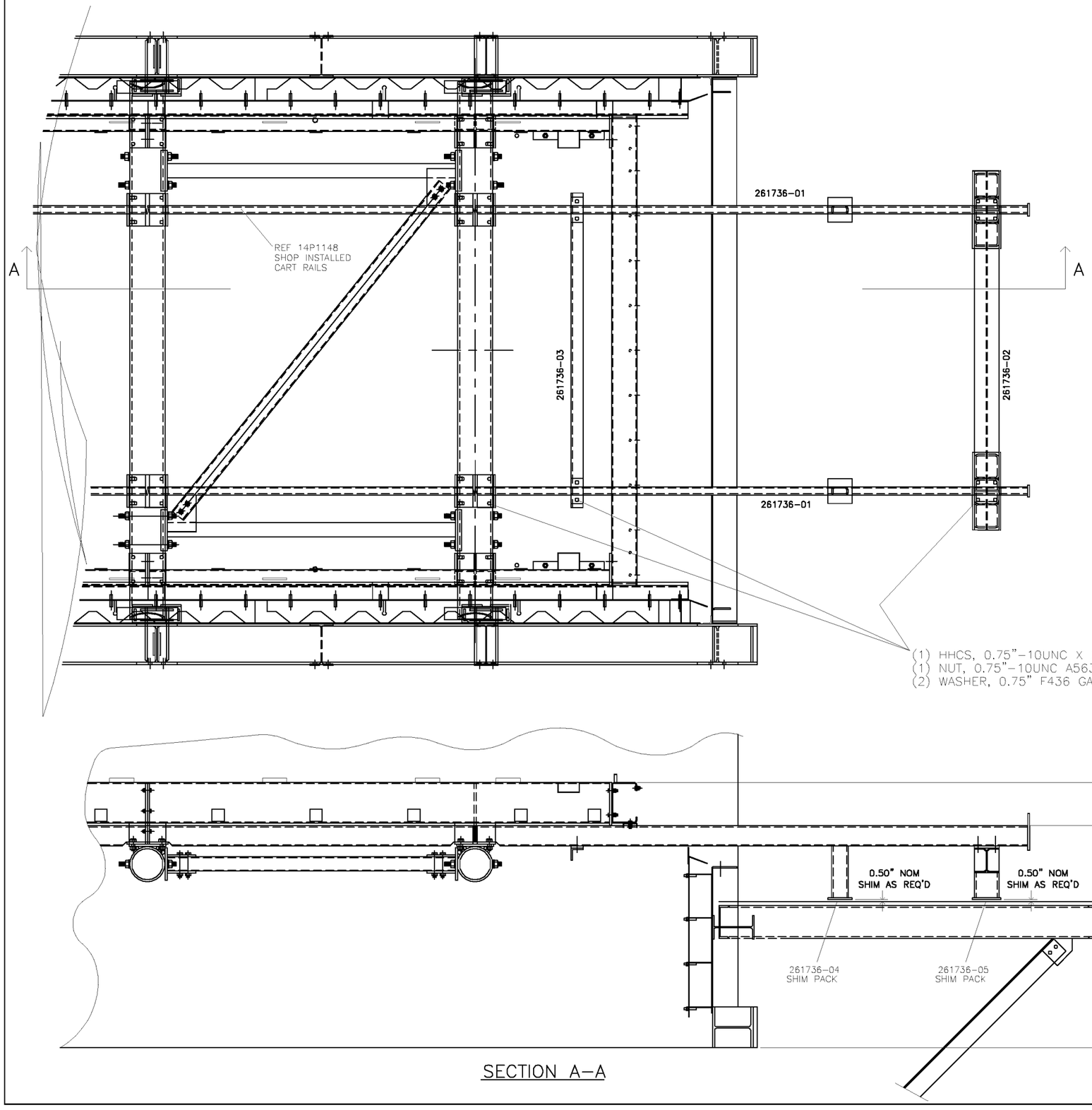
DRAWN: N/A
DES: N. HUNTER 03/07/12
ENGR'G: A. YUNG 03/07/12
APP: J. HUNTER 03/17/11
QA: J. HUNTER 03/07/12
M.F.G. 261027
ENGR'G/MFG: LM6000PF
PROJ.NO.: 0100882

CHUGACH ELECTRIC ASSOCIATION INC.
SOUTHCENTRAL POWER PROJECT

TITLE: CO CATALYST INSTALLATION

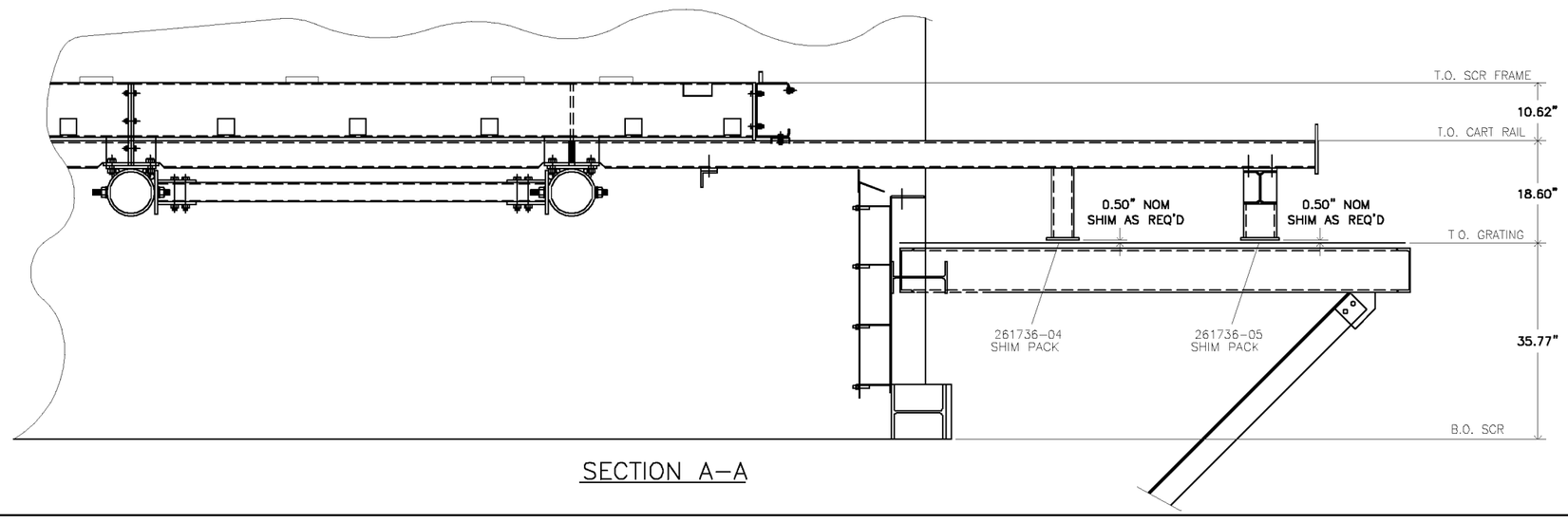
DWG. NO. 261735 REV E REL. 00
SCALE: 1 : 24 SHEET NO. 01 OF 01

DRWG LOC. P:\A\100882\261735



THESE PARTS SHIP LOOSE
QUANTITIES SHOWN IN BOM ARE FOR (1) SYSTEM
(3) SYSTEMS TOTAL REQ'D

PART NO.	QTY	DESCRIPTION
261736-01	2	CART RAIL EXTENSION
261736-02	1	CART RAIL EXTENSION SUPPORT
261736-03	1	CART RAIL EXTENSION ANGLE BRACE
261736-04	2	SHIM SET
261736-05	2	SHIM SET
	18	HHCS, 0.75"-10UNC X 2.25" A325 GALV
	18	NUT, 0.75"-10UNC A563 GALV
	36	WASHER, 0.75" F436 GALV



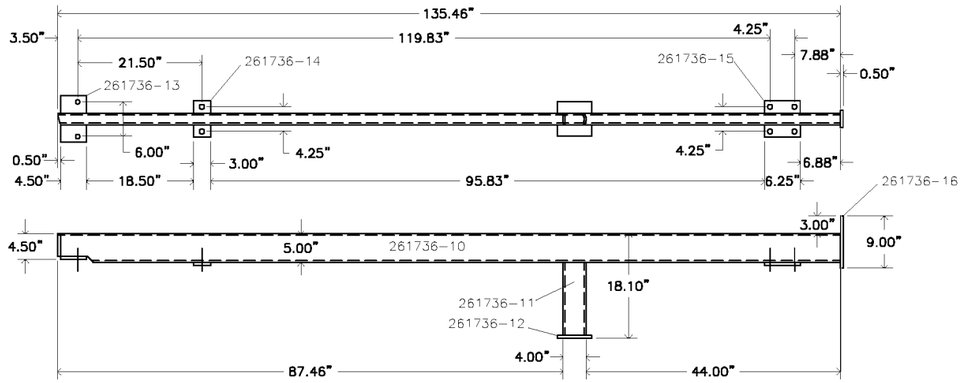
SECTION A-A

REV	DESCRIPTION	BY	DATE

NOTES:

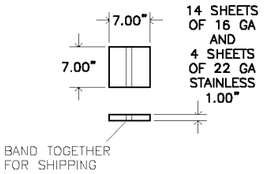
SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

1=32 PLOT SCALE	MEDFORD FABRICATION	
3/8"=1' DRAWING SCALE		
CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
DRAFTER	CART RAIL EXTENSION GROUP FIELD INSTALLED ITEMS	
10 MAR 11 DATE		
P.O. NUMBER	261736 DRAWING NO.	1 SHEET / REV.



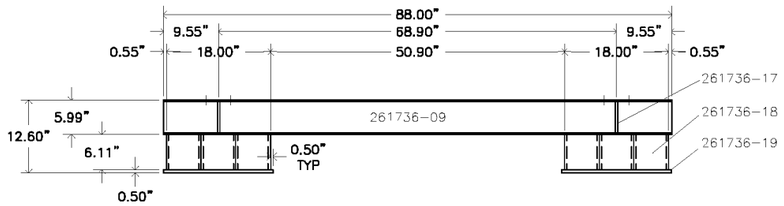
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(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL
PAINT YELLOW
SHIP LOOSE



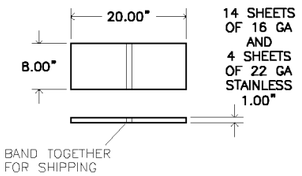
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(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL
PAINT YELLOW
SHIP LOOSE



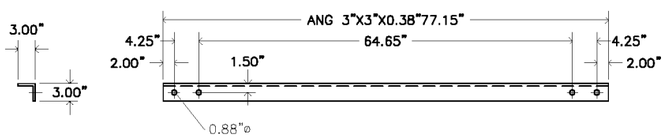
261736-02

(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL
PAINT YELLOW
SHIP LOOSE



261736-05

(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL
PAINT YELLOW
SHIP LOOSE



261736-03

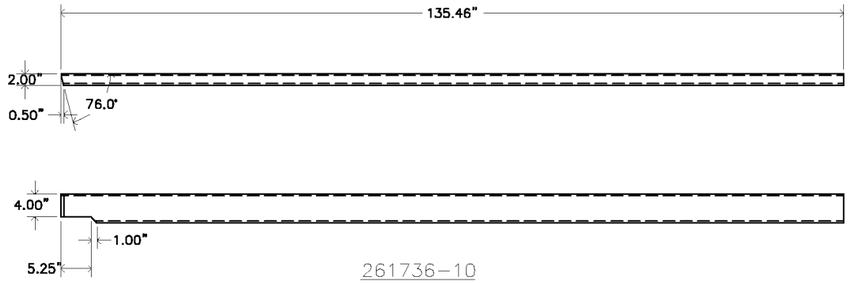
(1) REQ'D PER SYSTEM
(3) REQ'D TOTAL
PAINT YELLOW
SHIP LOOSE

REV	DESCRIPTION	BY	DATE

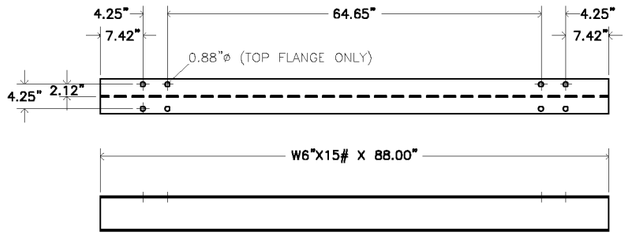
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SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

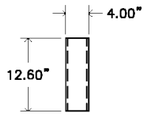
1=24 PLOT SCALE	MEDFORD FABRICATION
1/2"=1' DRAWING SCALE	
CHECKED	INNOVATIVE STEAM TECH CUSTOMER / CHUGACH, ANCHORAGE AK JOB
DRAFTER	CART RAIL EXTENSION GROUP FIELD INSTALLED ITEMS
10 MAR 11 DATE	
P.O. NUMBER	261736 DRAWING NO. / 2 SHEET / △ REV.



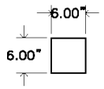
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(6) REQ'D TOTAL



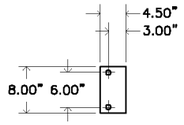
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(6) REQ'D TOTAL



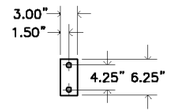
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(6) REQ'D TOTAL



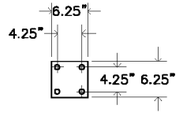
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PL 0.50" ASTM A36
(40 KSI MIN) CERTS REQ'D
ESAB 261736-12
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



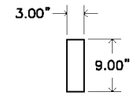
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(40 KSI MIN) CERTS REQ'D
ESAB 14P1148-15
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



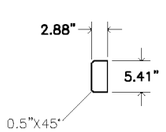
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(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



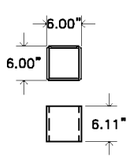
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(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



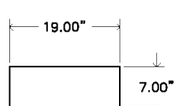
261736-16
PL 0.50" ASTM A36
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ESAB 261736-16
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL



261736-17
PL 0.38" ASTM A36
(40 KSI MIN) CERTS REQ'D
ESAB 261736-17
(4) REQ'D PER SYSTEM
(12) REQ'D TOTAL



261736-18
TB 6"X6"X0.25" A500 GR B
(6) REQ'D PER SYSTEM
(18) REQ'D TOTAL



261736-19
PL 0.50" ASTM A36
(40 KSI MIN) CERTS REQ'D
ESAB 261736-19
(2) REQ'D PER SYSTEM
(6) REQ'D TOTAL

REV	DESCRIPTION	BY	DATE

NOTES:

SLCI CONTRACT NO.: 0689
CONTRACT NO.: 51041
PROJECT NAME: SOUTHCENTRAL POWER PROJECT
PROJECT LOCATION: ANCHORAGE, ALASKA

1=24 PLOT SCALE	MEDFORD FABRICATION	
1/2"=1' DRAWING SCALE		
CHECKED	INNOVATIVE STEAM TECH CUSTOMER	CHUGACH, ANCHORAGE AK JOB
DRAFTER	CART RAIL EXTENSION GROUP FIELD INSTALLED ITEMS	
10 MAR 11 DATE		
P.O. NUMBER	261736 DRAWING NO.	3 SHEET / REV.

Estimated Average Engine Performance NOT FOR GUARANTEE

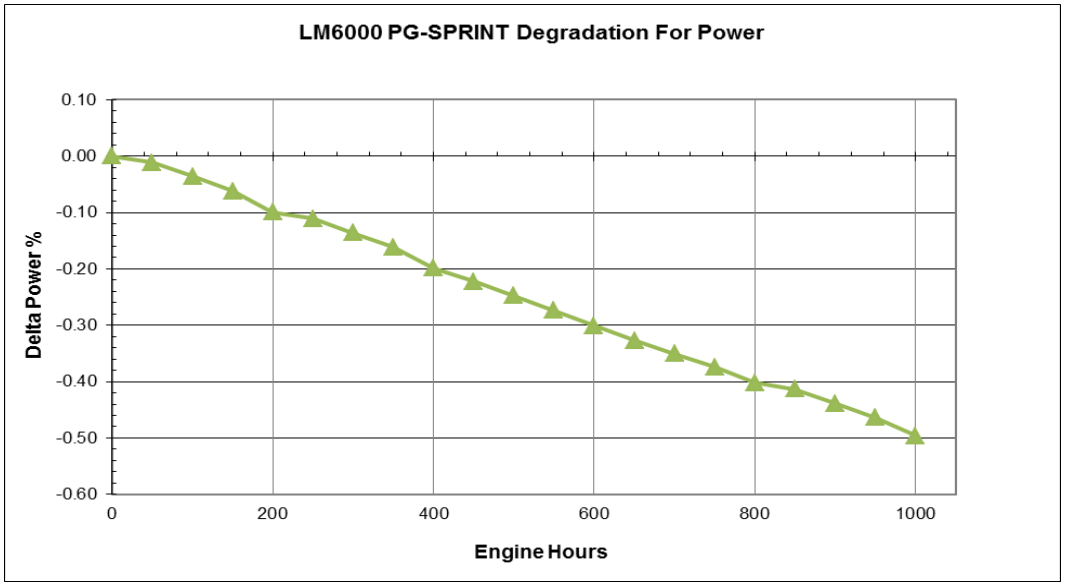
GE Energy

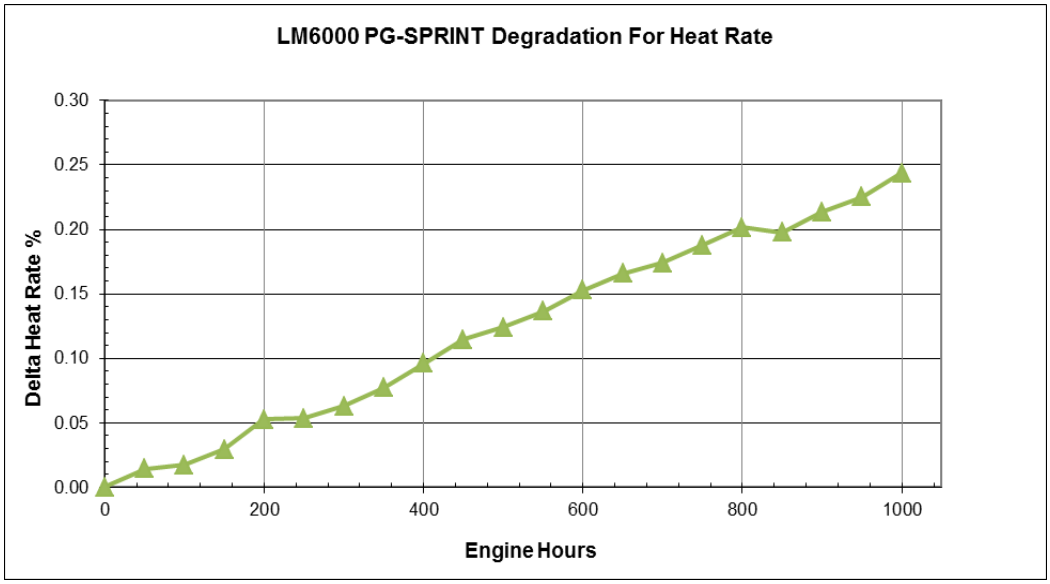
Performance By:
See Also:

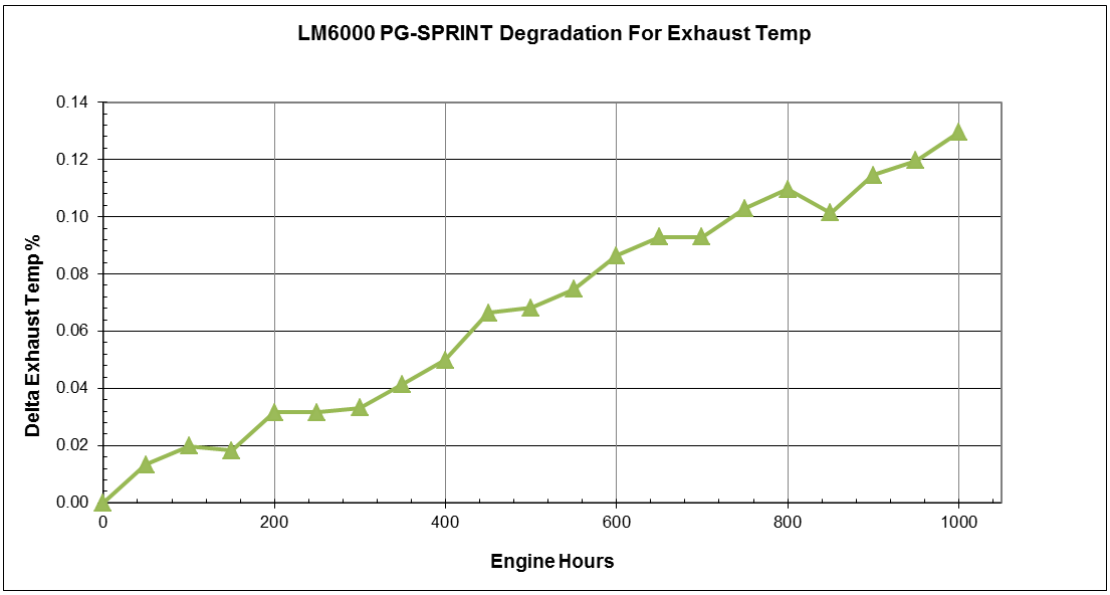
Engine: **LM6000 PG-SPRINT w/ VIGV**
Deck Info:
Generator: **BDAX 290ERT 60Hz, 13.8kV, 0.85PF (14839)**
Fuel: **Site Gas Fuel#900-3364, 20030 Btu/lb,LHV**

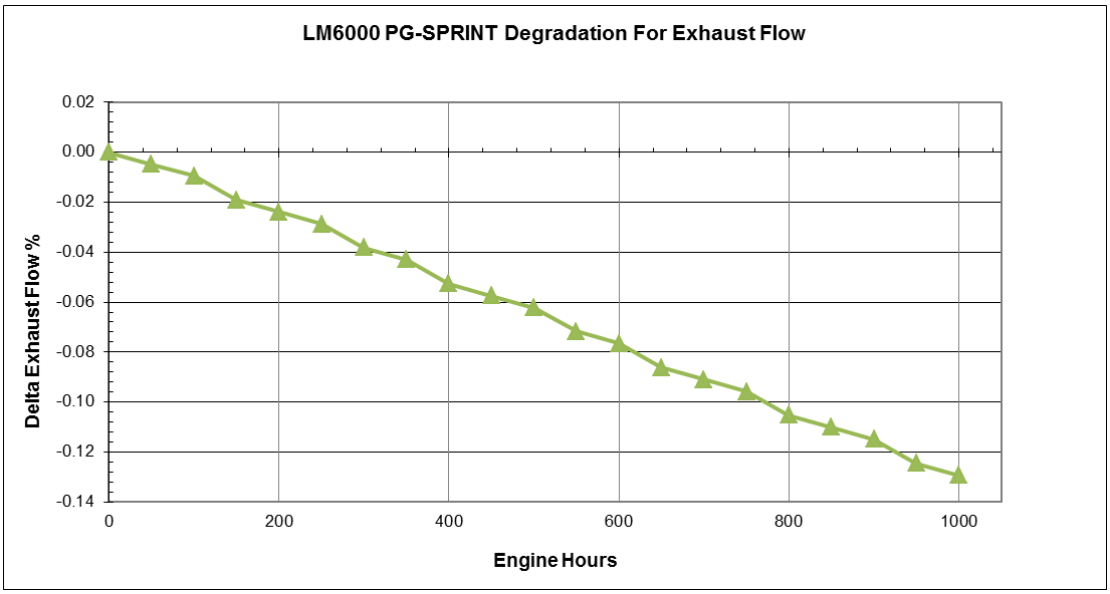
Date: **2/1/2013**
Time: **4:29:16 PM**
Version: **3.9.6b**

This Deterioration model was generated using the following parameters:
Ambient Temp of 59.0°F, 60.0% RH, 751.0ft., Inlet Temp of 48.0°F, 5.00 Inlet Loss, 14.00 Exhaust Loss and Water Injected to 25ppm.






LM6000 PG-SPRINT Degradation For Exhaust Temp
Delta Exhaust Temp %
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
200
400
600
800
1000
Engine Hours


LM6000 PG-SPRINT Degradation For Exhaust Flow
Delta Exhaust Flow %
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0
200
400
600
800
1000
Engine Hours

Performance Guarantees

6.1 Introduction

This Guarantee contains the following:

- Net Plant Performance Guarantee for Combined-Cycle Operation
- Emissions Guarantees
- Noise Guarantees
- Operability Guarantees
- Revision Date: 10 September 2013

6.2 Performance Guarantee for Combined-Cycle Operation (1x160LM)

Operating Point	Fuel	Net Plant Output (kW)	Net Plant Heat Rate (BTU/kWh, HHV)	SCR Ammonia Consumption (lb/hr)	Gas Turbine Demineralized Water Consumption (lb/hr)
Case 1: Evaluation point 1: 67 MW, with Base Loaded Gas Turbine	Natural Gas	67,050	7,904	150	34,756
Case 2: Evaluation Point 2: 33 MW	Natural Gas	--	8,692	--	--

$$\textbf{Net Plant Heat Rate} = \frac{\textbf{Heat Consumption (BTU/h, HHV)}}{\textbf{Net Plant Electric Power Output (kW)}}$$

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CONFIDENTIAL INFORMATION

6.2.1 Basis for Combined-Cycle Performance Guarantee

The Combined-Cycle Plant performance guarantees listed above are based on the scope of equipment supply as defined in this specification and the Division of Responsibility, and are stated for the following operating conditions and cycle parameters.

A. Equipment is in a new and clean condition with less than 250 hours of operation. For hours exceeding this value, degradation corrections will be per degradation curve supplied by Contractor. The indicated fired hour exceeds what is specified in Contractor typical test procedure. Hence Contractor reserves the right to establish the cleanliness of the engine and perform corrective action if necessary before testing.

B. Gas turbine operating at stable, base load, steady-state conditions. Base load is defined as the gas turbine operating at maximum output of such unit when the unit is limited by turbine control limiters. The turbine control limiters are as follows:

   T48 = LPT inlet temperature

   T3 = HPC discharge temperature

   PS3 = HPC discharge pressure

   XN25R = HP rotor corrected speed

   Part load heat rate guarantees are based on the as-tested base load power levels.

C. Ambient air dry bulb temperature = 75°F.
   Ambient air relative humidity = 50 %

D. Barometric pressure = 14.3 psia.

E. Natural gas fuel is in compliance with General Electric Gas Fuel Specification MID-TD-000-1.

F. Natural gas composition:

Component	**Molar %**
Methane, CH_4	94.4
Ethane, C_2H_6	2.17
Propane, C_3H_8	0.13
Butane, C_4H_{10}	0.13
Pentane, C_5H_{12}	0.03
Hexane, C_6H_{14}	0.02
Carbon Dioxide, CO_2	1.7
Nitrogen, N_2	1.42
Max Total Sulfur	0.5 grains per 100 scf

Source of gas composition: REQUEST FOR PROPOSAL FOR DESIGN AND FURNISHING OF POWER ISLAND EQUIPMENT FOR THE GLENARM REPOWERING PROJECT, Section 480020, Page 6.

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G. Natural gas lower heating value (LHV) = 20,030 BTU/lb.

H. Natural gas ratio of HHV/LHV = 1.1086

I. City natural gas supplied to the fuel gas terminal point, located at the site boundary, at a pressure of 150 psig and a temperature of 77°F. If pressure reduction is necessary after the terminal point, then the fuel temperature will be measured after the pressure reduction. Any energy consumption associated with fuel preheating, required to maintain a minimum superheat in the fuel, is not included in this guarantee.

J. Natural gas performance is based on operation with a SAC combustion system with gas turbine diluent injection for NOx control. Nominal diluent injection rate per gas turbine is displayed on the guarantee heat balances. Performance guarantees will be subject to correction if it is necessary to increase or decrease diluent injection rate.

K. SPRINT system status = On for case 1, Off for case 2.

L. Gas turbine demineralized water consumption is based only upon diluent injection for NOx control and SPRINT system and does not include non-standard, intermittent, maintenance, testing, water wash, and other unusual operations.

M. Inlet air chiller status = On for case 1 to achieve net plant MW target, Off for case 2.

N. Inlet air heating system status = Off for case 1, On for case 2 to achieve net plant MW target.

O. Fuel gas compressor status = On.

P. Once through steam generator:

High pressure blowdown = 0%.

Inlet temperature to OTSG is uncontrolled.

Q. Ammonia consumption is based only upon SCR within the OTSG and testing shall be conducted on a one-hour average basis.

R. STG inlet valve VWO (valves wide open) will be no more than 95% of mechanical travel capability.

S. The equipment closed loop cooling water temperature is 10 degrees F higher than the condenser cooling water temperature

T. Generator terminal power factor = 0.85, lagging.

U. Generator terminal frequency = 60 Hz.

V. Electrical system losses beyond the high voltage side of the step-up transformer, other than those of the excitation system are not included.

W. Combined-Cycle performance is based on thermal cycle design and piping losses as defined in Contractor heat balances listed below. City allowance for piping and other equipment losses is provided between heat balance state points S1 to S2. The performance test procedure will adjust for losses, which exceed these values.

Case 1	HB # CCA-17604-NG, Revision 0	February 12, 2013
Case 2	HB # CCA-17605-NG, Revision 0	February 12, 2013

X. Tests to determine guaranteed performance shall be conducted in accordance with the mutually agreed upon test procedure.

6.3 Emission Guarantees

6.3.1 Combined-Cycle Emission Guarantees

Pollutant	Compressor Inlet Temperature Range	Gas Turbine Load	Gas Fuel	Emissions Value
NOx Emissions, ppmvd, Ref. 15 % O_2	20°F to 140°F	20 to 100 % of Base Load		2
CO Emissions, ppmvd, Ref. 15 % O_2	20°F to 100°F	20 to 100 % of Base Load		2
	100°F to 140°F	40 to 100 % of Base Load		2
VOC Emissions, ppmvd, Ref. 15 % O_2 as CH4	20°F to 140°F	20 to 100 % of Base Load		2
NH3 Emissions, ppmvd, Ref. 15 % O_2	20°F to 140°F	20 to 100 % of Base Load		5
PM-10, lb/hr	20°F to 140°F	Base Load		4

6.3.2 Emissions Guarantee Conditions

These emissions are based on the following conditions:

Emissions levels are based on control equipment as defined in the General Plant Description of this document.

General

A. Natural gas fuel shall be in compliance with General Electric Gas Fuel Specification MID-TD-000-1 latest revision.
B. Gas turbine diluent injection for NOx control must be operating.
C. Testing and system adjustments are conducted in accordance with GEK-28172,

Standard Field Testing Procedure for Emissions Compliance.

D. Gaseous emissions are typically on a one-hour average basis and particulates are on a three-hour average basis. Gas turbine operating at stable steady-state conditions.

E. Compressor inlet temperature range of 20°F to 140°F.

F. Contractor reserves the right to determine the emission rates on a net basis wherein emissions at the gas turbine inlet are subtracted from the measured exhaust emission rate if required to demonstrate guarantee rate.

G. Mass flow based emissions are reported on a per stack basis.

H. Emissions from sources other than the Gas Turbine and OTSG duct burner are not included.

I. Sulfur emissions are a function of the sulfur present in the incoming air and fuel flows. Since the gas turbine and OTSG have no influence on the sulfur, sulfur based emissions are not guaranteed.

Particulate Matter (PM)

A. PM-10 guarantee is based on a natural gas sulfur content of less than or equal to 0.5 grains/100 SCF.

B. PM-10 emissions include filterable and condensable emissions. The following additional criteria and precautions are required at this particulate guarantee level:

C. Contractor/City must mutually agree on the use of a PM testing firm that meets the specified qualification criteria.

D. PM Testing firm and laboratory must meet qualification criteria specified in GEK-28172.

E. Multiple re-testing (at City's expense) must be allowed, if required.

F. Allowance for background ambient particulate levels must be included.

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6.4 Noise Guarantees

6.4.1 Near Field Combined Cycle Noise Guarantees

Fuel	**Gas Turbine Load**	**SPL,** dBA
Natural Gas	Base	85 Average

The average sound pressure levels (SPL) (re: 20 micropascals) from the indoor and/or outdoor Contractor equipment defined in the scope of supply, shall not exceed the value stated above, when measured 1 m (3 ft) in the horizontal plane and at an elevation of 1.5 m (5 ft) above the gas turbine operating level, steam turbine operating level (if different), and generator operating level (if different) identified on the General Arrangement drawings. Walkways and/or platforms that are not easily accessible by stairs are excluded from the above guarantee.

Areas inside the steam turbine enclosure that are not considered accessible operator levels (i.e. ground level and mezzanine level) are exempt from the above guarantee.

Near field guarantees apply to areas along a Site specific Source Envelope(s), determined by a line established 1 meter (3 ft.) from the outermost surface of the equipment defined in the proposal scope of supply (including noise abatement equipment). Depending on the site arrangement and relationship of equipment locations, multiple source envelopes may be designated. (See sample figure 4.1 – 1 below)

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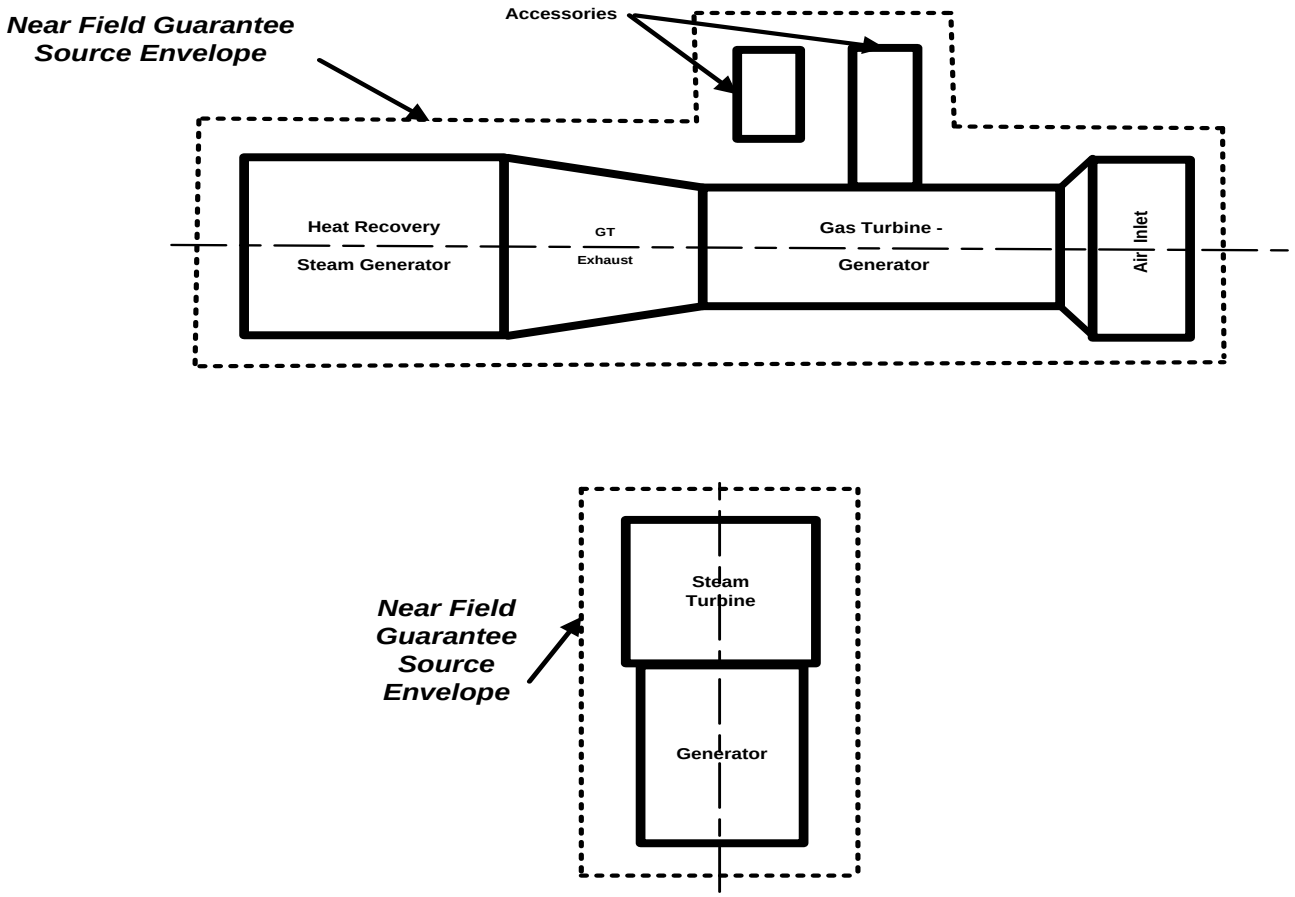


FIGURE 3.1-1- Multi-Shaft

For reference only

6.4.1.1 Basis for Near Field Noise Guarantees

A. The Contractor supplied equipment will be deemed compliant with the acoustic guarantee if the arithmetic average result from measurements taken as described in the conformed specifications, Section 4.2, after background noise corrections have been applied do not exceed the noise limit specified above. For cases where a noise abatement enclosure or wall(s) is included to meet the guaranteed sound pressure level in the near field, all measurements for compliance verification will be taken outside of the noise abatement enclosure or wall(s) in the near field.

B. Testing will be conducted in accordance with a project specific test plan agreed to by both the City and Contractor.

C. Equipment is operated in a new and clean condition when measurements are taken. All access compartments, doors, panels and other temporary openings are fully closed, all silencing hardware is fully installed and all systems designed to be airtight are sealed. Inspection of installation quality will be conducted prior to compliance testing. Identified defects must be corrected prior to compliance testing.

D. Corrections for background noise are to be made according to the conformed specifications, Section 4.7. Background noise is defined in the conformed specifications.

E. Measurements shall be taken as described in the conformed specifications, Section 4.2.

F. Responsibility for measurement and development of the project specific test plan will be stated in the contract.

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6.4.2 Far Field Combined Cycle Noise Guarantees

6.4.2.1 Contractor Submittal Forms

The southwest corner of the Glenarm Building has been selected as a common reference point within the plant from which the distance to each of the fourteen receptors shown on Exhibit "A" has been determined. The specific site conditions that exist at the fourteen receptor locations shall be considered a valid, inclusive part of the guaranteed noise levels and measurement results. The effects from terrain features, building structure attenuations and reflections, ground absorption and reflections, and other anomalies specific to the existing site conditions at each test site shall be considered a valid part of the test measurements and the Contractor's noise guarantee. Each of these effects are to be included in the guaranteed noise levels and measurement results. No additional corrections shall be permitted to normalize the results to a standardized "flat-world" test site, other than those listed below.

The other site conditions (not listed above) may have a significant effect on the measurement results and shall be corrected with appropriate post-measurement adjustments or avoided during the measurements. These site conditions include the following:

1. existing background noise from the power plant and/or community;
2. large reflective surfaces other than the ground surface that are closer than 50 feet to the measurement microphone at locations C01, C03, C04, C09, C11, C12, and C14;
3. large reflective surfaces other than the ground surface that are closer than 25 feet to the measurement microphone at locations C02, C05, C06, C07, C08, C10, and C13; and
4. atmospheric conditions such as temperature, wind, humidity, inversions layers and temperature lapses.

The above three site conditions shall not be included in the Contractor's guarantee or the measurement results if the effects are considered significant.

All test measurement results shall be rounded up or down to the nearest whole decibel value after all corrections are applied according to the procedures listed in the Conformed Specification. The resulting decibel level after rounding shall be used to determine compliance with the guaranteed noise levels at near-field (in plant) and far-field (community) locations. The guaranteed noise levels are shown on the following Submittal Forms:

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FORM A

START-UP NOISE GUARANTEES AT COMMUNITY LOCATIONS

Community Location No. (Ground Elev.)	Dist. To SW Corner of Glenarm Bldg. Ref. Point - Ground El. 752.0	① Maximum Allowed Power Island Start-Up Noise Level, L_{EQ} dBA*	② Guaranteed Power Island Start-Up Noise Level, L_{EQ} dBA	③ Amount Above (+) or Below (-) the Maximum Allowed Noise Level, dB ② minus ①⁂	④ Will Power Island Start-Up Noise Produce Audible Tones at This Location? (Y or N)	⑤ Meets Noise Spec Requirements at This Location?? (Y or N)
(Refer to Exhibit A)						
Example calculation point:		56	54	- 2	N	Y
C01 (753.9)	421 Ft.	57	57	0	N	Y
C02 (753.1)	263 Ft.	65	65	0	N	Y
C03 (754.0)	618 Ft.	67	67	0	N	Y
C04 (752.4)	277 Ft.	68	68	0	N	Y
C05 (752.3)	245 Ft.	67	67	0	N	Y
C06 (803.1)	588 Ft.	51	51	0	N	Y
C07 (786.9)	459 Ft.	58	58	0	N	Y
C08 (761.8)	350 Ft.	63	63	0	N	Y
C09 (756.5)	298 Ft.	67	67	0	N	Y
C10 (767.6)	459 Ft.	55	55	0	N	Y
C11 (764.2)	609 Ft.	63	63	0	N	Y
C12 (777.9)	740 Ft.	66	66	0	N	Y
C13 (826.7)	915 Ft.	57	57	0	N	Y
C14 (819.0)	1025 Ft.	54	54	0	N	Y

* The maximum allowed noise level is from the Power Island equipment alone with no contributions from the pre-existing plant noise, balance of plant equipment noise, or community background noise.

⁂ The amount above or below the maximum allowed noise level is a simple subtraction of column ① from column ②.

The Contractor of the Power Island equipment shall guarantee and be responsible for meeting their noise projections as shown under the columns designated ② and ④in the table above when measured during the quietest period of the night (typically between 2 and 4 a.m.). If the calculated result in column ③ is greater than 0 dB at any location, or the response in column ④ is "Y" (yes) at any location, the noise spec requirements will not be met at that location.

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FORM B

NORMAL PRODUCTION NOISE** GUARANTEES AT COMMUNITY LOCATIONS

Community Location No. (Ground Elev.)	Dist. to SW Corner of Glenarm Bldg. Ref. Point - Ground El. 752.0	① Maximum Allowed Power Island Production Noise Level, L_{EQ} dBA*	② Guaranteed Power Island Production Noise Level, L_{EQ} dBA**	③ Amount Above (+) or Below (-) the Maximum Allowed Noise Level, dB ② minus ①⁂	④ Will Power Island Production Noise Produce Audible Tones at This Location? (Y or N)	⑤ Meets Noise Spec Requirements at This Location?? (Y or N)
(Refer to Exhibit A)						
Example calculation point:		56	54	- 2	N	Y
C01 (753.9)	421 Ft.	57	57	0	N	Y
C02 (753.1)	263 Ft.	65	65	0	N	Y
C03 (754.0)	618 Ft.	67	67	0	N	Y
C04 (752.4)	277 Ft.	68	68	0	N	Y
C05 (752.3)	245 Ft.	67	67	0	N	Y
C06 (803.1)	588 Ft.	51	51	0	N	Y
C07 (786.9)	459 Ft.	58	58	0	N	Y
C08 (761.8)	350 Ft.	63	63	0	N	Y
C09 (756.5)	298 Ft.	67	67	0	N	Y
C10 (767.6)	459 Ft.	55	55	0	N	Y
C11 (764.2)	609 Ft.	63	63	0	N	Y
C12 (777.9)	740 Ft.	66	66	0	N	Y
C13 (826.7)	915 Ft.	57	57	0	N	Y
C14 (819.0)	1025 Ft.	54	54	0	N	Y

* The maximum allowed noise level is from the Power Island equipment alone with no contributions from the pre-existing plant noise, balance of plant equipment noise, or community background noise.

** Normal production of power generation shall be at the *worst-case load condition* as defined in the specifications.

⁂ The amount above or below the maximum allowed noise level is a simple subtraction of column ① from column ②.

The Contractor of the Power Island equipment shall guarantee and be responsible for meeting their noise projections as shown under the columns designated ② and ④in the table above when measured during the quietest period of the night (typically between 2 and 4 a.m.). If the calculated result in column ③ is greater than 0 dB at any location, or the response in column ④ is "Y" (yes) at any location, the noise spec requirements will not be met at that location.

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FORM C

SHUTDOWN NOISE GUARANTEES AT COMMUNITY LOCATIONS

Community Location No. (Ground Elev.)	Dist. to SW Corner of Glenarm Bldg. Ref. Point - Ground El. 752.0	① Maximum Allowed Power Island Shutdown Noise Level, L_{EQ} dBA*	② Guaranteed Power Island Shutdown Noise Level, L_{EQ} dBA	③ Amount Above (+) or Below (-) the Maximum Allowed Noise Level, dB ② minus ①⁂	④ Will Power Island Shutdown Noise Produce Audible Tones at This Location? (Y or N)	⑤ Meets Noise Spec Requirements at This Location?? (Y or N)
(Refer to Exhibit A)						
Example calculation point:		56	54	- 2	N	Y
C01 (753.9)	421 Ft.	57	57	0	N	Y
C02 (753.1)	263 Ft.	65	65	0	N	Y
C03 (754.0)	618 Ft.	67	67	0	N	Y
C04 (752.4)	277 Ft.	68	68	0	N	Y
C05 (752.3)	245 Ft.	67	67	0	N	Y
C06 (803.1)	588 Ft.	51	51	0	N	Y
C07 (786.9)	459 Ft.	58	58	0	N	Y
C08 (761.8)	350 Ft.	63	63	0	N	Y
C09 (756.5)	298 Ft.	67	67	0	N	Y
C10 (767.6)	459 Ft.	55	55	0	N	Y
C11 (764.2)	609 Ft.	63	63	0	N	Y
C12 (777.9)	740 Ft.	66	66	0	N	Y
C13 (826.7)	915 Ft.	57	57	0	N	Y
C14 (819.0)	1025 Ft.	54	54	0	N	Y

* The maximum allowed noise level is from the Power Island equipment alone with no contributions from the pre-existing plant noise, balance of plant equipment noise, or community background noise.

⁂ The amount above or below the maximum allowed noise level is a simple subtraction of column ① from column ②.

The Contractor of the Power Island equipment shall guarantee and be responsible for meeting their noise projections as shown under the columns designated ② and ④in the table above when measured during the quietest period of the night (typically between 2 and 4 a.m.). If the calculated result in column ③ is greater than 0 dB at any location, or the response in column ④ is "Y" (yes) at any location, the noise spec requirements will not be met at that location.

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FORM D

NOISE LEVEL GUARANTEES FOR GAS VENTING IMPULSE NOISE DURING START-UP AND SHUTDOWN AT COMMUNITY MEASUREMENT LOCATIONS

Contractor's Equipment Noise Performance Guarantee		
★**Guaranteed Maximum Impulse SPL (LIMP) of Vent Noise at C08:**	45	dBA, re: 20 micropascals
★**Guaranteed Maximum Impulse SPL (LIMP) of Vent Noise at State Street:**	45	dBA, re: 20 micropascals
Exceptions:		

★ **All valid start-up and shutdown vent noise measurements shall be measured individually as a single noise event at two receptor locations: C08 and the center of State Street due south of the Glenarm Building Reference Point. The vent noise shall be measured on a Sound Level Meter using the Impulse response setting and the A-Weighting. A minimum of (2) start-up gas venting impulse noises and (2) shutdown gas venting impulse noises shall be measured. The highest of these shall be reported as the final result for the vent noise performance.**

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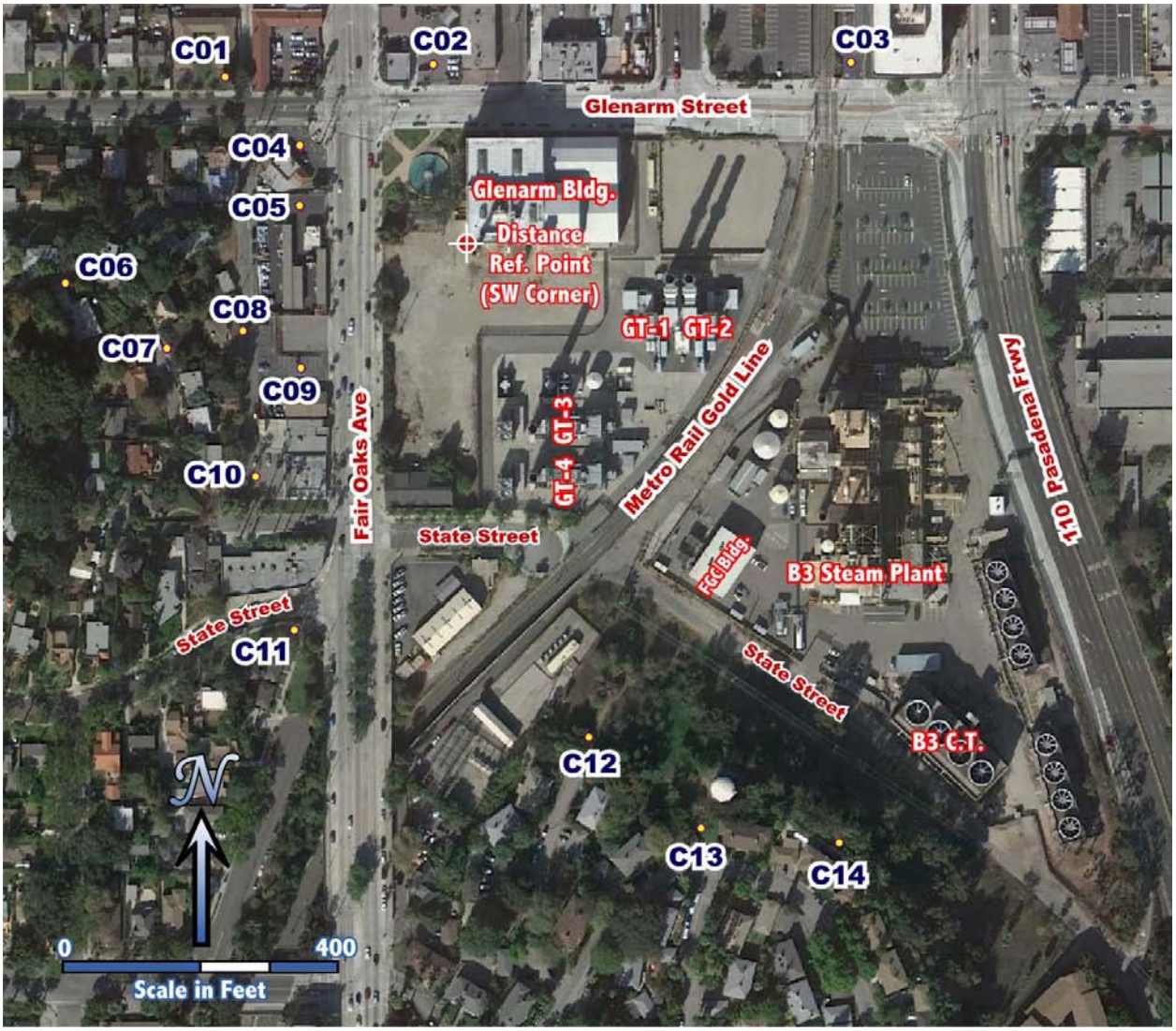


Figure 3.2-1 Far Field Receptor Locations

Exhibit A. Locations Outside the Plant for the Noise Performance Guarantees and the Noise Performance Acceptance Tests

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6.4.2.2 Basis for Far Field Noise Guarantees

A. Testing will be conducted in accordance with a project specific test plan agreed to by both the City and Contractor.
B. Equipment is operated in a new and clean condition and all access compartments, doors, panels and other temporary openings are fully closed when measurements are taken. Inspection of installation quality will be conducted prior to compliance testing. Identified defects must be corrected prior to compliance testing.
C. Corrections for background noise are to be made according to the conformed specifications, Section 4.8. Background noise is defined in the conformed specifications.
D. The above far field noise guarantees are valid with the current existing obstacles (buildings, tanks, barriers, etc.) between the power plant and the receivers.
E. Noises of an interim nature such as steam safety relief valves are not included in the above guarantee.
F. Measurements shall be taken as described in the conformed specifications, Sections 4.3, 4.4, and 4.5.
G. Responsibility for measurement and development of the project specific test plan will be stated in the contract.

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6.5 Operability Guarantees

6.5.1 Gas Turbine Startup Time Guarantee

Start time is time between initial start command and achievement of base load.

	Minutes
Starting time from GT ready to start to GT Full Speed Full Load (FSFL)	Not to exceed 10, based on the following notes

A. The gas turbine is considered to start up with no allowance for exhaust purge time. If purge credit is lost, a full exhaust purge cycle is required and will add to the total starting time accordingly.
B. At initial start command, the GTG unit shall be ready to start, on turning mode, site utilities available.
C. Generator lube oil pump must be running.
D. Automatic operation of SPRINT is enabled.
E. Full speed full load is defined as the gas turbine operating at maximum output of such unit when the unit is limited by turbine control limiters. It requires a stable grid, defined as +/- 0.12 Hz and +/-5% voltage. The turbine control limiters are as follows:
   T48 = LPT inlet temperature
   T3 = HPC discharge temperature
   PS3 = HPC discharge pressure
   XN25R = HP rotor corrected speed
   Fuel consumption regulator
F. Synchronization time is excluded in the current guarantee figure.
G. Unit must be out of icing condition according to PP-17). This warm-up period is to be excluded from the 10-minute start.
H. Emissions guarantees are not in effect.
I. Problems caused by non-Contractor equipment will negate the testing.

6.5.2 Combined Cycle Operability Guarantees

6.5.2.1 Startup and Shutdown Emissions Guarantees

Type of Event	NOx as NO2, lbs./event	CO, lbs./event
CC Cold Start	28.68	23.61

Shutdown	11.7	9.9

Basis for Startup and Shutdown Emission Guarantees

A. Guaranteed startup emissions values are for a period not to exceed 120 minutes, as described in the Contract, Article 9.

B. Guaranteed shutdown emissions values are for a period not to exceed 60 minutes, as described in the Contract, Article 9.

C. Natural gas fuel shall be in compliance with General Electric Gas Fuel Specification MID-TD-000-1, September 2009

D. Guaranteed mass totals (lbs,) are as measured at the stack.

E. The measurement system for startup and shutdown emissions will be the CONTRACTOR supplied CEMS following calibration. Continuous emissions concentration (ppm) signal from the plant stack CEMS will be converted to emissions mass flow (lb./hr.) using gas turbine control exhaust flow signal and integrated over time from gas turbine firing to gas turbine base load. To obtain mass total (lb.) for the event.

F. Emissions testing will be performed simultaneous with startup time tests. Following plant commissioning as deemed necessary by Contractor, a single test of, startup, and shutdown each will be performed. CEMS data input to the CO and NOx mass flow calculation will be collected and a total lbs. value generated for the startup event. Multiple such trial starts may be performed. A single passed test for each event constitutes meeting the guarantee. In keeping with these requirements, a detailed test procedure will be mutually agreed upon.

G. The SCR, CO catalyst, NH3 injection system and controls have been installed and deemed ready for emissions testing by Contractor. CEMS has been confirmed by Contractor to be functioning per Contractor specification.

H. Prior to testing, the unit will have successfully achieved base load by completing a startup sequence and demonstrated stable operation with the grid.

I. All equipment and controls must be operating normally and all controls are in the automatic mode of operation.

J. Ambient temperature is within the limits specified.

K. All conditions stated within the 10 minute Gas Turbine Startup Guarantee shall apply to the 120 Minute Startup Guarantee.

6.5.2.2 Startup and Shutdown Heat Consumption Guarantees

Type of Event	Heat Consumption (BTU, LHV/HHV)
Startup: 120 minute	No more than 922.02 MMBtu (LHV) and 1023.12 MMBtu (HHV),

period	
Shutdown: 60 minute period	No more than 431.41 MMBtu (LHV) and 478.7 MMBtu (HHV).

Basis for Startup Heat Consumption Guarantees

A. All conditions stated in the Basis for Startup Time Guarantees must be met
B. Guaranteed value is the sum of the below heat consumptions:
   - Heat Consumption is for the gas turbine only
   - Heat Consumption for any other auxiliary equipment such as heaters are not included.

Basis for Shutdown Heat Consumption Guarantees

A. Shutdown shall begin at the initiation of the shutdown sequence, with a GT ramp down to a minimum load point, approximately 20%, over a period of 15 minutes. Then the GT shall resume the standard ramp down schedule to idle and fuel shutoff. The total fuel consumed is the accumulated total for 60 minutes prior to fuel shutoff.

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CITY OF PASADENA
GLENARM REPOWER
CALIFORNIA
CCA17604NG Rev:0

by: MM Lampo
12-Feb-2013

160LM Multi Shaft
Ambient Conditions: 14.30 psia, 75.0 °F, 50.00 % RH
Natural Gas, SAC **Base Load Operation**
Gas Turbine: **Inlet Chiller On**
Steam Turbine: 1 x LSB **67 MW Net Plant Guarantee**

1. Plant Performance

1.1 Power (kW)

Gas Turbine Power (1 units)		54020
Steam Turbine Power		15820
Gross Equipment Power *		69840
Equipment Auxiliary Power		550
Net Equipment Power		69290
Plant Auxiliary Power		2240
Net Plant Power		67050

* Gross Power At Generator Terminals Minus Excitation Power

1.2 Fuel

Fuel Type - Natural Gas
Specification - MID-TD-000-1
Combustion System - SAC

Heating Value (Btu/lb)	LHV	20,030.
	HHV(dry)	22,206.
	HHV(dry)/LHV	1.1086
Heat Consumption (10^6 Btu/hr)	LHV	478.
	HHV(dry)	530.

1.3 Heat Rate

1.3.1 Net Equipment Heat Rate (Btu/kWh)	LHV	6,899.
	HHV(dry)	7,648.
1.3.2 Net Equipment Thermal Efficiency (%)	LHV	49.46
	HHV(dry)	44.61
1.3.3 Net Plant Heat Rate (Btu/kWh)	LHV	7,129.
	HHV(dry)	7,904.
1.3.4 Net Plant Thermal Efficiency (%)	LHV	47.86
	HHV(dry)	43.17

1.4 Operating Conditions

Ambient Air Temperature (°F)	Dry Bulb	75.0
	Wet Bulb	62.4
	Dew Point	55.1
Ambient Relative Humidity (%)		50.00
Ambient Air Pressure (psia)		14.30
Site Elevation (ft above MSL)		751.
Compressor Inlet Temperature (°F)	Dry Bulb	63.0
Steam Turbine Exhaust Pressure ("Hga (@ 32°F)A)		2.04

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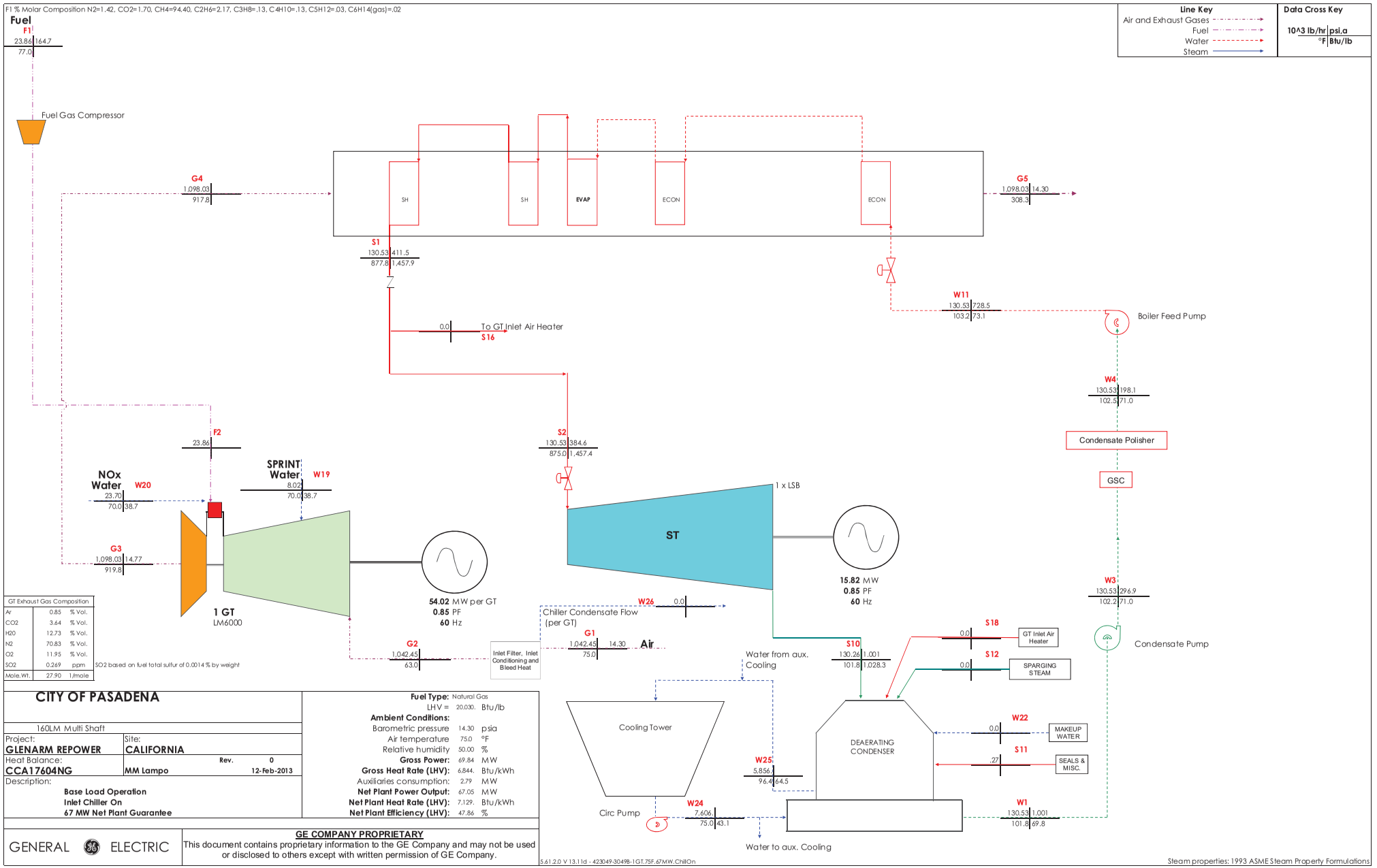
1.5 Equipment Auxiliary Power (kW)

1.5.1 Gas Turbine Generator (1 GT(s))	
Lube Oil Pump	
Hydraulic Oil Pump	
Compartment Vent Fans	
Seal Oil Pump	
SPRINT Water Supply Pump	
Controls & Instrumentation	
Water Injection Pump	
Gas Turbine Subtotal	430
1.5.2 Steam Turbine Generator	
Lube Oil Pump	
Lube Oil Vapor Extractor	
Lube Oil Conditioner	
Hydraulic Fluid Pump	
Hydraulic Fluid Cooling Fan	
Hydraulic Fluid Conditioning Pump	
Steam Gland Exhauster Blower	
Steam Turbine Subtotal	50
1.5.3 Once Through Steam Generator (1 OTSG(s))	
Controls & Instrumentation	20
SCR/CO Catalyst Aux Power	50
HRSG Subtotal	70
Total Equipment Auxiliary Power	550

1.6 Plant Auxiliary Power (kW)

Condensate pumps	
Boiler Feedwater pumps	
Circulating Cooling Water Pumps	
Cooling Tower Fans	
Transformer Losses	
Instrument Air Compressors	
Fuel Gas Compressor	
Electric Chiller System	
Vacuum Pumps	
Total Plant Auxiliary Power	2240

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F1 % Molar Composition N2=1.42, CO2=1.70, CH4=94.40, C2H6=2.17, C3H8=.13, C4H10=.13, C5H12=.03, C6H14(gas)=.02
Fuel
F1
23.86 164.7
77.0
Line Key
Air and Exhaust Gases
Fuel
Water
Steam
Data Cross Key
10^3 lb/hr psi.a
°F Btu/lb
Fuel Gas Compressor
G4
1,098.03
917.8
SH
SH
EVAP
ECON
ECON
G5
1,098.03 14.30
308.3
S1
130.53 411.5
877.8 1,457.9
W11
130.53 728.5
103.2 73.1
Boiler Feed Pump
0.0
To GT Inlet Air Heater
S16
W4
130.53 198.1
102.5 71.0
Condensate Polisher
F2
23.86
S2
130.53 384.6
875.0 1,457.4
GSC
NOx Water
W20
23.70
70.0 38.7
SPRINT Water
W19
8.02
70.0 38.7
1 x LSB
ST
G3
1,098.03 14.77
919.8
15.82 MW
0.85 PF
60 Hz
W3
130.53 296.9
102.2 71.0
54.02 MW per GT
0.85 PF
60 Hz
W26
0.0
Chiller Condensate Flow
(per GT)
S18
0.0
GT Inlet Air Heater
Condensate Pump
G1
1,042.45 14.30
75.0
Air
S10
130.26 1,001
101.8 1,028.3
Water from aux. Cooling
S12
0.0
SPARGING STEAM
1 GT
LM6000
G2
1,042.45
63.0
Inlet Filter, Inlet Conditioning and Bleed Heat
W22
0.0
MAKEUP WATER
Cooling Tower
DEAERATING CONDENSER
S11
.27
SEALS & MISC.
W25
5,856.1
96.4 64.5
Circ Pump
W24
7,606
75.0 43.1
W1
130.53 1,001
101.8 69.8
Water to aux. Cooling
GT Exhaust Gas Composition
Ar 0.85 % Vol.
CO2 3.64 % Vol.
H20 12.73 % Vol.
N2 70.83 % Vol.
O2 11.95 % Vol.
SO2 0.269 ppm
Mole.Wt. 27.90 1/mole
SO2 based on fuel total sulfur of 0.0014 % by weight
CITY OF PASADENA
160LM Multi Shaft
Project: GLENARM REPOWER
Site: CALIFORNIA
Heat Balance: CCA17604NG
Rev. 0
MM Lampo 12-Feb-2013
Description:
Base Load Operation
Inlet Chiller On
67 MW Net Plant Guarantee
Fuel Type: Natural Gas
LHV = 20,030. Btu/lb
Ambient Conditions:
Barometric pressure 14.30 psia
Air temperature 75.0 °F
Relative humidity 50.00 %
Gross Power: 69.84 MW
Gross Heat Rate (LHV): 6,844. Btu/kWh
Auxiliaries consumption: 2.79 MW
Net Plant Power Output: 67.05 MW
Net Plant Heat Rate (LHV): 7,129. Btu/kWh
Net Plant Efficiency (LHV): 47.86 %
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5.61.2.0 V 13.11d - 423049-3049B-1GT.75F.67MW.ChillOn
Steam properties: 1993 ASME Steam Property Formulations

CITY OF PASADENA
GLENARM REPOWER
CALIFORNIA
CCA17605NG Rev:0

by: MM Lampo
12-Feb-2013

160LM Multi Shaft
Ambient Conditions: 14.30 psia, 75.0 °F, 50.00 % RH
Natural Gas, SAC **Part Load Operation**
Gas Turbine: **Inlet Heater On**
Steam Turbine: 1 x LSB **33 MW Net Plant Guarantee**

1. Plant Performance

1.1 Power (kW)

Gas Turbine Power (1 units)		24400
Steam Turbine Power		10510
Gross Equipment Power *		34910
Equipment Auxiliary Power		550
Net Equipment Power		34360
Plant Auxiliary Power		1350
Net Plant Power		33010

* Gross Power At Generator Terminals Minus Excitation Power

1.2 Fuel

Fuel Type - Natural Gas
Specification - MID-TD-000-1
Combustion System - SAC

Heating Value (Btu/lb)	LHV	20,030.
	HHV(dry)	22,206.
	HHV(dry)/LHV	1.1086
Heat Consumption (10^6 Btu/hr)	LHV	259.
	HHV(dry)	287.

1.3 Heat Rate

1.3.1 Net Equipment Heat Rate (Btu/kWh)	LHV	7,532.
	HHV(dry)	8,350.
1.3.2 Net Equipment Thermal Efficiency (%)	LHV	45.30
	HHV(dry)	40.86
1.3.3 Net Plant Heat Rate (Btu/kWh)	LHV	7,840.
	HHV(dry)	8,692.
1.3.4 Net Plant Thermal Efficiency (%)	LHV	43.52
	HHV(dry)	39.26

1.4 Operating Conditions

Ambient Air Temperature (°F)	Dry Bulb	75.0
	Wet Bulb	62.4
	Dew Point	55.1
Ambient Relative Humidity (%)		50.00
Ambient Air Pressure (psia)		14.30
Site Elevation (ft above MSL)		751.
Compressor Inlet Temperature (°F)	Dry Bulb	140.0
Steam Turbine Exhaust Pressure ("Hga (@ 32°F)A)		1.52

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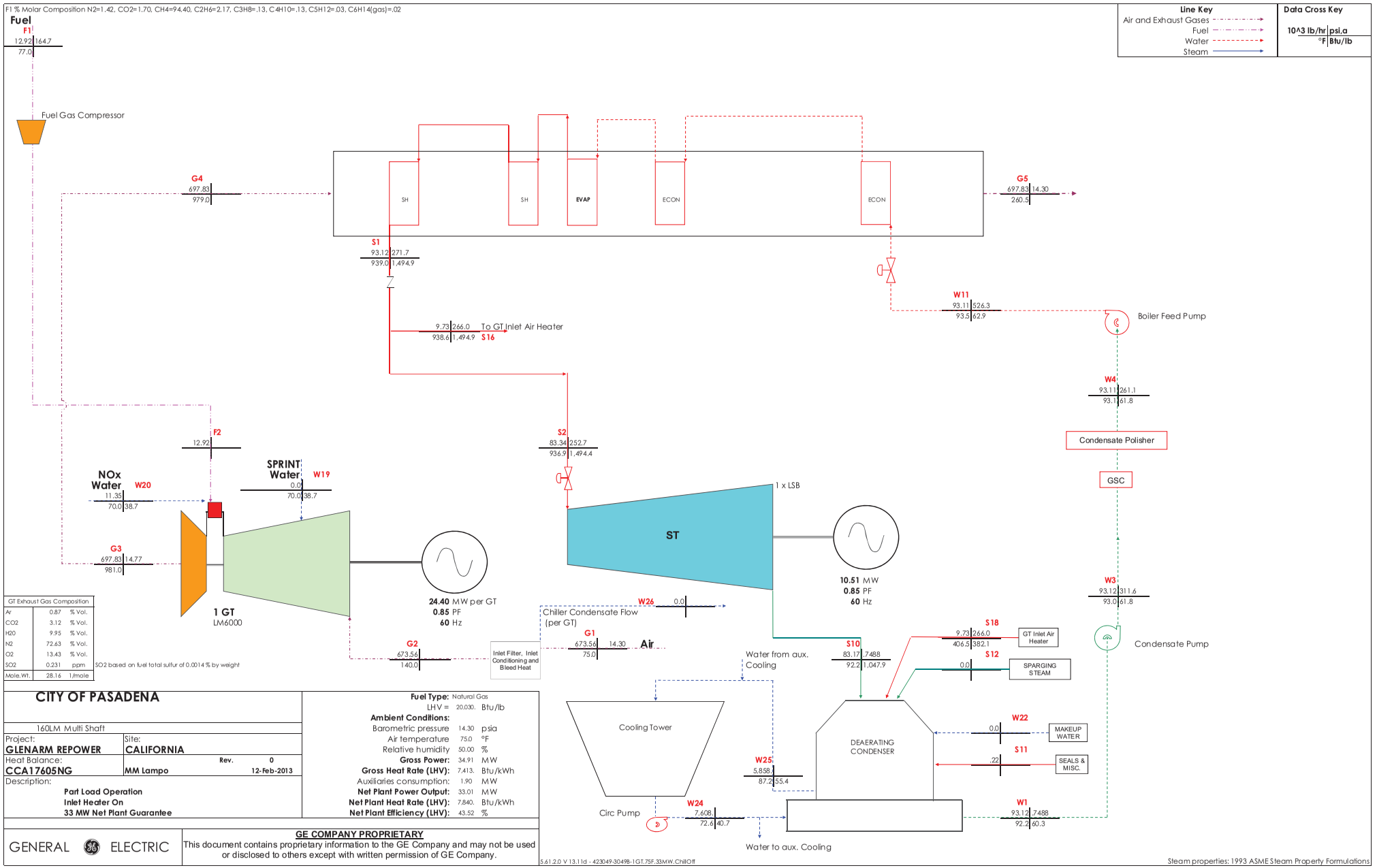
1.5 Equipment Auxiliary Power (kW)

1.5.1 Gas Turbine Generator (1 GT(s))	
Lube Oil Pump	
Hydraulic Oil Pump	
Compartment Vent Fans	
Seal Oil Pump	
SPRINT Water Supply Pump	
Controls & Instrumentation	
Water Injection Pump	
Gas Turbine Subtotal	430
1.5.2 Steam Turbine Generator	
Lube Oil Pump	
Lube Oil Vapor Extractor	
Lube Oil Conditioner	
Hydraulic Fluid Pump	
Hydraulic Fluid Cooling Fan	
Hydraulic Fluid Conditioning Pump	
Steam Gland Exhauster Blower	
Steam Turbine Subtotal	50
1.5.3 Once Through Steam Generator (1 OTSG(s))	
Controls & Instrumentation	20
SCR/CO Catalyst Aux Power	50
HRSG Subtotal	70
Total Equipment Auxiliary Power	550

1.6 Plant Auxiliary Power (kW)

Condensate pumps	
Boiler Feedwater pumps	
Circulating Cooling Water Pumps	
Cooling Tower Fans	
Transformer Losses	
Instrument Air Compressors	
Fuel Gas Compressor	
Electric Chiller System	
Vacuum Pumps	
Total Plant Auxiliary Power	1350

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F1 % Molar Composition N2=1.42, CO2=1.70, CH4=94.40, C2H6=2.17, C3H8=.13, C4H10=.13, C5H12=.03, C6H14(gas)=.02
Line Key
Air and Exhaust Gases
Fuel
Water
Steam
Data Cross Key
10^3 lb/hr | psi.a
°F | Btu/lb
Fuel
F1
12.92 | 164.7
77.0
Fuel Gas Compressor
G4
697.83
979.0
SH
SH
EVAP
ECON
ECON
G5
697.83 | 14.30
260.5
S1
93.12 | 271.7
939.0 | 1,494.9
9.73 | 266.0 To GT Inlet Air Heater
938.6 | 1,494.9 S16
W11
93.11 | 526.3
93.5 | 62.9
Boiler Feed Pump
W4
93.11 | 261.1
93.1 | 61.8
Condensate Polisher
GSC
F2
12.92
S2
83.34 | 252.7
936.9 | 1,494.4
NOx Water W20
11.35
70.0 | 38.7
SPRINT Water W19
0.0
70.0 | 38.7
G3
697.83 | 14.77
981.0
1 GT
LM6000
24.40 MW per GT
0.85 PF
60 Hz
1 x LSB
ST
10.51 MW
0.85 PF
60 Hz
W3
93.12 | 311.6
93.0 | 61.8
Condensate Pump
W26 0.0
Chiller Condensate Flow (per GT)
G1
673.56 | 14.30 Air
75.0
G2
673.56
140.0
Inlet Filter, Inlet Conditioning and Bleed Heat
Water from aux. Cooling
S10
83.17 | 7.488
92.2 | 1,047.9
S18
9.73 | 266.0
406.5 | 382.1
GT Inlet Air Heater
S12
0.0
SPARGING STEAM
Cooling Tower
DEAERATING CONDENSER
W22
0.0
MAKEUP WATER
S11
.22
SEALS & MISC.
W25
5,858.1
87.2 | 55.4
Circ Pump
W24
7,608
72.6 | 40.7
W1
93.12 | 7.488
92.2 | 60.3
Water to aux. Cooling
GT Exhaust Gas Composition
Ar 0.87 % Vol.
CO2 3.12 % Vol.
H20 9.95 % Vol.
N2 72.63 % Vol.
O2 13.43 % Vol.
SO2 0.231 ppm
Mole. Wt. 28.16 1/mole
SO2 based on fuel total sulfur of 0.0014 % by weight
CITY OF PASADENA
160LM Multi Shaft
Project: GLENARM REPOWER
Site: CALIFORNIA
Heat Balance: CCA17605NG
Rev. 0
MM Lampo 12-Feb-2013
Description:
Part Load Operation
Inlet Heater On
33 MW Net Plant Guarantee
Fuel Type: Natural Gas
LHV = 20,030. Btu/lb
Ambient Conditions:
Barometric pressure 14.30 psia
Air temperature 75.0 °F
Relative humidity 50.00 %
Gross Power: 34.91 MW
Gross Heat Rate (LHV): 7,413. Btu/kWh
Auxiliaries consumption: 1.90 MW
Net Plant Power Output: 33.01 MW
Net Plant Heat Rate (LHV): 7,840. Btu/kWh
Net Plant Efficiency (LHV): 43.52 %
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5.61.2.0 V 13.11d - 423049-3049B-1GT.75F.33MW.ChillOff
Steam properties: 1993 ASME Steam Property Formulations

Gas Turbine Generator

Turbine Engine

The latest additions to the LM6000 Product Line are the PG (SAC) and PH (DLE) gas turbines, which are derived from the core of CF6-80C2, GE's high thrust, high efficiency aircraft engine. There are more than 3700 engines in service and many more are on order. They have accumulated more than 178 million hours of operations. The high pressure turbine for PG/PH is derived from the CF6-80E1. The CF6-80E1 has been in service since 1995. Nearly 500 CF6-80E1s are in service and many more are on order. It has logged more than 9 million flight hours, primarily on the A330 fleet. Both LM and aviation engines have a common design and share most major parts. The Low Pressure Turbine, High Pressure Compressor, High Pressure Turbine, and SAC Combustor are virtually identical. This use of flight-proven parts, produced in high volume, contributes to the low initial cost and high operating efficiency of the LM6000.

Additionally, the LM6000 PG and PH remain 94% common with the PC, PD and PF gas turbines, while providing up to 25% more power and an 18% increase in exhaust energy in the same footprint. There are more than 1000 LM6000 engines in operation worldwide with more than 21 million hours of operations.

Major Engine Components:

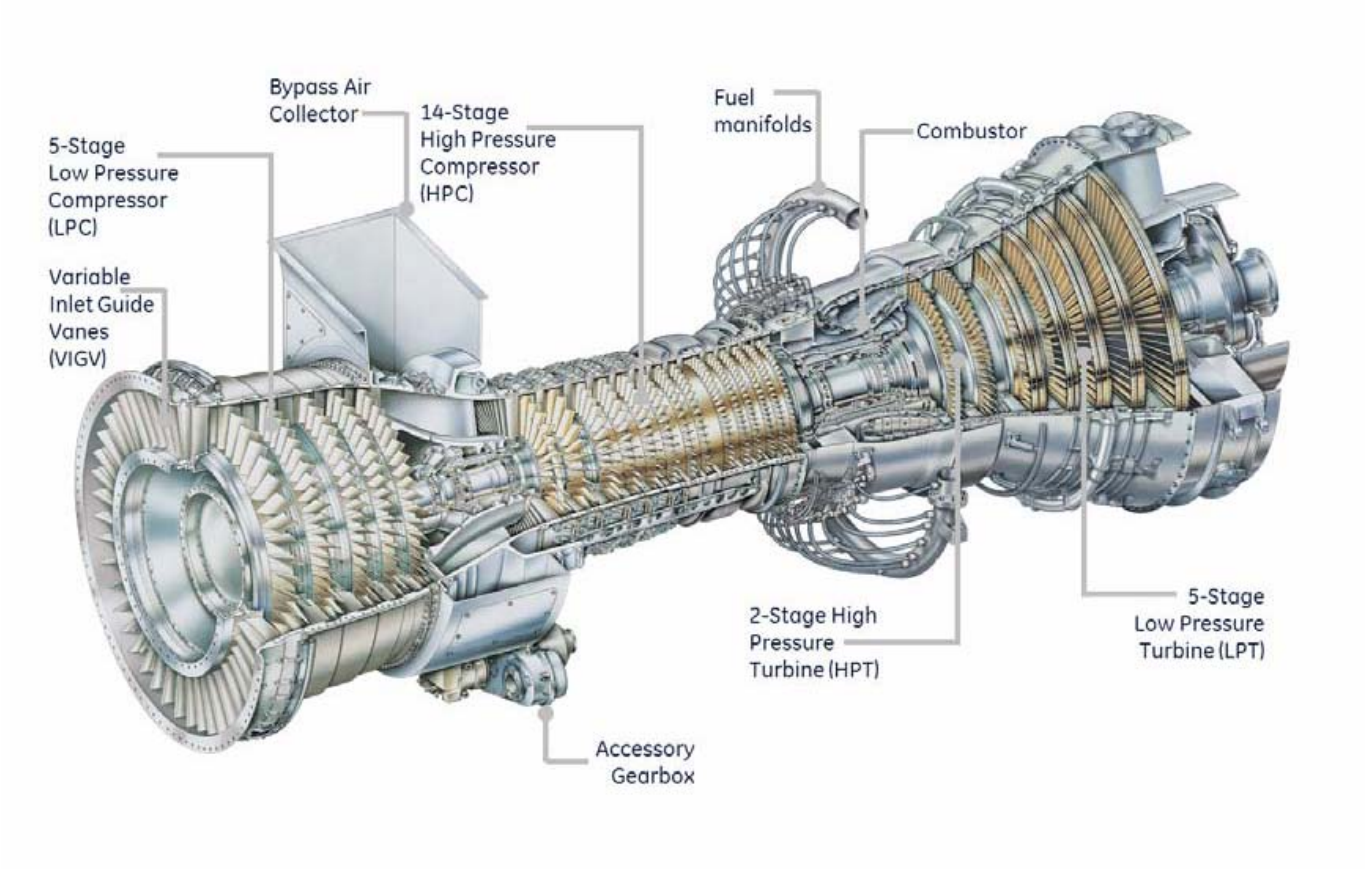
- 5-stage low-pressure compressor (LPC)
- 14-stage variable geometry high pressure compressor (HPC)
- Single Annular Combustor (SAC) (PG)
- 2-stage air-cooled high pressure turbine (HPT)
- 5-stage low pressure turbine (LPT)
- Accessory Gear Box

The LM6000 has two concentric rotor shafts: The LPC and LPT are assembled on one shaft, forming the Low Pressure Rotor. The HPC and HPT are assembled on the other shaft, forming the High Pressure Rotor.

The LM6000 uses the Low Pressure Turbine (LPT) to power the output shaft. By eliminating the separate power turbine found in many other gas turbines, the LM6000 design simplifies the engine and improves fuel efficiency. The LM6000 gas turbine drives the generator via a flexible dry type coupling connected to the front, or "cold," end of the LPC shaft

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LM6000 Major Engine Components

Turbine Cycle

- Filtered air enters the bellmouth and flows through guide vanes to the LPC
- LPC compresses air by 2.6:1 ratio
- Air flows from LPC through the front frame & bypass air collector to HPC
- Air enters HPC through Inlet Guide Vanes
- The HPC compresses air by 13:1 ratio
- 30 Fuel (SAC) nozzles mix air and fuel
- Air-Fuel mixture is ignited in Annular Combustor
- Hot combustion gases expand through HPT driving the HPC
- Hot combustion gasses expand further through LPT driving the LPC flanged end of the LPC shaft, which drives the reduction gearbox and electric generator
- Exhaust gasses exit engine/package at the exhaust flange

Inlet and VIGV Section

The turbine inlet straightens the air stream and directs it into the Low Pressure Compressor (LPC). Contractor furnishes the LM6000 PG engine with Variable Inlet Guide Vanes (VIGV).

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Low Pressure Compressor

The Low Pressure Compressor (LPC) is a 5-stage axial flow compressor with a 2.6:1 pressure ratio. A horizontally split casing provides access to blades and vanes. Borescope ports permit flow path inspection.

Bypass Air Collector

The LM6000 matches the airflow between the Low Pressure (LP) and High Pressure Compressor (HPC) with 12 hydraulically actuated variable bypass valves mounted in the turbine front frame. During start-up and part-load operation these valves open partially and vent excess air to the bypass air collector. The bypass air collector also supports the accessory gearbox.

High Pressure Compressor

The LM6000 High Pressure Compressor (HPC) is a 14-stage unit. Variable stators in stages 1-5 ensure high efficiency throughout the starting and operating range. The stator geometry of stages 6 through 14 is fixed horizontally. This allows ready access to the stator vanes and rotor blades for inspection or replacement. The pressure ratio of PG/PH increases to 35:1 from 30:1 for a PC engine, allowing for more mass flow through the engine.

Combustion Section

Fuel to the gas turbine will be controlled based on control mode, fuel schedules, and the load condition. For normal start sequence (13 minutes), gradual load changes are preferred with at least 5-minute ramp from idle to maximum power. If a fast start (10 minutes) is required, the load may be ramped from idle to full load in 4 minutes as part of the start sequence provided in operation. Normal load reduction transients should be no faster than 2-3 minutes from maximum power to synchronous idle.

Thirty nozzles feed fuel into the LM6000 annular combustor, providing a uniform heat profile to the High Pressure Turbine (HPT). This produces maximum output with low thermal stress. The swirler-cup dome design produces a lean thoroughly mixed, lean fuel/air mixture in the primary zone of the combustor. This provides cleaner combustion and reduces NO_X. Available nozzle designs allow natural gas, distillate or dual-fuel operation. The nozzles also permit NO_X reduction with water injection (natural gas and distillate fuels). The annular combustor design provides low pressure loss, low exit temperature and extended operating life. A Hastelloy X inner liner resists corrosion and extends combustor life.

High Pressure Turbine

The High Pressure Turbine (HPT) is a 2-stage, air-cooled turbine rotated by the hot gasses exiting the combustor. The HPT powers the High Pressure Compressor (HPC) to supply high-pressure air to the combustor. Turbine disks, blades and stator are air-cooled for efficiency. Air foils are thermal-barrier-coated to improve durability and resist erosion and corrosion.

Low Pressure Turbine

The 5-stage Low Pressure Turbine (LPT) receives the outlet flow from the HPT. The LPT drives the Low Pressure Compressor and the driven load (generator, compressor, etc.) through a shaft concentric to the HPT shaft. Air foils have been optimized to provide improved efficiency.

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Gas Turbine Support Structures

The LM6000 gas turbine uses three frames to support the LP and HP rotors, the front frame, compressor rear frame and the turbine rear frame. This configuration produces excellent rotor stability and closely controlled blade tip clearance.

Front Frame

The LM6000 front frame is a major engine structure that provides support for the LPC shaft and the forward end of the HPC shaft. The frame also forms an airflow path between the outlet of the LPC and the inlet of the HPC. The front engine mounts attach to the front frame. The front frame contains the engine "A" sump that incorporates the thrust and radial bearings to support the LPC rotor and a radial bearing which supports the forward end of the HPC rotor. Lubrication oil supply and scavenge lines for the "A" sump are routed inside the front frame struts. The accessory gearbox drive shaft is located in the "A" sump and extends out through the strut located at the six o'clock position.
Pads are contained on the frame outer case for mounting of the two High Pressure Compressor inlet temperature sensors.

Compressor Rear Frame

The compressor rear frame (CRF) consists of an outer case, 10 struts and the "B-C" sump housing. The outer case supports the combustor and 30 fuel nozzles. The hub supports both the thrust bearing, the radial bearing and in turn, the mid-section of the HP rotor system. The PG/PH has incorporated an improved CRF based on the design of the existing LMS100 CRF. This provides more operability and performance to increase the output of the PG/PH gas turbine.

Turbine Rear Frame

The turbine rear frame supports the rear engine mount and contains the D-E sump. The 14-strut rear frame guides and straightens the exhaust flow for lower pressure drop and greater efficiency.

Accessory Drive System

The hydraulic starter, lube and scavenge pump, variable geometry hydraulic pump, and other accessories are mounted on and driven by the accessory gearbox. The accessory gearbox is located below the front HPC casing at the six o'clock position on the LPC bleed air collector and is driven by the transfer gearbox through a short horizontal shaft. The transfer gearbox is driven by the high-pressure rotor system. The gearbox is supported from the LPC bleed air collector.

Auxiliary Equipment Module

The base auxiliary equipment module is provided with the unit and integrates several functions and is equipped with enclosure. The following is included as part of the standard auxiliary equipment module:

Auxiliary Module

- Synthetic lube oil system components including: reservoir, duplex oil filter and duplex shell/tube oil-to-coolant heat exchangers
- Electro-hydraulic start system components, including: electric starting motor, variable displacement hydraulic pump, reservoir, air/oil cooler, low pressure return filter, and case drain return filter
- On-line/off-line water wash system, including: reservoir, supply valves, solenoid valves, pump, electric tank heater, in-line water filter, and instrument air filter

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Inlet Air System Single-Stage Design

The air inlet system is designed to protect the gas turbine, generator and equipment compartments from effects of air-borne dirt, contamination and foreign objects. It also provides a pre-engineered, modular design to minimize field assembly and eliminate field welding.

Filtration Specification

The LM6000 pulse filter removes more than 99.9% of all particles 5.0micron and larger by utilizing a single-stage, pulse-cleaned design.

Engine Combustion Air	253,000 scfm / 7,164 m3/min
Turbine Ventilation Air	60,000 scfm / 1,699 m3/min.
Generator Ventilation Air	45,000 scfm / 1,274 m3/min.
Total Typical Air Flow	358,000 scfm / 10,137 m3/min.

Pulse Air Filter (Self Cleaning Legged Housing)

This single-stage self-cleaning filtration system is a well-suited for dry, high dust areas (desert-like conditions) as well as cold weather environment hazards such as blowing snow, hoarfrost and ice fog. Filtration elements are pulsed in banks (rows) to clean the filters. The pulsing is repeated until a predetermined value is reached. Instrument compressed air can be used for the pulsing.

The filter house mounts above the turbine enclosure and is supported with legs. Downward airflow provides filtered air for combustion and ventilation. This compact filter design is easily installed in the field, and it eliminates City supplied ducting. The filter system includes a stainless steel inlet silencer and a ladder and platform for inspection and servicing of the filter. Lighted internal walkways provide generous working room for replacement and maintenance of the filter elements.

Filter House Materials

The filter housing is constructed of 3/16 inch / 4.5 mm steel plate. Protective paint is applied to the exterior and interior carbon steel surfaces.

Floors and drain pans downstream of the inlet air chiller coils are stainless steel to resist corrosion.

Inlet Screens/Weatherhood

The weather hood provides a deflecting surface to prevent driving rain and snow from entering the filter house. In addition, paper, leaves and wind-blown trash are blocked by the inlet screen. This component makes up the exterior face of the filter house and is manufactured from carbon steel. Acoustically lined weather hood is provided to reduce noise emissions.

Pulse Filter

The high-efficiency conical and cylindrical pulse filter elements (provided as a pair) are mounted to a vertically oriented dirty-to-clean air separation sheet (“tube sheet”) within the pulse filter modules. The element media is a low-pressure drop, fully synthetic media specially treated to maximize pulse cleaning performance. The filter elements are designed specifically for gas turbine protection, offering high filtration efficiency (F9 per EN779:2002) and optimal pulse cleaning performance.

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Clean Air Plenum

After passing though the filter elements, the filtered air exits the pulse filter modules and enters the clean air plenum. This fabricated structure is the center section of the inlet filter assembly and separates ventilation air from combustion air.

Transition Ducts

Combustion air flows through a transition duct from the clean air plenum to the combustion air inlet silencer. Ventilation air flows through transition ducts to the turbine and generator compartment. 316 Stainless Steel material is provided for wetted surfaces.

Inlet Silencer

The inlet silencer is a low-pressure-drop device located in the combustion air stream before the inlet volute. The silencer attenuates noise from the turbine and helps maintain the unit's low noise level.

Inlet Volute

The inlet volute is stainless steel weldment that directs the combustion air flowing down from the filter and turns it 90 degrees to flow axially into the turbine inlet. Vanes within the volute smooth the airflow and present a balanced air stream to the turbine bellmouth.

Combustion Air Cooling – Chiller Coil

Lowering the combustion air inlet temperature can increase the power output of the LM6000 generator set. When specified, Contractor furnishes high performance inlet air chilling coils as an integral part of the air inlet system. City provides adequate quantities of a chilled water/glycol mixture and interconnecting piping to Contractor furnished chilling coils at the filter house. The same coils can be used for anti-icing.

Package Enclosures

The package is equipped with a generator, a turbine and an auxiliary module enclosure. The unit enclosures are designed for outdoor installation with wind loads up to 150 mph / 240 km/h per ASCE 7-05 and CBC 2010. The enclosures reduces the average near field noise to 85 dB (A) at 3 ft. / 1.0 m from the enclosure and 5 ft. / 1.5m above grade. Each enclosure is provided with access doors and AC lighting.

The turbine enclosure contains an integral overhead bridge crane to facilitate engine removal.

Enclosure walls are a “sandwich” construction filled with insulation blankets of high temperature, sound attenuating material. The inner wall panel is fabricated from perforated 1.21 mm / 18-gauge stainless steel. The outer wall panel is 1.9 mm / 14-gauge cold rolled carbon steel, painted with abrasion resistant, exterior quality epoxy paint.

The turbine and generator enclosure walls are supported by a structural steel framework that can withstand external wind loading and the internal pressure developed by the fire extinguishing system. External door hinges, latches and mounting hardware are stainless steel or chrome plated.

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Enclosure Lighting

AC lighting for the interior of the gas turbine and generator enclosures is provided. DC lighting is provided as well in the generator and turbine enclosures.

Enclosure Ventilation System

The ventilation system removes heat from the turbine and generator enclosures and removes combustible gases in the event of a fuel system failure. Both the turbine and generator enclosures are fully ventilated by redundant fans to improve reliability. Ventilation air is filtered to the same quality levels as the gas turbine combustion air.

Turbine Enclosure Ventilation

Ventilation air enters the turbine enclosure around the inlet collector. Dual 125 hp / 93 kW exhaust fans (1 running / 1 standby) create induced-draft airflow of approximately 60,000 scfm / 1,699 m3.

Generator Enclosure Ventilation

Filtered air is forced into the generator enclosure by dual 100 hp / 75 kW forced draft fans (1 running / 1 stand-by) through ducts from the inlet air filter. The 45,000 scfm / 1,270 m3/min. airflow cools the generator and the generator enclosure.

The ventilation fans produce a positive pressure in the generator enclosure, providing additional isolation from the turbine enclosure for gas leak protection purposes. This contributes to classification of the generator enclosure as a non-hazardous area.

Auxiliary Enclosure Ventilation

Ventilation air enters the compartment through two roof mounted forced draft units (1 running/1standby). The unit supplies 3027 ACFM/86 m3/min of ventilation air.

Noise Control

The LM6000 enclosure and air inlet silencer reduce the average near field noise to 85 dB (A) at 3 ft. / 1.0 m from the enclosure and 5 ft / 1.5 m above grade.

Turbine Exhaust

The LM6000 exhausts air is extracted axially through a flange located at the end of the turbine enclosure. This provides low restrictions and a direct path into the heat recovery equipment.

Baseplate

LM6000 generator sets are mounted on rugged I-beam baseplates to simplify shipping and installation.

The basic equipment is supplied with the support structures consisting of a two-piece skid assembly, which is sectioned between the gas turbine and the generator. The full depth, bolted section is designed to provide the full structural properties of the wide flange I-beams. Full depth cross members are utilized to provide a rigid design that meets the requirements of CBC2010 and is therefore suitable for installation in earthquake areas. The baseplate support system is enhanced by the installation of a

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heavy-duty, welded superstructure which utilizes 6 inch x 6 inch x 3/8 inch wall structural tubing for wall columns and roof beams.

Tapered pins between the baseplates simplify field alignment and temporary lifting (round pin design) trunnions can be installed, providing a convenient structure for transportation.

Fuel System

Gas Fuel System

The gas fuel system contains the following major components. They are mounted in the turbine enclosure, adjacent to the engine.

- Fuel gas strainer
- Fuel gas flow meter
- Instrumentation
- Primary shutoff valve
- Fuel metering valve
- Secondary shutoff valve
- Fuel gas manifold
- Shipped loose manual shut-off valve

Gas Fuel Flow

Gas fuel must be supplied to the package baseplate connection at 725 ± 20 psig for PG (SAC) turbine. Please see Attachment 10 for applicable fuel specification. Lower fuel supply pressure requirements for base load operation may be possible in certain circumstances.

A City supplied pressure regulator, pressure relief valve and Contractor supplied manually operated shut-off valve should be installed in the City fuel supply system outside of main unit.

Pressure and Temperature Monitoring

Pressure transmitters monitor the fuel supply pressure upstream and downstream of the fuel metering valve and forward the data to the fuel control and sequencer system. A platinum, dual element temperature RTD monitors fuel supply temperature and forwards the data to the fuel control and sequencer system.

Fuel Shutoff Valves and Safety Venting

Fuel shutoff valves manage gas flow to the combustor. Solenoid piloted fuel shutoff valves are quick-closure valve assemblies located upstream and downstream of the gas fuel metering valve. These fail-close valves are either fully open to allow fuel flow or fully closed to prevent fuel flow.

During startup, the shutoff valves are opened and fuel flow to the gas manifold is metered by the gas fuel metering valve. During shutdown, when the shutoff valves are closed, a solenoid-operated vent valve opens to vent the fuel supply line between shutoff valves to a safe area.

A gas fuel drain valve opens during certain shutdown conditions to purge the gas manifold and the engine.

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Fuel-Metering Valve

The electronically controlled fuel valve provides accurate, non-pulsating fuel flow to the turbine during starting, steady-state operation and dynamic load changes.

Low fuel gas pressure starting is possible, using the electrical output of the LM6000 to power a fuel gas compressor. The LM6000 can start on a minimum 250 psig/1724 kPag fuel gas pressure. At this pressure the LM6000 produces enough electrical power to start a fuel gas compressor. The compressor then builds the fuel gas pressure up for full power output.

This "bootstrap" starting simplifies gas utility requirements and eliminates high electrical "demand charges" for starting the gas compressor motors.

Independent Lube Oil Systems

The LM6000 gas turbine is lubricated with synthetic lube oil (SLO) while a separate mineral lube oil (MLO) system lubricates the generator and gearbox.

Dual shell and tube coolers are used to cool both turbine and generator lube oil. The turbine lube oil system is mounted on the auxiliary module. The generator/gearbox lube oil system is a separate skid. Lube oil piping, fittings and reservoirs are Type 304 stainless steel and valves have stainless steel trim.

Gas Turbine Lube Oil System

The gas turbine lube oil system has two lube oil circuits:

Supply System - Provides filtered, cool oil to the turbine bearings.

Scavenge System - Recovers (scavenges) the lube oil from the bearing drain sumps. It also filters and cools the oil and returns it to the reservoir.

These two circuits cool, lubricate and protect the turbine. The turbine supply system contains the following major components:

- SLO reservoir
- Supply pump
- Supply filter

The scavenge system contains the following major components:

- Scavenge filter/5-element scavenge pump
- Duplex shell and tube water / oil heat exchanger
- Air/oil separator system

Turbine Lube Oil Supply Description

Synthetic lube oil is stored in a 250 gal/946 l capacity stainless steel reservoir mounted on the auxiliary module. The reservoir is fitted with a level gauge, a level transmitter, a filler connection, and a demister/flame arrestor. The reservoir also includes a thermostatically controlled heater and a lube oil temperature transmitter RTD.

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A positive displacement lube oil pump, mounted on the gas turbine accessory drive gearbox, takes suction from the lube oil reservoir. The pump discharge is filtered by a duplex, 6 micron (absolute), full-flow filter located on the auxiliary module. Filter elements can be changed while the turbine is running.

The lube oil supply passes through an anti-siphon check valve and is distributed to the bearing chambers, where oil is sprayed onto each engine bearing.

Pressure transmitters and temperature RTDs monitor lube oil supply with readout, alarm and shutdown at the turbine control panel. Chip detectors in the A and B sumps and in the common scavenge return provide alarms if metal chips are detected in the lube oil. A differential pressure transmitter senses filter differential pressure and warns the operator of dirty filter conditions.

Turbine Lube Oil Scavenge Description

Oil flows through the turbine bearings and accumulates in the bearing sumps. A 5-element scavenge pump is connected to a low point drain in each sump. Whenever the engine is turning the scavenge pump is working to remove oil from the sump drains.

The scavenge pump discharge flows through a 6 micron (absolute) duplex filter, then is cooled by a shell and tube cooler, (1 running / 1 standby) and then returns the oil to the reservoir.

Dual elements RTD on each scavenge line measures temperature, with readout, alarm and shutdown at the turbine control panel. A check valve on the pump discharge prevents siphoning of oil back into the engine during shutdown.

Each bearing sump is vented by the air/oil separator system, consisting of a pre-separator, air-to-oil cooler, and a final separator. Recovered oil drains back to the reservoir to reduce emissions and oil consumption.

Duplex shell and tube coolers (1 running /1 standby) rejects 12,565 Btu/min (13257 kJ/min) from the turbine lube oil circuit. A thermostatic valve regulates the amount of hot oil that bypasses the cooler maintain reservoir oil temperature.

Generator/Gearbox Lube Oil System

The generator/gearbox lubrication system provides approximately 389 gpm/1473 lpm of cooled and filtered mineral oil to the generator/gearbox bearings. The generator/gearbox lube oil reservoir, pumps and duplex filters are located on a separate lube oil module. The lube oil filters may be changed while the unit is operating. Filters have stainless steel plates. Valves are carbon steel bodies with stainless steel trim. The duplex shell and tube coolers serving the generator/gearbox lube oil system are also located on the lube oil module.

The generator/gearbox lube oil system has two lube oil circuits:

Supply System – Provides cool, filtered oil to the generator bearings. The supply system contains the following major components:

- MLO reservoir
- AC pump
- Generator driven mechanical pump

- Four-element jacking oil pump
- Duplex shell and tube heat exchanger
- Duplex filter

Return System - Recovers the lube oil from the bearing drain sumps and returns it to the reservoir.

These two circuits cool, lubricate and protect the generator and gearbox.

Generator/Gearbox Lube Oil Supply Description

A 304 stainless steel reservoir includes a level gauge, a level transmitter, fill connection with strainer and a drain valve. Two heater units turn on at 90 °F (32 °C) falling temperature keeping the oil heated to prevent condensation when the unit is stopped. The lube system has three pumps mounted on the reservoir:

- Main pump: 389 gpm/1473 lpm with a 40 hp/30 kW AC motor
- Standby pump: 389 gpm/1473 lpm with a 40 hp/30 kW AC motor
- Emergency coastdown pump: 165 gpm/625 lpm with a 20 hp/15 kW DC motor

The reservoir assembly includes:

- Duplex 100% filters (6 micron absolute)
- Duplex shell and tube heat exchangers sized to reject 46,475 Btu/min or 49,033 kJ/min
- Oil-mist heat exchanger and motor-driven oil demister
- Accumulators for coastdown and emergency operations

A standby AC pump will provide additional protection in the event the primary AC lube oil pump fails. A standby DC pump will provide coast down protection in the event AC power is lost. The oil flows through the orifice and into the bearings and forms a film that cools and lubricates the journal. Pressure transmitters at the bearing supply header provide low pressure alarm and shutdown signals to the unit control panel. If the supply pressure drops, a low lube oil pressure switch automatically starts the auxiliary lube oil pump. An annunciator alarm indicates that the auxiliary pump is running. If the lube oil pressure falls to a lower level, the turbine generator set shuts down. The primary and auxiliary lube oil pumps can each supply 100% of the generator lube oil requirements.

Each pump is equipped with a pressure relief valve piped to the reservoir. Lube oil pressure at the supply header is controlled by a pressure regulating valve, which bypasses excessive oil flow to the reservoir. The redundant generator/gearbox lube oil filters (6 micron absolute) are mounted on the lube oil module. Filters may be replaced during operation by switching the manual transfer valve. A differential pressure transmitter senses pressure drop across filter to indicate filter cleanliness and provides alarm in case filter requires changing.

Generator/Gearbox Lube Oil Return Description

Each bearing has a gravity drain and sight glass to visually verify oil flow. A dual element RTD is embedded in each generator bearing to measure the actual metal temperature. These RTDs are continuously monitored at the unit control panel and provide alarm and trip signals. The gearbox has a turning gear to rotate the shaft. The gearbox bearing RTDs also provide alarm and trip signals.

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For starting and water wash cycles, the generator rotor is lifted off the bearing seats with a film of high-pressure oil from a small "jacking oil" pump. The oil film reduces bearing friction and helps the rotor "break away" and begin turning.

City Cooling Water Requirements

City provides continuous water or water/glycol solution to the turbine lube oil, generator/gearbox lube oil cooler flange connections and the GLO tank demister at 95°F/ 35°C and a maximum water pressure of 100 psig / 689 kPag.

The turbine lube oil cooling water requirements are 120 gpm/454 lpm with a load rejection of 12,656 Btu/min/13,257 KJ/min. The generator/gearbox lube oil cooler cooling water requirements are 325 gpm/1325 lpm. Total heat rejection for generator/gearbox is approximately 47,012 Btu/min /49,600 kJ/min. The GLO tank demister requires 41 gpm/155 lpm. Total heat rejection is 1377 Btu/min/1452 kJ/min.

Starting System

The LM6000 turbine is started by an electro-hydraulic system, including an electric motor, a pump, a hydraulic starter motor, and other equipment described below. The starter rotates the LM6000 high-pressure compressor shaft for purging, cool down, engine starting and water wash sequences.

The hydraulic start system consists of a hydraulic starting motor / clutch mounted on the turbine accessory gearbox, and the following equipment mounted on the auxiliary module:

- 200 HP / 150 kW electric starting pump motor
- Variable displacement hydraulic pump
- 40 gal. / 151 l hydraulic reservoir
- Air/oil cooler
- Low pressure return filter and case drain return filter

Hydraulic Start System

The hydraulic circuit is a closed loop design with a 40-gallon / 151 l reservoir. The system requires an initial fill of approximately 40 gallons / 151 l of ISO VG 46 premium, anti-wear petroleum-based hydraulic fluid.

During each start cycle a charge-pump portion of the main pump draws fluid from the reservoir to prime the system and supply control oil. Controls modulate the main pump flow from zero to approximately 56 gpm / 212 lpm during the starting cycle. This permits accurate control of gas generator speed for purging, ignition and acceleration. The starter pump increases the hydraulic fluid pressure and delivers the pressurized fluid to the hydraulic starter motor. A portion of the return fluid from the starter motor is routed back to the starter pump. Before reaching the main hydraulic pump on the auxiliary skid, the oil is filtered through a low-pressure, return filter.

Low-pressure hydraulic fluid from the starter motor case is routed off the main skid to the auxiliary skid. On the auxiliary skid, the hydraulic fluid flows through a case drain return filter and an air to oil heat exchanger before returning to the reservoir.

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Starting System Operation

To start the gas turbine, the hydraulic motor must:

- Rotate the gas generator to purge the engine
- Accelerate the gas generator to ignition speed
- Continue acceleration to self-sustaining speed

The starter accelerates the gas generator to 2,400 rpm and cranks for 90 seconds in typical simple cycle applications. This forces purging air through the gas turbine and exhaust stack to remove hydrocarbons that may have accumulated during the prior shutdown.

Air-flow during the purge cycle is approximately 7842 scfm / 222 M^3/min. After the purge cycle, Fuel flow is initiated, igniters are actuated, and the turbine starts. Then the starter and the combustion accelerate the gas generator to 4600 rpm where the starter disengages automatically.

The gas generator continues to accelerate until it reaches idle speed. The turbine is now self-sustaining.

Overall start time varies with stack height. The unit with once through steam generator will require a longer purge cycle, typically 15 to 30 minutes. Refer to Contractor's position paper #7 and #8 in for OTSG unit requiring 10 minute start-up.

The typical LM6000 in simple cycle application can reach full power from a cold start in 10 minutes.

Water Wash System

Despite air filtration, gas turbine compressor blades tend to become dirty resulting in decreased compressor performance and lower gas turbine efficiency. Optimal turbine performance is achieved by periodically cleaning compressor stages of the gas turbine. The water wash system provides a mechanism for cleaning the engine compressor during normal operation (online water washing) or when the turbine has been shut down (off-line water washing) in order to recover the compressor efficiency and gas turbine power output. See Attachment 10 for compressor cleaning water/detergent specifications.

Water Wash Equipment

Both on-line and off-line spray nozzles are mounted on the Inlet Air Volute on the main baseplate. The remaining water wash equipment below is mounted on the auxiliary module:

- 100 gallon / 379 l stainless steel reservoir
- Manual water and chemical (detergent) supply valves
- Solenoid valves to sequence water wash and purging
- Motor-driven pressurizing pump
- Electric heater in tank
- In-line water filter

Cleaning Solution Specifications

Cleaning agents (liquid detergent) conforming to Contractor's Specification MID-TD-0000-5 are recommended for washing the gas generator section of the engine. Water and solvents are mixed within the reservoir and sprayed into the turbine inlet. Water is then sprayed in the inlet to rinse the turbine.

A water/anti-freeze mixture must be used for dilution and rinsing in ambient temperatures of 50°F / 10°C, or lower.

Water Quality Standards

Please refer to Contractor's Specification MID-TD-0000-4 in Attachment 10 for the Compressor Cleaning water purity requirements to wash the gas turbine.

Interface Requirements

City supplies a source of water and instrument/compressed air to purge lines at flange connections on auxiliary module. Interconnecting piping and hoses to the permanently mounted turbine spray manifold are provided as part of standard scope of supply.

Fire Protection System

The LM6000 turbine generator set includes controls and sensors to detect fire, unsafe temperatures or explosive atmospheres in the turbine and generator enclosures. The system releases CO_2 if fire is detected.

The package enclosure is designed to reduce the hazard of fire and explosion. A wall separates the turbine and generator enclosures to provide isolation. Ventilation systems, with redundant fans, create a positive pressure in the generator enclosure and a negative pressure in the turbine enclosure. This maintains separation and prevents hydrocarbons entering from the generator enclosure. The turbine and generator enclosures are protected by gas detectors, thermal detectors, optical flame detectors and a CO_2 extinguishing system conforming to NFPA 12.

Gas Detectors

Four explosion proof gas detectors and two explosion proof infrared gas detectors are provided. Three hydrocarbon gas detectors are located in the turbine compartment. Two hydrocarbon gas detectors are located below the turbine, and three gas detectors are located in the turbine enclosure near ventilation exhaust duct. A fourth detector is located in the generator compartment. Two infrared gas detectors are located in the ventilation exhaust duct. If the gas detectors in the turbine or generator compartments sense a gas concentration of 15% LEL, a warning is initiated. If a sensor detects a gas concentration of 25% lower explosion limit, an emergency shutdown is initiated. If an infrared sensor senses a gas concentration of 5% LEL, a warning is initiated. If a sensor detects a gas concentration of 10% LEL, an emergency shutdown is initiated.

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Optical Flame Detectors

There are three Optical flame detectors mounted in the turbine enclosure and one mounted in the generator enclosure. A flame indication by a turbine enclosure sensor causes an emergency shutdown and release of CO2.

Thermal Detectors

The turbine enclosure temperature is monitored by two thermal spot detectors, initiating a shutdown at 450°F / 232.2°C. The generator enclosure temperature is monitored by three thermal spot detectors, initiating a shutdown at 225°F / 107.2°C.

In addition to alarm and shutdown functions, the thermal spot detectors provide enclosure temperature signals for the turbine control panel HMI. The spot temperature detectors are bi-metallic and respond to both temperature and rate-of-rise. They trigger a unit shut down and release of the CO_2 when tripped.

Manual System Trip

Three manual trip stations are located on the main enclosure; one on each side near the center of the package, and the third at the exciter end of the generator.

CO2 Extinguishing System

The system components include:

- Main CO_2 storage cylinders
- Reserve CO_2 storage cylinders
- Valves, piping and wiring

The pressurized CO_2 bottles are stored on a rack that includes manifolds, controls, valves and a weigh scale. The reserve cylinders are an “automatic backup,” and are released, if the detectors still indicate a hazard, 90 seconds after release of the main cylinders.

Contractor provides piping within the main enclosure from the pressure connection to the nozzles in the turbine and generator enclosures. Release of the CO_2 is controlled by the fire system control panel or by a manual valve at the unit.

Signals from the equipment-mounted sensors are monitored by solid-state modules in the control panel. The panel-mounted unit includes logic, memory and output functions.

Dedicated Power Supply

A dedicated 24 VDC battery system with charger, to power the fire and gas protection and control system is furnished by BOP contractor per DOR document. This battery system shall conform to NFPA 12 requirements.

Control System

Turbine Control Panel compares the signal from each sensor to alarm and shutdown set points. Any alarm signal sounds an alarm at the control panel and in the turbine enclosure.

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Any shutdown signal from a gas detector, optical detector, thermal detector, or manual station closes a contact and causes an emergency shutdown of the unit.

Defective Sensor Protection

Each sensor is connected with closed loop circuitry to verify its readiness. Should the sensor or its wiring become defective, a "fault" condition is indicated on the control panel.

CO2 Release Logic

When a shutdown signal is received the control system turns off the ventilation fans and sounds an alarm horn at the panel and both inside and outside of the turbine enclosure. After a time delay, CO_2 is released into the generator and turbine enclosures.

A CO_2 concentration sufficient to extinguish flames is reached in approximately 30 seconds. If the primary cylinders should fail to discharge within four seconds, the reserve cylinders are discharged. If flames are still detected 90 seconds after the primary CO_2 cylinders have been discharged, the reserve cylinders are discharged.

SPRINT® Power Augmentation

SPRINT® boosts engine performance up to 60.0 MW (ISO conditions) using a spray intercooling design that increases the mass flow by cooling the air during the compression process. The system is based on an atomized water spray injected through spray nozzles placed at two locations, one between the high pressure and low pressure compressors, and the second at inlet bellmouth. Water is atomized using high pressure air taken off of the eighth stage bleed. The water flow rate is metered, using the appropriate engine control schedules and at the inlet bellmouth. Bellmouth and inter-stage portions on SPRINT® alternate operation based on turbine inlet temperature. City supplies demineralized water at flow rates between 14 gpm and 29 gpm (53 lpm to 110 lpm), 25 psig/172 kPag and 100 °F/38 °C to the connection on the unit. Water must meet Contractor's specification MID-TD-0000-3 in Attachment 10.

NOx Control – Water Injection System

The water injection system contains the following major components. All components are mounted on the auxiliary and main skids. Duplex low pressure filter, duplex water injection pump(s), flow transmitter, and flow metering valve. To control the amount of oxides of nitrogen (NOx) emitted by the gas turbine during normal operation, demineralized water is injected into the combustor section of the gas turbine through the water injection manifold. Demineralized water from a City source is pressurized by the selected water injection pump and pumped into the main skid.

Water Filter and Water Injection Pump Equipment

Demineralized water supplied to the auxiliary skid must meet Contractor's quality requirements MID-TD-0000-3 in Attachment 10. The demineralized water is pressurized by the centrifugal water injection pump and the water flows through a duplex water injection filter, where it is filtered to 25 microns. Two identical water injection pumps are provided in the system (primary and standby) for redundant system. If there is a pump failure, the operator, after investigating the cause of the failure to verify the problem is not related to water supply or piping problems, can then select the standby pump from the human

machine interface (HMI) screen. The standby pump becomes the primary pump and the operator can enable the water injection system. Necessary pressure and temperature instrumentation allow remote monitoring of the water injection system on the auxiliary skid. The water injection pumps require a variable speed controller for operation. This is recommended to be placed in close proximity to the Turbine Control panel. One controller is provided per pump.

Main Skid

Water flow enters the main skid piping at an operating pressure of 800-880 psig/5.5-6.1 MPag for gas fuel operation and 955-1100 psig/6.6-7.6 MPag for liquid fuel. An electrically actuated water injection flow-metering valve modulates de-mineralized water flow to the engine manifold and to the water return in response to data received and processed by the control system. Downstream of the metering valve, de-mineralized water flows through a solenoid shutoff valve which opens when the control system commands the water injection system active and closes when the GTG set is stopped or the water injection system is commanded off. A flow transmitter sends a signal to the digital control system providing flow data used to calculate total water use and, in return, calculate the water-to-fuel ratio.

When the system is not in operation, any water in the manifold piping drains from the system through a manifold drain solenoid valve. Pressure in the downstream piping blows any residual water out of the system. The gas fuel purge flow from the engine manifold assists in clearing residual water from the system piping. Necessary pressure and temperature instrumentation allow remote monitoring of the water injection system on the auxiliary and main skids. All piping is stainless steel, and the valves are trimmed with stainless steel.

Winterization to 0°F

This includes, but not limited to the following modifications depending on the level of winterization required:

- Heat tracing and insulation of applicable unit mounted piping
- Enclosing and heating exposed instruments and equipment, as selected by Contractor.
- Winterization enclosures for the auxiliary skid, as selected by Contractor. The enclosures, when required, protect equipment in cold weather and are equipped with hand held fire extinguishers.

Totally Enclosed Water-Air Cooled Generator (TEWAC)

Totally Enclosed Water-Air Cooled Generator (TEWAC), 2-pole generator operating at 13.8 kV, 60 Hz. Generator is capable of handling City power requirement throughout a wide ambient temperature range. The generator includes a brushless excitation system with permanent magnet generator. Neutral and line side cubicles are included. The generator nameplate rating will be based on 0.85 power factor, although performance data and guarantees may be based on another power factor. Rotor removal tools are included.

A closed circuit air system with water/air cooling in place of the filtered air-cooling system is provided. City must supply 618 gpm (2,339 lpm) of treated water, 100 °F (37.8 °C) for cooler, to the generator at above 30 psig up to maximum design pressure of 100 psig (690 kPag). If the cooling water is to be reused, a City supplied circulation water-cooling loop should be sized to reject up to 958 kW, 3,272,000 BTU / Hr.

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Gearbox

The Unit is supplied with a gearbox that reduces the turbine shaft speed from 3905 to 3600 RPM for 60 Hz applications.

The gearbox is a double helical parallel shaft speed reduction machine. It has a pinion shaft, a gear shaft, torque limiting device, turning gear, lube oil cooling and lubrication system, and bearing temperature and vibration probes. The pinion shaft is supported by two (2) split sleeve bearings lubricated by a pressurized mineral oil system as well as for gear shaft. The design has combined the requirements from both API 613 and AGMA 6011 and other related AGMA standards. A Safe Set torque limiting device is placed between torque shaft and quill shaft to protect drive train equipment including gas turbine, coupling, and generator. The turning gear for the whole drive train is mounted on the non-drive end of pinion shaft. It provides the power to turn the whole low speed drive train shaft for various purposes, such as starting and motoring.

Gas Vent Line Silencers

Contractor shall design and provide two (2) silencers for gas fuel vent lines (SOV-2006 and SOV-2004) as shown on fuel system F&ID 969260 drawing for installation by others. All vent pipings are for others to furnish and install.

Generator Protection Relays

The package is supplied with redundant microprocessor-based generator protective relay modules, mounted in the TCP. The protective relay system includes functions necessary for protection of the generator. One Beckwith M3425A and one SEL-300G3 multifunction generator protection relays including the comprehensive protection function are provided.

Digital Control System

The package is supplied with a free-standing Turbine Control Panel (TCP) suitable for mounting in an indoor, non-hazardous area. The control system features an integrated turbine control system, vibration monitor, digital meter, digital generator protective relay module and an HMI (human machine interface) display of key discrete and analog data. Alarm and shutdown events are displayed on the HMI automatically. An Ethernet TCP/IP Port is provided to transmit unit conditions (status, pressures, temperature, etc.) to the City's distributed control system. The HMI is a panel mounted or desktop PC located next to the TCP. Power for the control panel shall be provided by a dedicated 24V DC battery system with dual 100% capacity chargers, which are part of BOP contractor scope of supply and installation. The Contractor’s interconnect cable schedule will show a calculation of 100ft of cable and the TCP must be installed within 100 meters of the gas turbine generator package.

Component Testing and Package Test

Every new gas turbine is performance tested under load in a Contractor’s Test Cell, using procedures developed for flight turbine reliability. The generator is tested to IEEE C50.13 standards at its factory of manufacture.

All gas turbine generator sets receive a static test including:

- Switch State (N.O. or N.C., actuation, wiring, and set point)
- Temperature element output and wiring
- Transmitter range, output, and wiring
- Solenoid operation
- Control valve torque motor, excitation, and return signal
- Fire system continuity, and device actuation
- System flushing verification
- Tubing integrity

Drawings, Data and Manuals

Refer to Attachment 11 in the contract.

Training

Refer to Attachment 14 in the contract.

Improvements and Changes

It is understood that the Contractor has the right to make changes in product design and add improvements to products or services at any time without incurring any obligations to install the same on or in connection with the Equipment or Services provided hereunder.

Performance Testing

Contractor will furnish an on-site test representative to be present during the execution of the gas turbine performance test for power output and heat rate. All other performance test personnel, emissions testing, noise testing and other tests are the responsibility of the City.

Remote Monitoring and Diagnostics

During the Equipment Warranty period, Contractor provides a remote monitoring and diagnostic service which includes remote monitoring of key gas turbine generator set parameters by Contractor's technical representatives at one of its remote monitoring centers. City will also have access to the call center (known as Quick Response Center) whereby Contractor's representatives may begin assessing and diagnosing monitored equipment issues over the phone.

City will provide, if requested by Contractor, a high-speed connection to the internet and IT support in the configuration of the Virtual Private Network (VPN) as required for installation and for connection to Contractor's remote monitoring center.

Remote Workstation

Contractor will furnish four Remote Work Stations, Remote Human Machine Interface, ("HMI") for the LM6000 gas turbine package, which shall provide full control of the Gas Turbine Generator Set with the same functions as the local HMI.

The module consists of:

- High Performance Desktop PC System equipped with an Ethernet TCP/IP serial port for communication with the CONTRACTOR Control System (good for communication up to 300').
- Animated graphical displays of the turbine, generator, and auxiliary system analog and digital parameters.
- Historical logging and trending system that can store/display historical data.
- Includes the capability to provide periodic reports
- Provides the capability to start, stop, and control the gas turbine generator system after a manual switch on the Turbine Control Panel is switched to remote control.

Professional Engineering Stamp

California Professional Engineering stamp of foundation, loading drawings, fire system drawings and concentration calculations are provided.

Codes and Standards

Contractor considers the applicable sections of the following US and ISO Codes and Standards to be the most relevant standards for gas turbine equipment. Our designs and procedures are generally compliant with applicable sections of the following:

ANSI A58.1	Minimum Design Loads for Buildings and Other Structures
ANSI B1.1	Unified Inch Screw Threads
ANSI B1.20.1	Pipe Threads
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory-Made Wrought Steel Butt Welding Fittings
ANSI B16.21	Non-Metallic Flat Gaskets for Pipe Flanges. (Spiral-wound gaskets per API 601 may be used, particularly in turbine compartment piping)
ANSI B31.1	Pressure Piping and Gas Turbine Piping Systems Comply
ANSI B133.2	Basic Gas Turbine
ANSI B133.3	Gas Turbine Auxiliary Equipment
ANSI B133.4	Gas Turbine Controls and Protection Systems
ANSI B133.5	Gas Turbine Electrical Equipment
ANSI B133.8	Gas Turbine Installation Sound Emissions
ANSI/NAFPA 12	Carbon Dioxide Extinguishing Systems
ANSI/NFPA 70 National Electrical Code	
ANSI/IEEE C37.90	Standard for Relays and Relay Systems Associated with Electrical Power Apparatus
ANSI C37.90A/ EEE-472	Guide for Surge Withstand Capability (SWC) Tests
ANSI C50.10	General Requirements for Synchronous Machines
ANSI C50.14	Requirements for Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators

ANSI C57.94	American Standard, Guide for Installation and Maintenance of Dry Type Transformers
ANSI C83.16	Relays Associated with Electrical Power Apparatus
ANSI/IEEE 100	IEEE Standard Dictionary of Electrical and Electronic Terms
ANSI/NEMA MG1	Motors and Generators
ANSI/NEMA MG2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motor and Generators
ANSI S1.2	Method for the Physical Measurement of Sound
ANSI S1.4	Method for the Measurement of Sound Pressure Levels
ANSI S1.13	Specification for Sound Level Meters
ANSI S6.1/ SAE/J184A	Qualifying a Sound Data Acquisition System
AGMA 6011	Standard Practice for High Speed Helical and Herringbone Gear Units
API 613	Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry
API 614	Lubrication, Shaft Sealing, and Control - Oil Systems for Special Purpose Applications
API 616	Gas Turbine for Refinery Services
API 650	Welded Steel Tanks for Oil Storage
API 670	Vibration Monitoring System
API 671	Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services
API 678	Accelerometer Based Vibration Monitoring Systems
API RP11PGT	Packaging Combustion Gas Turbines
ASME PTC22	Gas Turbine Power Plants - Performance Test Codes
ASME SECTION VIII	ASME Boiler and Pressure Vessel Code
ASME SECTION IX	ASME Boiler and Pressure Vessel Code
ANSI IEEE C37.2	Electrical Power System Device Function Numbers (Contractor complies with respect to device designations except that in a few case device number had to be modified or added to fit Contractor's needs).
IBC 2009	International Building Code
IEEE STD 421	IEEE Standard Criteria and Definitions for Excitation Systems for Synchronous Motors
EIA RS-232	Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange
EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
CAN/CSA 22.2 No. 1010.1-92	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
ANSI/ISA S82.02.01 1999	Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment - General Requirements
UL 796	Printed Circuit Boards
ANSI IPC Guidelines	
ANSI IPC/EIA Guidelines	

EN 55081-2	General Emission Standard
EN 50082-2	Generic Immunity Industrial Environment
EN 55011	Radiated and Conducted Emissions
IEC 61000-4-2	Electrostatic Discharge Susceptibility
IEC 61000-4-3	Radiated RF Immunity
IEC 61000-4-4	Electrical Fast Transit Susceptibility
IEC 61000-4-5	Surge Immunity
IEC 61000-4-6	Conducted RF Immunity
IEC61000-4-11	Voltage Variation, Dips & Interruptions
ANSI/IEEE C37.90.1	Surge
EN 50021 Electrical	Apparatus for Potentially Explosive Atmospheres
CAAA	Clean Air Act and Amendments Comprehensive Environmental Response, Compensation and Liability Act of 1980.
CFR	Code of Federal Regulations
Title 29,	Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FAA	Federal Aviation Administration Regulations
NERC	North American Electric Reliability Corporation (Reference to generator and excitation system only)
Cal/OSHA	Title 8, Ladders, Platforms & walkways.
CALTRANS	State of California Department of Transportation, Standard Specifications and applicable Special Provisions and Reference Specifications, as last Revised
CBC	California Building Code, 2010 Edition, (Including Title 24 – Requirements for California PE Stamped Finite Element Analysis)
CCRs	California Code of Regulations • Business and Professions Code Section 6704, et seq.; Section 6730 and 6736. (Requires state registration to practice as a Civil Engineer or Structural Engineer in California). • Vehicle Code Section 35780, et. Seq. (Requires a permit for Cal-trans to transport heavy loads on state roads).

Contractor's Gas Turbine Drafting Standards are based on the following Standards as appropriate to the gas turbine. Please note that in several instances, symbols, etc. have been devised for Contractor's special needs (such as flow dividers and manifolds:

ANSI Y14.15B	Electrical and Electronics Diagrams (On base gas turbine and accessory base equipment)
ANSI Y14.17	Fluid Power Diagrams
ANSI Y14.36	Surface Texture Symbols
ANSI 299/IEEE 315	Graphic Symbols for Electrical and Electronics Diagrams
ANSI Y32.10	Graphical Symbols for Fluid Power Diagram
ANSI Y32.11	Graphical Symbols for Process Flow Diagram
ANSI Z32.2.3	Graphical Symbols for Pipe Fittings, Valves & Piping
AWS A2.0-68	Welding Symbols

Once Through Steam Generator

Introduction

The Once Through Steam Generator (OTSG) is designed to match the operating characteristics of the GE gas turbine to provide the optimum performance for the total power plant cycle. The OTSG is designed to be fully integrated into the combined-cycle system and includes required inlet/outlet ductwork, structural supports, piping and accessories.

Significant features of the OTSG are:

- Modular box design provides short installation cycle
- Fast startup and shutdown capability
- Operational flexibility

General Description

The OTSG is a single-pressure level, non-reheat, unfired, forced circulation type steam generator with vertical gas turbine exhaust gas flow through horizontal tube heat transfer sections. The heat transfer sections are configured to obtain optimum exhaust gas energy utilization based on thermo-economic considerations. The typical heat transfer section configuration is shown on the OTSG Flow Diagram in the Mechanical/Fluid Systems Diagrams Attachment 1.

Feedwater flows through the heat transfer sections counter to the exhaust gas flow and is progressively heated, evaporated and superheated as it passes through the unit.

Heat transfer in the OTSG is accomplished through convection in the banks of externally finned tubes. The tube and fin geometry and tube pitch configuration are selected to match the specification and to optimize the performance. The tubes are made of material capable of exposure to high temperatures.

The OTSG casing and ductwork are welded construction, gas tight, and stiffened to withstand internal gas pressure and external loads. The casing and ductwork are insulated and lagged to reduce heat loss and provide personnel protection. The insulation and lagging is applied internally. The insulation and lagging materials, finishes and application methods are selected to meet the environment and the operating parameters of the gas turbine.

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Casing and duct work may be insulated internally or externally depending on the final configuration. The insulation is designed to limit surface temperatures as required by the contract. Internal insulation and liners are typically pre-installed at the factory; external insulation and lagging is typically installed in the field. Vents and drains required for the startup and operation of the OTSG are provided. In addition, all steam/water sample and chemical injection connections are provided.

A system of platforms, stairways and ladders is provided for inspection and maintenance access to valves, instrumentation and access doors. Each lane is typically equipped with an access door.

The OTSG will be supplied by Innovative Steam Technology (IST) who have been reviewed and approved by Contractor.

The preliminary combined-cycle water, steam and exhaust gas circuits are shown on the Heat Balance Diagrams contained in Attachment 1.

The water, steam and exhaust gas terminal points, and the typical control and instrumentation device arrangement, are shown on the OTSG Flow Diagram contained in the Mechanical/Fluid Systems Diagrams Attachment 1.

Codes and Regulations

The OTSG proper is designed and fabricated in accordance with the rules of Section I and Section VIII of the ASME Boiler and Pressure Vessel Code.

The OTSG external piping is furnished in accordance with the requirements of ANSI/ASME B31.1, Power Piping and ASME, Section I, Boiler and Pressure Vessel Code.

For purposes of establishing a base, the editions of the ASME and ANSI/ASME at the contract date are utilized. Where actual design of the equipment to the requirements of codes and standards mandated by the date of contract award or thereafter result in a change in the cost of the equipment and/or services provided. The contract price shall be adjusted accordingly.

OTSG Major Components (Typical)

Heat Transfer Sections

Feed water flow through the inlet is counter to the exhaust gas flow, from the inlet to the outlet header through the multi-pass arrangement of finned tubes. The tube sections in the OTSG are such that no discernible distinction is made between economizer, evaporator and superheater.

High Pressure Section

Feed water is piped from the feed water system to the inlet header from which it flows through an arrangement of finned tubes to the outlet header. The flow is counter to the exhaust gas flow. The super heater section raises the steam temperature from saturation to a superheat temperature consistent with the gas turbine exhaust gas conditions and requirements of the steam turbine.

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Gas Turbine Exhaust Ductwork System and Stack

An exhaust ductwork system is provided to deliver the gas turbine exhaust gas from the gas turbine through the OTSG.

The exhaust gas stack on an OTSG is typically rectangular and is typically an extension of the ductwork.

A stack damper and silencer are supplied. The ductwork system is designed to minimize pressure drop and distribute the exhaust gas uniformly.

Emission test ports are provided in the stack for emission testing along with associated access and personnel protection, where required.

Selective Catalytic Reduction Catalyst (SCR)

The selective catalytic reduction (SCR) system is designed to reduce nitrogen oxides (NOx) pollution in the gas turbine exhaust gas to a level stated in the "Performance Guarantees" Attachment 6 of this document.

The SCR system is comprised of a NOx catalyst supported within a modular framework. This module, together with inlet and outlet flanges and transitions, becomes an integral portion of the OTSG. It is positioned within a specific temperature range along the gas path in order to support the catalytic reaction involved in the removal of nitrogen oxides from of the exhaust gas. An ammonia injection grid with an aqueous ammonia system is also supplied as part of the SCR system. The grid is located upstream of the catalyst. The control unit, in response to sensors and instrumentation, regulates ammonia dilution and injection. A skid-mounted ammonia flow control unit including two (2) ammonia dilution air fans and motors, ammonia/air mixing chamber, aqueous ammonia evaporation system and dilution air heater is provided as part of the complete system.

The OTSG is capable of operating dry with out and heat transfer upstream of the catalyst. Two dilution air fans are provided. The air dilution system is sized to reduce the dry run temperature entering the OTSG to 800°F which corresponds to the SCR operating temperature.

The SCR Catalyst shall have a design life of five (5) years

Oxidation Catalyst (OC)

The oxidation catalyst (OC) system is designed to reduce carbon monoxide (CO) in the gas turbine exhaust gas to a level stated in the "Performance Guarantees" Attachment 6 of this document.

The oxidation catalyst module shall consist of suitable substrate, washcoat and catalytically active material bonded together.

Catalyst materials shall be shop-fabricated into a removable module that can be easily slipped in or out of the housing.

The CO Catalyst shall have a design life of six (6) years

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Support Structure, Stairways, Ladders and Platforms

The OTSG heat transfer sections, inlet/outlet ductwork systems are supported by a structure designed in accordance with the equipment data, the site conditions and applicable structural codes and standards.

Stairways, ladders and platforms are provided for operation and maintenance access to valves, instrumentation, stack damper motor, and emission test ports. All stairways and platforms are provided with handrails and kick plates. Platform grating and stair treads are typically open, hot dipped galvanized.

Piping

OTSG interconnecting piping is provided to transfer the water and steam between the heat transfer sections and OTSG modules.

Accessories

Instrumentation, controls and valves are provided in accordance with the OTSG Flow Diagram contained in the Mechanical/Fluid Systems Diagrams Attachment 1and in accordance with ASME, Section I, Boiler and Pressure Vessel Code.

The OTSG shall be given a final coat of primer in the shop. Touch up primer shall be shipped with the OTSG to the field for use by the BOP Contractor.

City Inspection

The City has the right to inspect the OTSG and parts thereof during fabrication to verify that the equipment/materials are supplied in accordance with the Scope of Work. A fabrication schedule will be submitted to permit the City to select appropriate times for inspection.

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Continuous Emissions Monitoring System

Scope

Contractor will provide one (1) CEM / DAHS system to monitor GTG exhaust gas emissions at the inlet to the SCR and at the Exhaust Stack exit. The equipment offered shall measure NOx emissions at the SCR inlet and NOx, CO, NH3 slip, and O2 at the Exhaust Stack Outlet.

The system proposed is a fully extractive sampling system. An 8ft x 10ft x 8ft walk-in shelter is provided to house the system components and is provided with a wall-mounted HVAC unit. The system will also consist of:

- Wall Mounted HVAC for shelter interior climate control
- Fully Extractive Sampling and Conditioning system
- Analyzer equipment to monitor NOx, CO, NH3 slip, and 0_2
- UPS (with 2.5 hour power supply) for PLC & Analyzers
- Multipoint Sample Probe for Stack Mounting (maximum flue gas velocity of 111 ft/sec)
- Single point probe for SCR inlet monitoring
- Field trimmable sample Umbilical Line (estimated length of 300 ft.) 150 ft. per sample point
- Calibration Gas Equipment Assembly
  - Startup / Initial run calibration gases
  - Gas Regulators for daily calibration gases
  - Gas cylinders & cylinder holders
- Data Acquisition & Handling System (DAHS)
  - DAHS Hardware in Control Room
  - DAHS Software /40 CFR Part 60 Configuration for Regulatory Reporting
- SCAQMD System RTU/Chart Recorders
- CEMS Plan, Test Protocols, QA/QC Plan, & Preliminary Monitoring Plan

The additional services are as follows:

- Start-up Technical Assistance: 4 days on site
- Training for Operators:
  - DAHS Operator Training – 1 day
  - Standard CEMS Training - 1 day
- Certification Testing and Support – 2 days

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Mechanical / Fluid

Equipment List

Component	Criteria	Description
Condenser	Heat Duty: 122 x10^6 BTU /hr @ 2.11 HgA	1x100% two pass stainless steel tubed water cooled condenser
Boiler Feed Pump	Flow: 280 GPM TDH: 732.4m	2x100% horizontal multi stage ring pump with VFD capable electric motor
Condensate Pump	Flow: 350 GPM TDH: 650 ft	2x100% vertical can multi stage constant speed electric motor driven centrifugal pump
Vacuum Pumps	FLOW =7.5 scfm SUCTION PRESS. = 1.0_ in. HgA per HEI	Liquid ring mechanical vacuum pumps
Condensate Purification Equipment	Flow: 169667 kg/hr	2x100% precoat type polishers
Critical Control Valves	HPBypass Flow: 156,100 lb/hr Recirc flow :40,000 lb/hr	1x100% full flow HP bypass per OTSG BFP recirc valve
Circulating water pumps	Flow 10100 GPM TDH: 80 ft	2x100% Vertical wet pip pump with fixed speed motor
Auxiliary circulating water pumps	Flow 2020 GPM TDH: 80 ft	3x50% Vertical wet pip pump with fixed speed motor
Cooling Tower	Flow 15,789 Range 21 F Approach 14F	Mechanical draft cooling tower 2 speed fans Fiberglass structure

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Acoustic enclosure	Pre-engineered steel structure (approximately 45'W x 65'L x 30'H)	STG Enclosure walls, roof, doors and ventilation system is based on meeting the in-plant and community noise level requirements
Instrument Air Compressors	skid-mounted, 2x 100% capacity air compressor	250 scfm 130 psig Outlet Dewpoint -40 deg F
Fuel Gas Compressors	2 x 100% skid mounted fuel gas rotary screw compressor	Min. Inlet pressure: 164.5 psig Outlet pressure: 730 psig Flow: 13 MMSCFD
Inlet Air Chiller	two (2) water cooled centrifugal chillers (2 x 50%)	Target Temp: 54 Deg F Capacity: 1720 tons total Flowrate: 2717 GPM
Electric Auxiliary Boiler	1x100% steam generator for steam seals and condenser sparging	Capacity: 1500 lb/hr Pressure: 150 Psi Electrical rating: 469 kW; 3 phase, 600V
Electric Seal Steam Superheater	1x100%	1,500 lb/hr 150 psi

Equipment Descriptions

Condenser

The unit will be equipped with a steam surface condenser. The condenser will be used to condense the exhaust steam from the steam turbines and deaerate the condensate prior to its use in the system. The condenser is also used to condense the dump steam during by-pass operation. Major components of the condenser include, but are not limited to the following:

- Hotwell sparging system
- Steam bypass dispersion headers internal to condenser
- Tubesheet leak detection trough

Boiler Feed Pump

Two (2) x100% boiler feed pump shall be provided. The feed pump is an electric driven multistage ring section variable speed design. The pump takes suction from the condensate pump and feeds to the HP section of the OTSG.

A multi stage ring section type pump is used for reliability and for easy maintenance. Minimum flow protection is provided by a pneumatic type minimum flow control valve (supplied by PIE Contractor) for each pump.

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Condensate Pump

Two (2) x100% condensate pump is supplied to transfer water to the boiler feed pump. A canned type pump is provided.

Minimum flow control is provided by a condensate recirculation flow control valve (supplied by others) located downstream of the gland steam condenser.

Condensate Purification Equipment

The following condensate purification equipment required for the once through steam generator design includes:

- 2x100% full flow precoat type polishers
- Isolation valves
- Instrumentation for monitoring and control
- Base mounting of equipment for easy field installation

Critical Control Valves

Contractor will supply loose the following critical control valves for the power island:

- HP bypass valves (and desuperheating control valves)
- HP feed pump recirc valve

The valves shall be supplied with the proper trim design to ensure proper operation over the full range of operation and shall also be provided with feature necessary to stay within required noise limits.

Acoustic Enclosure

STG Enclosure walls, roof, doors and ventilation system is based on meeting the in-plant and community noise level specified.

- Building frame designed for the applicable codes and local conditions present in Pasadena, California
- Acoustic assemblies consist of a galvanized 24 gauge exterior cladding (standard 1½" deep profile), a custom blended acoustic insulation and a galvanized custom perforated interior liner
- Pre-engineered steel structure: removable walls and roof and personnel access doors with perimeter seals
- Ventilation system design based on a total equipment heat rejection of 110 kW
- Four (4) wall mounted air intakes, Two (2) 5 hp roof ventilators, 8 7kw unit heaters

Instrument Air Compressor

Contractor will provide one (1) skid-mounted, 2x 100% capacity air compressor sufficiently sized for the instrument air requirements for the LM6000 PG GTG package and combined cycle power island equipment. The air compressor system will be a self-contained package including:

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- a PLC control and indicator panel,
- air dryer,
- coalescing pre-filters,
- particulate after-filters
- air receiver

Instrument Air Compressor System design specification is as follows:

Compressor Type	Rotary screw (Oil free)
Rated Flow, scfm	250
Rated Pressure, psig	130
Air Dryers	Dual Tower Desiccant (Heatless)
Outlet Dewpoint (^{o}F)	-40
Receiver Capacity (gallons)	1060

Fuel Gas Compressor

Contractor will provide a 2 x 100% skid mounted fuel gas rotary screw compressor systems for the LM6000PG combustion turbine. Each of the (2) two skid mounted gas compressor skids will provide the fuel gas flow required for one (1) LM6000 GT. Each of the two (2) gas compressor systems are skid mounted and includes the following equipment:

- One (1) Inlet Suction Scrubber
- Rotary screw type gas compressor
- Electric motor,
- Oil separator
- Duplex Fuel Gas Filter/Coalescer
- Lube oil pump
- Shell & tube cooler for lube oil
- Fuel gas recycle valve
- Fuel gas discharge shell & tube cooler
- PLC control panel
- Isolation valves and appropriate instrumentation
- Sound Attenuation walls to reduce near field noise to $\leq$ 85 dBA.

Gas compressor design basis is as follows:

Parameter	Units	Value
Gas Type		Natural Gas
Fuel gas Inlet pressure (minimum)	psig	164.5
Fuel gas inlet pressure (maximum)	psig	200
Fuel gas Inlet flow	MMSCFD	13

Fuel gas Suction Temperature	^{o}F	77
Fuel Gas Compressor outlet pressure	psig	730

GTG Inlet Air Chilling/Heating

Contractor will provide a packaged modularized inlet air conditioning system that will allow for conditioning of the GT inlet air. The system is designed to operate in the following air conditioning modes:

- GT Inlet Air Chilling
- GT Inlet Air Heating

In the inlet air chilling mode, the turbine inlet combustion air temperature is decreased for the LM6000 PG GTG package to maintain the desired power output during hot day conditions. The package consists of two (2) water cooled centrifugal chillers (2 x 50%) mounted on a heavy structural steel skid with packaged piping, valves, chilled water pumps, MCC's and controls installed and pre-wired. The chiller system will be prefabricated to the maximum extent possible such that field installation consists of setting chiller skids on the customer provided foundations, connecting utility services and control interfaces, and interconnecting chilled water and cooling water piping between modules and cooling coils.

The package is designed to require a single MV power feeder and a single LV power feeder. All MV and LV MCC's, bus connections, and step-down transformers to utility and control voltages are included and pre-wired within the chiller package to minimize field wiring required at the site. All switchgear, starters, and control enclosures are located in the climate controlled "dry room" within the overall package enclosure. A weatherproof insulated enclosure will be provided over the skid to provide weather protection and acoustical attenuation as well as thermal insulation:

The design basis for the GTG Inlet air chilling mode is:

Elevation		751 ft.
Ambient Design Point Dry Bulb Temperature		97 ^{o}F
Ambient Design Point Wet Bulb Temperature		77.34
Target T2 GT inlet air Temperature		54 ^{o}F
Chilling Tonnage		(2 x 860 Tons) 1720 tons total
Chiller Plant Parasitic load		
Fluid	Water/Dynalene HC-10	1,212 kW
	Water/25% Propylene Glycol (PG)	1,264 kW
Condenser Water Flow Rate		2717 GPM
Condenser Water Supply Temperature		85 ^{o}F

***Note:** The above design parameters are estimates and are subject to modifications during the detailed design phase project execution phase.

The chilling system proposed will consist of:

- Two (2) 860 TR Nominal Centrifugal Chillers (4160 V, 60 Hz Motors)
- 3 x 50% Primary fixed speed Chilled Water Pumps
- Allen Bradley PLC Control System
- Structural Steel Base
- Factory Packaged Enclosure painted Ameron PSX700 GE Pearl Grey
- HVAC Unit for module climate control
- Exhaust Fans and Louvers
- Refrigerant Monitoring and ventilation per ASHRAE 15
- Lifting Lugs
- Low Voltage (LV) MCC
- High Voltage (HV) MCC
- Service Monorail for pumps
- Temperature Control Valves

In inlet air heating mode, a shell & tube heat exchanger is provided. The heat exchanger will utilize extraction steam from the Once Through Steam Generator (OTSG) to heat the fluid contained within the chilled water closed loop. The system will utilize the chilled water pumps and temperature control valve to provide the hot water flow to the GTG inlet coils in order to increase the GTG inlet air temperature. The heat exchanger skid for inlet heating will include:

- One (1) Carbon Steel Shell & Tube Heat Exchanger designed and constructed to ASME Sec. 8 Div. 1
- Miscellaneous valves and fittings
- Painted Carbon steel base frame.

The design basis for the GTG Inlet air heating mode is:

<table>
<tr><td colspan="3">Ambient Design Point Dry Bulb Temperature</td><td>32 ^{o}F</td></tr>
<tr><td colspan="3">T2 GT inlet air Temperature</td><td>140 ^{o}F</td></tr>
<tr><td rowspan="6">Heated Fluid Coil data</td><td rowspan="3">Dynalene –HC10</td><td>Coil Entering Fluid Temp</td><td>145 ^{o}F</td></tr>
<tr><td>Coil Leaving Fluid Temp</td><td>128.3 ^{o}F</td></tr>
<tr><td>Fluid Flow rate</td><td>2500 GPM</td></tr>
<tr><td rowspan="3">25% PG</td><td>Coil Entering Fluid Temp</td><td>145 ^{o}F</td></tr>
<tr><td>Coil Leaving Fluid Temp</td><td>128.7 ^{o}F</td></tr>
<tr><td>Fluid Flow rate</td><td>2500 GPM</td></tr>
<tr><td colspan="2" rowspan="3">Heat Exchanger Supply steam properties</td><td>Pressure</td><td>167.7 psia</td></tr>
<tr><td>Temperature</td><td>570 ^{o}F</td></tr>
<tr><td>Mass flow rate</td><td>17.37 kpph</td></tr>
</table>

***Note:** The above design parameters are estimates and are subject to modifications during the detailed design phase project execution phase.

A central *controls system* will be provided for controlling the entire inlet air conditioning system for heating and cooling modes. The system proposed will monitor and control the chiller and all chiller related auxiliary equipment. Operation and monitoring of the system will be provided, locally, through full color graphical touch screen HMI interface mounted in the package which will control gas turbine inlet temperature from operator selection of gas turbine inlet temperature target.

To be supplied by others:

- MV and LV electrical feeds to the module electrical room.
- Cooling Water interconnect piping for chiller condenser heat rejection from plant cooling tower.
- Chilled water Interconnect piping between Chiller Package, Shell & Tube Heat exchanger, and GTG inlet Air Coils.
- Extraction Steam interconnect piping between Inlet heating Shell & Tube heat exchanger skid and OTSG extraction steam header (or designated tie-in point)
- Extraction Steam pressure control valve to condition supply steam from OTSG to the heat exchanger design conditions.
- External electrical and controls wiring
- First fill of Chilled Water Fluid (Dynalene HC-10)

Duplex Fuel Gas Filter Coalescer

Contractor will supply one (1) skid mounted, duplex (2 x 100%) coalescing gas fuel filter skid. The skid will be placed near the gas turbine generator package. Fuel gas piping will consist of carbon steel upstream of the duplex coalescing filter skids, and stainless steel downstream of the skids. The skid will come complete with following design features:

- Vessel to be ASME Section 8 Div. 1 (2001 Edition) designed and code stamped
- Vessel to include separator designed for removal of 99.9% of particles (1 micron or larger)
- Stainless steel piping construction (304)

Instrumentation to include pressure gauges, level gauges, and pressure safety relief valves relief valves

- Isolation manual valves for maintenance purposes

SYSTEM DESCRIPTIONS

Main Steam System

The Main Steam System transfers steam from the Once Through Steam Generator (OTSG) to the steam turbine. The main steam system consists of the high pressure (HP) steam system.

HP steam exits the HP OTSG superheater and is directed to the HP steam header through a stop check valve. The HP steam supply from the OTSG is provided with a bypass valve. The bypass valve is used for turbine startup and during plant upset conditions.

Instrumentation for measurement of pressure, flow, and temperature is provided. Drain valves and drain pots are provided as required to ensure proper removal of condensate from all steam lines during startup, shutdown, and normal operation.

Auxiliary Steam System

The auxiliary steam system is used to provide seal steam for the steam turbine shafts.

During normal operation seal steam is supplied from the HP steam system. During plant startup seal steam is provided by startup seal steam boiler.

The startup seal steam boiler also allows vacuum to be maintained overnight.

Auxiliary and seal steam temperature and pressure control will be provided as required by the final steam turbine design.

Contractor will furnish a packaged type, factory assembles electric auxiliary steam generator.

The boiler will furnish saturated steam for steam turbine seals and sparging. It will include a digital controller with a Modbus link for supervisory plant controls. The vessel shall be constructed in accordance with ASME Boiler Code.

An auxiliary feed pump will be included and would operate in parallel with the condensate pumps to forward condenser water to the auxiliary boiler.

Contractor will furnish an electric seal steam superheater to provide the required steam conditions.

Condensate System

The condensate system condenses the exhaust steam from the steam turbine and transfers the condensate to the boiler feed pump. The condensate system also supplies water for bypass desuperheating, chemical injection, hood spray, etc.

The condensate system consists of the following major components:

- Water Cooled Condenser
- Condensate Pump
- Gland Exhaust Condenser
- Vacuum pumps
- Condensate Purification System

The condenser is used to condense the exhaust steam from the steam turbine. Proper condensate level is maintained automatically by adding makeup water when necessary and dumping excess water when necessary to stay in the proper control range.

Two (2) x100% condensate pumps are provided. The condensate pump transfers condensate from the condenser to the boiler feed pump suction. Minimum flow protection is provided by the use of a minimum flow control valve. This valve also provides minimum flow through the gland exhaust condenser.

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Condensate Purification

A pre coat type polisher system is used to supply the OTSG with the proper quality feed water.

The system consists of 2x100% ASME vertical filter vessels, each with a set of filter elements with powdered resin coating. Dissolved solids are captured in the pre coat and suspended solids are retained in the surface of the filter elements. When the filters are at capacity, they are taken off service, backwashed, and a new layer of resin is applied.

The system is controlled by a local PLC. Backwash and recoating are manually initiated by the operator based on system operating parameters. The actual backwash and recoating operations are fully automated.

Additional equipment includes recirculation pump skid, injection pump skid, backwash receiving tank, air receiver, and dewatering bags.

Condenser Air Removal System

The purpose of the condenser air removal system is to create and maintain the condenser vacuum by removing air and non-condensable gases.

Two (2) by 100% liquid ring vacuum pumps are supplied. During hogging both pumps are operated to evacuate the condenser. For vacuum holding operation one pump is in operation and the second pump is in standby.

Cooling is provided through the auxiliary cooling loop system.

Feedwater System

The feedwater system delivers feedwater from the condensate pump discharge to the HP section of the OTSG.

The OTSG is provided with two (2) x100% multi stage ring section type feedwater pumps.

The required minimum flow through each pump is provided by pneumatic minimum flow recirculation control valve.

Feedwater is also used for HP steam desuperheating.

Circulating Cooling Water

Circulating cooling water is provided by two (2) x 100% capacity circulating water pumps located in the cooling tower basin. The circulating cooling water flows from the bottom of the cooling tower to the cooling tower basin. The circulating water pumps discharge into a common header which supplies cooling water to the surface condenser. The circulating water is heated as it passes through the surface condenser. The hot circulating water discharges from the surface condenser and is directed back to the cooling tower.

Three x 50% auxiliary circulating water pumps are provided in the same basin. These pumps supply cooling water to the auxiliary cooling water heat exchangers, the vacuum pumps and the inlet chilling

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system. Water is returned via the condenser circulating water return line to the cooling tower. This cycle operates independent of the main circulating water pumps to permit simple cycle operation without running the main circulating water pumps.

The evaporative cooling tower is an in-line, multi-cell, counter-flow, mechanically induced draft design. The circulating water is directed to the top of each cell by means of riser pipes and directed to a distribution header from where it is discharged through spray nozzles. The water is cooled by evaporative cooling and sensible cooling as it falls down the tower packing, and comes in contact with cooling air drawn by fans mounted on the top deck of the cooling tower.

The cooling tower blow down is taken downstream of the circulating water pumps. Raw water is used to make up the circulating water losses due to evaporation, drift and blowdown. Raw water header from the plant boundary will be divided to supply make up water to the cooling tower basin and water to other miscellaneous users.

The cooling tower will be supplied to meet the slope requirements of the cooling tower basin, to be designed by the BOP contractor. Any additional fiberglass column length has been accounted for by Contractor as part of this scope of supply.

Sampling and Analysis

The Sampling and Analysis System by BOP Contractor provides a means to monitor the performance of the steam-condensate-feedwater cycle, to monitor the quality of various process fluids and to provide sufficient data to operating personnel for detection of any deviations from control limits so that corrective action can be taken.

Samples are withdrawn from the system and directed to a centrally located sample panel. At the sample panel the steam and water samples are properly conditioned and then directed to the analyzers. Provisions for grab sampling are also provided at the sample panel.

The typical sample points and analyses are as follows:

Sample Point	**Analyses**
Condensate (before polisher)	Conductivity, pH
Condensate (after polisher, before chemical injection)	Conductivity, pH
Boiler Feedwater (condensate after chemical injection)	Conductivity, cation conductivity, pH, O2
HP superheated steam (one point per OTSG)	Cation conductivity, degassed cation conductivity, sodium
Auxiliary Steam	Cation conductivity
LP superheated steam (one point per OTSG)	Cation conductivity
Demineralized Makeup water	Conductivity (in situ)

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Circulating Water	Conductivity, pH

The component cooling water system for the steam turbine and gas turbine is monitored by periodic grab sample.

Final sampling system design (sample points, analyses) depends on the final plant design.

Steam Cycle Drains

The steam cycle drains system is divided into two separate subsystems: vacuum drains and atmospheric drains.

The vacuum drains are directed to a receiver header and then gravity flow back to the condenser hotwell.

The atmospheric drains are directed to a flash tank that is vented to atmosphere. These drains are pumped to the cooling tower basin.

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Terminal Points

General

This section along with the drawings included in the Drawings / Diagrams Section of this proposal define and locate the limits of supply, terminal points and interface points. Terminal points shown on the drawings take precedence over the information provided in this section. For specific terminal point conditions, refer to the "Design Criteria/Assumptions" Tab.

Terminal Points

Gas Turbine	
All piping, including Fuel Gas, Cooling Water, Demineralized Water, Lube Oil, Compressed Air, Instrument Air, Hydraulic Start Oil	Flanged or threaded connection on Contractor baseplate for turbine generator and accessory skids
Inlet Air-to-Filter	Atmosphere
Turbine Package Ventilation/Cooling Air	Atmosphere
Instruments on Contractor's Baseplate	Terminal box on baseplate
Instrument/ communication wiring in Turbine Control Panel	Terminal in Turbine Control Panel
High Voltage Connections	Bus bar in Contractor's Lineside cubicle
Generator Ground Connections	Contractor's Neutral cubicle
Electric Motors	Terminal box on individual motor
Ladders and Platforms for Air Filter	Ladders and Platforms for Inlet Air Filter maintenance only
DC Power Supply for Control System and Fire and Gas Systems	Terminal in Turbine Control Panel
Inlet Air Chiller chilled water supply and return	Flanged connections at the filter house and the chiller

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Steam Turbine	
Steam	Inlet to main stop valve , , Seal system connections, gland steam return, and Gland condenser inlet,
Condensate	Inlet/outlet to gland seal condenser and LP hood spray connection on casing
Cooling Water	Inlet/outlet to hydraulic coolers , Inlet/outlet to lube oil cooler and inlet /outlet of generator TEWAC cooler
Hydraulic Oil	Inlet/outlet to hydraulic power unit and connections at valves
Lube Oil	Inlet/outlet to lube oil skid and connections at turbine/generator bearing PURCHASER connections
Drains	Connections on stop and admission valves, Connections on turbine casing and Outlet to gland seal condenser
Non-Condensable	Discharge on gland seal exhauster
OTSG	
See M195 in the drawings section for OTSG terminal points	
MECHANICAL BALANCE OF PLANT	
Inlet/Outlet of supplied balance of plant equipment and at drain/vent connections. Refer to flow diagrams in Tab 34 for terminal points	

Electrical, Instrumentation and Controls

Generators	Generator Line Accessory Compartment (GLAC)
Generators	Generator Neutral Accessory Compartment (GNAC)
Data Line for Dedicated On Site Monitoring	A dedicated data line to each TCP is required for the On Site Monitor (OSM) system

Civil / Structural

Foundation Interface	At underside of equipment base

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Engineering and Design, Drawings and Documentation, and Customer Collaboration

Engineering and Design

General

Engineering design and drafting services will be consistent with Contractor's standard design practices and follow as closely as practical the Owner's specified requirements.

After contract award, a staff of competent discipline engineers will develop the Contractor Engineering work scope defined herein with timeliness and in accordance with the specific requirements of the project.

Product design for the equipment supplied by Contractor, such as the gas turbine, steam turbine, generator, Once Through Steam Generator (OTSG), Continuous Emissions Monitoring System (CEMS) and their related auxiliary components will be provided.

Systems and Thermal Engineering

The following engineering services are provided for the Combined-Cycle Power Plant:

- Definition of the system technical design criteria and requirements, including the plant operating modes, presentation of the performance data, and the plant control requirements.
- Definition of the power cycle and the performance guarantees
- Preparation of performance curves for the expected performance for base load operation including correction data and curves for ambient pressure, ambient temperature and condenser pressure or cooling water temperatures. The curves will provide the necessary corrections to the boundary conditions of Contractor's performance guarantee.
- Preparation of cycle heat balance and performance data for the guarantee points and part-load conditions for the site ambient temperature range.

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Civil and Structural Engineering

No civil or structural design work is included. However, Contractor will provide foundation interface data for the equipment supplied in terms of loading, anchor bolt location requirements, and embedment and foundation sleeve requirements.

Mechanical Engineering

The following items are considered part of the overall mechanical design work:

- Specification and supply of the following plant equipment as included in the contract scope of supply:
  - Gas Turbine Generator
  - OTSG
  - condensate polisher
  - steam turbine generator (STG)
  - main condenser and air removal equipment
  - boiler feed pumps, condensate pumps and circulating water pumps, air compressor, fuel gas compressor, chiller, electric auxiliary steam equipment and cooling tower.
  - Procurement support for above plant equipment includes preparation of specifications, and review and approval of the equipment vendor drawings and design documentation.
  - Mechanical interface data for the equipment supplied, including outline dimensions, interface locations for supports, piping connections, vent and drain sizes and locations and maintenance clearances.

Electrical Engineering

The following items are considered part of the overall electrical design work:

- Preparation of one–line diagrams for the Contractor supplied equipment illustrating major power equipment and power circuitry. These drawings will indicate the ratings of the major electrical apparatus, as well as identify the instrumentation and protective relaying functions being provided.
- Electrical interface data for Contractor supplied equipment, including location of junction boxes, electrical terminal points, and grounding connections to enable the Owner to complete the electrical design for the plant.
- Specification and supply of the step-up transformer

Controls Engineering

The following items are considered part of the overall controls engineering work:

- GTG, fuel gas compressor and chiller control systems and interface
- Preparation of functional requirements of the OTSG and BOP controlled items in Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included.

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- Preparation of the Purchase Specifications, purchasing, review of supplier documents and drawings for:
  - Turbine Bypass Valves
  - Continuous Emissions Monitoring System

The following work is not considered part of the overall Controls Engineering work included in the base scope of supply:

- Logic drawings for control loops in the Contractor scope of supply
- On site or remote Engineering support during commissioning of the DCS.

Units of Measure, Drawing Approval, and Instruction Manuals

- The station installation drawings are prepared in English and/or SI units of measurement based on contractual requirements. As soon as practicable after the work is started a distribution list will be established to dispatch to the Owner drawings, diagrams, and material lists in CD/DVD and on-line formats.
- The Owner's engineer may review the electrical one–line, turbine generator mechanical outlines and flow diagrams for the Contractor supplied equipment before their use is permitted. Errors detected in any drawings submitted will be corrected. A distribution list for dispatching to the Owner's engineer drawings and diagrams in CD/DVD and on-line format will be established as soon as practicable after the design work is started. The above approval will not be cause for waiver of any responsibility for discrepancies and errors made by others, but not detected in the examination.

The approval time–cycle will be per the contract requirements.

- Instruction manuals that describe the modes of equipment operation and the necessary on–site maintenance for all items described herein will be delivered to Contractor's collaboration tool.

Typical Drawings and Documentation

Refer to Attachment 11 – Document Delivery Schedule:

Customer Collaboration

The GE Customer Collaborative Environment is a single portal that provides a **secure platform** for seamless communication and workflow processes that take place between Contractor, its customers, and suppliers worldwide. It is a medium over which all phases of a GE Energy Products project can be executed, from plant conception, through development, design, construction, commissioning, and operation.

Unique and valuable tools that are accessible from the environment help our customers make decisions related to plant design, construction, and operation. Since the collaborative environment is an Internet-based technology, it can be accessed from anywhere in the world, at anytime.

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Commissioning and Startup

General

The City will be responsible for the plant overall construction, pre-commissioning, commissioning, startup and testing. Contractor will support the commissioning activities with technical personnel; along with one additional advisor (Contractor commissioning advisor) to coordinate with the City the commissioning of the Contractor supplied equipment. The support of the Contractor commissioning advisor is typically based on a firm to schedule plan. Should the time be extended and this support continues to be required by the City a change order will need to be issued.

The project includes for the Contractor scope of supply the technical direction required to perform component and equipment commissioning, startup and testing. Overall plant coordination and scheduling responsibilities remain with City. Contractor will provide input to the overall commissioning schedule for Contractor scope of supply as defined in the contract.

The commissioning, startup and testing of equipment, components, instruments and systems are performed in accordance with the requirements of the equipment manufacturers and their suppliers. Testing methods, procedures and techniques applied are conducted in accordance with Contractor's standard practices and applicable codes and standards as set forth in this contract as interpreted by Contractor.

During the commissioning, startup and testing period, documentation, test and data records are maintained using Contractor standard forms and procedures for Contractor Supplied equipment.

The City will supply qualified and experienced mechanical, electrical, instrumentation technicians and skilled construction crafts support with supervision, to support all phases of the commissioning, startup and testing

Contractor sub-supplier service engineers for checkout, testing, startup and initial operation of equipment, components and systems are arranged and will be scheduled, as required.

After completion of the commissioning, startup and testing Contractor will participate with the City and constructor in a walk down of Contractor supplied equipment and systems. Contract deficient items will be corrected or added to the project punch list for completion.

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Scope of Work

Overall plant commissioning, startup and testing is divided into pre-commissioning support, commissioning and startup and testing advisory services. Services provided during these activities include coordinating with the City in preparing testing procedures for Contractor scope of supply. A commissioning advisor will be mobilized to technically supervise and provide coordination to complete the Contractor scope of supply commissioning, startup and functional testing per contract requirements.

Pre-commissioning Support

The Contractor commissioning advisor will provide input to the City's constructor in the field pre-commissioning activities to facilitate an efficient commissioning, startup and testing of Contractor equipment. The commissioning advisor will review necessary prerequisite component and system testing, cleaning, flushing, initial checkout and testing procedures and provide comments.

Contractor will provide recommended system turnover dates for the Contractor supplied equipment to support the planned first fire date.

City will develop pre-commissioning and system cleaning procedures. These procedures will be mutually agreed between the City and Contractor commissioning advisor where these systems interface with Contractor scope of supply.

Commissioning

The City has the overall plant commissioning management responsibility and to lead the commissioning, plant integrated functional testing, operation supervision of the power plant during pre-commissioning, commissioning, and system startup and testing until final acceptance.

Commissioning activities closely follow the construction and pre-commissioning activities and will commence after the system has been turned over from the constructor to the City's commissioning team. Prior to commencing the technical direction of Contractor's scope of supply, Contractor must accept, along with the City's commissioning team, the system turnover packages from construction for Contractor equipment.

The Contractor commissioning advisor will coordinate with the City's commissioning team in implementing the commissioning related administrative activities as it applies to Contractor's scope of supply. Typically the following:

- Attend daily startup meetings
- Give inputs to "Startup Plan of the Day"
- Give inputs to startup "Critical Action Item" list
- Establish "Startup Field Report" program for engineering support of field issues
- Give input to a control room log
- Maintain commissioning startup and testing records for Contractor's scope of supply

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Plant Startup and Testing Services

In addition, the Contractor commissioning advisor will provide technical advice the following typical startup and operational tests to demonstrate Contractor equipment operation and shutdown as defined in the contract. All startup and testing will be done in accordance with Contractor standard procedures and contract requirements:

- Advise on the checkout of Contractor equipment control logic
- Coordinate the Combustion system tuning
- Coordinate the Over speed trip test (if required)
- Coordinate Contract required operation testing to demonstrate Contractor equipment operation
- Coordinate the final turnover documents and coordinate orderly turnover of Contractor supplied equipment to the City's Plant Operations and Maintenance (O&M) personnel

City's Responsibilities

The City Construction and pre-commissioning of all plant equipment and systems, including Contractor scope of supply, in accordance with the design & specification requirements, including but is not limited to the following activities:

- Construction completion in accordance with the design & specifications
- Inspect, lubricate, stroke, adjust/set switches, etc. on manual, motor-operated and control valves and dampers
- Test and calibrate Contractor supplied plant and skid-mounted instrumentation as required. Flow meters (fuel, water and Sprint) must be removed for calibration. Calibration records are to be included in the turnover package.
- Craft labor and supervision, technicians, standard and special tools and services to calibrate, set and injection test all meters and protective relays
- Perform equipment cold alignment checks
- Initial motor uncoupled run-in checks, including vibration, temperature rise, in rush current test and balance (if required)
- Remove, inspect and reinstall orifice plates, flow nozzles and control valve spool pieces
- Ensure adequate supply of demineralized water to accommodate pre-commissioning testing and cleaning
- Hydrostatic testing of piping, vessels, OTSG, etc.
- Ground grid testing
- OTSG & Steam Systems Chemical Cleaning
- Steam systems Cleaning
- System Flushing

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- Setting and testing of all facility relays based on coordination study. This includes the primary and/or secondary injections to fully function test, calibrate and commissioning all relays associated with the facility.
- Continuity check of the electrical cables and "Cold Loop Checks"
- Megger test and high voltage insulation testing of electrical cables
- Phase and rotation checks for electrical motors
- Conduct pipe hanger surveys and set hangers to cold and hot settings

Lead the system turnover process, including but not limited to system construction & pre commissioning completion, assembling the turnover packages, quality documentation, system walkdowns and obtain Contractor acceptance prior to system turnover to Contractor commissioning for Contractor's scope of supply.

All craft labor, craft labor supervision, technicians, materials, consumables, initial fills, refills and top offs, standard tools, special tools and temporary equipment to perform all commissioning, startup and testing. This support will be required to be scheduled seven (7) days a week with 24 hours a day coverage as required.

Technicians to support electrical, instrument and control Hot Loop checks for all systems.

Storage, testing, treatment and disposal of all facility generated effluents.

Plant Chemistry Program implementation including Chemists, Technicians, Chemicals, Specific Chemical Injection Quantities and Rates, and Analysis Equipment.

Required analysis of gases and fluids including but not limited to demineralized water, fuel oil, fuel gas, lube oil and hydraulic oil.

For the systems where the City designed the Control Software, the City will assign to the site the necessary controls engineers to commission that software and equipment.

Support Contractor with all required Commissioning Reports, Plant Trip and Unplanned Event Reports

Routine equipment maintenance during the commissioning, startup and testing.

Contractor and the City will agree on the appropriate site EHS program, including the specific program to cover the Lock Out/Tag Out (LOTO) procedure. The City will implement the agreed to LOTO program.

All startup consumables, spare parts and materials.

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Steam Turbine & Generator Overview

Preferred Supplier: Shin Nippon Machinery Co., Ltd., subsidiary of SUMITOMO

Model: C8-R11-RX

Steam Turbine Manufacturer: Shin Nippon (Mfg. Location – Japan)

Generator: Hyundai Ideal (Mfg. Location – USA)

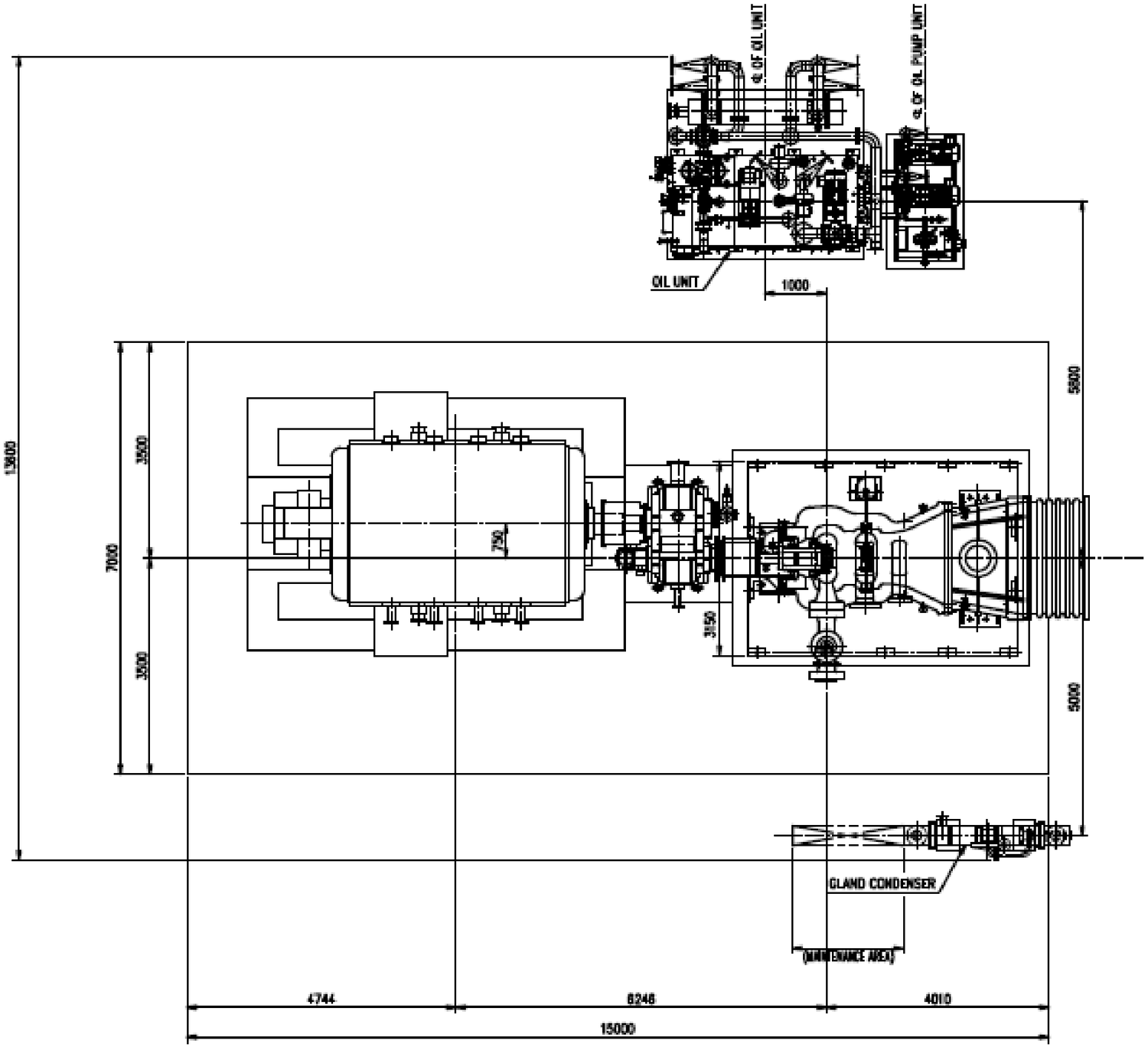
Steam Turbine Design: Horizontal axial flow, impulse, multistage condensing, non-extraction, gear reduction

- Rated output – 15.26MW
- Operating conditions – 6200/1800rpm, inlet press – 373psia, inlet temp – 849F, exh press – 1psia, max flow – 128,040 lbm/hr @ 1psia

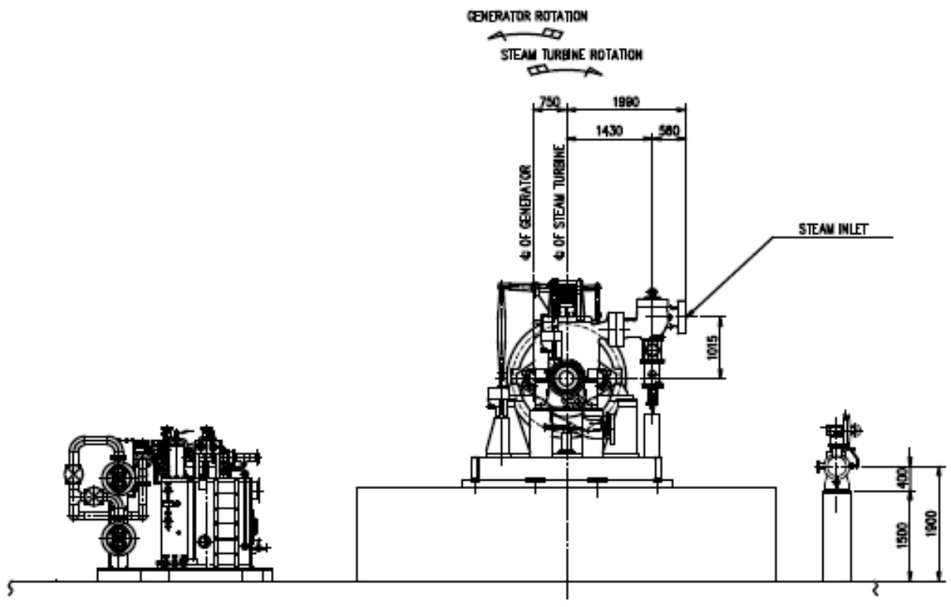
Generator Design: TEWAC, Horizontal brushless synchronous generator

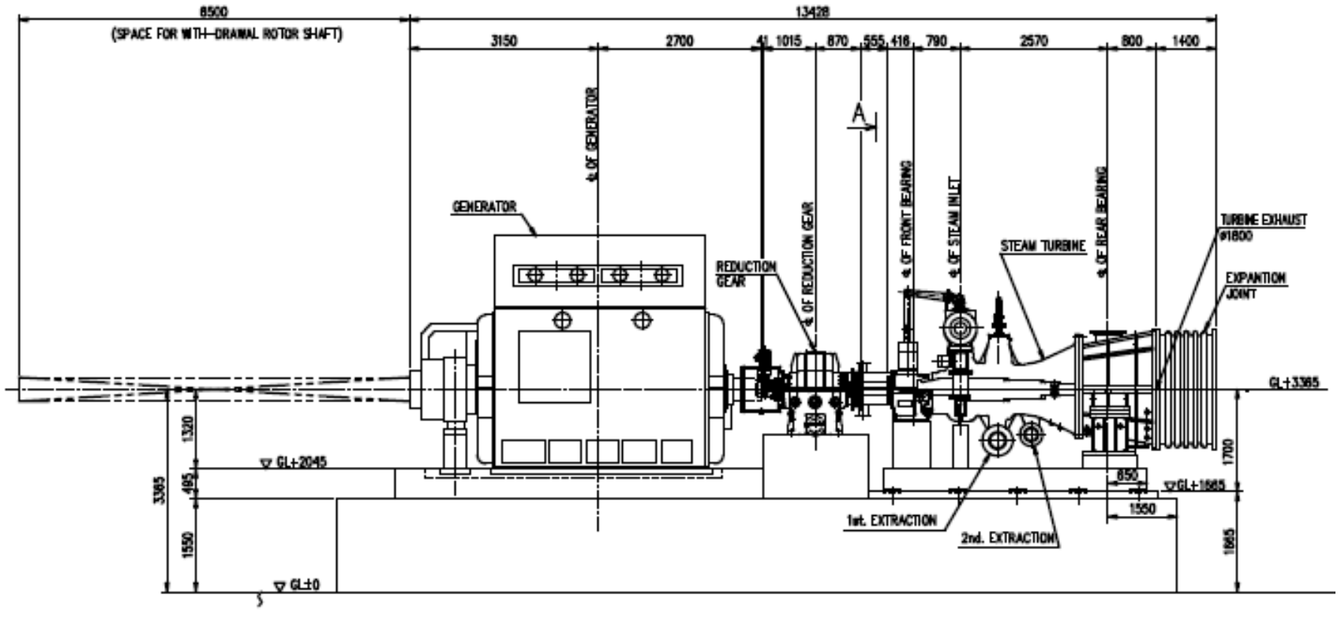
- Rated output – 15.26MW
- Operating conditions – 1800rpm, 17,952KVA, 0.85PF, 3Ph-60Hz, 13,800V, WYE conn, continuous duty

Steam Turbine & Generator Overview



Steam Turbine & Generator Overview





Steam Turbine & Generator Overview

Acoustic Enclosure

Supplier: None Selected

Design: Pre-engineered steel frame construction, roof & walls acoustic panels assys

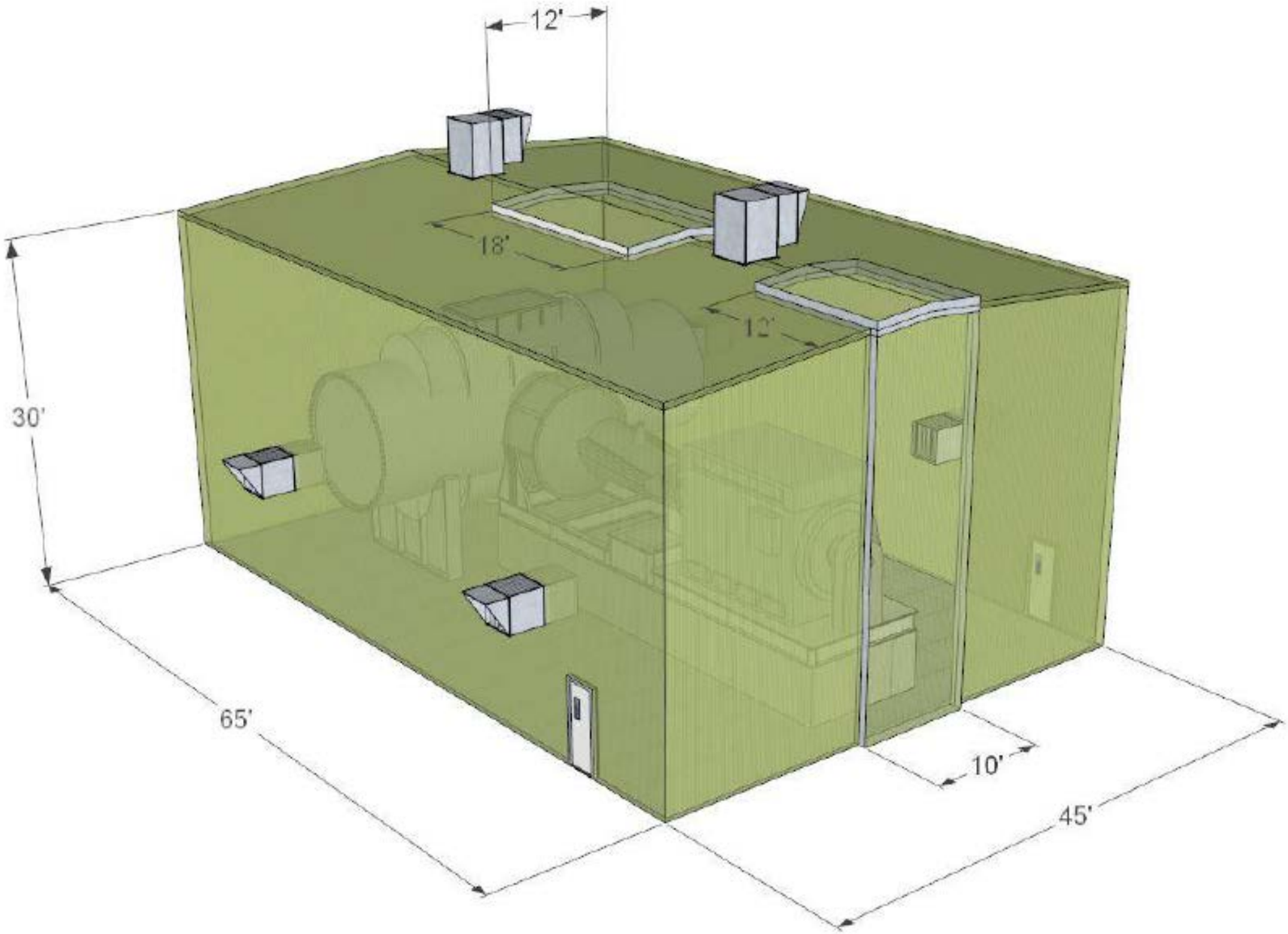
Equipment housed: STG, condenser, gland condenser, vacuum pumps, condensate pumps, aux boiler feed pump, oil & hyd skid

Access: Personnel doors and removable wall and roof panels

Design Consideration: Equipment final layout, maintenance access (i.e. generator rotor removal, condenser tube removal, ST rotor removal), equipment noise emission, escape egress requirements

Comments: FP not included (GE is going to water mist for HD GTs), acoustic enclosure not designed for supporting heavy items such as piping, cable tray, etc.

Acoustic Enclosure Concept

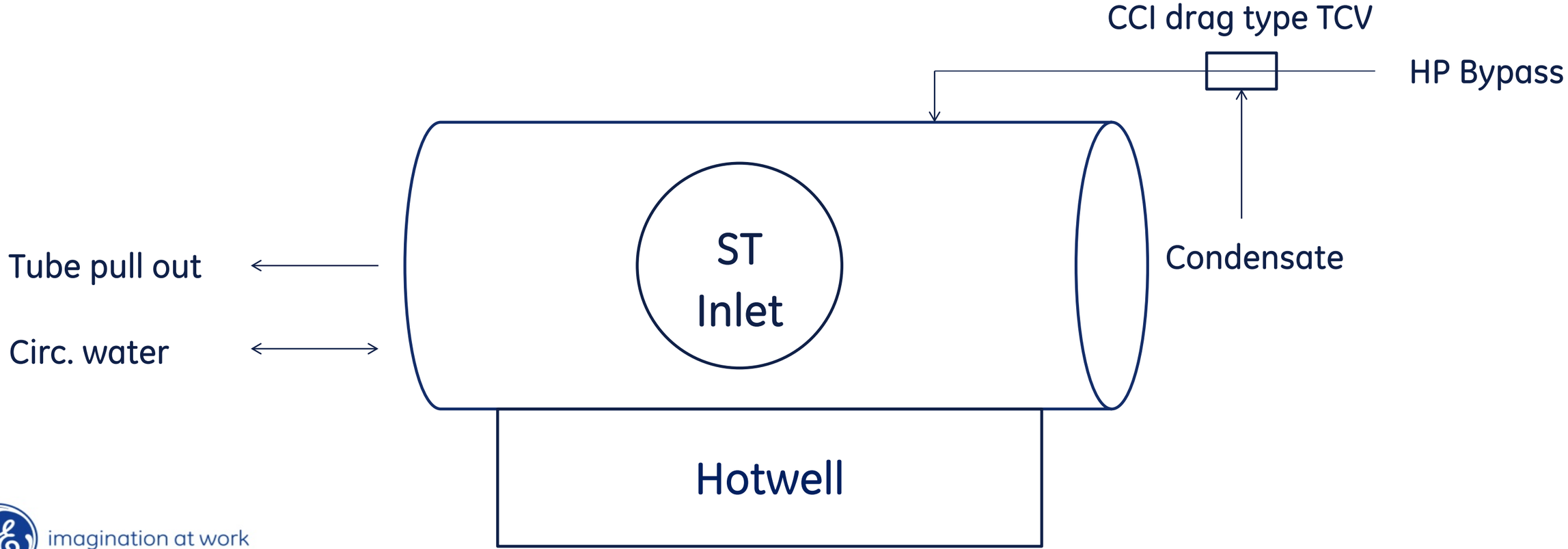


Surface Condenser Overview

Supplier: None Selected

Design: 2-pass, deaerating, 2 x 100% vacuum pumps with silencers, 100% bypass operation

Arrangement: Final arrangement will be available per drawing schedule. Tubes are in horizontal plane and will be accessible through flanged water box. Pullout will be through removable acoustic bldg panel on North side of building



Cooling Tower Overview

Supplier: None Selected

Design: Reinforced composite construction, multi-cell counter flow design, mechanical induce draft, PVC no-fouling fill, drift eliminators

Access: Fan deck accessible by stair tower and caged ladder per OSHA specs

Design Consideration: Design & max ambient wet bulb temp, design & max water inlet/outlet temp, design flow rate, heat duty rejection load, acoustic noise requirements

Arrangement: Final arrangement will be available per drawing schedule. Two cell arrangement is expected.

Comments: Sump basin design and FP not included. Owner has mentioned deluge type FP

Other Mechanical Equipment

Aux Circulating Water Pumps

Supplier: None Selected

Design: Submersible pump, 3 x 50% configuration, automatic failover

Design Consideration: Design & max TDH, design & max flow rate, heat duty rejection load, max. heat rise, acoustic noise requirements

Arrangement: Sump arrangement by BOP contractor

Comments:

Other Mechanical Equipment

Condensate Polisher

Supplier: None Selected

Design: Pre-coat resin back flushable, duel filter vessels, recirculation skid, resin injection skid

Design Consideration: Condensate chemistry including TSS, condensate flow rate, condensate temp

Arrangement: Final arrangement will be available per drawing schedule.

Comments: None

Other Mechanical Equipment

Aux Boiler

Supplier: None Selected

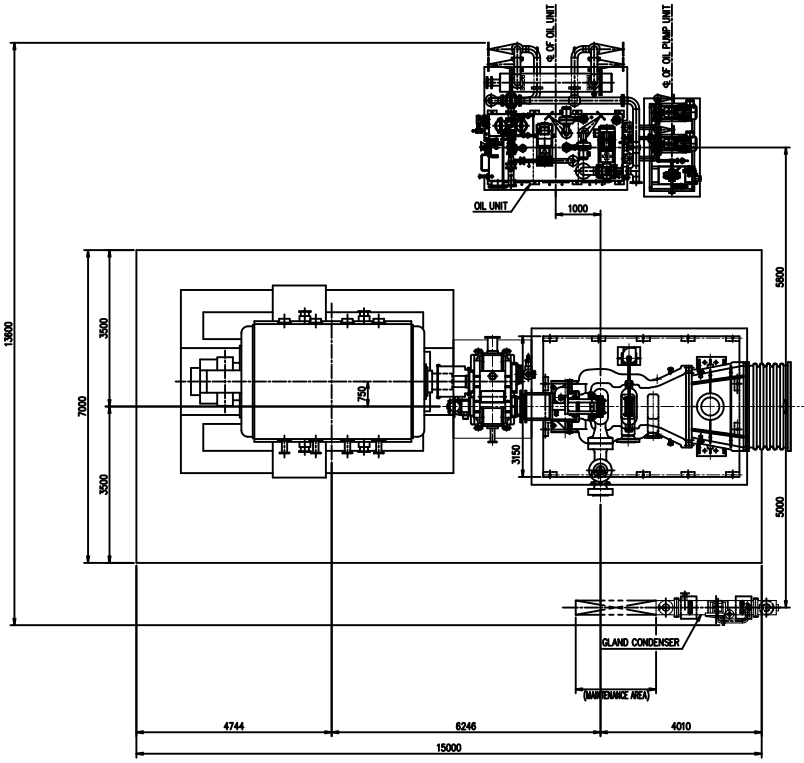
Design: Electric heating element, ASME code vessel

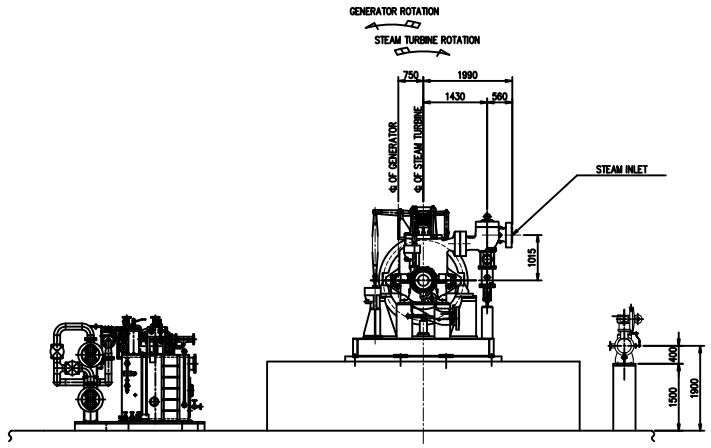
Design Consideration: Operating steam pressure & flow rate

Arrangement: Final arrangement will be available per drawing schedule

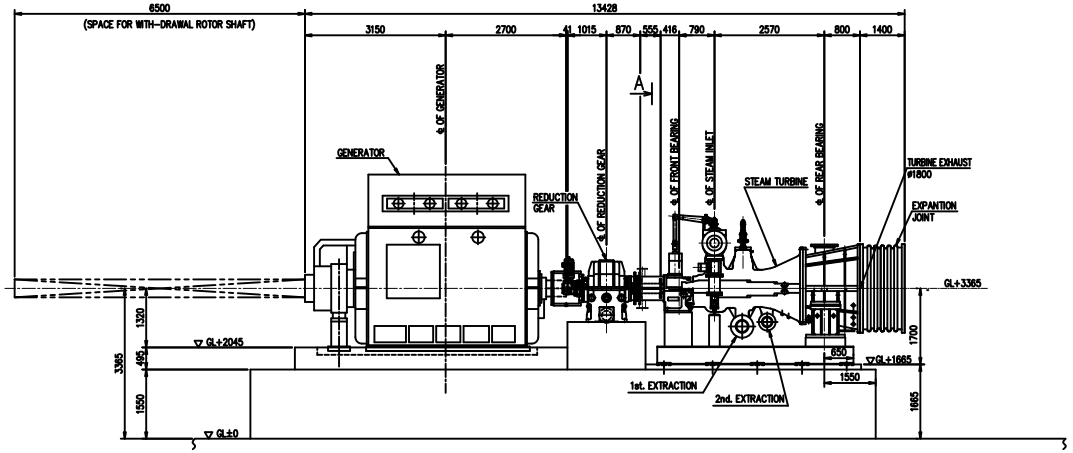
Comments: Owner wanted to know what systems are in use when aux boiler is in operation. This depends on operating mode.

FOR INFORMATION ONLY
VENDOR NOT FINALIZED





SECTION A–A



A

FOR REFERENCE

NO.	NAME OF PARTS	品名	MATL 材料	QT 数	REMARK 備考

REV.	DATE	DESCRIPTION	CHECKED	REVIEWED	APPROVED

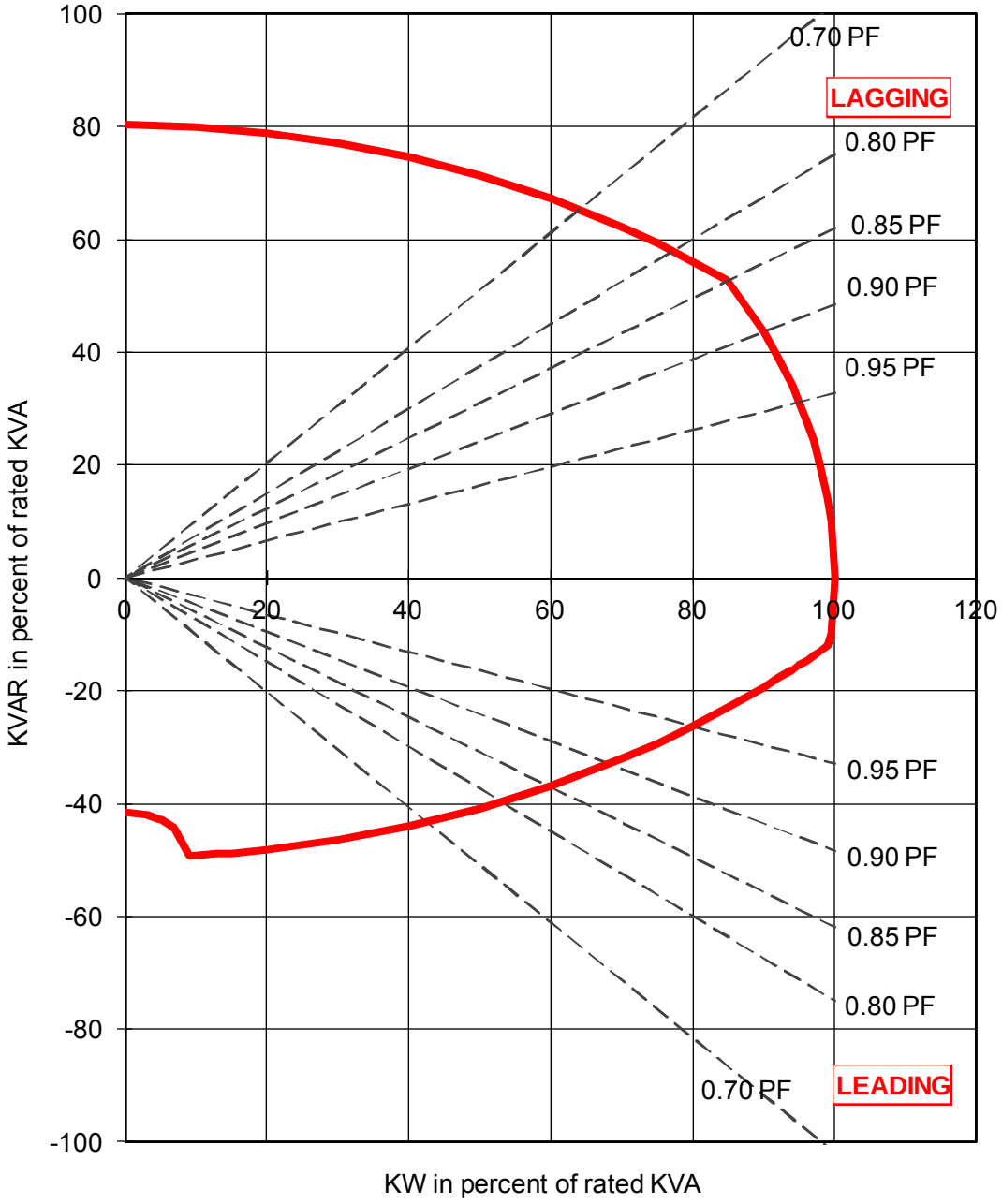
☐ FOR APPROVAL ☐ PRELIMINARY
☐ FOR INFORMATION ☐ FOR REFERENCE
☐ FINAL ☐ REVISION

CUSTOMER 顧客		APPROVED 承認	TYPE 型式 C8X AXIAL EXHAUST
FOR 向先		REVIEWED 審査	NAME 名称 STEAM TURBINE
ITEM No. ___	ORDER No. 注番	CHECKED 点検	LAY OUT
SCALE 尺度 NONE	PROJECTION 投影法 3RD ANGLE	DWG.No. 図番 C8X-0002-10	REV. Gr.4
FIRST ISSUED DATE 初版発行日		新日本造機株式会社 SHIN NIPPON MACHINERY CO.,LTD.	

DWG.NO. 図番
ORIGINAL DWG.
Form No. e-033

HYUNDAI IDEAL
ELECTRIC CO.

REACTIVE CAPABILITY CURVE



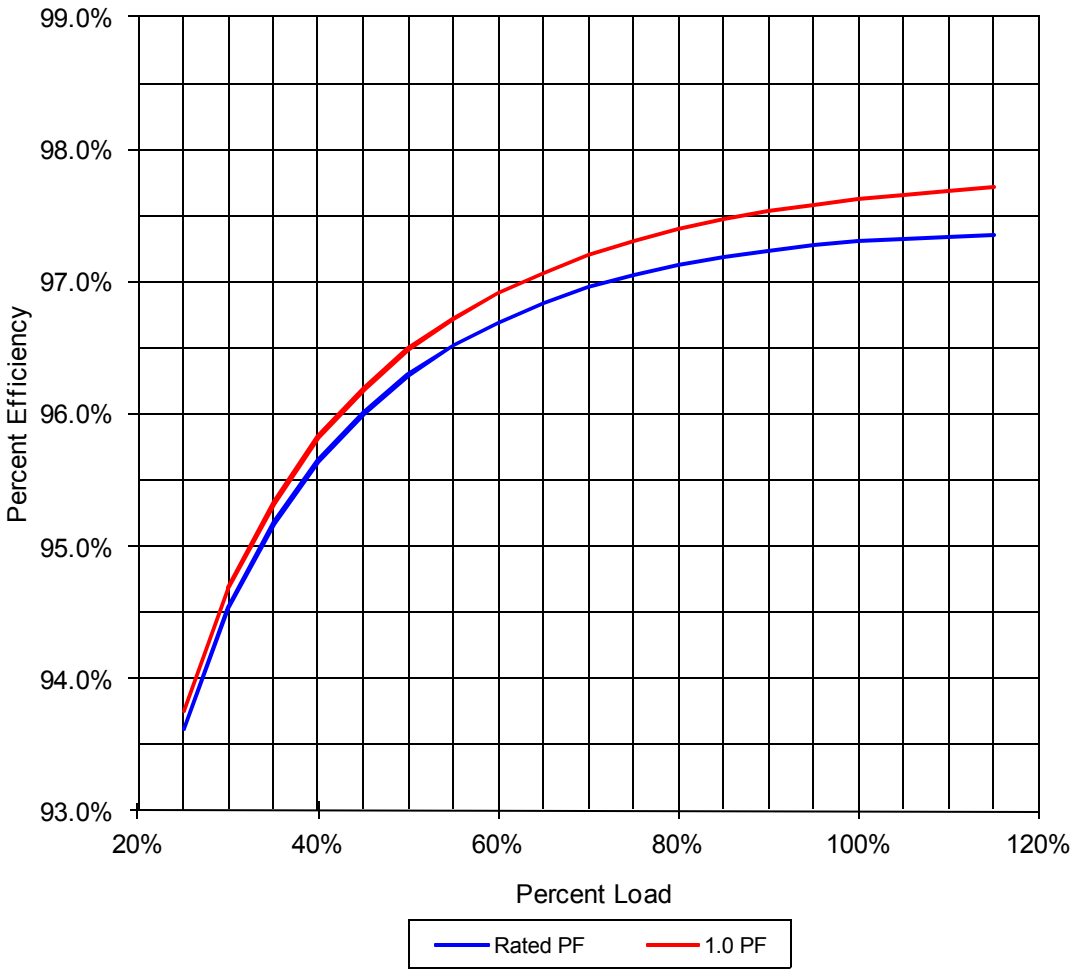
Rating:

17953 KVA
13800 Volts
766 Amps
0.85 P.F.
1800 RPM

FOR INFORMATION ONLY.
VENDOR NOT FINALIZED.

HYUNDAI IDEAL
ELECTRIC CO.

EFFICIENCY CURVES



100% Load = 12,850 kW

Rating:

17953 KVA
13800 Volts
766 Amps
0.85 P.F.
1800 RPM

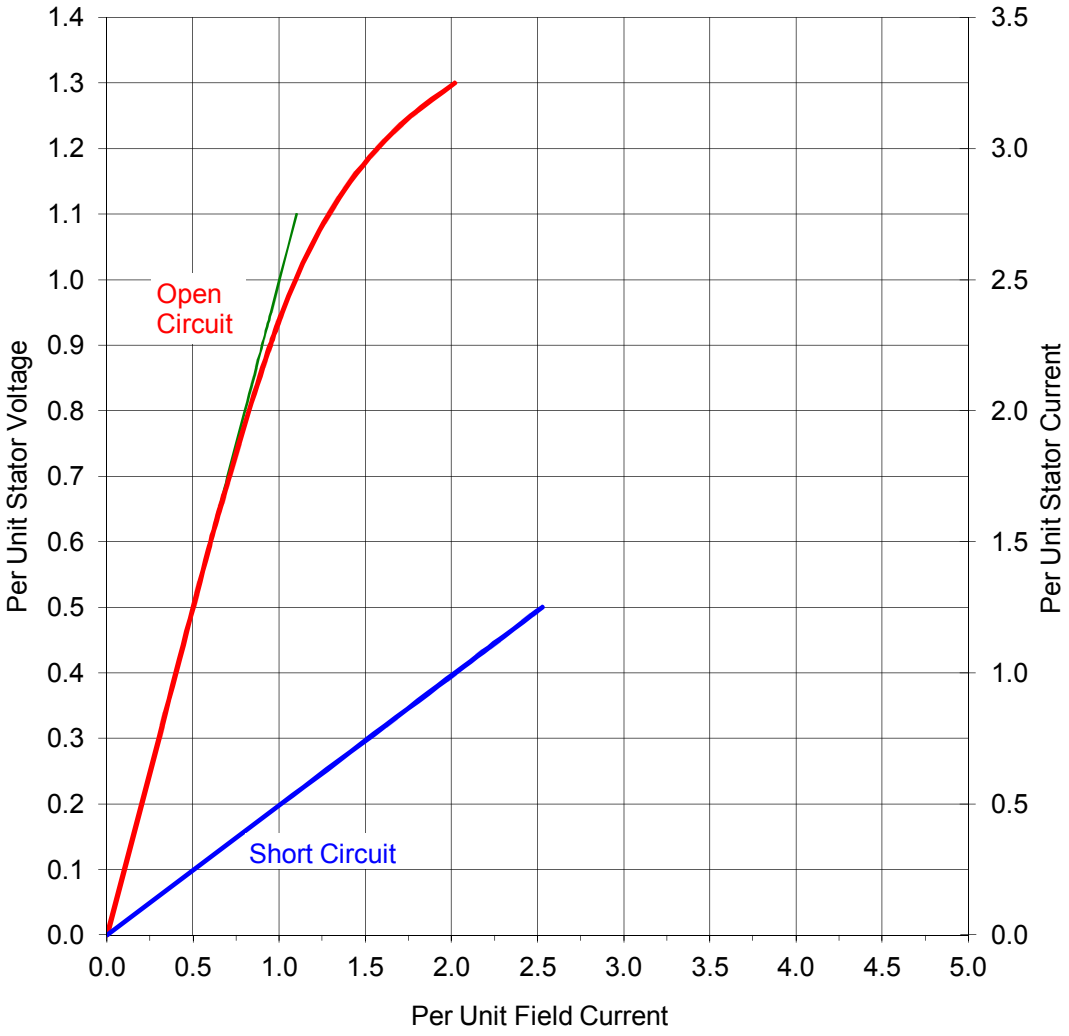
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VENDOR NOT FINALIZED.

rev. 0

EE- 7844C

HYUNDAI IDEAL
ELECTRIC CO.

SATURATION CURVES



Rating:

17953 KVA
13800 Volts
766 Amps
0.85 P.F.
1800 RPM

FOR INFORMATION ONLY.
VENDOR NOT FINALIZED.

rev. 0

EE- 7844D

Attachment 23

Obligations of Site Representatives

Contractor will provide technical advice for the installation and commissioning of the GTG, steam generators, STG, OTSG and the Contractor-supplied Power Island Equipment as stated in the contract. Installation services will include technical advice for the installation of the Contractor supplied equipment, flushing, equipment checkout, and commissioning of mechanical and electrical systems.

The specific personnel required at site for the installation and commissioning of the Contractor supplied equipment is as identified below. The scope of work included in the proposal assumes that the installation and commissioning schedule of the Contractor supplied equipment is not impacted by the installation and commissioning schedules of additional balance of plant equipment and systems that are not provided by Contractor.

Contractor provides the following start-up and commissioning services:

- Site Manager — Responsible for the execution of Contractor on-site services. This person will lead a team consisting of Contractor and vendor technical advisors who will assist in the installation, erection, startup, commissioning and testing of the plant:
  - Coordinate Contractor site activities with the City
  - Assure recommended quality control procedures are applied
  - Coordinate the interface with project home office, manufacturing facilities and suppliers
  - Interface with all suppliers on warranty items
  - Review work for quality
- Materials Coordinator (at Site) - Coordinates shipments, contacts transportation services, produces necessary export/import documents and sets up an inventory control at the site.
- Start-Up/Commissioning Management Advisor (at Site)
- Gas-Turbine-Generator Technical Advisors (at Site)
- Once Through Steam Generator Technical Advisor (at Site)
- Steam-Turbine-Generator Technical Advisor (at Site)
- Condenser Technical Advisor (at Site)
- Cooling Tower Technical Advisor (at Site)
- Pump Technical Advisor (at Site)
- Critical Control Valve Technical Advisor (at Site)
- Condensate Polisher Technical Advisor (at Site)
- CEMS Technical Advisor (at Site)
- GSU Technical Advisor (at Site)
- Chiller Technical Advisor (at Site)

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Contractor has assumed the City will take all necessary precautions, at all times, for the safety of Contractor personnel at site. This will include, but will not be limited to, instruction of the City's safety practices, proper and safe handling of hazardous substances and protection of Contractor personnel from exposure thereto, energization / de-energization of all power systems (electrical, mechanical and hydraulic) using a safe and effective lock-out tag procedure, and conducting periodic safety meetings during construction and start-up.

Contractor may, from time to time, conduct safety audits to insure safe conditions exist and make recommendations to the City concerning the same. If, in Contractor's opinion, the safe execution of Services at site is, or is apt to be, imperiled by local conditions, Contractor may remove some or all of its personnel from the site and/or supervise performances of all or any part of its Services and/or evacuate its personnel and the City will assist in said evacuation. If the Contractor personnel require medical attention, local City facilities will be made available to Contractor personnel for the duration of such needs. If, at site, Contractor encounters toxic substances, hazardous substances or hazardous wastes that require special handling and/or disposal, the City will take whatever precautions are required to eliminate such hazardous conditions. If any such hazardous materials cause an increase in Contractor's cost of or the time required for performance of any part of the work, an equitable adjustment shall be made in the price and schedule. The City will properly dispose of all hazardous materials produced or generated in the course of Contractor's work at site.

The normal workweek will be limited to 60 hours [ten (10) hours per day for six (6) days per week]. Standby time will be billed incremental to the specific hours / durations agreed if technicians are required to be on standby during non-working days. If the Installation and Commissioning schedule dictates longer working hour durations then additional resources can be provided on an incremental daily rate basis. The pricing for these services includes all travel and living expenses and is based on multiple mobilizations.

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Test Philosophy

Performance Test Philosophy for Multi-Shaft Combined-Cycle, All-at-Once Installation

General

The performance guarantees for the multi-shaft, combined-cycle system include net plant output and net plant heat rate. The tests to determine compliance with these guarantees will be input/output tests for the entire system using station instrumentation with measurements of additional parameters required to assure that the system is operating at contract conditions, or to enable correction of measured performance to the guarantee basis conditions which are defined in the Performance Guarantees.

The system performance guarantees apply to equipment in new and clean condition. The performance tests must be conducted as soon as possible after the initial startup.

Contractor will prepare a detailed test procedure based on ASME PTC-46, which is submitted to the Owner for mutual agreement a couple of months before the planned date for the tests.

Performance correction curves shall be finalized prior to performance testing. The updated correction curves will be included with the performance test procedure.

An analysis of the test measurement uncertainty will be included with the test procedure.

Tests to demonstrate part load guarantees, if required, will be conducted in accordance with the Combined Cycle Part Load Performance Testing Philosophy (GEK 111095).

Procedure

Contractor provides technical assistance of the test.

The compressor is cleaned in accordance with applicable GE documents and instructions on compressor cleaning and is inspected by the Contractor representative. The Contractor representative will be the sole judge with respect to condition of the gas turbine at the time of testing.

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The system is brought to steady-state test conditions prior to the collection of performance test data. Sufficient data is recorded to determine the system performance and to correct it to performance guarantee basis conditions. The demineralizer will be turned off during the performance test.

If a turbine hall is provided the following comfort conditioned zones will be operated at the upper end of the temperature range while cooling and the lower end while heating. Turbine hall ventilation flow will be reduced to the larger of the following: flow required to achieve the maximum internal turbine hall temperature or flow required to achieve the minimum number of air exchanges per hour. At the conclusion of the performance tests, Contractor will perform calculations to determine performance relative to guarantee and will issue a report covering the entire testing program for submittal to the Owner. GTG testing must be in accordance with "*TYPICAL_LM6000_PC_PG_SAC_SGTGPTM-C-GAS_DkTrns_(012413)_Rev4*" found in Attachment 5.3.

Performance Evaluation

Performance Evaluation at Base Load or Specified % Load

The combined-cycle system performance test is conducted as described above and the measured performance will be corrected to guarantee basis conditions. The corrected performance will be evaluated relative to the performance guarantees as defined below:

1) Combined-Cycle Power

$$kW_{CC} = \left\{ \left[\sum_{i=1}^{n} kW_i \right] + kW_{ST} - kW_{AUX} + kW_{aADJ} \right\} * kW_{ADJ} * kW_D$$

2) Heat Consumption

$$HC_{CC} = \left\{ \left[\sum_{i=1}^{n} HC_i \right] + HC_{aADJ} \right\} * HC_{ADJ}$$

3) Combined-Cycle Heat Rate

$$HR_{CC} = \frac{HC_{CC}}{kW_{CC}} * kW_D * HR_D$$

Where:

Symbol	
n	Number of Gas Turbines and HRSGs in the system.
kW_{CC}	Combined-Cycle Net Plant Output (kW) corrected to guarantee basis conditions.
kW_i	Gas Turbine-Generator Measured Output (kW) during the combined-cycle performance test for each unit.
kW_{ST}	Steam Turbine-Generator Measured Output (kW) during the combined-cycle performance test.
kW_{AUX}	Equipment and BOP Auxiliary Power (kW) measured during the

	combined-cycle performance test.
kW_{aADJ}	Combined-Cycle additive Output adjustment to guarantee basis conditions (Generator power factor, ST backpressure etc.).
kW_{ADJ}	Combined-Cycle multiplicative Output adjustment to guarantee basis conditions (Ambient site conditions, Fuel properties, etc.).
kW_D	Combined Cycle Output Degradation coefficient to account for fired hours above contractually allowable fired hours.
HC_{CC}	Sum of Heat Consumptions adjusted to guarantee conditions, calculated from measured fuel flow and heating value.
HC_i	Heat Consumption calculated from fuel flow and heating value measured during the performance test for each GT/HRSG unit.
HC_{aADJ}	Additive Heat Consumption adjustment to guarantee basis conditions for the system.
HC_{ADJ}	Multiplicative Heat Consumption adjustment to guarantee basis conditions (Ambient site conditions, Fuel properties, etc.) for the system.
HR_{CC}	Combined-Cycle Net Plant Heat Rate corrected to guarantee basis conditions.
HR_D	Combined Cycle Heat Rate Degradation coefficient to account for fired hours above contractually allowable fired hours

The test procedure includes correction factors and curves for test variations such as, but not limited to, ambient temperature, ambient pressure, ambient relative humidity, steam line losses, fuel properties, gas turbine water injection or generator frequency to correct the measured performance data from actual conditions to guarantee basis conditions.

Net output guarantees are satisfied if the corrected and adjusted output (kW_{CC}) surrounded by the test tolerance encompasses the guaranteed output or falls above it. Net heat rate guarantee is satisfied if the corrected and adjusted heat rate (HR_{CC}) surrounded by the test tolerance encompasses the guaranteed heat rate or falls below it.

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GEK 28172m
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GE Energy

Standard Field Testing Procedure for Emission Compliance
Based on US EPA, ISO and EN Methodology

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred to General Electric Company.

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TABLE OF CONTENTS

I. TEST PHILOSOPHY 3
II. EMISSION TESTING 3
A. General 3
B. Testing When Duct Burners Are Present 3
C. Nitrogen Oxides Emissions 3
D. Carbon Monoxide Emissions (If Required) 5
E. Unburned Hydrocarbon Emissions (If Required) 7
F. Volatile Organic Compound Emissions (If Required) 8
G. Sulfur Emissions (If Required) 8
H. Particulate Matter Emissions 8
I. Filterable PM10 Emissions (If Required) 12
J. Condensable Particulate Matter Emissions (If Required) 13
K. Opacity (If Required) 14
L. Ammonia Slip (If Required) 14
M. Formaldehyde (If Required) 14
N. Certification of Calibration Gases 16
O. Exhaust Gas Flow Determination 16
P. Fuel Bound Nitrogen Determination (if required) 17
Q. Reporting Preliminary Test Results 17

APPENDICES

Appendix A. Summary Table for Reporting Preliminary Test Results Prior to Demobilization – Simple Cycle or Combined Cycle without Duct Firing 18
Appendix B. Summary Table for Reporting Preliminary Test Results Prior to Demobilization – Combined Cycle with duct firing 19
Appendix C. Turbine Emissions Performance Test Readiness Checklist 20
Appendix D. Pretest - Turbine Emissions Particulate Matter Test Checklist 23
Appendix E. Sampling Run - Turbine Emissions Particulate Matter Test Checklist 24
Appendix F. Laboratory - Turbine Emissions Particulate Matter Test Checklist 25
Appendix G. Particulate Matter Test Firm and Laboratory Recommended Qualification Criteria 26
Appendix H. Metric Unit Table 27

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I. TEST PHILOSOPHY

Testing to demonstrate emission guarantees (if required) will be performed using procedures that are mutually agreed to between GE and the Purchaser. GE engineers and/or technical advisors may be present at the tests for procedural direction. EPA test methods are preferred to demonstrate compliance with GE's emissions guarantees unless otherwise stated in this procedure or the Tab 3 Performance Guarantees. ISO and European Union (EN) methods are also presented herein for comparability to the preferred EPA methods. Other test methods will be considered on a case-by-case basis, as necessary.

II. EMISSION TESTING

A. General

Emission testing identified herein shall be within [GE's] or [Customer's] scope of supply using procedures which are mutually agreed upon. GE and Customer must mutually agree on the use of the testing firm. For Particulate Matter (PM) testing, test process control is critical, and must be performed by a test firm and laboratory meeting the qualification criteria shown in Appendix G. Sampling for inlet concentrations may be required, at the sole discretion of GE, in order to demonstrate compliance with emission guarantees. GE guarantees apply to the net increase of these pollutant emissions above ambient background levels. Re-testing (at purchaser's expense) must be allowed, if required.

The purpose of this GEK is to provide overall guidance for emissions testing methodology; a site-specific test protocol should be developed for each project by [GE] or [Customer] according to contract requirements. Any other test methods than those described herein need to be reviewed and approved by GE for applicability of use.

A Turbine Emissions Performance Test Readiness Checklist (Appendix C) has been attached at the end of this document to provide guidance on pre-test preparations, and should be completed prior to any testing.

B. Testing When Duct Burners Are Present

When testing a unit equipped with duct burners (supplemental firing), testing should be conducted in a manner that differentiates the contribution from the gas turbine and the contribution from the duct burners. For gaseous pollutants, this can sometimes be accomplished by testing simultaneously upstream and downstream of the duct burners. If this type of testing is not possible, testing should be performed with the duct burners off and then repeated with the duct burners on. Further details will be contained in the site-specific test protocol.

C. Nitrogen Oxides Emissions

Before the official compliance testing is begun, the NO_x reduction system (e.g. dry low NO_x (DLN) or water injection) will be adjusted (tuned) to meet performance and emissions criterion. Where water and/or steam injection is used for NO_x abatement, the gas turbine control system will contain a pre-programmed schedule for either water or steam injection. This schedule may be adjusted to achieve an appropriate emission level and minimize the supply requirements. Once the proper injection schedule has been established, it is maintained throughout the testing, and is programmed into the control system.

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1. GE Preferred Method: The NO_x emission testing and related oxygen testing will be in accordance with U.S. EPA Method 20 presented in the Code of Federal Regulations Title 40, Part 60 (40 CFR part 60 Appendix A, 40 CFR part 60 Subparts Da – Standards of Performance for Electric Utility Steam Generating Units applicable to IGCC units, and KKKK – Standards of Performance for Stationary Combustion Turbines, with the following modifications, limitations and additions:

   a) The NO_x instrument will be limited to a chemiluminescent type which meets 40CFR60 Appendix A, Method 7E.

   b) The span of the NOx analyzer will be set for appropriate range of the expected NOx readings.

   c) Oxygen will be sampled simultaneously with all NOx readings since 40 CFR Part 60, Subpart KKKK (and GE's NOx guarantee) requires corrections to 15% O2. Method 20 from 40 CFR Part 60 Appendix A is used for the oxygen analysis.

   d) For diffusion flame combustors using water, steam or nitrogen injection for NOx reduction, GE's standard injection control algorithm instantaneously corrects for ISO reference conditions. An EPA Memorandum to GE dated June 2, 1997 approves the injection control algorithm in lieu of the ISO correction equation under 40 CFR Subpart GG, which applies to existing gas turbines that commenced construction, modification or reconstruction before February 18, 2005.

2. ISO Method: ISO Method 11042, Part 1 is acceptable for testing of gas turbines for NOx, but is not the preferred GE method. This method references ISO Method 10849, which is the automated analysis method for NOx. The main differences of the ISO method with respect to EPA Method 7E are:

   a) ISO 11042 does not include a system bias check.

   b) The ISO drift check is performed over 2 hours while the length of the EPA drift check varies depending on the regulatory requirement.

   c) ISO 11042 span and zero drift allowances are tighter than EPA Method 7E, and are not achievable / realistic for the expected low NOx levels.

   d) ISO 11042 does not include a converter efficiency check.

3. EN Method: EN Method 14792 is acceptable for testing of gas turbines for NO_x, but is not the preferred GE method. When using this method, the following requirements must be followed:

   a) Measurement point selection should adhere to the procedures of EN Method 15259, Sections 8.2 and 8.3.

   b) Upon conclusion of the Direct Calibration Error Test specified in Section 8.4.2.2 of the method a gas containing 40-60% of the NO concentration of the span gas should be directly injected into the analyzer and its response recorded to verify linearity of the instrument. The absolute difference between instrument response to direct injection of the mid-range calibration gas and the certified concentration of the mid-range calibration gas shall be less than or equal to 2% of the certified span gas concentration before proceeding with testing.

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c) When adjusting the analyzer to the span gas response as described in Section 8.4.2.2 the response to the span gas should be recorded and the absolute difference between the instrument response and the certified concentration of the span gas shall be less than +/- 2% of the certified concentration of the span gas.

d) All calibration gases used in conjunction with this method will be certified in accordance with United States EPA Protocol 1 or will have a valid ISO17025 certificate of calibration.

e) Zero and Span checks as outlined in Section 8.4.3 of the method must be performed after every test run.

f) The efficiency of the NO_2 to NO converter shall be demonstrated on-site, prior to conducting any measurements used to determine conformance with performance guarantees.

g) Each test run will use the equation below to determine average gaseous concentrations (not corrected for diluent) obtained during the test.

$$C_{Gas} = \left(C_{Avg} - C_o\right)\frac{C_{MA}}{C_M - C_o}$$

Where:

C_{Gas} = Average effluent gas concentration adjusted for bias and drift.
C_{Avg} = Average unadjusted gas concentration indicated by data recorder for the test run.
C_O = Average of the pre and post –test system response to the low-level (zero) calibration gas.
C_{MA} = Certified concentration of the upscale calibration gas.
C_M = Average of the pre and post -test system response to the upscale calibration gas

GE recommends the use of EPA Method 20 for NO_x testing. If ISO Method 11042 is used, a chemiluminescent-type analyzer must be used, following the span and drift allowances of EPA Method 20 and a system bias check should also be performed according to EPA Method 20; in addition, a stratification test and multi-point sampling (if required by the stratification test results) must be performed in accordance with Method 20.

D. Carbon Monoxide Emissions (If Required)

Sampling for CO is typically the same as sampling for NO_x with the same line feeding the different instruments.

1. GE Preferred Method: EPA Method 10 per 40 CFR Part 60 Appendix A is used, but only the continuous sample method per Section 5.1 is acceptable to GE. A recorder is mandatory, not optional as per 5.3.9, with a span that gives an appropriate range of the guarantee readings.

2. ISO Method: ISO Method 11042, Part 1 also applies to acceptance testing of gas turbines for CO. This method references ISO Method 12039, which is the automated analysis method for CO. The main differences of the ISO method with respect to EPA Method 10 are:

   a) ISO 11042 does not include a system bias check.

   b) ISO 11042 span and zero drift allowances are tighter than EPA Method 10.

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3. EN Method: EN Method 15058 also applies to acceptance testing of gas turbines for CO. The following additional requirements must be followed:

   a) Measurement point selection should adhere to the procedures of EN Method 15259, Sections 8.2 and 8.3.

   b) Upon conclusion of the Direct Calibration Error Test specified in Section 8.4.2.2 of the method a gas containing 40-60% of the nitrogen oxide concentration of the span gas should be directly injected into the analyzer and its response recorded to verify linearity of the instrument. The absolute difference between instrument response to direct injection of the mid-range calibration gas and the certified concentration of the mid-range calibration gas shall be less than or equal to 2% of the certified span gas concentration before proceeding with testing.

   c) When adjusting the analyzer to the span gas response as described in Section 8.4.2.2 the response to the span gas should be recorded and the absolute difference between the instrument response and the certified concentration of the span gas shall be less than +/- 2% of the certified concentration of the span gas.

   d) All calibration gases used in conjunction with this method will be certified in accordance with United States EPA Protocol 1 or will have a valid ISO17025 certificate of calibration.

   e) Zero and Span checks as outlined in Section 8.4.3 of the method must be performed after every test run.

   f) Each test run will use the equation below to determine average gaseous concentrations (not corrected for diluent) obtained during the test.

$$C_{Gas} = \left(C_{Avg} - C_o\right)\frac{C_{MA}}{C_M - C_o}$$

Where:

C_{Gas} =	Average effluent gas concentration adjusted for bias and drift.
C_{Avg} =	Average unadjusted gas concentration indicated by data recorder for the test run.
C_O =	Average of the pre and post –test system response to the low-level (zero) calibration gas.
C_{MA} =	Certified concentration of the upscale calibration gas.
C_M =	Average of the pre and post -test system response to the upscale calibration gas

GE recommends the use of EPA Method 10 for CO testing. If ISO Method 11042 is used the span and drift allowances of EPA Method 6C should be followed and a system bias check should also be performed according to EPA Method 6C.

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E. Unburned Hydrocarbon Emissions (If Required)

1. GE Preferred Method: Sampling and analysis to measure unburned hydrocarbon (UHC) emissions must be done on a wet basis to avoid condensing out the higher hydrocarbons. Moisture determination by EPA Method 4 (or Method 5) is necessary to convert results to a dry basis. Method 25A per 40CFR60 Appendix A is used for unburned hydrocarbons. Results are presented as methane (CH4). This method uses a flame ionization detector (FID) or analyzer. Calibration gases should be methane in an air matrix to avoid synergism effects.

2. ISO Method: ISO Method 11042, Part 1 also includes guidelines for acceptance testing of gas turbines for UHC. This method uses a FID like the EPA method. The main differences of the ISO method with respect to EPA Method 25A are:

   a) ISO 11042 does not include a system bias check.

   b) ISO 11042 span and zero drift allowances are tighter than EPA Method 25A, and are not achievable / realistic for the expected low UHC levels.

   c) The minimum range allowed is 0 to 10 ppm and the measured concentration must be at least 50 percent of the instrument range.

   Expected UHC emissions from most of GE's gas turbine units will be below the threshold for the ISO method, therefore it is not recommended for GE units, where expected UHC concentrations are less than 5 ppm.

3. EN Method: EN Method 12619 applies to acceptance testing of turbines for total organic compounds. The following additional requirements must be followed:

   a) Upon conclusion of the Instrument Adjustment procedure specified in Section 6.1.1 of the method, a gas containing 40%-60% of the concentration of the span gas should be directly injected into the analyzer and its response recorded to verify linearity of the instrument. The absolute difference between instrument response to direct injection of the mid-range calibration gas and the certified concentration of the mid-range calibration gas shall be less than or equal to 2% of the certified span gas concentration before proceeding with testing.

   b) When adjusting the analyzer to the span gas response as described in Section 6.1.1, the response to the span gas should be recorded and the absolute difference between the instrument response and the certified concentration of the span gas shall be less than +/- 2% of the certified concentration of the span gas.

   c) When performing the procedure set forth in Section 6.1.2, the system response to the span gas should be recorded and the absolute difference between the system response and the certified concentration of the span gas shall be less than +/- 5% of the certified concentration of the span gas.

   d) Zero and Span checks as outlined in Section 6.1.2 of the method must be performed before and after every test run. The test run shall be considered invalid if the absolute difference between the pre-test zero gas check and post-test zero gas check is greater than 3% of the certified span gas concentration. Likewise the test run will similarly be invalidated if the absolute difference between the pre-test span gas check and post-test span gas check is greater than 3% of the certified span gas concentration.

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F. Volatile Organic Compound Emissions (If Required)

1. GE Preferred Method: When volatile organic compound (VOC) emissions (non-methane, non-ethane hydrocarbons) are required, U.S. EPA Method 18 per Section 8.2.2 (Direct Interface Sampling and Analysis) should be used. This method requires a gas chromatograph at the site. GE requires calibration of the measurement train at the sampling probe.

2. ISO Method: There are no performance specifications within ISO 11042 for VOC measurement, only suggested procedures; therefore GE recommends the use of EPA Method 18.

3. EN Method: EN Method 13649 applies to acceptance testing of gas turbines for determination of individual gaseous organic compounds. The following additional requirements must be followed:

   a) Performance of EN 13649 should be in conjunction with one of the following total organic compound methods: EPA Method 25A, ISO Method 11042, or EN 12619. Sample duration of EN 13649 tests should not be less than the sample duration of the total organic method that is employed in conjunction with the EN 13649 test.

   b) Proper sample handling and shipping procedures must be followed to ensure that samples do not degrade before they are analyzed.

G. Sulfur Emissions (If Required)

1. GE Preferred Method: Sulfur emissions will be determined by use of fuel flow data and fuel analysis for sulfur content according to ASTM Method D3246 for natural gas firing and ASTM Method D4294 for distillate oil firing.

2. ISO Method: ISO 11042 recommends the use of fuel analysis for determination of sulfur dioxide emissions; therefore it is in accordance with GE's preferred method. The above ASTM Method, or demonstrated ISO equivalent, should be used for sulfur analysis.

H. Particulate Matter Emissions

1. Particulate testing must be performed by a Test Firm, Individual Tester and Laboratory meeting the minimum qualification criteria listed for each in Appendix G of this document.

2. Prior to testing, the tester is required to complete the "Pre-Test – Turbine Emissions Particulate Matter Test Checklist" shown in Appendix D of this document. If any question is answered with "No," the issue must be reviewed as indicated in the Appendix to determine appropriate action.

3. Prior to testing, the tester must review the questions in "Sampling Run – Turbine Emissions Particulate Matter Test Checklist" shown in Appendix E of this document, and be aware of any factor which may require testing to be suspended. After testing is complete, the tester must complete the checklist and review any "No" responses as instructed in the Appendix.

4. After the Laboratory has completed work, the Lab Technician must complete the "Laboratory – Turbine Emissions Particulate Matter Test Checklist" shown in Appendix F of this document. If any response is "No", a full explanation of the issue and subsequent action shall be provided and reviewed with the GE Environmental Engineer.

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5. The following operational conditions should also be met whenever testing for PM:

    a. The combustion turbine must run for a minimum of 300 total-fired hours prior to any PM testing, and must operate at base load for a minimum of 3 to 4 hours prior to any PM test run to achieve steady-state wheelspace temperatures (gas turbine nozzle final stage temperature).

    b. The combustion turbine inlet and exhaust systems must be cleaned and free of any dirt, sand, mud, rust or other contaminants.

    c. Exhaust must be wiped down to prevent metal weepage from stainless steel (400 series) becoming airborne.

    d. Check for wooden spacers left in the HRSG and leaks in the inlet, as applicable.

    e. The area around the turbine is to be treated (e.g. sprayed down with water) to minimize airborne dust.

    f. A compressor wash prior to testing is required.

6. A pre-test checklist that outlines the above operational conditions is attached at the end of this document for use prior to GE emissions testing.

7. The following laboratory conditions should also be met by the lab analyzing the PM samples:

    a. The tolerance for consecutive weights must be reduced from 0.5 mg down to 0.1 mg and weights recorded to the nearest 0.01 mg.

8. Allowance for background ambient particulate levels must be provided, as appropriate. The ambient PM measurement method will be determined on a case-by-case basis, if necessary.

9. Test ports shall be stainless steel and inspected to be clear of any dirt, debris or rust prior to test.

10. Test conditions on the stack must be fully documented and reported, including any activities in the surrounding area that might impact PM levels or introduce contamination (e.g. high winds, high pollen count, wildfires, road grading). Any unusual site conditions may require postponement of testing or addition of extra test runs.

11. Mass emission rates of particulate matter shall be calculated using fuel flow and exhaust flow determined by the EPA Method 19, F-factor method. (See section N.1.a)

12. Filterable Particulate Matter

    a. Preferred method: US EPA Method 5B, described below, is the preferred default method for 60 Hz machines. EN method 13284-1, described below, is the required method for 50 Hz machines, especially those located in the European Union. EPA or ISO methods for 50 Hz machines will be considered on a case-by-case basis.

    b. US EPA Method: Particulate matter (PM) emissions shall be determined in accordance with U.S. EPA Method 5B with traversing per Methods 1 and 2, as contained in 40 CFR 60 Appendix A. The following modifications and limitations on choices within the methods apply.

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c. At least four test runs must be performed (not three as stated by the method). The four runs are to be averaged.

d. Sampling probe internal surfaces must be made of chemically inert and non-catalytic material such as quartz.

e. The filter material shall be glass fiber or quartz.

f. Multiple, pre-assembled sampling train components, such as filters preloaded in filter housings, must be used to reduce field handling of samples, or a clean field recovery area must be provided to mitigate sample contamination.

g. Use of Method 5B requires the probe and filter to be heated to 320 to 345°F (160 to 174°C) and precludes any concern over determination of the sulfuric acid dewpoint. The Method 5B pre- and post-test filter bakes are also conducted at the elevated temperatures indicated previously.

h. Sampling technique shall provide a fairly large exhaust gas sample, with an objective of 125 standard cubic feet (SCF) (3.5 standard cubic meters (SCM)); minimum sample time shall be 3 hours per run.

i. A sample run must be invalidated and repeated if the glass probe liner breaks or any other piece of equipment fails in such a way as to potentially introduce contamination.

j. All recovery brushes shall be Teflon-coated, and in new and clean condition with no signs of wear.

k. Any damage to the sample filter must be noted, if recovering it in the field. Carefully recover as much of the filter as possible and make note of what was unrecoverable.

l. HPLC-grade reagents must be used for all sample collection and recovery.

m. One reagent blank (from the recovery wash bottle into a sample jar) shall be performed after every run.

n. One field blank (assembly of sample train, leak check and all activities up to sampling stack gas, followed by recovery) shall be performed for each unit that is tested.

o. Field train blank results 1.5 times or greater than lab reagent results require additional assessment and written approval by GE Environmental and Acoustic Engineering prior to deeming the results acceptable.

p. Measurement of percent by volume of oxygen and carbon dioxide shall be done using EPA Method 3A in lieu of EPA Method 3.

q. If test equipment is disassembled and reassembled between ports a leak check is required after reassembly prior to continuing testing.

r. Use of Teflon frits is required (in lieu of glass).

s. Impinger water must be weighed and not measured volumetrically.

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13. ISO Method:

    The preferred ISO Method is ISO 12141:2002 with an in-stack filter; the minimum sample time must be 3 hours per run; the sampling points should be determined according to EPA Method 1; and high-purity reagents must be used to avoid contamination.

    ISO Method 11042, Part 1 also applies to acceptance testing of gas turbines for PM with reference to ISO Method 9096, a manual-gravimetric, multi-point sampling procedure. The main differences of the ISO method as compared to EPA Method 5 are:

    a. ISO 9096 covers both in-stack and out-of-stack filter methods.

    b. ISO 11042 calls for 12 to 20 sampling points, whereas the EPA methods specify 8 to 24 sampling points.

    c. ISO 9096 is recommended for concentrations from 20 mg/m^3 to 1000 mg/m^3.

    d. ISO 12141:2002 is similar to ISO 9096, but is recommended for lower PM concentrations in the range of 5 mg/m^3 to 20 mg/m^3.

14. EN Method: The preferred EN Method is EN 13284-1 with an in-stack filter heated and a minimum sample time of 3 hours per run. The following additional requirements must be followed:

    a. Determine the filter tare weight following the procedures of EN 13284-1 Section 7.2, except filters should be baked at 160 ºC +/- 5 ºC for a period of three hours, then cooled in a dessicator for a minimum of 4 hours before weighing.

    b. The portion of the sample system between the tip of the nozzle and filter must be rinsed and recovered after every test run.

    c. After sampling, determine the final filter weight according to the practices established in EN13284-1 Section 7.3 and 7.4 except filters should be baked at 160 ºC +/- 5 ºC for a period of six hours, then cooled in a dessicator for a minimum of two hours prior to initiating the weighing procedure in Section 7.3.

    d. Acetone used in the conduct of EN 13284-1 should exhibit dry residue of less than 8 mg/l.

    e. Measurement point selection should adhere to the procedures of EN Method 15259, Sections 8.2 and 8.3.

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I. Filterable PM10 Emissions (If Required)

PM10 is particulate matter with an aerodynamic diameter less than 10 microns.

Preferred method: GE recommends the use of US EPA methods, described in Section 1 below, for PM10 sampling.

1. US EPA Method: PM10 emissions shall be determined by sampling, analysis and calculation in accordance with U.S. EPA Method 201A for front-half filterable particulate matter and Method 202 for back half condensable particulate matter with traversing per Methods 1 and 2. All methods are as listed in 40 CFR 60, Appendix A except for Method 201A, which is per 40 CFR 51, Appendix M and Method 202, which is as promulgated December 17, 1991 (56 FR 65433). The following modifications and limitations within the methods apply:

   a. At least four test runs must be performed (not three as stated by the method). The four runs are to be averaged.

   b. Sampling probe internal surfaces must be made of chemically inert and non-catalytic material such as quartz.

   c. The filter material shall be glass fiber or quartz.

   d. Multiple, pre-assembled sampling train components, such as filters preloaded in filter housings, must be used to reduce field handling of samples, or a clean recovery area must be provided to mitigate sample contamination.

   e. Sampling technique shall provide a fairly large exhaust gas sample, with an objective of 125 standard cubic feet (SCF) (3.5 standard cubic meters (SCM)); minimum sample time shall be 4 to 6 hours.

   f. A sample run must be invalidated and repeated if the glass probe liner breaks or any other piece of equipment fails in such a way as to potentially introduce contamination.

   g. All recovery brushes shall be Teflon-coated, and in new and clean condition with no signs of wear.

   h. Any damage to the sample filter must be noted, if recovering it in the field. Carefully recover as much of the filter as possible and make note of what was unrecoverable.

   i. HPLC-grade reagents must be used for all sample collection and recovery.

   j. One reagent blank (from the recovery wash bottle into a sample jar) shall be performed after every run.

   k. One field blank (assembly of sample train, leak check and all activities up to sampling stack gas, followed by recovery) shall be performed for each unit that is tested.

   l. Field train blank results 1.5 times or greater than lab reagent results require additional assessment and written approval by GE Environmental and Acoustic Engineering prior to deeming the results acceptable.

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m. Measurement of percent by volume of oxygen and carbon dioxide shall be done using EPA Method 3A in lieu of EPA Method 3.

n. If test equipment is disassembled and reassembled between ports a leak check is required after reassembly prior to continuing testing.

o. Use of Teflon frits is required (in lieu of glass).

p. Impinger water must be weighed and not measured volumetrically.

q. ISO Method: ISO Method 23210:2009 measures PM10 and PM2.5 (filterable particulate only) through a two-stage cascade impactor. GE prefers the use of cyclones rather than impactors, therefore GE recommends the use of EPA Methods as outlined above, if required.

J. Condensable Particulate Matter Emissions (If Required)

1. US EPA Method: Condensable PM emissions shall be determined by sampling, analysis and calculation in accordance with U.S. EPA Method 202 as promulgated on December 17, 1991 (56 FR 65433). The following modifications and limitations within the method apply:

a. At the conclusion of each test run, the sample train must be purged with N2 gas at a rate of 20 liters per minute (lpm) for a period of one hour.

b. HPLC-grade reagents must be used for all sample collection and recovery.

c. One reagent blank (from the recovery wash bottle into a sample jar) shall be performed after every run.

d. One field blank (assembly of sample train, leak check and all activities up to sampling stack gas, followed by recovery) shall be performed for each unit that is tested.

e. Field train blank results 1.5 times or greater than lab reagent results require additional assessment and written approval by GE Environmental and Acoustic Engineering prior to deeming the results acceptable.

f. Method 202 equipment shall be free of stopcock grease.

g. The following laboratory conditions should also be met by the lab analyzing the PM samples:

   a. The tolerance for consecutive weights must be reduced from 0.5 mg down to 0.1 mg and weights recorded to the nearest 0.01 mg.

   b. A 5 ml aliquot should be removed from the inorganic fraction prior to organic extraction and analyzed for sulfate using low-level ion chromatography.

h. The NH4OH titration of the inorganic fraction should be done to neutralize any acid. This helps stabilize the sample and reduces variability

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K. Opacity (If Required)

1. GE Preferred Method: Opacity shall be measured in accordance with EPA Method 9 from 40 CFR 60, Appendix A. If a continuous opacity monitor is installed in the exhaust stack and has been certified against a reference method (EPA Method 9 or equivalent), the data from this continuous monitor may be used in lieu of Method 9, subject to approval by GE.

2. ISO Method: ISO Method 11042, Part 1 utilizes the Bacharach source test procedure for smoke number determination. There is no direct correlation between percent opacity and measurements based on the Bacharach scale. Therefore, only EPA Method 9 (or a certified continuous opacity monitor) may be utilized to demonstrate compliance with GE's opacity guarantee, if required.

L. Ammonia Slip (If Required)

1. GE Preferred Method: EPA has not yet promulgated a method for measuring ammonia slip. In the interim, GE has established a preference for the use of on-site sampling and analysis plus calculations in accordance with the industry procedure of indophenol absorptiometrics to determine ammonia slip emissions. This procedure requires the use of reactant solutions and a photoelectric spectrophotometer at the plant site. Additional testing details will be incorporated into a site-specific test protocol, as required.

2. ISO Method: ISO method 11042 does not provide performance specifications for ammonia measurement. The standard proposes using chemiluminescent NOx analyzers. A converter is used to oxidize the NH3 to NO, while a second converter reduces NO2 to NO without affecting the NH3; the difference between these two NOx readings is the NH3 concentration. A single analyzer with two converters or two separate analyzers may be used.

   GE recommends the use of the indophenol method for its low detection limit and on-site results. Use of EPA CTM-027 is also acceptable. When using CTM-027, an ion specific electrode will be necessary for on-site results and ion chromatography for the off-site laboratory analysis.

M. Formaldehyde (If Required)

1. GE Preferred Method: If a customer requires formaldehyde testing for their permit, GE recommends that it be measured using California Air Resources Board (CARB) Method 430. This method is a wet-impingement method, and uses dinitrophenylhydrazine (DNPH) as the impinger solution. In order to enhance the method to achieve a detection level of less than 91 parts per billion by volume, dry (ppbvd) at 15% O_2 (the proposed EPA limit in 40 CFR Part 63 – National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines), the following modifications to the method must be followed:

   a. Using typical field blank results, the target sample volume should be approximately 100 liters. At the maximum sampling rate allowed in the method of 0.5 lpm, a run time of 3 hours and 20 minutes is necessary to achieve the minimum aldehyde mass ratio. Sampling rate shall not exceed 0.5 lpm.

   b. Background levels of formaldehyde in the sampling equipment, reagents, and ambient environments are chronic challenges to measuring low parts per billion levels of formaldehyde in the stack. Ambient formaldehyde contamination of the collected sample in the field shall be minimized through appropriate containment and handling of all samples and sampling equipment in clean, formaldehyde-free areas. In some locations, purged glove

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boxes or similar apparatus may be required. In addition, the sample train must be assembled and recovered in a tented area purged with 99.999% nitrogen.

c. A pre-test leak check, but no post-test leak check (to minimize sample contamination), shall be performed as specified in Section 8.1.4 of the method. A small, fresh activated charcoal tube (such as commercially available tubes used for personal exposure or indoor air sampling) should be temporarily attached to the end of the probe (e.g. with a short length of Teflon tubing) prior to performing leak checks to minimize contamination from ambient air.

d. Other measures to avoid potential field contamination shall include: use a fresh, pre-cleaned polytetrafluoroethylene (PTFE), borosilicate glass, or quartz probe liner for each test run; do not perform a post-test rinse of the sampling probe unless visible condensate is present; do not recycle probe liners in the field.

e. Maintain the sampling probe temperature range between 248 and 273ºF (120 to 134ºC) to avoid condensation of water in the probe, which would necessitate a probe rinse.

f. The laboratory selected to perform the sample analyses shall demonstrate a limit of detection (LOD) capability of less than 0.5 µg of formaldehyde per sample. LOD shall be calculated as specified in CARB Method 430 Section 11.6.

g. Sampling equipment shall include screw-top DNPH impingers that can be fitted with either Teflon-lined screw caps (for storage and shipment) or an impinger stem (for sampling) that have been charged and sealed in the laboratory that will be used for sample analyses. The pre-charged impingers and samples shall be stored and shipped at 4 ºC, using dry ice, until immediately before and after sampling and laboratory analysis.

h. The cleaned sampling equipment is to be sealed in the laboratory and not opened until final train assembly at the sampling location.

i. All handling of wetted sampling equipment is to be performed using polyethylene laboratory gloves to eliminate the potential for aldehydes contamination from the skin. Latex, nitrile, or vinyl gloves shall not be used.

j. To minimize potential contamination, it is advised that the test team members not consume alcohol during the 24 hours prior to sampling and throughout the sampling campaign. Metabolites of alcohol include aldehydes. Alcohol digestion and respiration significantly increases formaldehyde levels in exhaled air, concentrations of 200 ppb and greater have been measured. Aldehydes are also transpired through the skin. Test team members should also refrain from smoking during test activities. If necessary, test team members shall wash their hands with soap and rinse thoroughly with clean water after a smoking break before returning to test activities. Exhaust from vehicles also contains formaldehyde. The sample recovery area should not be in the vicinity of a source of exhaust. Use of aftershave lotion, cologne or perfume should be avoided while testing.

k. Every test shall include at least one sampling train blank (field blank) for each test run, as specified in CARB Method 430 Section 10.1.1. The field blank shall be performed immediately prior to each run. The field blank shall include all of the same components and procedures as a test run, including a leak check as described above in item L.1.c.

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l. The blank-corrected sample value shall be calculated exactly as specified in CARB Method 430 Section 11.10, i.e. based on the concentration of formaldehyde in the liquid samples and blanks (e.g., ug/mL).

m. For maximum accuracy, it is recommended that a sampling train control console that incorporates both a calibrated precision rotameter and a low-flow dry gas meter be used for the tests (e.g., an EPA Method 0030 Volatile Organic Sampling Train control console). A standard Method 5 dry gas meter shall not be used for determining sample volume because the sample flow rate is below the calibrated range of such equipment. Alternatively, a precision rotameter alone may be used provided it is properly instrumented to measure inlet sample gas temperature and pressure and the indicated rate is corrected for actual conditions.

n. The CARB Method 430 reporting protocol of five times the field blank if results are below detection limits should not be used. Stack sample results should be corrected by the field blank average. Applicability of the CARB Method 430 reporting protocol will yield over-reporting values if the stack level is below five times the average field blank (FB) level.

o. ISO Method: There is no known ISO method for measurement of formaldehyde.

N. Certification of Calibration Gases

All gases used in certification of instruments or performance of emissions guarantee demonstrations shall be analyzed and certified in a manner and by a laboratory mutually agreeable to GE and Purchaser. Examples of acceptable certification are:

1. U.S. EPA Standard Methods

   a. U.S. EPA Protocols

   b. U.S. National Bureau of Standards Certification Procedures

   c. ISO Standard Methods (e.g. ISO/TS 14167).

O. Exhaust Gas Flow Determination

1. GE Preferred Method: GE has established preferences for the determination of exhaust flow based on accuracy of the determination. GE recommends the following:

   a. The primary exhaust flow determination shall be by the F-factor method per 40CFR60, Appendix A, Method 19 (as specified in Method 20 for gas turbine emissions). The F-factor constants from Table 19-1 shall be applied in all cases where possible per Paragraph 3.1.

   b. Where available, the compressor inlet airflow signal shall also be used to compute exhaust flow. Exhaust flow on a dry basis is the turbine inlet airflow minus the water vapor plus the fuel flow minus the water formed from the combustion of hydrogen in the fuel. Gas turbine inlet air is measured using the compressor inlet air scroll as a flow element.

a. Flow measurements by Velocity Traverse, per 40 CFR 60, Appendix A, Methods 1 and 2, can result in errors of 25 percent or more in this application, and is not acceptable.

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b. ISO Method: ISO Method 10780 is similar to EPA Method 1 and 2, using an L and S type pitot tube to determine the velocity and volume flow rate of a gas stream, and is therefore not recommended for the reason cited in N.1.(c) above.

P. Fuel Bound Nitrogen Determination (if required)

1. GE Preferred Method: Prior to emission testing, analyses for fuel bound nitrogen must be determined in accordance with ASTM D4629, which is based on a combustion / chemiluminescence method.

Q. Reporting Preliminary Test Results

The Vendor must use the attached spreadsheets as applicable for reporting preliminary test results prior to test site demobilization or make provisions to complete prior to site demobilization. A more comprehensive set of data will be required for final reporting, to be specified in the project-specific test protocol. Please contact GE for the most recent version of these spreadsheets prior to submittal.

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Appendix A.
Summary Table for Reporting Preliminary Test Results Prior to Demobilization – Simple Cycle or Combined Cycle without Duct Firing

Revise as necessary based on what is applicable to the testing project. Simple Cycle or Combined Cycle without duct firing.

Project Name _____
Site Location _____

Date				
Test Number	1	2	3	Average
Start and End Time of Test				
Test Condition				
TURBINE OPERATING CONDITIONS				
Compressor Discharge Pressure(psig) (CPD)				
Compressor Inlet Temperature(°F) (CTIM)				
Fuel Flow (lbs/sec) (FQG, FQLM1)				
Steam or Water Injection Flowrate (lbs/sec) (WQJ)				
Power Augmentation Steam (lbs/sec) (WQJA)				
Steam or Water Flow/Fuel Flow Ratio (WXJ)				
Generator Output (MW) (DWATT)				
Heat Input (million Btu/hr)				
Inlet Guide Vane Setting (CSGV)				
Mean Turbine Exhaust Temperature (°F) (TTXM)				
Specific Humidity lbs H2O/lb Dry Air (CMHUM)				
Barometric Pressure, in Hg (AFPAP)				
Stack Exhaust Temperature (°F)				
AMBIENT DATA				
Wet Bulb Temperature (°F)				
Dry Bulb Temperature (°F)				
Barometric Pressure, in Hg				
Specific Humidity lbs H2O/lb Dry Air				
EMISSION DATA				
NOx ppmvd				
NOx ppmvd @ 15% O2				
O2 % by volume, dry basis				
CO2 % by volume, dry basis				
CO ppmvd				
Moisture (% by volume)				
UHC ppmvw, ppmvd				
VOC ppmvw, ppmvd				
SO2 ppmvd @ 15% O2				
Exhaust Flow, dscfm				

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Appendix B.
Summary Table for Reporting Preliminary Test Results Prior to Demobilization – Combined Cycle with duct firing

Revise as necessary based on what is applicable to the testing project.
Combined Cycle with duct firing.

Project Name _____
Site Location _____

Date				
Test Number	1	2	3	Average
Start and End Time of Test				
Test Condition				
TURBINE OPERATING CONDITIONS				
Compressor Discharge Pressure(psig) (CPD)				
Compressor Inlet Temperature(°F) (CTIM)				
Turbine Fuel Flow (lbs/sec) (FQG, FQLM1)				
Steam or Water Injection Flowrate (lbs/sec) (WQJ)				
Power Augmentation Steam (lbs/sec) (WQJA)				
Steam or Water Flow/Fuel Flow Ratio (WXJ)				
Generator Output (MW) (DWATT)				
Turbine Heat Input (million Btu/hr)				
Inlet Guide Vane Setting (CSGV)				
Mean Turbine Exhaust Temperature (°F) (TTXM)				
Specific Humidity lbs H2O/lb Dry Air (CMHUM)				
Barometric Pressure, in Hg (AFPAP)				
Stack Exhaust Temperature (°F)				
Duct Burner Fuel Flow				
Duct Burner Heat Input (million Btu/hr)				
AMBIENT DATA				
Wet Bulb Temperature (°F)				
Dry Bulb Temperature (°F)				
Barometric Pressure, in Hg				
Specific Humidity lbs H2O/lb Dry Air				
TURBINE FUEL ANALYSIS				
Heating Value Btu/lb				
DUCT BURNER FUEL ANALYSIS				
Heating Value Btu/lb				
JOINT FIRE CONCENTRATIONS				
NOx ppmvd				
NOx ppmvd @ 15% O2				
O2 % by volume, dry basis				
CO2 % by volume, dry basis				
CO ppmvd				
SO2 ppmvd @ 15% O2				
TURBINE ONLY CONCENTRATIONS				
NOx ppmvd				
NOx ppmvd @ 15% O2				
O2 % by volume, dry basis				
CO2 % by volume, dry basis				
CO ppmvd				
JOINT FIRE EXHAUST FLOW & MASS EMISSION RATES				
HRSG Exhaust Flow, dscfm				
TURBINE ONLY EXHAUST FLOW & MASS EMISSION RATES				
Transition Duct Exhaust Flow, dscfm				

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Appendix C.
Turbine Emissions Performance Test Readiness Checklist

Customer:_____ Checklist Completed By:_____ Title:_____
Site:_____ Date:_____
Unit:_____

Please answer all of the following questions and return this form **at least 72 hours prior to the test date.** Questions should be directed to the GE Power Generation Manager of Environmental and Acoustics Engineering.

	SYSTEM / OPERATION	Circle (Y, N, or N/A)			If no, why?	
GAS TURBINE FUEL SYSTEM						
1	Has Mark V or VI fuel flow reading accuracy been checked using ASME Method?	Y	N	N/A		
2	Has gas turbine reached full load on gas fuel firing?	Y	N	N/A		
3	Has running on gas at full load exceeded 10 hours?	Y	N	N/A		
4	Has distillate oil fuel flow divider accuracy been checked across the load range?	Y	N	N/A		
5	Has gas turbine reached full load on oil fuel firing?	Y	N	N/A		
6	Has running on oil at full load exceeded 10 hours?	Y	N	N/A		
7	Has fuel transfer from gas to oil been conducted?	Y	N	N/A		
8	Has more than one transfer been conducted?	Y	N	N/A		
9	Has fuel transfer from oil to gas been conducted?	Y	N	N/A		
10	Has more than one transfer been conducted?	Y	N	N/A		
11	Have purge and check valves been operating properly?	Y	N	N/A		
12	If fuel transfer in either direction has not been smooth, has the system been recalibrated and tested?	Y	N	N/A		
13	**Has a fuel oil sample been taken and tested for fuel bound nitrogen (FBN), sulfur content and ash content? Fuel sample analysis results: FBN:_____ ppm by weight Sulfur:_____ % by weight Ash:_____ %	Y	N	N/A		X1
WATER / STEAM INJECTION SYSTEM						
14	**Is water injection system operating within specification across the load range?	Y	N	N/A		X2
15	Has the flow meter been calibrated?	Y	N	N/A		
16	Is the system set to operate in automatic mode across the load range?	Y	N	N/A		

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	SYSTEM / OPERATION	Circle (Y, N, or N/A)			If no, why?	
INLET BLEED HEAT						
17	Has inlet bleed heat system been commissioned?	Y	N	N/A		
18	Is the system set to operate in automatic mode?	Y	N	N/A		
CONTROL SYSTEM / INSTRUMENTATION						
19	Have gas fuel flow signals been checked (zero and span)?	Y	N	N/A		
20	Have oil fuel flow signals been checked (zero and span)?	Y	N	N/A		
21	Has humidity sensor accuracy been checked using a psychrometer?	Y	N	N/A		
22	Have bell mouth D.P. sensors been calibrated?	Y	N	N/A		
23	Have the air flow calculations been verified?	Y	N	N/A		
CONTINUOUS EMISSION MONITORS						
24	Has the CEMS system been installed and checked out?	Y	N	N/A		
25	Is the system currently conducting daily calibrations (zero and span)?	Y	N	N/A		
26	Does the CEMS have nearly full bottles of calibration gases?	Y	N	N/A		
HRSG STACK						
27	**Have the proper EPA test port locations been verified?	Y	N	N/A		X3
28	Have the proper CEMS test port locations been verified?	Y	N	N/A		
29	Are the proper walkways, ladders and platforms installed?	Y	N	N/A		
30	Is the stack properly insulated in the areas that personnel will be working or passing?	Y	N	N/A		
31	Is reliable electric power available at test area?	Y	N	N/A		
BYPASS STACK						
32	Is emissions testing of bypass stack required by permit?	Y	N	N/A		
33	**Have the proper EPA test port locations been verified?	Y	N	N/A		X4
34	Have the proper CEMS test port locations been verified?	Y	N	N/A		
35	Are the proper walkways, ladders and platforms installed?	Y	N	N/A		
36	Is the stack properly insulated in the areas that personnel will be working or passing?	Y	N	N/A		
37	Is reliable electric power available at test area?	Y	N	N/A		

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	SYSTEM / OPERATION	Circle (Y, N, or N/A)			If no, why?	
DUCT BURNER						
38	Does the HRSG have a duct burner (DB)?	Y	N	N/A		
39	Is the DB designed for dual fuel firing?	Y	N	N/A		
40	Is it scheduled to burn natural gas fuel?	Y	N	N/A		
41	Is it scheduled to burn distillate oil fuel?	Y	N	N/A		
42	Has the gas fuel flow meter been calibrated?	Y	N	N/A		
43	Has the oil fuel flow meter been calibrated?	Y	N	N/A		
44	**Has the DB been fully fired on gas fuel?	Y	N	N/A		X5
45	**Has the DB been fully fired on oil fuel?	Y	N	N/A		X6
46	Are air emission monitoring ports located upstream of the DB in the transition duct?	Y	N	N/A		
47	Is black smoke noticeable when firing DB on oil?	Y	N	N/A		
SELECTED CATALYTIC REDUCTION (SCR)						
48	Does the HRSG incorporate an SCR system?	Y	N	N/A		
49	Has the SCR system been checked for proper installation?	Y	N	N/A		
50	**Has the ammonia system been checked out for proper function over the load range?	Y	N	N/A		X7
51	Has the SCR system been operated at full load?	Y	N	N/A		
CARBON MONOXIDE (CO) CATALYST						
52	Does the HRSG incorporate a CO catalyst?	Y	N	N/A		
53	**Has the catalyst system been checked for proper installation?	Y	N	N/A		X8

ADDITIONAL COMMENTS

Env. Engr. to check off whether key questions (**) were answered and enter score here.

Score

__ / 8

Env. Eng. use only

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Appendix D.
Pretest - Turbine Emissions Particulate Matter Test Checklist

Customer: _____ Checklist Completed By: _____
Site: _____ Date: _____
Unit: _____

Please answer all of the following questions and return this form via fax or email to _____
prior to testing. Any "no" responses to questions below should be approved in writing by onsite GE personnel, GE's third party observer, or the environmental engineer assigned to the project.

	SYSTEM / OPERATION		Circle		If no, why?
SAMPLING SITE CONDITIONS					
1	Are the test port locations at proper distance from upstream and downstream disturbances? (*To be determined by GE PPS*)	Y	N	N/A	
2	Are the test ports made of stainless steel?	Y	N	N/A	
3	Are the ports free of corrosion and/or residual particulate matter?	Y	N	N/A	
4	Is the area around the stack paved?	Y	N	N/A	
4a	If not paved, has it been sprayed down to reduce fugitive dust?	Y	N	N/A	
5	Is there a clean area near the base of the stack that can be used for sample recovery/equipment preparation?	Y	N	N/A	
SAMPLING EQUIPMENT					
7	Is the sampling equipment in new and clean condition?	Y	N	N/A	
8	Is the sample free of any lubricants or grease that may interfere with the test results?	Y	N	N/A	
9	Have the filters and housings been pre-assembled offsite?	Y	N	N/A	
10	Were HPLC grade reagents brought to site for use with all sample recovery?	Y	N	N/A	

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Appendix E.
Sampling Run - Turbine Emissions Particulate Matter Test Checklist

Customer: _____ Checklist Completed By: _____
Site: _____ Date: _____
Unit: _____ Run #: _____

Please answer all of the following questions and return this form via fax or email to _____ **within 24 hours of testing**. Any "no" responses to questions below should be approved in writing by onsite GE personnel, GE's third party observer, or the environmental engineer assigned to the project.

	SYSTEM / OPERATION	Circle			If no, why?
AMBIENT CONDITIONS					
1	Are ambient air conditions acceptable for testing? (i.e. no high winds, high dust in area etc.)	Y	N	N/A	
SAMPLING PROCEDURE					
1	If a glass or quartz probe liner was used and broke during testing was the test halted and test run repeated? Please mark N/A if other liner material was used.	Y	N	N/A	
2	If performing Method 202, was the post-test N2 purge performed? It must be done after every run according to the Method 202 procedure.	Y	N	N/A	
3	Was the filter undamaged during removal from the filter holder?	Y	N	N/A	
3a	If damaged, were all pieces recovered?	Y	N	N/A	
QA/QC					
4	Has a reagent blank been taken for each run from the sample recovery equipment used in the field?	Y	N	N/A	
5	Has a field blank been performed (train assembled and leak checked, then recovered)?	Y	N	N/A	

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Appendix F.
Laboratory - Turbine Emissions Particulate Matter Test Checklist

Customer: _____ Checklist Completed By: _____
Site: _____ Date: _____
Unit: _____ Run #: _____

Please answer all of the following questions and return this form via fax or email to _____ **within 24 hours of testing**. Any "no" responses to questions below should be approved in writing by onsite GE personnel, GE's third party observer, or the environmental engineer assigned to the project.

SYSTEM / OPERATION Circle If no, why?

SAMPLING PROCEDURE						
1	Is constant weight procedure to a tolerance of two consecutive weights within 0.1 mg of each other and are weights recorded to the nearest 0.01 mg?	Y	N	N/A		
2	Was sulfate aliquot removed for analysis by IC?	Y	N	N/A		
3	Was titration with NH4OH performed?	Y	N	N/A		
4	Were all lab notes and weighing records submitted with the results?	Y	N	N/A		

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Appendix G.
Particulate Matter Test Firm and Laboratory Recommended Qualification Criteria

Test Firm

A) Must have 10 years experience

B) Must have experience on 5 Gas Turbines

C) Must have 2 Customer references

D) Must be ASTM Certified or equivalent as approved by GE

E) Must submit an example test report for review

Individual Test Leader

A) Must have 5 years experience

B) Must have experience on 2 Gas Turbines

C) Must be Source Evaluation Society or ASTM certified or equivalent as approved by GE

D) Must submit an example test report for review

E) Must have received and acknowledged GE training for Particulate Matter testing

Laboratory

A) Must be State Certified (if applicable)

B) Must use a balance with 0.01 mg resolution

C) Must have experience with optional procedures

D) Must have 5 years experience

E) Must have experience with low level ion chromatography

F) Must agree to all GE requirements

G) Must submit an example report with detail for review

Laboratory Technician

A) Must have 1 years experience

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Appendix H.

Metric Unit Table

Temperature	**degrees C**
Mass Flow	**kg/sec, kg/hr**
Heat Input	**GJ/hr**
Pressure	**Bar**
Fuel heating value	**kJ/kg**
Exhaust Flow	**Nm3/hr**
Volumetric concentration	**mg/Nm3**
Mass concentration	**mg/kg**
F factor	**dscm/J**
Emission factor	**mg/MJ**

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SPECIFICATION FOR GAS TURBINE GENERATOR PERFORMANCE TEST MEASUREMENT (SGTGPTM)
LM6000 PC / PG SAC, NATURAL GAS FUEL REV4

I. INTRODUCTION

A Customer's acceptance of a gas turbine power generation facility is usually preceded by proof of compliance with specific performance requirements for the gas turbine generator set(s). GE Power & Water provided a performance guarantee of Output at the generator terminals and Heat Rate that is passed through to the Customer on a gross or unit net basis. In addition, Exhaust Temperature and Energy guarantees may also be provided.

If the Customer plans to use the results of the field test as a basis to determine the fulfillment of contractual requirements, the party responsible for conducting the test will provide the following services:

- Schedule, coordinate, and manage the logistics with respect to the performance test and equipment.
- Provide the final project specific performance test specification (see final paragraph of Section I).
- Validate calibration of pertinent instruments.
- Provide a post-test uncertainty analysis.
- Execute the performance test: data collection, data distribution to parties, fuel sampling, etc.
- Reduce the recorded data in accordance with the manufacturer's site performance data correction procedure.
- Issue a preliminary and final performance test report.

All services are dependent on the scope agreement between all parties. GE Energy may provide on-site support at the Customer's request. Please contact the Project Manager for details.

The test specification outlined below is the GE specification for testing. The Final Agreed Performance Test Specification will be generated by the Testing Entity; all parties will review the specification and iterate until an agreed final version is reached 120 days prior to the performance test date. The specification must be approved by all Parties 120 days before starting the Performance Test. The Final Agreed Performance Test Specification will be a more detailed document containing the GE specification provided here and this additional information:

- Test plan, schedule, and logistics
- Division of responsibility
- Exact instrumentation to be supplied
- Instrument installation
- Source of data collection for all parameters
- Marked up drawings showing installation or if equipment was modified for

installation, one-line and three-line diagrams showing the power meter and auxiliary power measurements
- Planned fuel sample process and laboratory information
- Method for documenting any deviations from the established test plan

This specification is a typical specification only and is for reference and illustrative purposes only. It is not a project specific specification and information contained herein, including numbers, scope, instruments, instrument set-up, etc., are not contractual obligations of GE Power & Water.

II. SCOPE AND PURPOSE

The primary purpose of this test shall be to demonstrate the guaranteed generator electrical output and heat rate for a GE Power & Water Aeroderivative Gas Turbine Generator (GTG). The guarantee power level will be achieved without exceeding specified engine control limits: High-pressure rotor speed, high-pressure compressor discharge pressure and temperature, and low-pressure turbine inlet temperature.

Other tests, such as emissions and noise, are typically identified by the permitting regulatory agency and, therefore, not covered in this document. However, the performance test will be performed while in compliance with NOx and CO emissions guarantees, if applicable. The Customer shall provide GE Power & Water with the emissions testing data during the performance test and the emissions data from the full emissions compliance test. All emissions measurements are in the scope of the Customer and must met the requirements of both parties.

The scopes of responsibilities will be agreed upon by all parties. A general scope of responsibilities is provided below:

- GE Power & Water shall provide a Correction Procedure model for computation of the performance test results. The Testing Entity may create a separate model for validation purposes; however, the GE Power & Water model shall be used as the primary model.
- The Testing Entity will appoint a Test Director who is responsible for supervising all aspects of the test.
- Both the Customer and the Testing Entity will be responsible for recording the data that is being collected.
- The primary results will be computed by the Testing Entity and verified by the Secondary Party.
- Personnel are to be provided by the Customer to assist in logging data and collecting fuel samples.
- One operator representing the Customer will be responsible for operating the unit. The operator may be assisted by a GE Power & Water Controls Technician.
- A site team of Technicians will be utilized for an offline compressor water wash. This procedure is to be conducted no more than three days prior to the performance test

and no less than one day before the performance test. GE Power & Water Technicians may assist.

- In addition to the above, all parties may have observers on the site during the test.
- GE Power & Water Performance Engineers shall establish GTG readiness for performance testing based on preliminary performance data. Preliminary data should be provided 2 weeks prior to the anticipated test date.
- If requested, a GE Power & Water Performance Engineer may provide on-site support to for the performance test.
- The test report shall be issued by the Testing Entity 2 weeks after the fuel samples data is available and all parties shall be allowed a 2 week period for review. If translation is required, the anticipated issue date will be 9 weeks after the fuel samples.
- All test data and reports, including emissions and noise, shall be provided to the GE Power & Water Performance Engineering Team.

III. TEST PROCEDURE

GE Power & Water testing procedures are in general compliance with ASME PTC 22–1997. Comments to ASME PTC 22–1997 are available for review. At GE Power & Water's option, the testing procedure may adapted to meet general compliance with ASME PTC 22-2005 upon providing notice to the customer and making comments to ASME PTC 22–2005 available.

A. Test Setup

The Customer will make a commercially reasonable effort to ensure the test takes place before 200 fired hours have elapsed on each gas turbine engine. Furthermore, the GTG must operate at steady base load and in new and clean condition for 24 cumulative hours prior to commencing the test. If the guarantee includes Exhaust Energy and/or Exhaust Temperature, this requirement of steady state, base load operational hours increases to 72 hours. If the Customer operates the equipment outside of the Seller's specific written operation instructions, GE Power & Water reserves the right to adjust the performance results with an additional degradation factor. GE Power & Water representatives shall determine, in their sole discretion, whether the GTG meets these criteria.

If more than 200 fired hours have elapsed before the test, degradation factors shall be applied.

B. Preparation

An off-line water wash is to be conducted, on each unit at site, no more than 3-days prior to, and no less than 1-day before, the scheduled performance test of initial unit.

Instruments and apparatus used for determinations shall be calibrated in accordance to the National Institute of Standards and Technology. Calibration

certificates for Customer furnished instruments shall be made available for GE Power & Water inspection prior to field-testing. Finally, GE Power & Water furnished instruments to the unit control panel shall be checked and properly adjusted prior to testing. **NOTE:** Additional details of the instrument requirements are provided in *Table 1 –Accuracy of Required Instruments* at the end of this document.

C. Establishing Test Readiness

Prior to initiating the performance test, GE Performance Engineers must establish GTG readiness. Preliminary testing shall be completed and sufficient time shall be allowed to evaluate the preliminary results, review the quantity and quality of data, and implement any agreed upon modifications to increase the test quality. Preliminary data shall be reviewed 2 weeks prior to the anticipated test date. Any adjustments made to the plant equipment or operation after the preliminary evaluation shall be reported to GE Power & Water. Testing shall not be conducted until GE Performance Engineering has released the engine for testing.

D. Conduct of the Test

1. Definition of Test Boundary

The test boundary establishes the equipment to be included in the test. All input and output energy streams must be determined with reference to the point at which they cross the test boundary. The test boundary for this test includes the Gas Turbine Generator, Control Limits, and Package Auxiliary Loads (if applicable – depends on the guarantee basis).

Typical GTG Package Auxiliaries ***(Example for Unit Net Basis Guarantees)***:

- Turbine Enclosure Vent Fan
- Generator/Gearbox Enclosure Vent Fan
- Generator/Gearbox Main Lube Oil Pump
- Generator/Gearbox Air/Oil Separator
- Turbine Air/Oil Separator Heat Exchanger Fan
- Lighting & Low Voltage Distribution System
- SPRINT Water Supply Pump
- Auxiliary Skid Enclosure Vent Fan
- Oil Cooler Fan
- Control House A/C

Each GTG Package Auxiliary Load listed above shall be measured individually at the MCC. Alternatively, if a MCC meter is available, it may be used provided that it measures only the loads specified on the Signed and Stamped Guarantee sheets.

The boundary for the inlet air temperature is established by the guaranteed conditions. If inlet heating/chilling is not used, the ambient temperature shall be the inlet temperature with a measured RH. If an evaporative cooler is used, the inlet air shall be the ambient temperature with an assumed effectiveness of 85% and a measured ambient RH. If inlet chilling/heating is used, the inlet temperature will be downstream of the chiller/heater and an assumed or calculated RH shall be used.

2. **Determination of GTG Steady State Condition**
Test data will be recorded only after the GTG is operated at a steady state base load condition for at least sixty (60) minutes. For the performance test, the GTG will be considered at steady state when variations from the average value (coefficient of variance) of the following parameters do not exceed the listed limits during the test period. The parameters are set for a fifty (50) minute test run. Any other length of test run, and the parameters will be adjusted.
   - Inlet Air Temperature ±4.0°F
   - Barometric Pressure ±0.5%
   - Power Output ±2.0%

3. **Test Duration and Number of Data Sets**
One test point will be conducted over a (50) *fifty-minute period*. A test point is defined as eleven (11) complete sets of manual instrument readings recorded at (5) *five-minute intervals* and all automated data shall be in thirty (30) second intervals.

4. **Data Collection Methodology**
Data collection methodology will be as follows:
   - The Test Director shall be provided to observe and support all aspects of the test.
   - If requested and agreed, one GE Power & Water Test Engineer may be provided to support all aspects of the test.
   - Personnel shall be provided by the Customer to collect fuel samples.
   - GE Power & Water and the Customer shall be responsible for recording the data that is being collected.
   - Manually collected data: The Customer shall collect back-up data manually where necessary: HMI screen shots, control system watch window screen shots.
   - Automated data collection: An automated data acquisition system shall be the preferred method of data collection.
   - Data sampling frequency: For automated data, a sampling rate of thirty (30) seconds shall be used. For manual data, a sampling rate of five (5) minutes shall be used.

   The Customer and a GE Power & Water representative will sign all data sheets at the completion of the test. All parties shall be provided with copies of all data sheets. The Testing Entity will retain the originals for use in preparing the official test report.

5. **Gas Fuel Analysis and Sampling**
The Owner will arrange for sampling and analysis of fuel. Analysis of fuel shall give composition of the natural gas in mole % (per ASTM D-1945), HHV, LHV and specific gravity (per ASTM D-3588). See Appendix IV for analysis methods.

   Three (3) fuel samples will be collected during the performance test. First sample is

taken at the beginning of the test, the second sample approximately 25 minutes into the test, and the third sample at the conclusion of the test. Sample bottles are to be marked with the time, data, unit/sample number, and fuel temperature at time of test.

Two (2) of the three (3) samples are to be sealed, labeled and sent off for analysis by the Customer. The third sample is to be held at the site until analyzed samples are reviewed and deemed acceptable by GE Power & Water and Customer. Appendix IV of the Correction Procedure (to be provided) will provide additional information on fuel sampling and analysis methods.

IV. INSTRUMENTS REQUIRED

Table 1 gives a general list of the test equipment, recommended accuracies, and parties responsible for supplying such equipment to conduct the performance test.

A. Generator Power Output

Generator output shall be measured by a precision 3-phase wattmeter with accuracy less than ±0.2%

GE Power & Water furnished current transformers are certified to ±0.3% accuracy. If more accurate CTs are required, the Customer will assume the scope of providing the instruments. Potential transformers shall be provided by the Customer. GE Power & Water recommends accuracy of to ±0.3% or better. A total KW monitoring system uncertainty of ±0.5% is attainable with this calibrated system.

If applicable, each GTG Package Auxiliary Load listed above shall be measured individually at the MCC. Alternatively, if a MCC meter is available, it may be used provided that it measures only the loads specified on the Signed and Stamped Guarantee sheets. GTG Package Auxiliary Loads are only applicable to unit net basis guarantees. Auxiliary loads shall be measured with accuracy of ±5.0% or better. A power factor of 0.85 is assumed unless measured. The GT power factor is not equivalent to the power factor of the auxiliary loads.

B. Fuel Heat Input - Gaseous Fuels

GE Power & Water Single Annular Combustor (SAC) packages use a flow meter rated at 1%, but capable of being calibrated in the range of 0.5% to 0.8%. If the Customer wishes to reduce the uncertainty below 0.8%, they shall design and construct a permanent flow meter capable of providing fuel flow with accuracy of 0.5% or better. If a further reduction in uncertainty is desired, the Customer shall design and construct a permanent flow meter capable of providing compensated fuel flow on a mass basis with uncertainty of ±0.5% or less. Compensation shall be calculated in accordance with AGA8.

The GTG SAC package includes fuel pressure and temperature sensors; however, if a secondary meter is installed, the Customer shall provide these instruments. The fuel temperature sensor and fuel pressure sensor shall be installed in close proximity to the fuel flow meter so the data collected is a representation of the fuel state at the meter. Pressure at the fuel gas meter is to be measured with a pressure transducer having ±0.25% accuracy. Temperature at the fuel gas meter is to be measured an accuracy of ±1°F. Compressibility of the fuel will be determined using the performance test fuel analysis and AGA8 calculations.

C. Engine Inlet Air Conditions

The ambient dry-bulb temperature is a primary measurement if the guarantee was created without inlet conditioning or if the guarantee was created with an evaporative cooler in service. The ambient dry bulb temperature shall be measured with at least eight (8) RTDs placed in the filter house with at least four (4) RTDs placed in each side of the filter house. The RTDs shall be placed in a location prior to inlet coils (if applicable) that allows for sufficient flow over the RTDs and installed in a manner that quantifies and minimized the spatial variation. The sensors shall be away from direct exposure to radiation and sunlight. The sensors shall be installed away from areas with flow disturbances. The individual sensor accuracy shall be ±0.26°F and the overall measurement uncertainty including spatial variation shall be ±1°F. Additional sensors may be required to reduce the overall measurement uncertainty. If the ambient dry bulb temperature is a secondary measurement, the instrumentation may be reduced and alternative schemes will be evaluated.

If the guarantee was created with inlet chilling or heating, the compressor inlet temperature (T2) will become the inlet temperature, a primary measurement, and shall be measured using eight (8) RTDs with four (4) RTDs placed in each side of the filter house. If any coil/pad/flow interference is included in the filter house hardware, , the RTDs shall be placed after this equipment and away from any flow disturbances to allow for a compressor inlet temperature reading. The RTDs shall be placed in a location that allows for sufficient flow over the RTDs and installed in a manner that quantifies and minimized the spatial variation. The overall measurement uncertainty including spatial variation shall be ±1°F. Additional sensors may be required to reduce the overall measurement uncertainty. If the unit is not inlet conditioned, the T2 measurement will be secondary and will be obtained by the dual thermocouple provided with the GE Power & Water package instrumentation. Expected uncertainty using the dual thermocouple is dependent on the package.

For both ambient and compressor inlet temperatures, the delta between the min and max sensor in one side of the filter house should be limited to 5°F. The delta between the bulk temperatures of the filter house sides shall be limited to 5°F. Any items causing the deltas, such as hot air streams from other processes shall be eliminated if possible or mitigated to the best extent.

The relative humidity shall be measured using at least two (2) digital relative humidity

sensors with one (1) sensor in each side of the filter house in the same location as the ambient air RTDs. A total accuracy of ±2% is expected. If the guarantee was created with inlet chilling or heating, the RH at station 2 (compressor inlet) is required for correction. Due to the environment at this station, direct measurement is not practical; therefore, the station 2 RH will be assumed or calculated. The assumed value of RH will be determined per an APP run using the ambient dry bulb temperature, the ambient RH, and the station 2 temperature.

Barometric pressure at the test site shall be measured with a barometer accurate to ±0.075%. Two sensors are recommended, but only one is required. Barometric pressure shall be measured as close as practical to the engine centerline.

Engine inlet total pressure loss shall be measured with a differential pressure transmitter with one line installed on the calibration valve of the P0 pressure transmitter and the other open to atmosphere. A total accuracy of ±0.25 inches of water is assumed. If GE Power & Water supplies the inlet air system, the inlet air system will be inspected. If GE Power & Water finds the air inlet system in a suitable condition, the engine inlet total pressure loss will be collected for reference information only and this value will be secondary - no correction for inlet total pressure loss will be made. If the inlet system is not in a suitable condition, GE Power & Water shall chose to either request the system be restored or will apply a correction for inlet pressure loss.

D. Engine Exhaust Static Pressure

For the exhaust static pressure loss measurement, a pressure transmitter shall be utilized if a connection port is made available. The Customer is responsible for supplying test port connections (static pressure taps) or ports for static pressure probes (pancake probes) for exhaust loss measurement. GE does not provide test ports between the turbine exhaust and exhaust stack, SCR, or boiler. Multiple ports are recommended to provide redundant measurements and also provide for troubleshooting. GE Power & Water recommends providing four equally spaced ports along the circumference of the duct. The Test Director may at that time choose to utilize all four ports either through a manifold/single pressure transducer or through multiple transducers.

Engine exhaust static pressure shall be measured at the discharge of the engine exhaust collector upstream of any heat recovery, catalytic converter or sound attenuation equipment. The instrument accuracy shall be ±0.25 inches of water or better and enough ports/instruments shall be provided to achieve a maximum uncertainty of 10%.

Exhaust pressure loss can be a difficult measurement to obtain accurately due to the flow conditions downstream of the GT exhaust. If an accurate measurement cannot be obtained, the parties will decide on an alternative plan. Exhaust pressure loss shall be measured at the discharge of the engine exhaust collector upstream of any heat recovery, catalytic converter or sound attenuation equipment.

If GE Power & Water supplies the exhaust system of the package, the exhaust air system will be inspected. If GE Power & Water finds the air exhaust system in a suitable condition, the engine exhaust pressure loss will be collected for reference information only, and no correction will be made for exhaust pressure loss.

E. NOX Water Injection

NOx water injection flow is measured via a Flow Technology turbine flow meter. The water temperature at the flow meter is measured with an RTD. The accuracy of the measurement and readout is ±0.5% for water flow.

F. Exhaust Temperature **(if Applicable)**

GE Power & Water recommends that the gas turbine exhaust temperature shall be measured using a grid of temperature sensors (rakes) located in the exhaust plenum of the gas turbine as close to the turbine/exhaust duct (HRSG, SCR, or stack inlet) interface point as possible. The duct surface of the exhaust shall be insulated to mitigate heat losses. The grid shall consist of at least 24 temperature sensors, spaced to measure equal area sections of the exhaust duct such that the maximum uncertainty of the measured exhaust temperature is ± 10.0 °F or better. This total uncertainty shall include contributions from the thermocouple wire (if applicable) and the processing equipment (if applicable). Individual sensor accuracy shall be ±0.5°F or better. Due to the non-uniform nature of exhaust flow, GE Power & Water recommends thermocouple rakes with at least 24 thermocouples. The TCs should be read individually and not ganged together. The measurement location should be away from any bends, transitions, or other flow disturbances. Each sensor shall be installed at least 8 inches from the wall of the duct to avoid boundary layer effects on the flow. The Customer is responsible for providing the available ports. The Testing Entity is responsible for providing the temporary test instrumentation and ensuring that the arrangement results in a total measurement uncertainty of ± 10.0 °F or better. If ports are provided downstream of the engine exhaust flange, GE Power & Water reserves the right to adjust the exhaust temperature measurement by the estimated temperature decay. If enough ports and instrumentation is not provided to obtain the desired measurement uncertainty, GE Power & Water reserves the right to adjust the exhaust temperature measurement and exhaust energy calculation with a commercial tolerance to account for the inadequate measurement. The commercial tolerance will be calculated based on the delta in uncertainty from the required ±10°F. A Test Deviation Letter will be provided to document the deviation from the proposed test specification. All uncertainty calculations must include the contribution due to spatial variation of the proposed measurement method.

The responsibility of exhaust temperature measurement is not in GE scope. Exhaust temperature measurements are required even if the guarantee only consists of exhaust energy.

G. Engine Exhaust Energy **(if Applicable)**

A proposed methodology outlining the calculation of exhaust gas energy will be provided in Section VII.C of the Correction Procedure. This methodology is based on an energy balance. Exhaust energy cannot be computed if the exhaust temperature is not measured. Since exhaust energy is heavily dependent on the exhaust temperature measurement, GE Power & Water reserves the right to adjust the exhaust energy calculation with a commercial tolerance if the exhaust temperature is inadequately measured. The commercial tolerance will be calculated based on the delta in uncertainty from the required exhaust temperature uncertainty of ±10°F. All uncertainty calculations must include the contribution due to spatial variation of the proposed measurement method. A Test Deviation Letter will be provided to document the deviation from the proposed test specification.

H. Emissions Measurements

The Customer shall make provisions to measure emissions in a method that is agreed to by all parties. If a CEMS is the proposed measurement device, the CEMS shall have gone through a certification process. The Customer shall provide information on making corrections for calibration and drift. GE Power & Water recommends using a qualified third party test entity with temporary instrumentation that will test for emissions in accordance to the methods established on the Stamped and Signed Guarantee Sheet. The only emissions measurements required during the performance test are NOx and CO.

V. ENGINE LIMIT ASSESSMENT

The following Unit Control Limit Parameters are to be recorded during the performance test for engine limit assessment:

- High Pressure Rotor speed, XN25
- Low Pressure Rotor Speed, XNSD
- Compressor Discharge Pressure, PS3
- Compressor Discharge Temperature, T3
- Low Pressure Turbine Inlet Temperature, T48

VI. TEST EXECUTION

The Test Director has the overall responsibility for starting and stopping test, for directing plant operation and the test personnel, and for all other aspects of the test execution. However, the Test Director may not deviate from the test plan without prior mutual agreement by all parties to the test.

A. Unit Operating Conditions

1. **Permissible Mode of Unit Control:**
   All Unit components will be operating within the respective manufacturer's specified continuous operating limits at base load. Test data will be recorded only when GTG is at base load and at a control limit (T3, PS3, T48, N25, N25R), and all test instrumentation are functioning satisfactory and in steady state condition for at least 30 minutes prior to testing. Please Note: If unit is in XNSD control, MW Limit Control, and/or Maximum or Minimum Fuel Control, then the performance test will not be conducted unless the GTG is in XNSD control due to the Max MW Limit Control Schedule or if the unit is in XNSD control due to a GE Performance Test Engineer approving a MW cutback to balance plant emissions or performance. Customers and or third party Test Entities may not make this decision without the written authorization of GE Power & Water.

2. **Operating Status of GTG Inlet Conditioning**
   Inlet conditioning shall match the stamped and signed guaranteed performance sheets. If an evaporative cooler was used in the guarantee, the performance test will not take place until the evaporative effectiveness is at least 85%. If applicable, the inlet chiller/heating system including all components shall be online, fully functional, and at steady state for the performance test. The chiller/heater must be capable to provide the capacity as stated on the Stamped and Signed Guarantee Sheet.

3. **Operating Status of GTG Package Auxiliary Loads:**
   The test should be conducted with normal auxiliary package service loads in operation. Unit service loads associated with Balance of Plant, emergency equipment, construction or any other operation, which is not normal day-to-day operation, are to be excluded from the test.

4. **Emissions:**
   Combustion Mapping must be completed prior to the performance test to insure the GTG meets the guarantee emission requirements. The performance test will not be conducted if emissions are in excess of the guaranteed limits. During the performance test, NOx water injection is to be used to maintain a NOx emission rate at the guaranteed value. The Customer shall make provisions to measure emissions in a method that is agreed to by all parties. The Customer shall provide all emissions test data to GE Power & Water.

5. **Applicable Operating Range for the Correction Procedure:**
   To reduce the effect of corrections, every effort within practicality shall be made to reduce the delta between the test conditions and guarantee conditions. For the performance test runs, allowable ranges from the guarantee point are provided in in this Section and in Section VII. Outside of these ranges, a Test Deviation will need to be signed and/or the correction procedure model will

require a revision. The correction model provided is not valid outside of this established range.

*EXAMPLE Table - Allowable ranges are project specific.

PARAMETERS	MIN	MAX

B. Permissible Deviations during Test Runs

1. **Typical Performance Test Restart Situation:**
   Any deviation outside of the Steady State Limits established in Section III.D.2 will require a restart of the performance test until the Steady State criteria are met.

2. **Allowable Deviation from Guarantee Conditions**
   To reduce the effect of corrections, every effort within practicality shall be made to reduce the delta between the test conditions and guarantee conditions. See Section VI.A.5 for the operating condition range.

2. **Typical Performance Test Abort Situation:**
   - NOx water must be online during the performance test. If NOx water injection goes offline during the performance test, then the test will be aborted.
   - The unit must be at base load with all systems operating (SPRINT, Inlet Heater if needed, Gas compressors if needed, etc...). If any of these systems go offline during the performance test, the test will be aborted.
   - If the unit trips offline for any reason, then the test will be aborted.
   - Unit goes into Maximum or Minimum Fuel Control.
   - NOX and/or CO emissions are in excess of the guaranteed limits (if applicable).

The performance test will be restarted as soon as the problem leading up to the abort situation is rectified.

VII. EVALUATION OF TEST RESULTS

The Gas Turbine Generators are designed and guaranteed to produce a certain output with a certain heat rate for a given set of ambient and operating conditions. As the ambient conditions deviate from the design values, the actual performance of the GTG changes. The ambient conditions at the time of testing are likely to be different from the values stated in the basis of guarantee. To account for these deviations from design ambient conditions, site-specific correction will be applied to the raw data to derive equivalent design condition results.

To reduce the effect of corrections, every effort within practicality shall be made to reduce the delta between the test conditions and guarantee conditions. For the performance test runs, the applicable range of operating conditions is listed in Section VI.A.5. Outside of these ranges, a test deviation will need to be signed and/or the correction procedure model will require a revision.

A. Guarantee Basis Site Conditions

The guarantee basis conditions are included on the GE Power & Water Stamped and Signed Guarantee Sheets, which are included in Appendix I.

B. Methodology for Data Reduction

The gas turbine generators are designed to produce a certain output with a certain heat rate for a given set of ambient and operating conditions. As the ambient conditions deviate from the guarantee basis values, the measured performance of the GTG changes. To account for the deviations from basis condition of the guarantee, a GE Power & Water Deck Transfer Correction Procedure has been compiled.

The Deck Transfer Correction Procedure uses the Application for Package Performance Systems cycle deck (APPS) to model gross output and heat rate at the performance test day conditions and also to provide the gross power and heat rate at the basis conditions of the guarantee.

From these performance runs, an overall correction for power and heat rate will be respectively determined and applied to the measured output and heat rate. In the Correction Procedure, an example of the Deck Transfer Methodology will be outlined in Appendix II.A and the APPS performance runs will be included in Appendix II.B.

****Gross Corrected Power = Measured Power at GT Generator Terminals Corrected for the Parameters Noted in Appendix II.**

****Gross Corrected Heat Rate = Calculated Heat Rate Corrected for the Parameters Noted in Appendix II.**

Corrected Exhaust Temperature = Measured Exhaust Temperature Corrected for the Parameters Noted in Appendix II

Corrected Exhaust Energy = Calculated Exhaust Energy (Energy Balance Method) Corrected for the Parameters Noted in Appendix II

** unit net basis guarantees will be adjusted by the measured package auxiliary loads.

Collected Performance Data (EXAMPLE)	
Barometric Pressure, psia	
Ambient Dry Bulb, °F	
Ambient Wet Bulb, °F	
Ambient Relative Humidity, %	
Compressor Inlet Temperature, °F	
Inlet Loss, inH2O, (No Correction taken as this is in GE Power & Water Scope of Supply)	
Exhaust Loss, inH2O,	
FF	Fuel Flow, scfm
FLHV	Fuel Lower Heating Value, Btu/scf
Measured Gross Power, Calculated Heat Rate, and Measured Package Auxiliary Loads	
MGPOW	Measured Gross Power, kW @ Generator Terminals
PwrFac	Power Factor
Cal_GHR	Calculated Gross Heat Rate, Btu/kW-hr = FF * FLHV / MGPOW
Deck Transfer Correction Methodology	
A	Modeled Power Output, APPS Deck Transfer Run (Case 100) @ **Guarantee Basis Conditions, kW**
B	Modeled Power Output, APPS Deck Transfer Run (Case 101) @ **Test Day Conditions, kW**
C	Modeled Heat Rate, APPS Deck Transfer Run (Case100) @ **Guarantee Basis Conditions, Btu/kW-hr**
D	Modeled Heat Rate, APPS Deck Transfer Run (Case 101) @ **Test Day Conditions, Btu/kW-hr**
Correction Factors	
CF_GP	Deck Transfer Correction Factor for Gross Power = B / A
CF_GHR	Deck Transfer Correction Factor for Gross Heat Rate = D / C
Gross Power and Heat Rate Correction Calculations	
CGO	Corrected Gross Ouput, kW = MGPOW / CF_GP
OM	**Output Margin, %**
CorrGHR, LHV	Corrected Gross Heat Rate, Btu/kW-hr (LHV) = Cal_GHR / CF_GHR
HRM	**Heat Rate Margin, %**

C. Method and Criteria for Evaluation of Test Results with Regard to Guaranteed Performance

The Test Director and GE Power & Water will independently evaluate test data once test fuel analyses are received. Test data correction is performed in accordance with General Electric "Gas Turbine Site Performance Test and Correction Procedure", GE Power & Water document #SSPCP2500-A. This document is the site specific correction procedure, which is provided 120 days prior to the anticipated test date.

Each measured test parameter's tolerance is defined as twice the estimated standard deviation (2-sigma). The uncertainty in the compliance parameter resulting from this tolerance is calculated for each measured test parameter. These uncertainties are then combined by root-sum-square analysis to obtain the total uncertainty for that compliance parameter. *Table 2* illustrates typical uncertainty calculations.

Applied tolerances are a commercial item and shall be discussed in the contract terms and conditions. From a technical perspective, measurement uncertainty shall not be applied to the corrected results and/ or performance correction calculations. Uncertainty shall be used prior to the test to measure the quality of test. If the uncertainty is not acceptable, the parties shall work on modifying the instrumentation to reduce the uncertainty. For exhaust temperature measurements, if enough ports and instrumentation is not provided to obtain the desired measurement uncertainty, GE Power & Water reserves the right to adjust the exhaust temperature measurement and exhaust energy calculation with a commercial tolerance to account for the inadequate measurement.

A full test report should be issued two weeks after the fuel analysis has been received. If translation is required, the anticipated issue date will be 9 weeks after the fuel samples.

D. Exhaust Energy Calculation Procedure **(Example, if Applicable)**

An energy balance around the GTG shall determine exhaust gas energy. Below is an outlined methodology, but details will be provided with the Correction Procedure. The ASME PTC-22 (2005) calculation method may only be used if the exhaust energy is guaranteed with reference to the T2 temperature; the PTC methodology utilizes the NASA Glenn coefficients, which do not work at a zero absolute temperature (ref 0°R).

The diagram below illustrates an energy balance around the GTG:

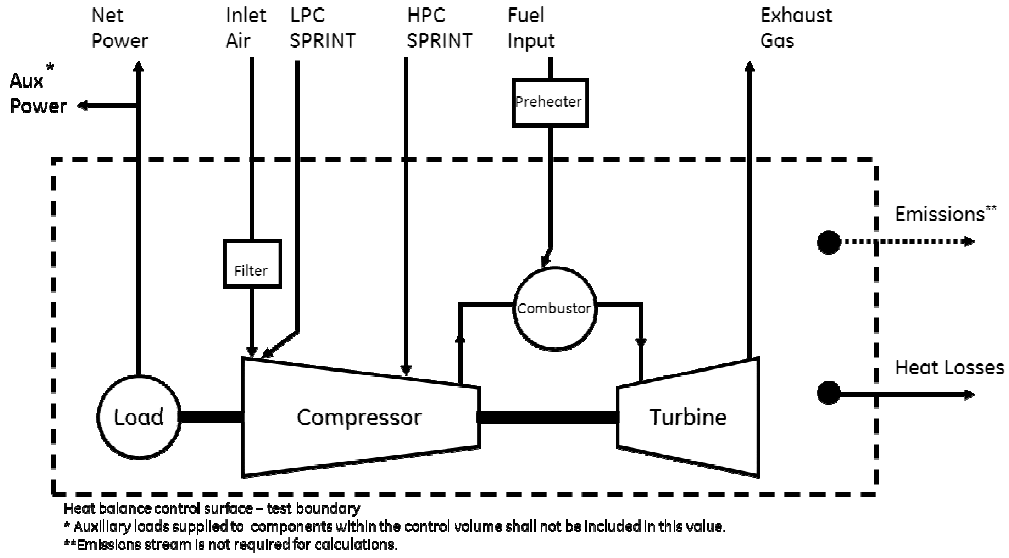


Figure 1: Control Envelope for Heat Balance Calculations (EXAMPLE)

A GTG energy balance results in the following equation:

Input Energy = Output Energy

$Q_{air} + Q_{fuel} + Q_{wtr\ inj} = Q_{kw} + Q_{loss} + Q_{exh} + Q_{gear\ loss}$

Or

$$Q_{exh} = Q_{air} + Q_{fuel} + Q_{wtr\ inj} - Q_{kw} - Q_{loss} - Q_{gear\ loss}$$

Setting the reference temperature T_{ref} equal to the inlet air temperature eliminates the Q_{air} term in the energy balance equation. This requires guaranteed exhaust energy to be referenced to T2. The exhaust energy guarantee is shown on the Stamped and Signed Guarantee Sheet. If this is the case, the equation reduced to the following:

$$Q_{exh} = Q_{fuel} + Q_{wtr\ inj} - Q_{kw} - Q_{loss} - Q_{gear\ loss}$$

Where:

Q_{air} (MMBtu/hr) = *Inlet Air Input Energy (zero for T2 referenced energies)*
= $m_{air} * (h_{air} - h_{air,ref}) / 1E6$

Q_{fuel} (MMBtu/hr) = *Fuel Gas Input Energy*
= $m_{fuel} * [LHV + (h_{fuel,temp} - h_{air,ref})] / 1E6$

$Q_{wtr\ inj}$ (MMBtu/hr) = *Water Injection (SPRINT and NOX Water as Separate Terms)*
= $m_{wtr\ inj} * [h_{inj}(P_{inj},T_{inj}) - H_{v,sat}(T_{ref})] / 1E6$

Q_{kw} (MMBtu/hr) = *Gas Turbine Power Output Energy*
= $PWR * (3412.14163\ Btu / kWh) / 1E6$

Q_{loss} (MMBtu/hr) = *Gas Turbine Heat Losses*
= $L_{gen} + L_{misc}$

$Q_{gear\ loss}$ (MMBtu/hr) = *Gear Box Loss*
= $GB_{loss} * (3412.12163\ Btu/ kWh) /1E6 * 0.85$

Where:

T_{ref}	=	reference temperature
m_{air}	=	inlet air mass flow rate (lb/hr)
h_{air}	=	inlet air enthalpy at measured temperature (Btu/lb)
$h_{air,ref}$	=	inlet air enthalpy at T_{ref} (Btu/lb)
m_{fuel}	=	fuel gas mass flow rate (lb/hr)
LHV	=	fuel gas lower heating value (Btu/lb)
$m_{wtr\ inj}$	=	water injection mass flow rate (klb/hr)
$h_{v,sat}(T_{ref})$	=	saturated vapor enthalpy (Btu/lb) at T_{ref}
$h_{inj}(P_{inj}. T_{inj})$	=	injection enthalpy (Btu/lb at measured P (P_{inj}) and T (T_{inj})
PWR	=	gas turbine power output net of excitation power (kW)
L_{gen}	=	Generator Losses (MMBtu/hr)
L_{misc}	=	Miscellaneous Losses (MMBtu/hr)
GBL_{loss}	=	Gearbox Losses (kW)

The Generator and Miscellaneous losses are determined from GE design data for the gas turbine. For an LM-6000 gas turbine the design losses are:

L_{gen} = [(100 – η_{gen}) /100] * PWR / 100 * 3412.14 Btu/kWh / 1E6

(η_{gen} is the generator efficiency determined from the generator curve which contains margin. To eliminate the margin, a 1.011 factor will be applied to the APPS data.) (To eliminate design margin, gearbox loss data in APPS will be decreased by a factor of 0.85)

L_{misc}^{*} = m_{air} * Losses

In order to determine L_{misc}, a value for the air flow to the turbine (m_{air}) needs to be determined (Flow losses are estimated based on a preliminary analysis from GE Power & Water Performance Engineering). A mass balance around the gas turbine results in the following equation:

m_{exh} = $m_{air} + m_{fuel} + m_{wtr\ inj}$

Exhaust flow will be determined by using the APPS model and if necessary by performing a mass balance by solving the energy balance equation for the exhaust gas flow rate:

$$m = \frac{Q_{exh} - Q_{kw} - Q_{loss} - Q_{gear}}{(h_{exh} - h_{exh,ref}) / 1000}$$

The exhaust gas enthalpies h_{exh} and $h_{exh,ref}$ are determined from the measured exhaust and selected reference temperatures, respectively, and the calculated exhaust gas molar composition. The exhaust gas molar composition is determined using combustion reaction stoichiometry (or APPS), the measured values for fuel gas composition, fuel gas flow rate, and water injection flow rate, and an initial guess for air flow rate. The exhaust enthalpy is then calculated using GE established thermodynamic data.

The energy balance may require iterative calculations depending on the inlet air flow estimate. GE Power & Water may employ data reconciliation methods on the energy balance.

The 1997 ASME Steam Tables shall be used for the properties of water and steam. In all energy calculations the International Table BTU is the BTU to be used, with a conversion factor of 1 BTU = 1,055.056 Joules.

Since the unit will operate at baseload during the performance test, bleed flows should be near zero. Bleed flows were not included in the provided example. Any bleed flow must be accounted for when calculating the energy and mass balances.

Table 1: Accuracy of Required Instruments (Proposed)

Instruments	Customer	GE Package	Testing Entity	Recommended [2]
Recording wattmeter			X	±0.20%
Potential transformers	X			±0.30%
Current transformers		X[3]		±0.30%
Primary fuel gas meter		X[5]		±1.0%
Fuel gas sampling device	X			Lab
Fuel gas pressure sensor		X[5]		±0.25%
Fuel gas temperature sensor		X[5]		±1.0°F
Engine inlet temperature (x8)			X[1]	±1.0°F
Barometric pressure transmitter			X	±0.075%
GT thermocouple system		X[1]		±2.0°F [4]
Ambient air RTDs (x8)			X[1]	±1.0°F
Inlet loss pressure transmitter			X	±0.25in. H2O
Relative humidity sensor (x2)			X	±2.0%
Exhaust loss pressure transmitter			X	±0.25in. H2O
Exhaust temperature (x24)			X[2]	±10°F
SPRINT water flow meter		X		±0.75%
Auxiliary power meter	X			±5.0%
Water Injection				
NOX water flow meter			X	±1.0%
NOX water temperature			X	±2.0°F
NOX/CO emissions	X			±1.5%

(1) See Section IV.C for details. The primary inlet temperature measurement is determined by the basis of guarantee conditions. All other measurements of air temperature are then considered secondary and the accuracy of instrumentation becomes less critical.

(2) Recommendations are for instrument accuracy except for exhaust temperature, and inlet temperature where the recommendation is for overall measurement uncertainty. Sensor accuracy for these temperatures shall be ±0.26°F for inlet temperature and ±0.50°F for exhaust temperature. Overall measurement uncertainty must be evaluated for all parameters. Additional sensors may be required to reduce the overall measurement uncertainty of a parameter.

(3) Provided that the Customer is accepting of the accuracy level. If a more accurate device(s) are required, the Customer shall assume the scope of providing the CTs.

(4) LM6000 PC accuracy is ±2.0°F. LM6000PG accuracy is ±6.4°F.

(5) See section IV.B for more details.

Table 2: Instrument Uncertainty (Example)

Pre Test Uncertainty of Corrected Gross Power Turbine Acceptance Test

Measured Parameter	Units	Average	Instrument Uncertainty B_I	Spatial Uncertainty B_s	Systematic Uncertainty B_C	Random Uncertainty** S_x	Total Uncertainty of Measured Parameter U_{95i}	Sensitivity θ_i ($\Delta R/\Delta P$)	Individual Uncertainty of Result (θ_i * U_{95i})
CT Gross Power	kW	53864.0	157.0	0	157.0	40.0	176.2	1.000	176.2
CT Power Factor	-	0.850	0.002	0	0.002	0.001	0.003	1160.0	3.045
Ambient DB Temperature	°F	68.0	0.26	0.86	0.90	0.200	0.983	155.00	152.44
Ambient Rel. Humidity	%RH	59.0	1.18	0.50	1.28	0.100	1.297	41.667	54.045
Ambient Pressure	psia	14.65	0.0110	0.001	0.011	0.005	0.015	9000.0	134.03
Fuel Temperature	°F	76.9	1.00	0	1.000	0.100	1.020	0.305	0.311
Fuel Heating Value (LHV)	btu/lbm	20,753	68.48	0	68.5	6.0	69.5	0.136	9.421
NOX Water Flow	lbm/hr	24,025	120.13	0	120.1	30.0	134.3	0.058	7.833
NOX Water Temperature	°F	100	1	0	1.0	1.5	3.2	1.400	4.427
Inlet DP	"H_20	5.00	0.050	0	0.05	0.050	0.1	0.00	0.000
Exhaust DP	"H_20	12.00	0.050	1.2	1.201	0.050	1.21	88.00	106.057
								Uncertainty (kW)	294.30
								Uncertainty (%)	0.55%

Pre Test Uncertainty of Corrected Gross Heat Rate Turbine Acceptance Test

Measured Parameter	Units	Average	Instrument Uncertainty B_I	Spatial Uncertainty B_s	Systematic Uncertainty B_C	Random Uncertainty** S_x	Total Uncertainty of Measured Parameter U_{95i}	Sensitivity θ_i ($\Delta R/\Delta P$)	Individual Uncertainty of Result (θ_i * U_{95i})
CT Gross Power	kW	53864.0	157.0	0	157.0	40.0	176.2	0.161	28.35
CT Power Factor	-	0.850	0.002	0	0.002	0.001	0.003	178.3	0.468
Ambient DB Temperature	°F	68.0	0.26	0.86	0.90	0.200	0.983	2.547	2.505
Ambient Rel. Humidity	%RH	59.0	1.18	0.5	1.28	0.100	1.297	1.230	1.596
Ambient Pressure	psia	14.65	0.0110	0.001	0.011	0.005	0.015	1444.750	21.516
Fuel Temperature	°F	76.9	1.00	0	1.000	0.100	1.020	0.225	0.230
Fuel Heating Value (LHV)	btu/lbm	20,753	68.48	0	68.5	6	69.5	0.421	29.24
NOX Water Flow	lbm/hr	24,025	120.13	0	120.1	30	134.3	0.023	3.05
NOX Water Temperature	°F	100	1.00	0	1.0	2	3.2	0.315	0.99
Inlet DP	"H_20	5.00	0.050	0	0.05	0.050	0.1	0.000	0.00
Exhaust DP	"H_20	12.00	0.050	1.2	1.201	0.050	1.21	11.042	13.308
Fuel Flow Rate	lb/hr	22,446	179.57	0	180	7	180.11	0.385	69.39
								Uncertainty HR (Btu/kWh)	84.46
								Uncertainty HR (%)	0.98%

**Random uncertainty estimate based on past tests using similar equipment

Estimated values - the final pre-test uncertainty including Exhaust Temp/Energy will be established by the testing entity.

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
Designate a PWP MMRP Monitor to prepare reports to submit weekly or monthly to Planning Case Planner	***PWP***	***Prior to the start of site preparation activities***				
1. Air Quality						
Mitigation Measure AQ-1: The Pasadena Water & Power Department and its contractors, via the City of Pasadena Public Works Department, shall require the implementation of a "Construction Staging and Traffic Management Plan" that provides for a temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Implement a "Construction Staging and Traffic Management Plan"	***File with Public Works Engineering Division***	***Prior to start of site preparation activities***	***During construction***			
Mitigation Measure AQ-2: The Pasadena Water & Power Department and its contractors, in consultation with the City of Pasadena Department of Transportation, shall require the implementation of a "Construction Staging and Traffic Management Plan" that identifies an on-site dedicated turn lane for the movement of construction trucks and equipment. When turning off-site, trucks will be required to utilize the on-site dedicated turn lane described in the plan.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Identify an on-site dedicated turn lane	***File with Public Works Engineering Division with Construction Staging and Management Plan***	***Prior to start of site preparation activities***	***During construction***			
Mitigation Measure AQ-3: The Pasadena Water & Power Department and its contractors shall require the implementation of a "Construction Staging and Traffic Management Plan" that provides for a construction relations officer to act as a community liaison concerning on-site construction activity	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
including resolution of issues related to PM10 generation.						
Designate a construction relations officer to act as a community liaison	***File with Public Works Engineering Division with Construction Staging and Management Plan***	***Prior to the start of site preparation activities***	***During construction***			
Mitigation Measure AQ-4: The Pasadena Water & Power Department and its contractors shall require that all vehicles and equipment are properly tuned and maintained according to manufacturers' specifications.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Tune and maintain all vehicles and equipment according to manufacturers' specifications.	***Update in monthly reports to Planning Case Manager***	***During construction***	***During construction***			
Mitigation Measure AQ-5: The Pasadena Water & Power Department and its contractors shall require the use of coatings and solvents with a VOC content that exceeds the requirements of Rule 1113 if available. All coatings and solvents shall at a minimum meet the requirements of Rule 1113 unless exempted.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Use coatings and solvents with a VOC content that exceeds the requirements of Rule 1113	***Update in monthly reports to Planning Case Manager***	***During construction***	***During construction***			
Mitigation Measure AQ-6: The Pasadena Water & Power Department and its contractors shall use construction materials that do not require painting to the extent economically feasible and that meet the project's structural, acoustical, aesthetic, or other needs.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Use construction materials that do not require painting	***Update in monthly reports to Planning Case Manager***	***During construction***	***During construction***			
Mitigation Measure AQ-7: The Pasadena Water & Power Department and its contractors shall use pre-painted	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
construction materials for major equipment. Materials that require field coating are exempt from this measure.						
Use pre-painted construction materials for major equipment	***Update in monthly reports to Planning Case Manager***	***During construction***	***During construction***			
Mitigation Measure AQ-8: The Pasadena Water & Power Department and its contractors shall require contractors to use model year 2007 and newer diesel haul trucks (e.g., material delivery trucks and soil import/export) pursuant to California Code of Regulations, Title 13, §2025.	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			
Use model year 2007 and newer diesel haul trucks (e.g., material delivery trucks and soil import/export) pursuant to California Code of Regulations, Title 13, §2025	***Update in monthly reports to Planning Case Manager***	***During construction***	***During construction***			
Mitigation Measure AQ-9: The Pasadena Water & Power Department and its contractors shall require the use of internal combustion engines/construction equipment that operate on the project site to meet the following: • At least 50 percent of construction equipment greater than 250 hp, which are on-site for 6 or more consecutive work days, shall meet Tier 3 emissions standards and be outfitted with BACT devices (e.g., Level 3 diesel emissions control devices) certified by CARB. • A copy of each unit's certified tier specification and BACT documentation shall be available for inspection during construction. The contractor(s) shall monitor and record compliance for each project construction phase and document	City of Pasadena Planning Division (Zoning Administrator)	During construction	During construction			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
efforts undertaken to increase the use of compliant off-road vehicles, such as but not limited to bid solicitation documents, fleet registration of successful vendor(s), etc. • Construction contractors supplying heavy duty diesel equipment, greater than 50 hp, will be encouraged to apply for AQMD SOON funds. Information including the AQMD website will be provided to each contractor which uses heavy duty diesel for on-site construction activities.						
Use internal combustion engines/construction equipment that operate on the project site to meet Tier 3 emission standards for 50 percent of construction equipment greater than 250 hp which are on-site for 6 or more consecutive work days ***Make available for inspection a copy of each unit's certified tier specification and BACT documentation*** ***Encourage construction contractors supplying heavy duty diesel equipment, greater than 50 hp to apply for AQMD SOON funds. Information including the AQMD website will be provided to each contractor which uses heavy duty diesel for on-site construction activities.***	***Update in monthly reports to Planning Case Manager*** ***Include with monthly report to Planning Case Manager***	***During construction***	***During construction***			
2. CULTURAL RESOURCES						
Mitigation Measure CULT-1: Archaeological Resources Treatment. If archaeological resources are encountered during project implementation, an archaeologist meeting the Secretary of the Interior's Professional Qualification Standards (the	City of Pasadena Planning Division (Zoning Administrator)	During grading and excavation, in the event that archaeological resources are encountered, Applicant to notify Planning Division and retain a qualified	If notified by Applicant of the presence of archaeological resources during construction, Planning Division to verify Applicant retention of qualified archaeologist for			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
"archaeologist") shall be immediately notified and retained by the applicant and approved by the City to oversee and carry out these mitigation measures. The archaeologist shall coordinate with the applicant as to the immediate treatment of the find until a proper site visit and evaluation is made by the archaeologist. The archaeologist shall be allowed to temporarily divert or redirect grading or excavation activities in the vicinity in order to make an evaluation of the find and determine appropriate treatment. Treatment will include the goals of preservation where practicable and public interpretation of historic and archaeological resources. All cultural resources recovered shall be documented on California Department of Parks and Recreation Site Forms to be filed with the CHRIS-SCCIC. The archaeologist shall prepare a final report about the find to be filed with Project Applicant, the City, and the CHRIS-SCCIC, as required by the California Office of Historic Preservation. The report shall include documentation and interpretation of resources recovered. Interpretation will include full evaluation of the eligibility with respect to the National and California Register and CEQA. The report shall also include all specialists' reports as appendices. The Lead Agency shall designate repositories in the event that significant resources are recovered. The archaeologist shall also determine the need for archaeological and Native American monitoring for any ground-disturbing activities thereafter. If warranted, the archaeologist will develop a monitoring program in coordination with a Native American		archaeologist to implement this mitigation measure.	implementation of this mitigation measure. Following project grading and excavation and prior to project construction, Planning Division to review and approve final report submitted by Applicant or qualified archaeologist.			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
representative (if there is potential to encounter prehistoric or Native American resources), the applicant, and the City. The monitoring program will also include a treatment plan for any additional resources encountered and a final report on findings.						
Retain and notify an archaeologist meeting the Secretary of the Interior's Professional Qualification Standards to oversee and carry out these mitigation measures if archaeological resources are encountered during project implementation	***Approval of archeologist required by Planning Division prior to start of grading activities***	***Prior to start of grading activities***	***During construction***			
Mitigation Measure CULT-2: Paleontological Resources Treatment. A qualified paleontologist shall attend a pre-grade meeting and develop a paleontological monitoring program to cover excavations in the event they occur into the older Quaternary Alluvium. A qualified paleontologist is defined as a paleontologist meeting the criteria established by the Society for Vertebrate Paleontology. If excavation into Quaternary deposits occurs, monitoring shall consist of visually inspecting fresh exposures of rock for larger fossil remains and, where appropriate, collecting wet or dry screened sediment samples of promising horizons for smaller fossil remains. If it is determined that excavation will not encounter Quaternary deposits, no further measures need be taken. The frequency of monitoring inspections shall be based on the rate of excavation and grading activities, the materials being excavated, and if found, the abundance and type of fossils encountered. If a fossil is found, the paleontologist shall be allowed to temporarily divert or	City of Pasadena Planning Division (Zoning Administrator)	During grading and excavation, in the event that paleontological resources are encountered, Applicant to notify Planning Division and retain a qualified paleontologist to implement this mitigation measure.	If notified by Applicant of the presence of paleontological resources during grading and excavation, Planning Division to confirm Applicant retention of qualified paleontologist for implementation of this mitigation measure. Following project grading and excavation and prior to project construction, Planning Division to confirm receipt of final report from Applicant or qualified paleontologist.			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
redirect grading and excavation activities in the area of the exposed fossil to facilitate evaluation and, if necessary, salvage. At the paleontologist's discretion and to reduce any construction delay, the grading and excavation contractor shall assist in removing rock samples for initial processing. Any fossils encountered and recovered shall be prepared to the point of identification and catalogued before they are donated to their final repository. Any fossils collected shall be donated to a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County. Accompanying notes, maps, and photographs shall also be filed at the repository. If fossils are found following completion of the above tasks, the paleontologist shall prepare a report summarizing the results of the monitoring and salvaging efforts, the methodology used in these efforts, as well as a description of the fossils collected and their significance. The report shall be submitted by the applicant to the lead agency, the Natural History Museum of Los Angeles County, and representatives of other appropriate or concerned agencies to signify the satisfactory completion of the project and required mitigation measures.						
Retain a qualified paleontologist to attend a pre-grade meeting and develop a paleontological monitoring program to cover excavations in the event they occur into the older Quaternary Alluvium	***Update in monthly reports to Planning Case Manager***	***During grading and excavation***	***Following project grading and excavation and prior to project construction, Planning Division to confirm receipt of final report from Applicant or qualified paleontologist.***			
Mitigation Measure CULT-3: **Human Remains Treatment.**	City of Pasadena Planning Division (Zoning	During grading and excavation, in the event	If notified by Applicant of the presence of human			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
If human remains are encountered unexpectedly during construction excavations and grading activities, State Health and Safety Code Section 7050.5 requires that no further disturbance shall occur until the County Coroner has made the necessary findings as to origin and disposition pursuant to PRC Section 5097.98. If the remains are determined to be of Native American descent, the coroner has 24 hours to notify the Native American Heritage Commission (NAHC). The NAHC shall then identify the person(s) thought to be the Most Likely Descendent of the deceased Native American, who shall then help determine what course of action shall be taken in dealing with the remains. The applicant shall then under take additional steps as necessary in accordance with *CEQA Guidelines* Section 15064.5(e). Preservation of the remains in place or project design alternatives shall be considered as possible courses of action by the applicant, the City, and the Most Likely Descendent.	Administrator)	that human remains are encountered, Applicant to notify Planning Division and initiate consultation the NAHC and follow that agency's recommended course of action to implement this mitigation measure.	remains during grading and excavation, Planning Division to confirm Applicant consultation with the NAHC for implementation of this mitigation measure. Following project grading and excavation and prior to project construction, Planning Division to confirm Applicant has completed the NAHC's recommended course of action.			
Contact coroner and NAHC representative if human remains are unexpectedly uncovered. Undertake additional steps in accordance with CEQA protocols.	***Update in monthly reports to Planning Case Manager***	***During grading and excavation***	***Following project grading and excavation and prior to project construction***			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
3. HAZARDS AND HAZARDOUS MATERIALS						
Mitigation Measure HAZ-1: Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs), as indicated in the Phase II Environmental Site Assessment, shall be excavated and disposed of off-site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above-mentioned locations is planned for off-site disposal, then the excavated soil shall be stockpiled and a WET test shall be made on stockpile soil samples to determine the soluble lead concentration of the stockpiled soil for soil disposal purposes.	City of Pasadena Fire Department	During grading and excavation, Applicant to implement this mitigation measure.	Prior to the commencement of construction, Building and Safety Division to verify Applicant compliance with this mitigation measure.			
Excavate and dispose of lead contaminated soil off-site in accordance with WET testing protocols	***Update in weekly reports to Fire Department***	***During grading and excavation***	***Prior to start of construction activities***			
Mitigation Measure HAZ-2: If the soil at the vicinity of the locations (as identified in the Phase II Environmental Site Assessment) where TRPH concentrations exceed 1,000 ppm is planned for off-site disposal, then the excavated soil shall be stockpiled and analytically tested for TPH and VOCs using EPA Method 8015 M and 8260B or per soil disposal facility requirements.	City of Pasadena Fire Department	During grading and excavation, Applicant to implement this mitigation measure.	Prior to the commencement of construction, Building and Safety Division to verify Applicant compliance with this mitigation measure.			
Excavate and dispose of TRPH contaminated soil off-site in accordance with EPA Method 8015 M and 8260B or per soil disposal facility requirements	***Update in weekly reports to Fire Department***	***During grading and excavation***	***Prior to the commencement of construction***			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
Mitigation Measure HAZ-3: During project design development and prior to initiation of excavation and grading activities, PWP shall retain a qualified environmental consultant to prepare a soils management plan that shall be submitted to the City of Pasadena Fire Department for review and approval. The soils management plan shall be implemented during excavation and grading activities on the project site to ensure that any contaminated soils are properly disposed of offsite. The plan shall include, but not necessarily be limited to the following: • A qualified environmental consultant shall be present as necessary during excavation or grading activities to monitor compliance with the soils management plan and to actively monitor the soils and excavations for evidence of contamination. • Any soil encountered during excavation or grading activities that appears to have been affected by hydrocarbons or any other contamination shall be evaluated, based upon appropriate laboratory analysis, by a qualified environmental consultant prior to offsite disposal at a licensed facility. • Soils in the southwestern corner of the site near Boring Location GP32 and where TRPH concentrations exceed 1,000 ppm, as identified in the Limited Phase II ESA, shall be segregated and analyzed prior to offsite disposal. This may require over-excavation in these area and further analysis of this soil to determine the extent of soil contamination.	City of Pasadena Fire Department	During project design development and prior to excavation and grading, Applicant to retain qualified consultant to prepare soils management plan and submit plan to Building and Safety Division for approval. During grading and excavation, Applicant to implement approved soils management plan. Upon completion of grading and excavation, Applicant to notify Building and Safety Division of completion of implementation of soils management plan.	Prior to the commencement of grading and excavation, Building and Safety Division to review and approve soils management plan. Following grading and excavation and prior to construction, Building and Safety Division to verify completion of implementation of soils management plan.			

Mitigation Measure	Monitoring or Enforcement Agency	Timeframes for Mitigation Implementation & Enforcement		Verification of Compliance		
		Applicant Implementation	Agency Enforcement	Initial	Date	Remarks
• All identified contaminated soils shall be properly handled and transported to an appropriately licensed disposal facility.						
Retain qualified consultant to prepare soils management plan	***Submit to Building and Safety Division***	***During project design development and prior to excavation and grading***	***Prior to the commencement of grading and excavation***			
Implement soils management plan	***Update in weekly reports to Fire Department***	***During excavation and grading***	***During excavation and grading***			
Notify Building and Safety Division of completion of implementation of soils management plan	***Update in weekly report to Fire Department and Building and Safety***	***Upon completion of grading and excavation***	***Upon completion of grading and excavation***			

South Coast Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178

Title Page
Facility ID: 800168
Revision #: 26
Date: August 15, 2013

FACILITY PERMIT TO OPERATE

PASADENA CITY, DWP
72 E GLENARM ST
PASADENA, CA 91105

NOTICE

IN ACCORDANCE WITH RULE 206, THIS PERMIT TO OPERATE OR A COPY THEREOF MUST BE KEPT AT THE LOCATION FOR WHICH IT IS ISSUED.

THIS PERMIT DOES NOT AUTHORIZE THE EMISSION OF AIR CONTAMINANTS IN EXCESS OF THOSE ALLOWED BY DIVISION 26 OF THE HEALTH AND SAFETY CODE OF THE STATE OF CALIFORNIA OR THE RULES OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT. THIS PERMIT SHALL NOT BE CONSTRUED AS PERMISSION TO VIOLATE EXISTING LAWS, ORDINANCES, REGULATIONS OR STATUTES OF ANY OTHER FEDERAL, STATE OR LOCAL GOVERNMENTAL AGENCIES.

Barry R. Wallerstein, D. Env.
EXECUTIVE OFFICER

By
Mohsen Nazemi, P.E.
Deputy Executive Officer
Engineering & Compliance

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

TABLE OF CONTENTS

Section	Description	Revision #	Date Issued
A	Facility Information	8	01/18/2008
B	RECLAIM Annual Emission Allocation	16	01/01/2013
C	Facility Plot Plan	TO BE DEVELOPED	
D	Facility Description and Equipment Specific Conditions	11	11/02/2012
E	Administrative Conditions	8	01/18/2008
F	RECLAIM Monitoring and Source Testing Requirements	7	01/18/2008
G	Recordkeeping and Reporting Requirements for RECLAIM Sources	7	01/18/2008
H	Permit To Construct and Temporary Permit to Operate	14	08/15/2013
I	Compliance Plans & Schedules	6	01/18/2008
J	Air Toxics	6	01/18/2008
K	Title V Administration	6	01/18/2008
Appendix			
A	NOx and SOx Emitting Equipment Exempt From Written Permit Pursuant to Rule 219	7	01/18/2008
B	Rule Emission Limits	6	01/18/2008

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions* And Requirements	Conditions
Process 2: INTERNAL COMBUSTION					
System 1: TURBINES					

* (1) (1A) (1B) Denotes RECLAIM emission factor
(2) (2A) (2B) Denotes RECLAIM emission rate
(3) Denotes RECLAIM concentration limit
(4) Denotes BACT emission limit
(5) (5A) (5B) Denotes command and control emission limit
(6) Denotes air toxie control rule limit
(7) Denotes NSR applicability limit
(8) (8A) (8B) Denotes 40 CFR limit (e.g. NSPS, NESHAPS, etc.)
(9) See App B for Emission Limits
(10) See section J for NESHAP/MACT requirements

** Refer to section F and G of this permit to determine the monitoring, recordkeeping and reporting requirements for this device.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions* And Requirements	Conditions
Process 2: INTERNAL COMBUSTION					
GAS TURBINE, GT-5, NATURAL GAS, GENERAL ELECTRIC, MODEL LM6000 PG SPRINT, COMBINED CYCLE, 547.5 MMBTU/HR HHV @ 64 DEG F, WITH WATER INJECTION A/N: 538115 Permit to Construct Issued: 08/15/13	D56	C66		**CO**: 2 PPMV NATURAL GAS (4) **[RULE 1703(a)(2) - PSD-BACT, 10-7-1988]**; **CO**: 2000 PPMV NATURAL GAS (5) **[RULE 407, 4-2-1982]**; **NOX**: 2 PPMV NATURAL GAS (4) **[RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011]**; **NOX**: 18.79 LBS/MMSCF NATURAL GAS (1A) **[RULE 2005, 6-3-2011]**; **NOX**: 25 PPMV NATURAL GAS (8) **[40CFR 60 Subpart KKKK, 7-6-2006]**; **NOX**: 42.83 LBS/MMSCF NATURAL GAS (1) **[RULE 2012, 5-6-2005]**; **PM**: 0.01 GRAINS/SCF NATURAL GAS (5A) **[RULE 475, 10-8-1976;** *RULE 475, 8-7-1978*]; **PM**: 0.1 GRAINS/SCF NATURAL GAS (5B) **[RULE 409, 8-7-1981]**; **PM**: 11 LBS/HR NATURAL GAS (5) **[RULE 475, 10-8-1976;** *RULE 475, 8-7-1978*]; **SO2**: (9) **[40CFR 72 - Acid Rain Provisions, 11-24-1997]**; **SO2**: 0.06 LBS/MMBTU NATURAL GAS (8) **[40CFR 60 Subpart KKKK, 7-6-2006]**; **VOC**: 2 PPMV NATURAL GAS (4) **[RULE 1303(a)(1)-BACT, 5-10-1996;** *RULE 1303(a)(1)*	A63.3, A99.8, A99.9, A99.10, A99.11, A195.8, A195.9, A195.10, A327.1, A433.1, A433.2, D29.6, D29.7, D29.8, D82.4, D82.5, E193.2, E193.3, H23.5, I297.1, K40.3, K67.7

* (1) (1A) (1B) Denotes RECLAIM emission factor; (2) (2A) (2B) Denotes RECLAIM emission rate; (3) Denotes RECLAIM concentration limit; (4) Denotes BACT emission limit; (5) (5A) (5B) Denotes command and control emission limit; (6) Denotes air toxic control rule limit; (7) Denotes NSR applicability limit; (8) (8A) (8B) Denotes 40 CFR limit (e.g. NSPS, NESHAPS, etc.); (9) See App B for Emission Limits; (10) See section J for NESHAP/MACT requirements

** Refer to section F and G of this permit to determine the monitoring, recordkeeping and reporting requirements for this device.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions* And Requirements	Conditions
Process 2: INTERNAL COMBUSTION					
				-BACT, 12-6-2002]	
GENERATOR, SERVING GT-5, 56.1 GROSS MW @ 64 DEG F A/N: 538115 Permit to Construct Issued: 08/15/13	B57				
STEAM TURBINE, ST-5, MAKE TBD, MODEL TBD A/N: 538115 Permit to Construct Issued: 08/15/13	B64				
GENERATOR, SERVING ST-5, 14.7 GROSS MW @ 64 DEG F A/N: 538115 Permit to Construct Issued: 08/15/13	B65				
CO OXIDATION CATALYST, NO.5, EMERACHEM, MODEL TBD, FIXED BED PLATINUM, VOLUME 100 CU FT A/N: 538120 Permit to Construct Issued: 08/15/13	C66	D56 C67			
SELECTIVE CATALYTIC REDUCTION, NO. 5, HALDOR TOPSOE, MODEL TBD, CATALYST VOLUME 848 CU FT A/N: 538120 Permit to Construct Issued: 08/15/13	C67	C66 S69		**NH3**: 5 PPMV NATURAL GAS (4) **[RULE 1303(a)(1) -BACT, 5-10-1996;** *RULE 1303(a)(1)-BACT, 12-6-2002*]	A195.11, D12.9, D12.10, D12.13, E179.3, E179.4, E179.6, E193.2
AMMONIA INJECTION, GRID, AQUEOUS AMMONIA A/N: 538120 Permit to Construct Issued: 08/15/13	B68				

* (1) (1A) (1B) Denotes RECLAIM emission factor
(2) (2A) (2B) Denotes RECLAIM emission rate
(3) Denotes RECLAIM concentration limit
(4) Denotes BACT emission limit
(5) (5A) (5B) Denotes command and control emission limit
(6) Denotes air toxic control rule limit
(7) Denotes NSR applicability limit
(8) (8A) (8B) Denotes 40 CFR limit (e.g. NSPS, NESHAPS, etc.)
(9) See App B for Emission Limits
(10) See section J for NESHAP/MACT requirements

** Refer to section F and G of this permit to determine the monitoring, recordkeeping and reporting requirements for this device.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall eomply with the terms and conditions set forth below:

Equipment	ID No.	Connected To	RECLAIM Source Type/ Monitoring Unit	Emissions* And Requirements	Conditions
Process 2: INTERNAL COMBUSTION					
STACK, SERVING GT-5, HEIGHT: 125 FT ; DIAMETER: 10 FT 2.04 IN A/N: 538115 Permit to Construct Issued: 08/15/13	S69	C67			

* (1) (1A) (1B) Denotes RECLAIM emission factor
(2) (2A) (2B) Denotes RECLAIM emission rate
(3) Denotes RECLAIM coneentration limit
(4) Denotes BACT emission limit
(5) (5A) (5B) Denotes command and eontrol emission limit
(6) Denotes air toxic control rule limit
(7) Denotes NSR applicability limit
(8) (8A) (8B) Denotes 40 CFR limit (e.g. NSPS, NESHAPS, etc.)
(9) See App B for Emission Limits
(10) See section J for NESHAP/MACT requirements

** Refer to seetion F and G of this permit to determine the monitoring, recordkeeping and reporting requirements for this device.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: DEVICE ID INDEX

The following sub-section provides an index to the devices that make up the facility description sorted by device ID.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: DEVICE ID INDEX

Device Index For Section H			
Device ID	**Section H Page No.**	**Process**	**System**
D56	3	2	1
B57	3	2	1
B64	3	2	1
B65	3	2	1
C66	3	2	1
C67	3	2	1
B68	3	2	1
S69	4	2	1

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

FACILITY CONDITIONS

F9.1 Except for open abrasive blasting operations, the operator shall not discharge into the atmosphere from any single source of emissions whatsoever any air contaminant for a period or periods aggregating more than three minutes in any one hour which is:

(a) As dark or darker in shade as that designated No.1 on the Ringelmann Chart, as published by the United States Bureau of Mines; or

(b) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subparagraph (a) of this condition.

[**RULE 401, 3-2-1984;** RULE 401, 11-9-2001]

F14.1 The operator shall not use fuel oil containing sulfur compounds in excess of 0.05 percent by weight.

The 0.05 percent sulfur limit shall not apply to existing supplies of any liquid fuel in storage as of October 1, 1993 until such supply is exhausted.

[**RULE 431.2, 5-4-1990;** RULE 431.2, 9-15-2000]

F14.2 The operator shall not purchase fuel oil containing sulfur compounds in excess of 15 ppm by weight as supplied by the supplier.

This condition shall become effective on or after June 1, 2004.

[**RULE 431.2, 5-4-1990;** RULE 431.2, 9-15-2000]

F16.1 The operator shall keep records, in a manner approved by the District, for the following parameter(s) or item(s):

purchase records of fuel oil and sulfur content of the fuel

[**RULE 3004(a)(4)-Periodic Monitoring, 12-12-1997**]

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

F18.1 Acid Rain SO2 Allowance Allocation for affected units are as follows:

Device ID	Boiler ID	Contaminant	Tons in any year
13	Broadway Unit No. B-1	SO2	126
14	Broadway Unit No. B-2	SO2	163
15	Broadway Unit No. B-3	SO2	74

a). The allowance allocation(s) shall apply to calendar years 2000 through 2009.

b). The number of allowances allocated to Phase II affected units by U.S. EPA may change in a 1998 revision to 40CFR73 Tables 2,3, and 4. In addition, the number of allowances actually held by an affected source in a unit account may differ from the number allocated by U.S. EPA. Neither of the aforementioned conditions necessitate a revision to the unit SO2 allowance allocations identified in this permit (see 40 CFR 72.84)

[**40CFR 73 Subpart B, 1-11-1993**]

F24.1 Accidental release prevention requirements of Section 112(r)(7):

a). The operator shall comply with the accidental release prevention requirements pursuant to 40 CFR Part 68 and shall submit to the Executive Officer, as a part of an annual compliance certification, a statement that certifies compliance with all of the requirements of 40 CFR Part 68, including the registration and submission of a risk management plan (RMP).

b). The operator shall submit any additional relevant information requested by the Executive Officer or designated agency.

[**40CFR 68 - Accidental Release Prevention, 5-24-1996**]

F52.1 This facility is subject to the applicable requirements of the following rules or regulation(s):

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The facility shall submit a detailed retirement plan for the permanent shutdown of Boiler B-3 (Device 15), describing in detail the steps and schedule that will be taken to render Boiler B-3 inoperable.

The retirement plan must be submitted to AQMD within 60 days of permit issuance. AQMD shall notify PDWP whether the plan is approvable. If AQMD notifies PDWP that the plan is not approvable, PDWP shall submit a revised plan addressing AQMD's concerns within 30 days.

PDWP shall not commence any construction of equipment for the repower project before the retirement plan for permanent shut down of Boiler B-3 is approved in writing by AQMD.

PDWP shall provide AQMD with a notarized statement that Boiler B-3 is permanently shut down and that any re-start or operation of the unit shall require a new Permit to Construct and be subject to all requirements of nonattainment new source review and the prevention of significant deterioration program.

The notarized statement shall be submitted within 30 days following the permanent shutdown of Boiler B-3.

PDWP shall notify AQMD 30 days prior to the implementation of the approved retirement plan for permanent shut down of Boiler B-3.

PDWP shall cease operation of Boiler B-3 (Device 15) within 90 calendar days of the first fire of turbine GT-5.

[RULE 1304(a)-Modeling and Offset Exemption, 6-14-1996]

DEVICE CONDITIONS

A. Emission Limits

A63.3 The operator shall limit emissions from this equipment as follows:

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

CONTAMINANT	EMISSIONS LIMIT
CO	Less than or equal to 5,873 LBS IN ANY ONE MONTH
PM10	Less than or equal to 3,010 LBS IN ANY ONE MONTH
VOC	Less than or equal to 1,436 LBS IN ANY ONE MONTH
SOX	Less than or equal to 588 LBS IN ANY ONE MONTH

The above limits apply after the equipment is commissioned.

The operator shall calculate the monthly emission limit(s) by using calendar monthly fuel use data and the following emission factors: VOC: 3.48 lbs/mmscf, PM10: 7.30 lbs/mmscf, SOx: 1.43 lbs/mmscf.

The operator shall calculate the emission limit(s) for CO after the CO CEMS certification based upon readings from the AQMD certified CEMS. In the event the CO CEMS is not operating or the emissions exceed the valid upper range of the analyzer, the emissions shall be calculated by using monthly fuel use data and the following factors: normal operation: 14.25 lbs/mmscf.

[RULE 1303(b)(2)-Offset, 5-10-1996; RULE 1303(b)(2)-Offset, 12-6-2002]

[Devices subject to this condition : D56]

A99.8 The 42.83 LBS/MMSCF NOX emission limit(s) shall only apply during the interim reporting period during initial turbine commissioning to report RECLAIM emissions.

[RULE 2012, 5-6-2005]

[Devices subject to this condition : D56]

A99.9 The 18.79 LBS/MMSCF NOX emission limit(s) shall only apply during the interim reporting period after initial turbine commissioning to report RECLAIM emissions.

[RULE 2012, 5-6-2005]

[Devices subject to this condition : D56]

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

A99.10 The 2.0 PPM NOX emission limit(s) shall not apply during turbine commissioning, start-up, shutdown, Water Injection and Intercooler Tuning (WIIT), and Ammonia Injection Grid Tuning (AIGT) periods. Start-up time shall not exceed 120 minutes for each start-up. Shutdown periods shall not exceed 60 minutes for each shutdown. The turbine shall be limited to a maximum of 5 start-ups per day, 155 start-ups per month, and 750 start-ups per year.

For the purposes of this condition, the beginning of start-up occurs at initial fire in the combustor of the combustion turbine through the full operation of the steam turbine generator. If during start-up, the process is aborted the process will count as one start-up.

For the purposes of this condition, shutdown shall be defined as the period of time from initiation of the shutdown sequence to cessation of firing.

For the purposes of this condition, WIIT shall be defined as the tuning of the gas turbine water injection and intercooler system. WIIT shall not exceed 12 hours. The operator shall limit the duration of WIIT to no more than 12 hours in any one month and 24 hours in any one year.

For the purposes of this condition, AIGT shall be defined as optimizing and re-balancing of the NH3 grid or catalyst modules, and the retuning of the turbine control systems. AIGT shall not exceed 10 hours. The operator shall limit the duration of AIGT to no more than 10 hours in any one year.

The commissioning period shall not exceed 204 hours.

[RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011]

[Devices subject to this condition : D56]

A99.11 The 2.0 PPM CO emission limit(s) shall not apply during turbine commissioning, start-up, shutdown, Water Injection and Intercooler Tuning (WIIT), and Ammonia Injection Grid Tuning (AIGT) periods. Start-up time shall not exceed 120 minutes for each start-up. Shutdown periods shall not exceed 60 minutes for each shutdown. The turbine shall be limited to a maximum of 5 start-ups per day, 155 start-ups per month, and 750 start-ups per year.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

For the purposes of this condition, the beginning of start-up occurs at initial fire in the combustor of the combustion turbine through the full operation of the steam turbine generator. If during start-up, the process is aborted the process will count as one start-up

For the purposes of this condition, shutdown shall be defined as the period of time from initiation of the shutdown sequence to cessation of firing.

For the purposes of this condition, WIIT shall be defined as the tuning of the gas turbine water injection and intercooler system. WIIT shall not exceed 12 hours. The operator shall limit the duration of WIIT to no more than 12 hours in any one month and 24 hours in any one year.

For the purposes of this condition, AIGT shall be defined as shall be defined as optimizing and re-balancing of the NH3 grid or catalyst modules, and the retuning of the turbine control systems. AIGT shall not exceed 10 hours. The operator shall limit the duration of AIGT to no more than 10 hours in any one year.

The commissioning period shall not exceed 204 hours.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1703(a)(2) - PSD-BACT, 10-7-1988]**

[Devices subject to this condition : D56]

A195.8 The 2.0 PPMV NOX emission limit(s) is averaged over 60 minutes at 15 percent O2, dry.

[RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011]

[Devices subject to this condition : D56]

A195.9 The 2.0 PPMV CO emission limit(s) is averaged over 60 minutes at 15 percent O2, dry.

[RULE 1303(a)(1)-BACT, 5-10-1996; RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1703(a)(2) - PSD-BACT, 10-7-1988]**

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

[Devices subject to this condition : D56]

A195.10 The 2.0 PPMV VOC emission limit(s) is averaged over 60 minutes at 15 percent O2, dry.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002]

[Devices subject to this condition : D56]

A195.11 The 5.0 PPMV NH3 emission limit(s) is averaged over 60 minutes at 15 percent O2, dry.

The operator shall calculate and continuously record the NH3 slip concentration using the following: NH3 (ppmv) = [a-b*c/1EE+06]*1EE+06/b, where: a = NH3 injection rate (lbs/hr)/17(lb/lb-mol), b = dry exhaust gas flow rate (scf/hr)/385.3 scf/lb-mol), c = change in measured NOx across the SCR (ppmvd at 15% O2).

The operator shall install and maintain a NOx analyzer to measure the SCR inlet NOx ppmv accurate to plus or minus 5 percent calibrated at least once every twelve months.

The NOx analyzer shall be installed and operated within 90 days of initial start-up.

The operator shall use the above described method or another alternative method approved by the Executive Officer.

The ammonia slip calculation procedures described above shall not be used for compliance determination or emission information without corroborative data using an approved reference method for the determination of ammonia.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002]

[Devices subject to this condition : C67]

A327.1 For the purpose of determining compliance with District Rule 475, combustion contaminant emissions may exceed the concentration limit or the mass emission limit listed, but not both limits at the same time.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

[**RULE 475, 10-8-1976**; RULE 475, 8-7-1978]

[Devices subject to this condition : D56]

A433.1 The operator shall comply at all times with the 2.0 ppm 1-hour BACT limit for NOx, except as defined in condition A99.10 and for the following scenarios:

Operating Scenario	Maximum Limit	Operational Limit
Start-up	28.68 lb	The mass emission limit shall be determined for start-up using CEMS minute by minute emission data. It shall be calculated to 120 minutes from the commencement of initial fire in the combustor
Shutdown	11.78 lb	The mass emission limit shall be determined for shutdown using CEMS minute by minute emission data. It shall be calculated to 60 minutes counted back from the cessation of firing

Records of minute by minute start-up and shutdown data shall be maintained and made available to the Executive Officer upon request.

[**RULE 2005, 6-3-2011**]

[Devices subject to this condition : D56]

A433.2 The operator shall comply at all times with the 2.0 ppm 1-hour BACT limit for CO, except as defined in condition A99.11 and for the following scenarios:

Operating Scenario	Maximum Limit	Operational Limit

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Start-up	23.61 lb	The mass emission limit shall be determined for start-up using CEMS minute by minute emission data. It shall be calculated to 120 minutes from the commencement of initial fire in the combustor
Shutdown	9.90 lb	The mass emission limit shall be determined for shutdown using CEMS minute by minute emission data. It shall be calculated to 60 minutes counted back from the cessation of firing

Records of minute by minute start-up and shutdown data shall be maintained and made available to the Executive Officer upon request.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1703(a)(2) - PSD-BACT, 10-7-1988**]

[Devices subject to this condition : D56]

D. Monitoring/Testing Requirements

D12.9 The operator shall install and maintain a(n) temperature gauge to accurately indicate the temperature in the exhaust at the inlet to the SCR reactor.

The operator shall also install and maintain a device to continuously record the parameter being measured.

The measuring device or gauge shall be accurate to within plus or minus 5 percent. It shall be calibrated once every 12 months.

The temperature shall be between 600 degrees F and 900 degrees F.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

D12.10 The operator shall install and maintain a(n) pressure gauge to accurately indicate the differential pressure across the SCR catalyst bed in inches of water column.

The operator shall also install and maintain a device to continuously record the parameter being measured.

The measuring device or gauge shall be accurate to within plus or minus 5 percent. It shall be calibrated once every 12 months.

The differential pressure shall less than 6.5 inches of water column.

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

D12.13 The operator shall install and maintain a(n) flow meter to accurately indicate the flow rate of the total hourly throughput of injected ammonia (NH3).

The operator shall also install and maintain a device to continuously record the parameter being measured.

The measuring device or gauge shall be accurate to within plus or minus 5 percent. It shall be calibrated once every 12 months.

The ammonia injection rate shall be between 84 and 107 lbs/hr.

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

D29.6 The operator shall conduct source test(s) for the pollutant(s) identified below.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Pollutant(s) to be tested	Required Test Method(s)	Averaging Time	Test Location
NOX emissions	District method 100.1	1 hour	Outlet of the SCR serving this equipment
CO emissions	District method 100.1	1 hour	Outlet of the SCR serving this equipment
SOX emissions	AQMD Laboratory Method 307-91	Not Applicable	Fuel Sample
VOC emissions	District Method 25.3	1 hour	Outlet of the SCR serving this equipment
PM10 emissions	Approved District method	District-approved averaging time	Outlet of the SCR serving this equipment
PM2.5	Approved District method	District-approved averaging time	Outlet of the SCR serving this equipment
NH3 emissions	District method 207.1 and 5.3 or EPA method 17	1 hour	Outlet of the SCR serving this equipment

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The test shall be conducted after AQMD approval of the source test protocol, but no later than 180 days after initial start-up. The AQMD shall be notified of the date and time of the test at least 10 days prior to the test.

The test shall be conducted to determine the oxygen levels in the exhaust. In addition, the tests shall measure the fuel flow rate (CFH), the flue gas flow rate. The combined gas turbine and steam turbine generating output in MW shall also be recorded if applicable.

The test shall be conducted in accordance with AQMD approved test protocol. The protocol shall be submitted to the AQMD engineer no later than 90 days before the proposed test date and shall be approved by the AQMD before the test commences. The test protocol shall include the proposed operating conditions of the turbine during the tests, the identity of the testing lab, a statement from the testing lab certifying that it meets the criteria of Rule 304, and a description of all sampling and analytical procedures.

For natural gas fired turbines only, an alternative to AQMD Method 25.3 for the purpose of demonstrating compliance with BACT as determined by CARB and AQMD, may be the following:

a) Triplicate stack gas samples are extracted directly into Summa canisters, maintaining a final canister pressure between 400-500 mm Hg absolute,

b) Pressurization of the Summa canisters is done with zero gas analyzed/certified to containing less than 0.05 ppmv total hydrocarbons as carbon, and

c) Analysis of Summa canisters is per unmodified EPA Method TO-12 (with preconcentration) or the canister analysis portion of AQMD Method 25.3 with a minimum detection limit of 0.3 ppmvC or less and reported to two significant figures, and

c) Analysis of Summa canisters is per unmodified EPA Method TO-12 (with preconcentration) or the canister analysis portion of AQMD Method 25.3 with a minimum detection limit of 0.3 ppmvC or less and reported to two significant figures, and

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The use of this alternative method for VOC compliance determination does not mean that it is more accurate than unmodified AQMD Method 25.3, nor does it mean that it may be used in lieu of AQMD Method 25.3 without prior approval, except for the determination of compliance with the BACT level of 2.0 ppmv VOC calculated as carbon set by CARB for natural gas fired turbines. The test results shall be reported with two significant digits.

The test shall be conducted when this equipment is operating at loads of 100, 75 and 50 percent of maximum load for NOx, CO, VOC, and ammonia tests. The PM10 and PM2.5 tests shall be conducted when this equipment is operating at 100 percent of maximum load.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1303(b)(2)-Offset, 5-10-1996;** RULE 1303(b)(2)-Offset, 12-6-2002; **RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011**]

[Devices subject to this condition : D56]

D29.7 The operator shall conduct source test(s) for the pollutant(s) identified below.

Pollutant(s) to be tested	Required Test Method(s)	Averaging Time	Test Location
NH3 emissions	District method 207.1 and 5.3 or EPA method 17	1 hour	Outlet of the SCR serving this equipment

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The test shall be conducted and the results submitted to the District within 45 days after the test date. The AQMD shall be notified of the date and time of the test at least 7 days prior to the test.

The test shall be conducted at least quarterly during the first twelve months of operation and at least annually thereafter. The NOx concentration, as determined by the CEMS, shall be simultaneously recorded during the ammonia slip test. If the CEMS is inoperable, a test shall be conducted to determine the NOx emissions using District Method 100.1 measured over a 60 minute averaging time period.

The test shall be conducted to demonstrate compliance with the Rule 1303 BACT concentration limit.

If the turbine is not in operation during one quarter, then no testing is required during that quarter.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002]

[Devices subject to this condition : D56]

D29.8 The operator shall conduct source test(s) for the pollutant(s) identified below.

Pollutant(s) to be tested	Required Test Method(s)	Averaging Time	Test Location
SOX emissions	AQMD Laboratory Method 307-91	Not Applicable	Fuel Sample
VOC emissions	District Method 25.3	1 hour	Outlet of the SCR serving this equipment
PM10 emissions	Approved District method	District-approved averaging time	Outlet of the SCR serving this equipment
PM2.5	Approved District method	District-approved averaging time	Outlet of the SCR serving this equipment

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The test(s) shall be conducted at least once every three years.

The test shall be conducted and the results submitted to the District within 60 days after the test date. The AQMD shall be notified of the date and time of the test at least 10 days prior to the test.

The test shall be conducted when the gas turbine is operating at 100 percent of maximum heat input.

For natural gas fired turbines only, an alternative to AQMD Method 25.3 for the purpose of demonstrating compliance with BACT as determined by CARB and AQMD, may be the following:

a) Triplicate stack gas samples are extracted directly into Summa canisters, maintaining a final canister pressure between 400-500 mm Hg absolute,

b) Pressurization of the Summa canisters is done with zero gas analyzed/certified to containing less than 0.05 ppmv total hydrocarbons as carbon, and

c) Analysis of Summa canisters is per unmodified EPA Method TO-12 (with preconcentration) or the canister analysis portion of AQMD Method 25.3 with a minimum detection limit of 0.3 ppmvC or less and reported to two significant figures, and

d) The temperature of the Summa canisters when extracting samples for analysis is not to be below 70 degrees Fahrenheit.

The use of this alternative method for VOC compliance determination does not mean that it is more accurate than unmodified AQMD Method 25.3, nor does it mean that it may be used in lieu of AQMD Method 25.3 without prior approval, except for the determination of compliance with the BACT level of 2.0 ppmv VOC calculated as carbon set by CARB for natural gas fired turbines. The test results shall be reported with two significant digits.

The test shall be conducted to demonstrate compliance with the Rule 1303 concentration and/or monthly emission limit.

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1303(b)(2)-Offset, 5-10-1996;** RULE 1303(b)(2)-Offset, 12-6-2002]

[Devices subject to this condition : D56]

D82.4 The operator shall install and maintain a CEMS to measure the following parameters:

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

CO concentration in ppmv

Concentrations shall be corrected to 15 percent oxygen on a dry basis.

The CEMS shall be installed to measure CO concentrations over a 15 minute averaging time period.

The CEMS shall be installed no later than 90 days after initial start-up of the turbine, and in accordance with an approved AQMD Rule 218 CEMS plan application. The operator shall not install the CEMS prior to receiving initial approval from AQMD. Within two weeks of the turbine start-up, the operator shall provide written notification to the District of the exact date of start-up.

The CEMS will convert the actual CO concentrations to mass emission rates (lbs/hr) and record the hourly emission rates on a continuous basis.

CO Emission Rate, lbs/hr = K*Cco*Fd[20.9% - %O2 d)][(Qg * HHV)/106], where

K = 7.267 *10-8 (lb/scf)/ppm

Cco = Average of four consecutive 15 min. ave. CO concentration, ppm

Fd = 8710 dscf/MMBTU natural gas

%O2 d = Hourly ave. % by vol. O2 dry, corresponding to Cco

Qg = Fuel gas usage during the hour, scf/hr

HHV = Gross high heating value of fuel gas, BTU/scf

[RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 218, 5-14-1999]

[Devices subject to this condition : D56]

D82.5 The operator shall install and maintain a CEMS to measure the following parameters:

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

NOX concentration in ppmv

Concentrations shall be corrected to 15 percent oxygen on a dry basis.

The CEMS shall be installed and operated no later than 90 days after initial start-up of the turbine, and in accordance with an approved AQMD REG XX CEMS plan application. The operator shall not install the CEMS prior to receiving initial approval from AQMD. Within two weeks of the turbine start-up, the operator shall provide written notification to the District of the exact date of start-up.

Rule 2012 provisional RATA testing shall be completed and submitted to the AQMD within 90 days of the conclusion of the turbine commissioning period. During the interim period between the initial start-up and provisional certification date of the CEMS, the operator shall comply with the monitoring requirements of Rule 2012(h)(2) and 2012(h)(3).

[RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011; RULE 2012, 5-6-2005]

[Devices subject to this condition : D56]

E. Equipment Operation/Construction Requirements

E179.3 For the purpose of the following condition number(s), continuously record shall be defined as recording at least once every hour and shall be calculated upon the average of the continuous monitoring for that hour.

Condition Number D 12- 9

Condition Number D 12-11

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

E179.4 For the purpose of the following condition number(s), continuously record shall be defined as recording at least once every hour and shall be calculated based upon the average of the continuous monitoring for that month.

Condition Number D 12-10

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

E179.6 For the purpose of the following condition number(s), continuously record shall be defined as recording at least once every hour and shall be calculated upon the average of the continuous monitoring for that hour.

Condition Number D 12- 9

Condition Number D 12-13

[RULE 2005, 6-3-2011]

[Devices subject to this condition : C67]

E193.2 The operator shall restrict the operation of this equipment according to the following specifications:

In accordance with all air quality mitigation measures stipulated in the final Environmental Impact Report (EIR), State Clearing House #2011091056.

[CA PRC CEQA, 11-23-1970]

[Devices subject to this condition : D56, C67]

E193.3 The operator shall upon completion of construction, operate and maintain this equipment according to the following specifications:

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

The operator shall record the total net power generated in a calendar month in megawatt-hours.

The operator shall calculate and record greenhouse gas emissions of each calendar month using the following formula:

GHG = 59.187 * FF

Where, GHG is the greenhouse gas emissions in tons of CO2E and FF is the monthly fuel usage in millions standard cubic feet.

The GHG emissions from this equipment shall not exceed 280,502 tons per year. The average GHG emissions shall not exceed 1050 pounds per net megawatt-hours. The operator shall calculate and record the GHG emissions in tons per year and pounds per net megawatt-hours on a 12 month rolling average with a new monthly period starting at the beginning of each month.

The operator shall maintain records in a manner approved by the District to demonstrate compliance with this condition. The records shall be made available to AQMD upon request.

[RULE 1714, 11-5-2010]

[Devices subject to this condition : D56]

H. Applicable Rules

H23.5 This equipment is subject to the applicable requirements of the following rules or regulations:

Contaminant	Rule	Rule/Subpart
NOX	40CFR60, SUBPART	KKKK
SOX	40CFR60, SUBPART	KKKK

[40CFR 60 Subpart KKKK, 7-6-2006]

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

[Devices subject to this condition : D56]

I. Administrative

I297.1 This equipment shall not be operated unless the facility holds 56397 pounds of NOx RTCs in its allocation account to offset the annual emissions increase for the first year of operation. RTCs held to satisfy this condition may be transferred only after one year from the initial start of operation. If the hold amount is partially satisfied by holding RTCs that expire midway through the hold period, those RTCs may be transferred upon their respective expiration dates. This hold amount is in addition to any other amount of RTCs required to be held under other condition(s) stated in this permit.

[**RULE 2005, 6-3-2011**]

[Devices subject to this condition : D56]

K. Record Keeping/Reporting

K40.3 The operator shall provide to the District a source test report in accordance with the following specifications:

FACILITY PERMIT TO OPERATE
PASADENA CITY, DWP

SECTION H: PERMIT TO CONSTRUCT AND TEMPORARY PERMIT TO OPERATE

The operator shall comply with the terms and conditions set forth below:

Source test results shall be submitted to the District no later than 90 days after the source test was conducted.

Emission data shall be expressed in terms of concentration (ppmv) corrected to 15 percent oxygen (dry basis), mass rate (lb/hr), and lb/MM cubic feet. In addition, solid PM emissions, if required to be tested, shall also be reported in terms of grains per DSCF and lbs/MMBtu.

All exhaust flow rate shall be expressed in terms of dry standard cubic feet per minute (DSCFM) and dry actual cubic feet per minute (DACFM).

All moisture concentration shall be expressed in terms of percent corrected to 15 percent oxygen.

Source test results shall also include the oxygen levels in the exhaust, fuel flow rate (CFH), heating content of the fuel, the flue gas temperature, and the generator power output (MW) under which the test was conducted.

[**RULE 1303(a)(1)-BACT, 5-10-1996;** RULE 1303(a)(1)-BACT, 12-6-2002; **RULE 1303(b)(2)-Offset, 5-10-1996;** RULE 1303(b)(2)-Offset, 12-6-2002; **RULE 1703(a)(2) - PSD-BACT, 10-7-1988; RULE 2005, 6-3-2011**]

[Devices subject to this condition : D56]

K67.7 The operator shall keep records, in a manner approved by the District, for the following parameter(s) or item(s):

Natural gas fuel use during the commissioning period.

[RULE 2012, 5-6-2005]

[Devices subject to this condition : D56]

South Coast
Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

August 16, 2013

Ms. Phyllis E. Currie
General Manager
Pasadena City, Department of Water and Power
85 E. State St.
Pasadena, CA 91105

SUBJECT: Title V Facility Significant Permit Revision (Facility ID: 800168)

Dear Ms. Currie:

Please find attached the Title Page, Table of Contents, and Section H of your Title V Facility Permit. The sections reflect the approval of the combined cycle generating system requested in your Title V Revision Application No. 538118.

This permit revision includes the Permit to Construct for the GE LM6000 SPRINT PG gas turbine and SCR. The EPA received a copy of the draft Section H of the Title V Facility Permit and engineering evaluation on May 2, 2013. The EPA concluded the review period on June 17, 2013 with no comments. The Public Notice was published on May 6, 2013 and mailed to addresses within a quarter mile of the facility on May 10, 2013. Blair High School and Westridge High School distributed the notices to their students on May 13, 2013. The 30 day public comment period ended on June 13, 2013 with no comments.

Equipment	Application No.	Permit Type
GE LM6000 SPRINT PG Gas Turbine, 56.1 MW	538115	PC
SCR/CO Catalyst	538120	PC

Please review the attached sections carefully. Insert the enclosed sections into your Title V Facility Permit and discard the earlier versions. Questions concerning changes to your permit should be directed to Mr. Marcel Saulis at (909) 396-3093.

Sincerely,

Mohsen Nazemi, P.E.
Deputy Executive Officer
Engineering & Compliance

MN:AYL:CT:JY:approval
Attachment

cc: Gerardo Rios, EPA Region IX – via email (R9AirPermits_sc@epa.gov)
Ed Pupka, Senior Enforcement Manager

Winston H. Hickox
Secretary for Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5537
Mailing Address: P.O. Box 1977 • Sacramento, California • 95812-1977
FAX (916) 341-5543 • Internet Address: http://www.swrcb.ca.gov

Gray Davis
Governor

January 31, 2003

JOE AWAD
CITY OF PASADENA WTR AND POWER
150 S LOS ROBLES STE 200
PASADENA, CA 91101

RECEIPT OF YOUR NOTICE OF INTENT

The State Water Resources Control Board (State Water Board) has received and processed your NOTICE OF INTENT TO COMPLY WITH THE TERMS OF THE GENERAL PERMIT TO DISCHARGE STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY. Accordingly, you are required to comply with the permit requirements.

Your WDID identification number is: **4 19S319995.** Please use this number in any future communications regarding this permit.

SITE DESCRIPTION

OWNER:	CITY OF PASADENA WTR AND POWER
DEVELOPER:	
COUNTY:	LOS ANGELES
SITE ADDRESS:	43 E STATE ST PASADENA, CA 91105
COMMENCEMENT DATE:	1/27/03
EST. COMPLETION DATE:	6/30/03

When construction is complete or ownership has been transferred, dischargers are required to notify the Regional Water Board by submitting a Notice of Termination (NOT). All State and local requirements must be met in accordance with Special Provision No. 7 of the General Permit. Enclosed is a NOT for your future use. If you do not notify the State Water Board that construction activity has been completed you will continue to be invoiced for the annual fee each January.

Please contact your Regional Water Board at (213) 576-6600 if you have any questions regarding permit requirements. To obtain storm water related information and forms, please visit the storm water web page at www.swrcb.ca.gov/stormwtr/index.html.

Sincerely,

Storm Water Section
Division of Water Quality

Enclosure

Attachment 2

State Water Resources Control Board

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

NOI STATUS (SEE INSTRUCTIONS)

MARK ONLY ONE ITEM 1. ☒ New Construction 2. ☐ Change of Information for WDID#

PROPERTY OWNER

Name	Contact Person		
CITY OF PASADENA WATER & POWER DEPT.	JOE AWAD		
Mailing Address	Title		
150 S. LOS ROBLES, SUITE 200	ENGINEERING MANAGER		
City	State	Zip	Phone
PASADENA	CA	91101	(626) 744 4019

DEVELOPER/CONTRACTOR INFORMATION

Developer/Contractor	Contact Person		
TBD	TBD		
Mailing Address	Title		
City	State	Zip	Phone
			( ) -

CONSTRUCTION PROJECT INFORMATION

Site/Project Name	Site Contact Person		
PASADENA POWER PLANT UPGRADE PROJECT	ALVIN BOYD		
Physical Address/Location	Latitude	Longitude	County
43 E. STATE STREET	34.125	118.15	LOS ANGELES
City (or nearest City)	Zip	Site Phone Number	Emergency Phone Number
PASADENA, CA	91105	(626) 744 -6564	(626) 826 2028

Total size of construction site area: 3.4 Acres

Total area to be disturbed: 3.1 Acres (% of total 92)

C. Percent of site imperviousness (including rooftops):
Before Construction: 95 %
After Construction: 92 %

D. Tract Number(s): _____, _____

E. Mile Post Marker: _____

Is the construction site part of a larger common plan of development or sale?
☐ YES ☒ NO

G. Name of plan or development:

Construction commencement date: 01/27/03

% of site to be mass graded: 25

J. Projected construction dates:
Complete grading: 03/15/03 Complete project: 06/30/03

Type of Construction (Check all that apply):

1. ☐ Residential 2. ☐ Commercial 3. ☐ Industrial 4. ☐ Reconstruction 5. ☐ Transportation
6. ☒ Utility Description: GAS TURBINES 7. ☐ Other (Please List): _____

BILLING INFORMATION

SEND BILL TO:	Name	Contact Person	
OWNER (as in II. above)			
DEVELOPER (as in III. above)	Mailing Address	Phone/Fax	
OTHER (enter information at right)	City	State	Zip

Does the erosion/sediment control plan address construction activities such as infrastructure and structures? ☐ YES ☐ NO

Name of local agency: _____ Phone: ( ) -

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification? ☐ YES ☒ NO

If yes, provide details: _____

/II. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☒ Indirectly to waters of the U.S.
2. ☒ Storm drain system - Enter owner's name: CITY OF PASADENA
3. ☐ Directly to waters of U.S. (e.g. , river, lake, creek, stream, bay, ocean, etc.)

B. Name of receiving water: (river, lake, creek, stream, bay, ocean): SAN PASQUAL CREEK

III. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ___/___/___ Date Amended: ___/___/___

☒ A SWPPP will be prepared and ready for review by (enter date): 01/27/03

☒ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

B. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes ☒ YES ☐ NO

Name: ALVIN BOYD Phone: (626) 744 -6564

C. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation ☒ YES ☐ NO

Name: ALVIN BOYD Phone: (626) 744 - 6564

2. Eliminating all unauthorized discharges ☒ YES ☐ NO

. VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

ave you included a vicinity map with this submittal? ☒ YES ☐ NO

ave you included payment of the annual fee with this submittal? ☒ YES ☐ NO

CERTIFICATIONS

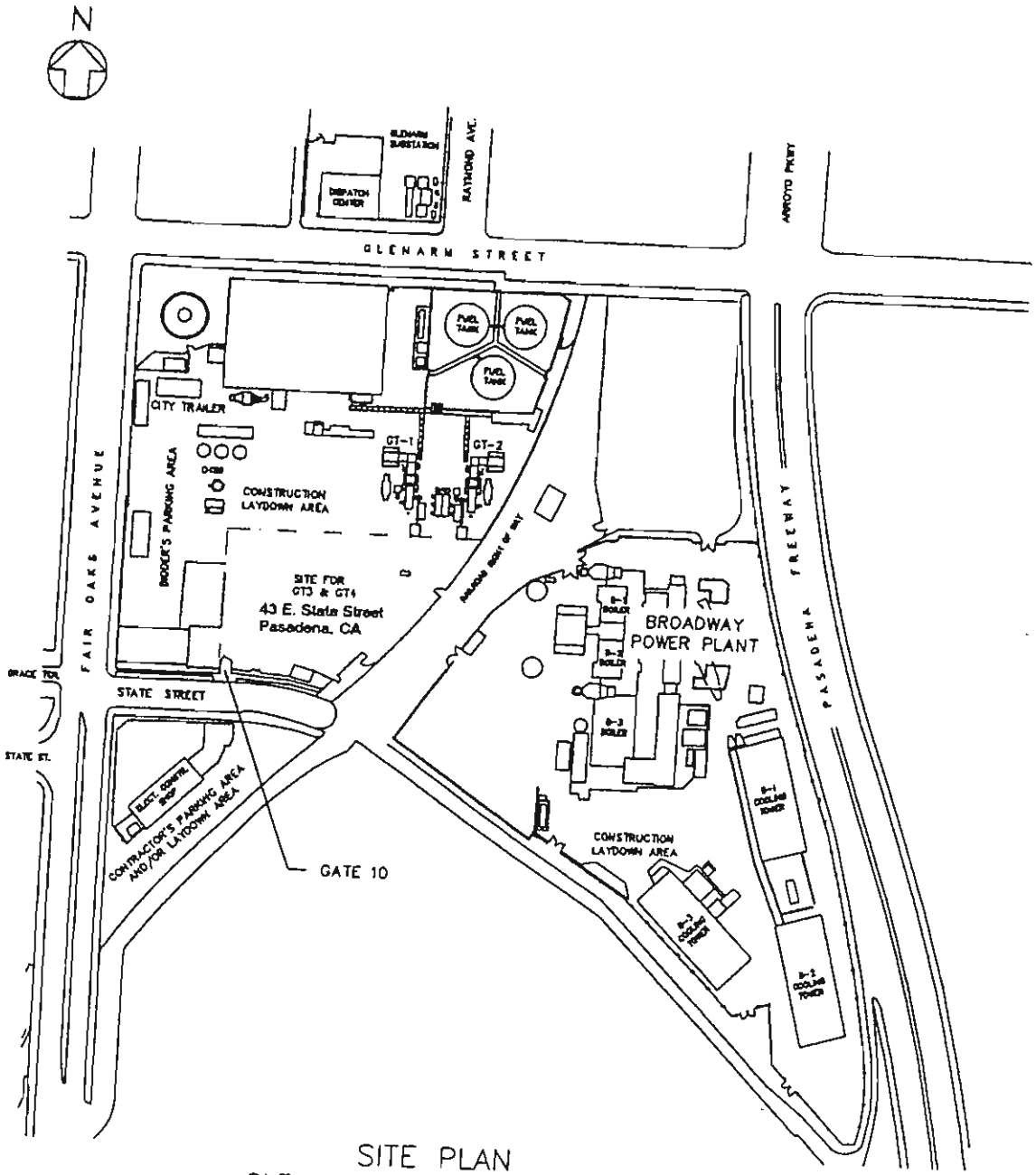
certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the erson or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false formation, including the possibility of fine or imprisonment. In addition, I certify that the provisions of the permit, including the velopment and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

nted Name: JOE AWAD

nature: _____ Date: 1/27/03

e: ENGINEERING MANAGER

ATTACHMENT 1



SITE PLAN
GLENARM & BROADWAY PLANTS

CITY OF PASADENA
WATER AND POWER DEPARTMENT

RJE DOBRE
9/27/2002

SCALE

DRAFT

City of Pasadena
Department of Water & Power

Pasadena Power Plant Upgrade Project,
Pasadena, California

Storm Water Pollution Prevention Plan for Construction Activities



CH2MHILL

January 2003

Table of Contents

General Construction Activity Storm Water Permit Ongoing Requirements 1

Certification 2

Section A: Storm Water Pollution Prevention Plan 3

1.0 Introduction 3
2.0 Objectives 4
3.0 Implementation Schedule 4
4.0 Availability 4
5.0 Required Changes 5
6.0 Source Identification 5
7.0 Erosion Control 8
8.0 Sediment Control 9
9.0 Non-storm Water Management 9
10.0 Post-construction Storm Water Management 9
11.0 Maintenance, Inspection and Repair 9
12.0 Training 10
13.0 List of Contractors/Subcontractors 10
14.0 Public Access 10
15.0 Preparer Certification 10

Section B: Monitoring Program 11

1.0 Required Changes 11
2.0 Implementation 11
3.0 Site Inspections 11
4.0 Compliance Certification 11
5.0 Noncompliance Reporting 11
6.0 Monitoring Records 12

Inventory of Potential Materials to be Used Onsite 12

Storm Water Pollution Prevention Plan Inspection Checklist 13

List of Tables

Table 1: Source Identification 5
Table 2: BMPs for Source Identification 6
Table 3: Inventory of Potential Materials to be Used Onsite 12

List of Figures

Figure 1: ..... Vicinity Map
Figure 2: ..... Location Map

Appendices

Appendix A: Notice of Intent and Application Package Contents
Appendix B: Construction Activity Schedule
Appendix C: Annual Certification
Appendix D: Best Management Practices
Appendix E: General Construction Activity Storm Water Permit
Appendix F: Copy of Notice of Termination Application Form

General Construction Activity Storm Water Permit Ongoing Requirements

The ongoing requirements of this permit are as follow:

1. Continued compliance with general permit provisions must be adhered to. This includes, by reference, this Storm Water Pollution Prevention Plan (SWPPP) and the Best Management Practices (BMPs).
2. Periodic monitoring of the site, inspection, and documentation must be conducted (Section B: Monitoring Program). No sampling of storm water is required.
3. Training of all personnel responsible for implementing this program (Section A: Storm Water Pollution Prevention Plan) must be conducted.
4. An annual certification that the project is in compliance with permit and SWPPP (Certification, Appendix C: General Construction Activity Storm Water Permit) must be made to State Water Resources Control Board (SWRCB) on July 1, 2003, and every year thereafter until Notice of Termination is filed.
5. A copy of the SWPPP, monitoring documentation, and acknowledgment by the Regional Water Quality Control Board (RWQCB) must be available at the construction site during construction activity.
6. A Notice to Terminate must be submitted to the RWQCB when construction activity has ceased and post-construction requirements have been met (Appendix F: Notice of Termination Information).
7. All records related to this permit and plan must be retained for at least 3 years from when the record was created.
8. The contents of this SWPPP and the sections of any other plans that it incorporates are enforceable by the EPA or other designated authority.

Compliance Certification

A statement certifying that the Pasadena Power Plant Upgrade construction activity is in compliance with the requirements of this general permit and its Storm Water Pollution Prevention Plan (SWPPP) at this site must be made to the California State Water Resource Control Board annually, beginning July 1, 2003, and every year thereafter until a Notice of Termination is filed with the Board. The certification must be made based on inspections conducted as part of Section B: Monitoring Program.

> "I certify under penalty of law that the construction activity at this Pasadena Power Plant Upgrade construction site is in compliance with the requirements of this general permit and its Storm Water Pollution Prevention Plan (SWPPP), to the best of my knowledge, based on my inquiry of the persons responsible for managing the site, or those persons directly responsible for gathering the monitoring program information. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

Printed Name: _____

Signature: _____

Date: _____

Title*: _____

Date of Original SWPPP: _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

*This certification statement must be signed by a responsible corporate official (or authorized individual). Include written authorization conferred upon corporate official to authorized individual.

Section A: Storm Water Pollution Prevention Plan

City of Pasadena, Department of Water and Power (PWP)
Pasadena Power Plant Upgrade Project
NPDES General Permit No. CAS000002

1.0 Introduction

The Pasadena Power Plant Upgrade Project is located at 45 East Glenarm Street, in Pasadena, California (Figure 1, Vicinity Map). This project involves the installation of two GE LM 6000 Gas Turbine Generator Sets, GT-3 and GT-4 (furnished by the city of Pasadena) along with the construction of a water treatment plant and installation of auxiliary equipment. The furnishing, installation, inspection, and testing of all materials and components required to provide a complete functioning simple cycle gas turbine facility for the City of Pasadena, Department of Water and Power will be completed.

The Pasadena Power Plant Upgrade Project consists of two construction areas (Figure 2, Location Map). The construction area located on the west side of Railroad Street is the Glenarm Construction Site, and the construction area located on the east side of Railroad Street is the Broadway Construction Site. This Storm Water Pollution Prevention Plan (SWPPP) covers both the Glenarm and Broadway Sites.

1.1 Site Activities

1. Soil excavation
2. Soil backfilling
3. Soil grading
4. Concrete foundation and slab construction
5. Pipefitting and welding
6. Electrical wire, cable, and conduit installation
7. Skid-mounted equipment setting and alignment
8. Structural steel erection
9. Painting
10. Asphalt paving
11. Pipeline Installation
12. Above-ground storage tank installation

2.0 Objectives

This SWPPP has been developed for and will be implemented to address the specific circumstances at the Pasadena Power Plant Upgrade construction site. This SWPPP is certified in accordance with the signatory requirements of Section C, Standard Provision for Construction Activities, of the General Permit and the certification found at the end of this document. The City of Pasadena, Department of Water and Power (PWP) is the entity applying for this permit and responsible for ensuring permit compliance. PWP will hold all contractors and subcontractors in this permit or otherwise affiliated with the construction project

responsible for fully implementing the conditions of this permit. This SWPPP meets the following objectives:

A. Identification of pollutant sources, including sources of sediment, that may affect the quality of storm water discharges associated with construction activity (storm water discharges) from the construction site.

B. Identification of non-storm water discharges.

C. Identification, construction, implementation in accordance with a time schedule, and maintaining of Best Management Practices (BMPs) to reduce or eliminate pollutants in storm water discharges and authorized non-storm water discharges from the construction site during construction.

D. Development of a maintenance schedule for BMPs that are installed during construction that are designed to reduce or eliminate pollutants after construction is completed (post-construction BMPs).

This report is organized into two sections. Section A is the SWPPP and Section B is the Monitoring Program. The report includes the following appendices:

Appendix A: Notice of Intent and Application Package Contents
Appendix B: Construction Activity Schedule
Appendix C: Annual Certification
Appendix D: Best Management Practices
Appendix E: General Construction Activity Storm Water Permit
Appendix F: Copy of Notice of Termination Application Form

3.0 Implementation Schedule

Construction activity will begin January 13, 2003. This SWPPP has been developed prior to the start of soil-disturbing activity and will be implemented concurrent with the commencement of soil-disturbing activities.

4.0 Availability

This SWPPP will be kept at the construction site during construction activity and available during working hours, commencing with the initial construction activity and ending with termination of coverage under the Notice of Termination.

5.0 Required Changes

A. PWP will amend the SWPPP whenever there is a change in construction or operations that may affect the discharge of pollutants to surface waters, ground waters, or a separate municipal storm sewer system. The SWPPP will also be amended if it does not meet any condition of the General Permit or has not achieved the general objective of reducing pollutants in storm water discharges. The SWPPP will be amended in a timely manner, but not more than 14 calendar days after the Regional Water Quality Control Board (RWQCB) determines that the SWPPP is in violation of any requirements of the General Permit.

B. The SWPPP will also be amended if the RWQCB or local agency with the concurrence of the RWQCB requires the SWPPP to be amended.

6.0 Source Identification

This section includes project information and pollutant source identification combined with an itemization of those BMPs specifically chosen to control the pollutants listed.

6.1 Pollutant Source and BMP Identification

This subsection describes potential sources that are likely to add pollutants to storm water discharges or that may result in non-storm water discharges from the construction site. Table 1 below lists the sources of potential pollutants and the pollutants of concern, and Table 2 lists the BMPs for each pollutant source. Detailed BMP fact sheets are included in Appendix D.

Table 1
Source Identification

Material/Equipment Storage, Fueling and Maintenance Areas	Dry Decontamination of oil, greases, fuel, and sediment from equipment
Equipment Decontamination Area	Dry Decontamination of oil, greases, fuel, and sediment from equipment
Soil Storage Area	Sediment
Loading/Unloading Operations	Material spills
Vehicle Entrance/Exits	Sediments
Disposal Areas and Construction Wastes	General Trash Disposal (Dumpsters)

Table 2
BMPs for Source Identification

Equipment Decontamination	Materials will be captured and disposed of.
Soil Storage Area	Store in designated areas, cover, and install silt fence, hay bales, visqueen, and fiberglass if required.
Material/Equipment Storage, Fueling and Maintenance Areas	Store in designated areas, with cover and containment, ensure spill equipment is readily available.
Loading/Unloading Operations	Position loading areas away from drainage patterns, build temporary berms around loading operations, ensure spill cleanup equipment is readily available.
Disposal Areas and Construction Wastes	In designated waste collection areas dispose in accordance with regulatory requirements.

6.1.1 Drainage Patterns and Slopes Anticipated After Grading Activities are Completed

The drainage patterns and slopes anticipated after construction and grading activities are completed will be generally the same as before construction. The site will be regraded to the existing conditions as near practical. Additional storm drain catch basins will be installed in the interior of the facility to reduce sheet flow leaving the property.

6.1.2 Onsite Drainage Patterns

The storm water drainage patterns are shown on the Location Map (Figure 2, Location Map). Storm water drainage from the Glenarm construction area flows naturally from the northwest

to the southeast. This pattern will be maintained during construction activities. Storm water drainage from the Broadway construction area flows in a westerly direction towards existing storm drains and catch basins as shown on Figure 2. Storm water run-on will be diverted from the construction areas by grading, diking, or berming of the site perimeters. Run-off from the construction areas will be diverted through silt fences, hay bales, and fiberglass barriers for sediment control. In areas where continuous grading activities occur, the storm drain catch basins will be sealed off with sand bags and in some areas, with sand bags and hay bales.

6.1.3 Control of Exposure to Contaminated Soil or Toxic Materials

Excavated soil at the site may contain elevated concentrations of lead and petroleum hydrocarbons in the diesel and heavy fuel oil range. BMPs that will be implemented to minimize the exposure of storm water to contaminated soil or toxic materials in the soil excavation and storage areas are as follows:

Train personnel to recognize contaminated soil, excavate, and directly load the soil into trucks for shipment and proper disposal through a licensed transportation and disposal service.

If construction personnel encounter unexpected potentially contaminated soil, the soil will be excavated, stockpiled, covered, characterized and profiled, and then disposed of properly.

All contaminated soil will be removed from the construction sites prior to the contractor construction effort.

6.1.4 Areas Designated for Storage

Storage of soil or waste

Waste will be stored in designated areas as shown on Figure 2. Clean backfill soil will be stored in stockpiles on site. Visqueen will be placed underneath and atop of the clean stockpiles as a barrier to prevent topsoil drainage.

All excavated contaminated soil will be directly loaded into trucks for shipment and disposed of properly through a licensed transportation and disposal service.

If construction personnel encounter unexpected potentially contaminated soil, the soil will be excavated, stockpiled, covered, characterized and profiled, and then disposed of properly. Should stockpiles of contaminated soil be established on site, the piles will be protected with coverings and berms placed around their perimeters.

Vehicle/Equipment storage, cleaning, and maintenance

BMPs for storage and service of vehicles and equipment at the construction site are included in Appendix D.

Construction material loading, unloading, and access areas

Construction material loading, unloading, and access areas will be situated near the construction site to avoid accidental material spills from entering the storm drainage system. Spill clean-up materials will be available in the immediate vicinity of the construction area. Materials being off-loaded will be checked for leaks prior to moving onto the construction site.

6.1.5 BMPs for Control of Discharges from Waste Handling and Disposal

A selected onsite waste collection area will be designated at both the Glenarm and Broadway Construction Sites. Trash dumpsters will be placed at each site. Waste collection will be arranged prior to the overflow of waste containers. Spills of waste materials will be cleaned up immediately, and spill materials will be in the immediate vicinity of the waste disposal area. Construction wastes will be collected, removed, and disposed of only at authorized disposal areas.

6.1.6 Post-construction BMPs

Post-construction BMPs are discussed in Section 10, Post-construction Storm Water Management.

6.2 Additional Information

6.2.1 Pollutant Sources and BMPs not Identified on Site Map

All potential pollutant sources have been identified in Table 1 above and listed in Table 3 at the end of Section B. Pre-construction control practices to reduce sediment and other pollutants into the storm water will include engineering analysis of the construction activities to determine ways to minimize the amount of disturbed soil and determine if a site plan can be developed so that minimal grading occurs.

6.2.2 Inventory of Materials Used and Activities Performed with Potential to Pollute

An inventory of materials that will be stored on the site is included in Table 3 located at the end of Section B. All of these materials are included in the categories of potential pollutant sources. BMPs for preventing these materials from polluting storm water are included in Appendix D. All materials will be stored in accordance with their labels, and state, local, and federal law.

6.2.3 Construction Site Surface Area Specifications

The size of the construction site surface area is approximately 3.4 acres. The percentage of the site that is impervious prior to construction is approximately 95%. The percentage of the site that is impervious post-construction is approximately 92%.

6.2.4 Copy of the NOI

A copy of the NOI is included in Appendix A and the original will be mailed to the Storm Water Permit Unit of the State Water Resources Control Board in the Water Quality Division.

6.2.5 Construction Activity Schedule

As required by this permit, the SWPPP includes a construction activity schedule in Appendix B.

6.2.6 Qualified Personnel

The following table lists the individuals responsible for the implementation of the SWPPP.

Responsibility	Name	Telephone
Inspections (Environmental Inspector)	Gurcharran Bawa	626/744-6562
Legal contact (responsible for overall construction project)	Joe Awad	626/744-4019 626/744-6258
Contact responsible for the implementation of all of the SWPPP	Gurcharran Bawa	626/744-6562

7.0 Erosion Control

The BMPs and control practices for erosion control are provided in Appendix D. All BMPs will be implemented upon initiation of construction activities as required.

In general, the erosion control methods consist of:

1. General environmental protection measures such as use of designated area and flagging of the site.
2. Sediment barriers including hay bales, silt fences, fiberglass, and sand bags.

The location map illustrates the construction perimeter for soil disturbance at the Glenarm and Broadway construction sites.

7.1 BMPs to Reduce Wind Erosion at All Times

Wind erosion control will be achieved through the application of water and an encapsulant that binds the surface of the soil particles together.

8.0 Sediment Control

The BMPs that will be implemented to prevent a net increase of sediment load in storm water discharges are described in Section 7 and fact sheets are included in Appendix D.

Deliveries and traffic will attempt to be scheduled at times when personnel are available to clean up if it is required.

9.0 Non-storm Water Management

Potential non-storm water discharges for the construction site may include the following:

- Potable water sources
- Uncontaminated water from dust control and general housekeeping practices

To the greatest extent practical, these discharges will be eliminated.

10.0 Post-construction Storm Water Management

This permit requires that descriptions of the BMPs used to reduce pollutants in storm water discharge after all construction phases have been completed at the site are addressed. Operation and maintenance of control practices after construction is completed are also required to be addressed, including short- and long-term funding sources and the responsible

party. In addition, to be able to file a Notice of Termination (NOT), the permittee must satisfy the following:

- Uniform vegetative cover of 70 percent
- Use of equivalent stabilization measures

Prior to construction of the new gas turbines, the site was concrete and asphalt paved. Therefore, post-construction controls will consist of regrading and paving the area to its original contours to the extent practical.

Revegetation will not be necessary, unless determined by the appropriate resource agency. PWP will be responsible for the funding of the regrading. Post-construction BMPs will be implemented in accordance with the Los Angeles County Standard Urban Storm Water Mitigation Plan (SUSMP) for the site.

11.0 Maintenance, Inspection, and Repair

For the duration of the project, inspections of the storm water controls and the effectiveness of the controls will be performed before and after storm events and once each 24 hours during extended storm events. Additional equipment and materials will be available onsite for rapid response to failures and emergencies. The name and telephone number of the person responsible for the inspections are provided in Section 6.2.6. The environmental inspector will designate personnel responsible for assisting in emergency situations. An inspection form will be filled out for each inspection and is filed in this plan. A blank inspection form is available at the end of this document.

12.0 Training

PWP will perform training to ensure the successful implementation of this SWPPP and permit compliance. Documentation of the training must be maintained. Prior to the beginning of construction, PWP will hold training to explain the requirements of this SWPPP and permit, and will conduct short refreshers during the construction activities on storm water pollution prevention.

At the initial training, all persons onsite who will have responsibility to act in accordance with this permit will be provided training. Persons directly responsible for ensuring that the permit is complied with, inspectors, and those installing the erosion control devices will receive detailed training on their responsibilities. Persons responsible for acting in accordance with the permit will be given a thorough overview of how storm water pollution will be prevented at this construction site. New personnel that require storm water training after the start of construction will be provided training within a reasonable amount of time, either by being provided the SWPPP to review, perform a review with another qualified personnel, or receive training in a subsequent training session. Documentation that new personnel were trained must be maintained.

Documentation of the training will consist of a dated training roster with signature, and a brief outline of what was covered during the training. "Refresher" training will be documented on a sheet with the date of the training and a brief statement of what was discussed. All documentation will be filed with this plan.

13.0 List of Contractors/Subcontractors

INSERT LIST OF CONTRACTOR/SUBCONTRACTOR NAMES, TELEPHONE NUMBERS, ADDRESSES, AND SPECIFIC AREAS OF RESPONSIBILITY, PRIOR TO BEGINNING CONSTRUCTION AND BRINGING THIS PLAN ONSITE.

14.0 Public Access

This SWPPP shall be provided, upon request, to the RWQCB and is available to the public, under Section 308(b) of the Clean Water Act.

15.0 Preparer Certification

This SWPPP and each of its amendments are signed by the discharger or his/her representative and include the date of the initial preparation and the date of each amendment. The SWPPP certification and amendments are included as part of this document.

Add
Subcontractor
List

Section B: Monitoring Program and Reporting Requirements

City of Pasadena, Department of Water and Power (PWP)
Pasadena Power Plant Upgrade Project
NPDES General Permit No. CAS000002

1.0 Required Changes

PWP understands that the RWQCB may require them to perform additional site inspections, submit reports and certifications, or perform sampling and analysis.

2.0 Implementation

The requirements of this section will be implemented at commencement of construction activity. PWP will be responsible for implementing these requirements until construction activity is completed and the site is stabilized.

3.0 Site Inspections

Qualified inspectors will conduct inspections of the construction site prior to anticipated storm events, during extended storm events, and after actual storm events to identify areas contributing to a discharge of storm water associated with construction activity. The names and contact numbers of the personnel are listed in Section 6.2.6. During extended storm events, inspections will be conducted during each 24-hour period. Inspections will be recorded on the inspection form provided at the end of this document. Completed inspections will be documented and filed with this document.

4.0 Compliance Certification

A certification made by PWP will be submitted to the RWQCB stating that the construction activity is in compliance with the requirements of the General Permit and the SWPPP. The certification will be made by July 1 of each year. A certification form is provided at the end of this document. Completed copies of certification forms will be filed with this document.

5.0 Noncompliance Reporting

PWP will make the necessary notification if a noncompliance event occurs, as described in the General Permit.

6.0 Monitoring Records

PWP will retain records of all inspections, compliance certifications, and noncompliance reports for at least 3 years from the date generated. While the construction is ongoing, the records will be on file with this document at the construction site. When construction is complete and the permit terminated, records will be on file at the PWP office located at 45 East Glenarm Street, Pasadena, California.

Table 3
Inventory of Potential Materials to be Used Onsite
The following list includes materials that may be used during construction activities at the site.

Material	Use and Disposal
Diesel (#2) Fuel	Diesel fuel will be spent in the powering of equipment, temporary pumps, and other engines.
Ethylene Glycol	Ethylene glycol (antifreeze) will be contained within vehicle and equipment engines.
Gasoline	Gasoline fuel will be spent in the powering of equipment, temporary pumps, and other engines.
Hydraulic fluid	Hydraulic fluid will be contained within vehicle and equipment engines.
Lubricants (motor oil, grease)	Motor oil will be contained within vehicle and equipment engines. Waste motor oil will be sent to licensed facilities for recycling. Grease and other lubricants will be spent.
Sulfuric Acid	Sulfuric acid is found in batteries located in construction equipment and vehicles. Spent batteries will be sent to licensed facilities for recycling or disposal.
Liquid Ammonia	Liquid ammonia may be contained on-site during the installation of the new ammonia tank located on the Broadway Construction Site.

Storm Water Pollution Prevention Plan Inspection Checklist

Site Location:_____

Inspection Date (Day/month/year): _____

Estimate of Beginning of Storm (Date/time): _____

Estimate of Duration of Storm (Date/time): _____

Estimate of Time Elapsed since Previous Storm (Days/hours): _____

Approximate Amount of Rainfall (Inches): _____

List All BMPs in Place (e.g., Silt Fence)	Was BMP Adequate?	If No, What Will Be Corrected?	Date Corrected

NOTE: INSPECTION AND REPAIR OF BMPs SHOULD ONLY BE CONDUCTED UNDER SAFE CONDITIONS, WHERE IT IS POSSIBLE TO ACCESS THESE DEVICES SAFELY IN INCLEMENT WEATHER. IF IT IS NOT POSSIBLE TO ACCESS SAFELY DURING A STORM, LIST A VISUAL INSPECTION OF STORM WATER AT OUTFALL, DISCHARGE POINT, OR DOWNSTREAM.

Inspected by:_____

Signature:_____

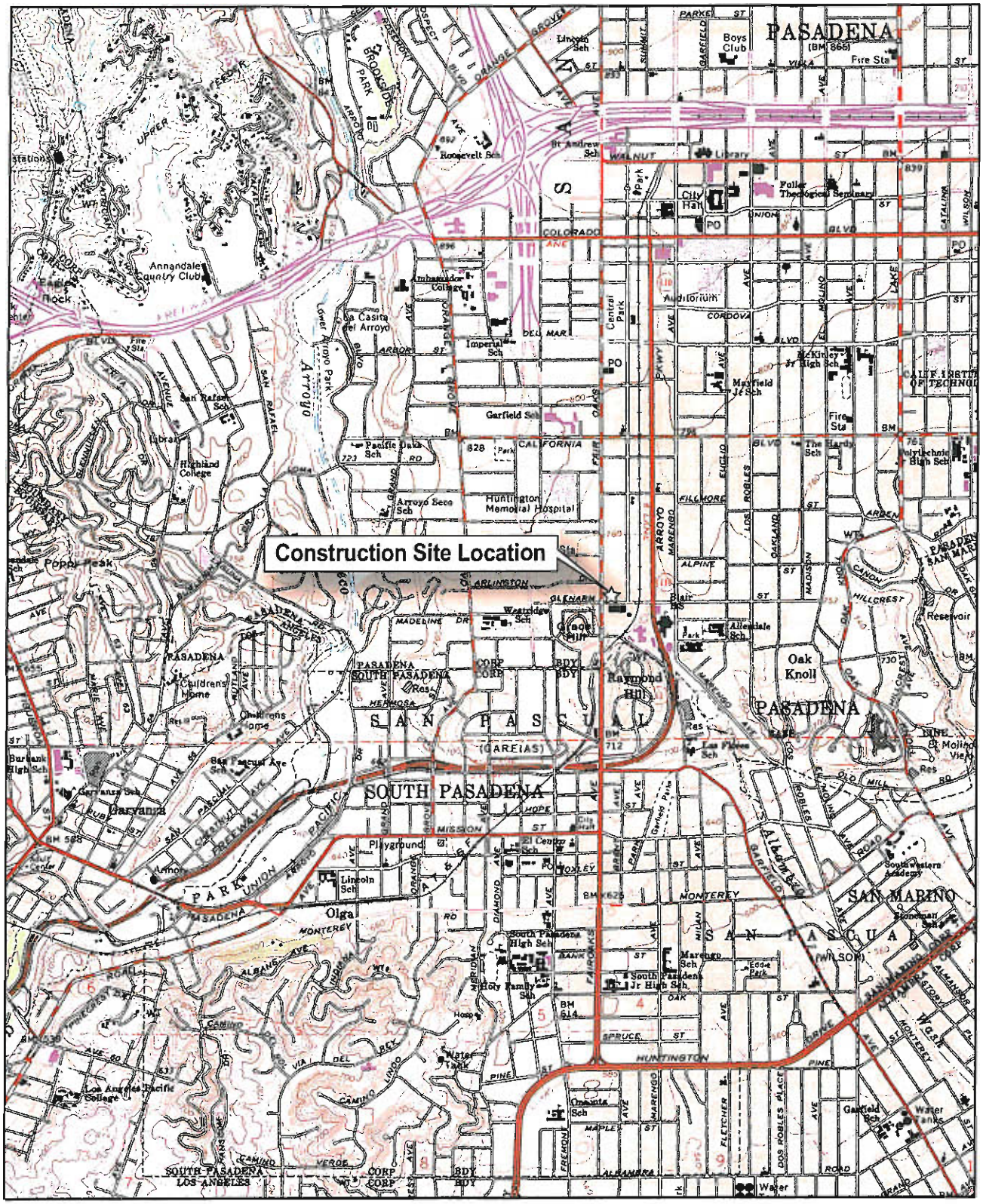
Title:_____

Figures

Storm Water Pollution Prevention Plan
Vicinity Map Requirements - California

Vicinity Map Requirements: (no size restriction)

- Location of project site with respect to easily identifiable major roadways, geographic features, or landmarks
- Construction site perimeter
- Geographic features surrounding the site
- General topography



N

0 0.5

Scale in Miles

Figure 1
Vicinity Map
Pasadena Power Plant Upgrade Project
45 East Glenarm Street
Pasadena, CA 91105

Source: U.S.G.S. 7.5 Minutes Quadrangle Maps: Pasadena, CA, 1988; Los Angeles, CA, 1981.

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Storm Water Pollution Prevention Plan Location Map Requirements - California

Site Map Requirements: (no size restriction)

- Existing and planned paved areas onsite
- Existing and planned permanent buildings onsite
- Construction site perimeter
- Existing and proposed lots
- Existing and proposed roadways
- Existing and proposed storm water collection and discharge points
- General topography before and after construction
- Anticipated discharge location where storm water from site drainage will drain to municipal storm sewer or other water body
- Drainage patterns across the project area
- Extension of map outside the site perimeter as far as necessary to illustrate relevant drainage areas
- Drainage patterns into each onsite storm water inlet point or receiving water
- Show where sediment and erosion control devices will be installed
- Show areas designated for storage of soil or waste, vehicle storage and service areas, construction material loading/unloading, and access areas, equipment storage, cleaning and maintenance areas
- Show the location of each post-construction BMP on the map

N

GLENARM CONSTRUCTION SITE

STABILIZED FAIROAKS CONSTRUCTION ENTRANCE

EXISTING CONSTRUCTION SITE TRAILER

GLENARM GAS HOUSE

CONSTRUCTION TRAILER COMPLEX

EXISTING GLENARM TRAILER

GLENARM SITE VEHICLE & EQUIPMENT PARKING

FUELING & MAINT. AREA

LOAD & UNLOAD OPERATIONS

DISPOSAL AREA/ CONST. WASTE

PIPE FABRICATION YARD

WAREHOUSE

EXIST. NEW

TIE-IN TO EXIST. STORM WATER PIPE BOX

FUTURE GATE

FENCE WITH 10" CONC. CURB

EXIST ASPHALT

NEW ASPHALT

FS

PASADENA FREEWAY

FUTURE AMMONIA UNLOADING AREA

EXISTING DEMINERALIZED WATER TANK

FUTURE DEMINERALIZED WATER TANK

GUTTER DRAIN

BROADWAY CONSTRUCTION SITE

STATE ST.

STABILIZED GLENARM CONSTRUCTION ENTRANCE

FUTURE MAIN STORMDRAIN OUTLET

STORM DRAIN POINT POINT

GAS COMPRESSOR

GAS COMPRESSOR UNIT

FUTURE AMMONIA TANK

EXISTING AMMONIA TANK

VEHICLE & EQUIPMENT PARKING

FUELING & MAINT. AREA

LOAD & UNLOAD OPERATIONS

DISPOSAL AREA/ CONST. WASTE

GLENARM & BROADWAY MATERIAL STORAGE

RAILROAD ST.

STATE ST.

STABILIZED BROADWAY CONSTRUCTION ENTRANCE

LEGEND

- ASPHALT PAVEMENT
- CONCRETE PAVEMENT
- FLOW DIRECTION
- CONSTRUCTION SITE PERIMETER
- FUTURE CATCH BASIN
- EXISTING CATCH BASIN
- MAN HOLE
- HAY BALES/SILT FENCES/ FIBERGLASS
- SANDBAGS
- FUTURE STRUCTURE FS

FIGURE 2
CONSTRUCTION STORM WATER POLLUTION PREVENTION PLAN
LOCATION MAP

PASADENA DEPT. OF WATER & POWER
POWER PLANT UPGRADE PROJECT
45 EAST GLENARM STREET
PASADENA, CA 91105

CH2MHILL

\\CHERON\CAD\PROJECTS\PASADENAPOWER

APPENDIX A

Notice of Intent

Attachment 2

State Water Resources Control Board

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

IOI STATUS (SEE INSTRUCTIONS)

ARK ONLY ONE ITEM 1. ☒ New Construction 2. ☐ Change of Information for WDID#

PROPERTY OWNER

ne CITY OF PASADENA WATER & POWER DEPT.	Contact Person JOE AWAD		
ling Address 150 S. LOS ROBLES, SUITE 200	Title ENGINEERING MANAGER		
PASADENA	State CA	Zip 91101	Phone (626) 744 4019

DEVELOPER/CONTRACTOR INFORMATION

eloper/Contractor TBD	Contact Person TBD		
ing Address	Title		
	State	Zip	Phone ( ) -

CONSTRUCTION PROJECT INFORMATION

/Project Name PASADENA POWER PLANT UPGRADE PROJECT	Site Contact Person ALVIN BOYD		
sical Address/Location 43 E. STATE STREET	Latitude 34.125	Longitude 118.15	County LOS ANGELES
(or nearest City) PASADENA, CA	Zip 91105	Site Phone Number (626) 744 -6564	Emergency Phone Number (626) 826 2028

Total size of construction site area: 3.4 Acres Total area to be disturbed: 3.1 Acres (% of total 92)	C. Percent of site imperviousness (including rooftops): Before Construction: 95 % After Construction: 92 %	D. Tract Number(s): _____, _____ E. Mile Post Marker: _____
s the construction site part of a larger common plan of development or sale? ☐ YES ☒ NO	G. Name of plan or development:	
Construction commencement date: 01/27/03 % of site to be mass graded: 25	J. Projected construction dates: Complete grading: 03/15/03	Complete project: 06/30/03

Type of Construction (Check all that apply):

1. ☐ Residential 2. ☐ Commercial 3. ☐ Industrial 4. ☐ Reconstruction 5. ☐ Transportation
6. ☒ Utility Description: GAS TURBINES 7. ☐ Other (Please List): _____

BILLING INFORMATION

D BILL TO: OWNER as in II. above)	Name	Contact Person	
DEVELOPER as in III. above)	Mailing Address	Phone/Fax	
OTHER enter information at right)	City	State	Zip

Does the erosion/sediment control plan address construction activities such as infrastructure and structures? ☐ YES ☐ NO

Name of local agency: _____ Phone: ( ) -

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification? ☐ YES ☒ NO

If yes, provide details: _____

II. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☒ Indirectly to waters of the U.S.
2. ☒ Storm drain system - Enter owner's name: CITY OF PASADENA
3. ☐ Directly to waters of U.S. (e.g. , river, lake, creek, stream, bay, ocean, etc.)

3. Name of receiving water: (river, lake, creek, stream, bay, ocean): SAN PASQUAL CREEK

II. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

\. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ___/___/___ Date Amended: ___/___/___

☒ A SWPPP will be prepared and ready for review by (enter date): 01/27/03

☒ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes. ☒ YES ☐ NO

Name: ALVIN BOYD Phone: (626) 744 -6564

. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation. ☒ YES ☐ NO

Name: ALVIN BOYD Phone: (626) 744 - 6564

2. Eliminating all unauthorized discharges. ☒ YES ☐ NO

VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

ive you included a vicinity map with this submittal? ☒ YES ☐ NO

ive you included payment of the annual fee with this submittal? ☒ YES ☐ NO

ERTIFICATIONS

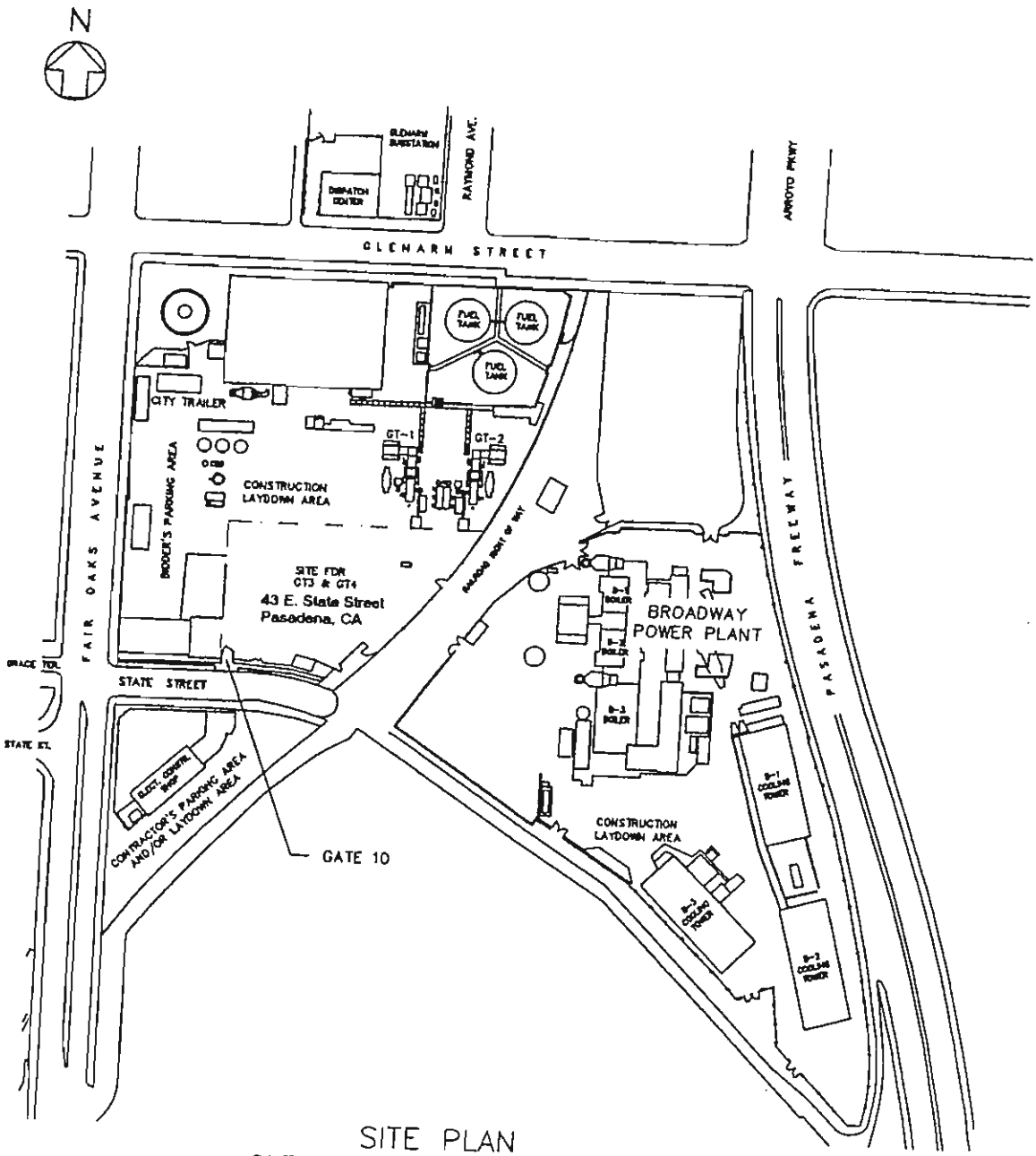
certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the rson or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false ormation, including the possibility of fine or imprisonment. In addition, I certify that the provisions of the permit, including the velopment and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

nted Name: JOE AWAD

nature: _____ Date: 1/27/03

s: ENGINEERING MANAGER

ATTACHMENT 1



SITE PLAN
GLENARM & BROADWAY PLANTS

CITY OF PASADENA
WATER AND POWER DEPARTMENT

ILIE DOBRE
9/27/2002

SCALE

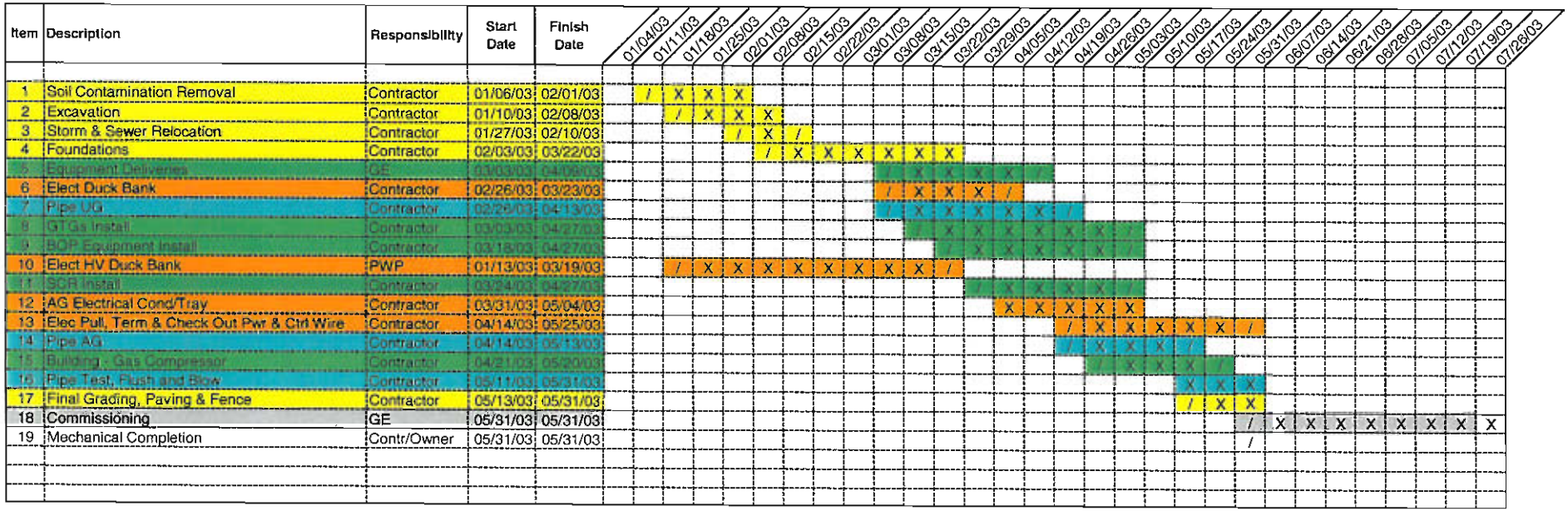
APPENDIX B

General Construction Schedule

Pasadena Department of Water and Power
Pasadena Power Plant Upgrade Project

Construction Schedule

Item	Description	Responsibility	Start Date	Finish Date
1	Soil Contamination Removal	Contractor	01/06/03	02/01/03
2	Excavation	Contractor	01/10/03	02/08/03
3	Storm & Sewer Relocation	Contractor	01/27/03	02/10/03
4	Foundations	Contractor	02/03/03	03/22/03
5	Equipment Deliveries	GE	03/03/03	04/06/03
6	Elect Duck Bank	Contractor	02/26/03	03/23/03
7	Pipe UG	Contractor	02/25/03	04/13/03
8	GTGs Install	Contractor	03/03/03	04/27/03
9	BOP Equipment Install	Contractor	03/18/03	04/27/03
10	Elect HV Duck Bank	PWP	01/13/03	03/19/03
11	SCR Install	Contractor	03/24/03	04/27/03
12	AG Electrical Cond/Tray	Contractor	03/31/03	05/04/03
13	Elec Pull, Term & Check Out Pwr & Ctrl Wire	Contractor	04/14/03	05/25/03
14	Pipe AG	Contractor	04/14/03	05/13/03
15	Building - Gas Compressor	Contractor	04/21/03	05/20/03
16	Pipe Test, Flush and Blow	Contractor	05/11/03	05/31/03
17	Final Grading, Paving & Fence	Contractor	05/13/03	05/31/03
18	Commissioning	GE	05/31/03	05/31/03
19	Mechanical Completion	Contr/Owner	05/31/03	05/31/03



APPENDIX C

Annual Certification

"I certify under penalty of law that the construction activity at this Pasadena Power Plant Upgrade construction site is in compliance with the requirements of this general permit and its Storm Water Pollution Prevention Plan (SWPPP), to the best of my knowledge, based on my inquiry of the persons responsible for managing the site, or those persons directly responsible for gathering the monitoring program information. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

Printed Name: _____

Signature: _____

Date: _____

Title*: _____

Date of Original SWPPP: _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

Amendment ___ : _____

*This certification statement must be signed by a responsible corporate official (or authorized individual). Include written authorization conferred upon corporate official to authorized individual.

APPENDIX D

Best Management Practices

BMP: Vehicle and Equipment Maintenance

Description

Prevent or reduce the discharge of pollutants to storm water from vehicle and equipment maintenance by running a "dry site." This involves using off-site facilities, performing work in designated areas only, providing cover for materials stored outside, checking for leaks and spills, containing and cleaning up spills immediately, and training employees and subcontractors.

Approach

- Keep vehicles and equipment clean, don't allow excessive build-up of oil and grease.
- Use off-site repair shops as much as possible. Maintaining vehicles and equipment outdoors or in areas where vehicle or equipment fluids may spill or leak onto the ground can pollute stormwater. If you maintain a large number of vehicles or pieces of equipment, consider using an offsite repair shop. These businesses are better equipped to handle vehicle fluids and spills properly.
- Performing this work off-site can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur on-site, use designated areas, located away from drainage courses, to prevent the runon of storm water and runoff of spills.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Use adsorbent materials on small spills rather than hosing down or burying the spill. Remove the adsorbent materials promptly and dispose of properly.
- Regularly inspect on-site vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment on site.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic, and transmission fluids.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.

Requirements

Costs (Capital, O&M)

- All of the above are low cost measures.

Maintenance

- Keep ample supplies of spill cleanup materials on-site.
- Inspect maintenance areas on a regular schedule.

Limitations

- Sending vehicles/equipment off-site should be done in conjunction with BMP C/PS8 (Stabilized Construction Entrance).

Additional Information - Vehicle and Equipment Maintenance

Outdoor vehicle or equipment maintenance is a potentially significant source of storm water pollution. Activities that can contaminate storm water include engine repair and service, particularly changing or replacement of fluids, and outdoor equipment storage and parking (dripping engines).

Listed below is further information if you must perform vehicle or equipment maintenance on-site.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, 1, 1, 1-trichloroethane, or methylene chloride. Many of these parts cleaners are harmful and must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents (1, 1, 1 -trichloroethane, methylene chloride, etc.) with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling/Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents (like 1,1,1-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.

Oil filters disposed of in trash cans or dumpsters can leak oil and contaminate storm water. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before

disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Do not bury used tires.

BMP: Vehicle and Equipment Cleaning

Description

Prevent or reduce the discharge of pollutants to storm water from vehicle and equipment cleaning by using off-site facilities, washing in designated areas only, eliminating discharges to the storm drain by infiltrating or recycling the wash water and training employees and subcontractors.

Approach

- Use off-site commercial washing businesses as much as possible. Washing vehicles and equipment outdoors or in areas where wash water flows onto the ground can pollute storm water.
- If you wash a large number of vehicles or pieces of equipment, consider conducting this work at an off-site commercial business. These businesses are better equipped to handle and dispose of the wash waters properly. Performing this work off-site can also be economical by eliminating the need for a separate washing operation at your site.
- If washing must occur on-site, use designated, bermed wash areas to prevent wash water contact with storm water, creeks, rivers, and other water bodies. The wash area can be sloped for wash water collection and subsequent infiltration into the ground.
- Use as little water as possible to avoid having to install erosion and sediment controls for the wash area.
- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning on-site. Steam cleaning can generate significant pollutant concentrations leading to potential storm water and groundwater contamination.

Requirements

Costs (Capital, O&M)

- All of the above are low cost measures.

Maintenance

- Minimal; some berm repair maybe necessary.

Limitations

- Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades.
- Sending vehicles/equipment off-site should be done in conjunction with PS7 (Stabilized Construction Entrance).

BMP: Vehicle and Equipment Fueling

Description

Prevent fuel spills and leaks, and reduce their impacts to storm water by using off-site facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors.

Approach

- Use off-site fueling stations as much as possible. Fueling vehicles and equipment outdoors or in areas where fuel may spill/leak onto the ground can pollute storm water. If you fuel a large number of vehicles or pieces of equipment, consider using an off-site fueling station. These businesses are better equipped to handle fuel and spills properly. Performing this work off-site can also be economical by eliminating the need for a separate fueling area at your site.
- If fueling must occur on-site, use designated areas, located away from drainage courses, to prevent the runon of storm water and the runoff of spills.
- Discourage "topping-off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/leaks.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Use adsorbent materials on small spills rather than hosing down or burying the spill. Remove the adsorbent materials promptly and dispose of properly.
- Carry out all Federal and State requirements regarding stationary above ground storage tanks.
- Do not use mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and perhaps small forklifts, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.

Requirements

Costs (Capital, O&M)

- All of the above measures are low cost, except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Maintenance

- Keep ample supplies of spill cleanup materials on-site.
- Inspect fueling areas and storage tanks on a regular schedule.

Limitations

- Sending vehicles/equipment off-site should be done in conjunction with PS7 (Stabilized Construction Entrance).

BMP: Contaminated Soil Management

Description

Prevent or reduce the discharge of pollutants to storm water from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly.

Approach

Contaminated soils may occur on your site for several reasons including:

- Past site uses and activities,
- Detected or undetected spills and leaks, and
- Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline-forming elements.

The following steps will help reduce storm water pollution from contaminated soil:

- Conduct thorough site planning including pre-construction geologic surveys.
- Look for contaminated soil as evidenced by discoloration, odors, or differences in soil properties.
- Seal bedrock fractures with grout or bentonite to reduce seepage from excavation.
- Prevent leaks and spills to the maximum extent practicable. Contaminated soil can be expensive to treat and/or dispose of properly. However, addressing the problem before building construction is much less expensive than after the buildings are in place.
- Test suspected soils at a certified laboratory.
- If the soil is contaminated, work with the local regulatory agencies to develop options for treatment and/or disposal.

Requirements

Costs (Capital, O&M)

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil can be quite expensive.

Maintenance

- Inspect excavated areas daily for signs of contaminated soil.

- Implement Spill Prevention and Control to prevent leaks and spills as much as possible.

Limitations

- Contaminated soils that cannot be treated on-site must be disposed of off-site by a licensed hazardous waste hauler.
- The presence of contaminated soil may indicate contaminated water as well.

BMP: Hazardous Waste Management

Description

Prevent or reduce the discharge of pollutants to storm water from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

Approach

Many of the chemicals used on-site can be hazardous materials which become hazardous waste upon disposal. These wastes may include:

- Paints and solvents,
- Petroleum products such as oils, fuels, and grease,
- Fertilizers, herbicides and pesticides,
- Acids for cleaning masonry,
- Soil stabilization additives such as calcium carbonate,
- Asphalt products, and
- Concrete curing compounds.

In addition, sites with existing structures may contain wastes which must be disposed of in accordance with Federal, State, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints,
- Asbestos, and
- PCBs (particularly in older transformers).

The following steps will help reduce storm water pollution from hazardous wastes:

Material Use

- Use all of the product before disposing of the container.
- Do not remove the original product label, it contains important safety and disposal information.
- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Overapplication is expensive and environmentally harmful. Till fertilizers and lime into soil rather than hydroseeding. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried off-site by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with Federal and State regulations.

Waste Recycling/Disposal

- Select a designated waste collection area on-site.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, make recycling impossible, and complicate disposal.
- Recycle any useful material such as used oil.
- Make sure that toxic liquid wastes (used oils, solvents, paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

Training

- Train employees and subcontractors in proper hazardous waste management.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

Requirements

Costs (Capital, O&M)

- All of the above are low cost measures.

Maintenance

- Inspect hazardous waste receptacles and area regularly.
- Arrange for regular hazardous waste collection.

Limitations

- Hazardous waste that cannot be re-used or recycled must be disposed of by a licensed hazardous waste hauler.

BMP: Solid Waste Management

Description

Prevent or reduce the discharge of pollutants to storm water from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Approach

Solid waste is one of the major pollutants resulting from construction. Construction debris includes:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction,
- Packaging materials including wood, paper and plastic,
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, masonry products, and
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes.

The following steps will help keep a site clean and reduce storm water pollution:

- Select a designated waste collection area on-site.
- When possible, locate containers in a covered area.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it's windy.
- Collect site trash daily.
- Erosion and sediment control devices tend to collect litter. Remove this solid waste promptly.
- Salvage or recycle any useful material.
- Make sure that toxic liquid wastes (used oils, solvents, paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.

- If a container does spill, clean up immediately.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.
- Train employees and subcontractors in proper solid waste management.

Requirements

Costs (Capital, O&M)

- All of the above are low cost measures.

Maintenance

- Collect site trash daily.
- Inspect construction waste area regularly.
- Arrange for regular waste collection.

Limitations

- There are no major limitations to this best management practice.

BMP: Spill Prevention and Control

Description

Prevent or reduce the discharge of pollutants to storm water from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, Material Delivery and Storage and Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this appendix.

Approach

The following steps will help reduce the storm water impacts of leaks and spills:

General Measures

- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.

Cleanup

- Clean up leaks and spills immediately.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and an absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up or excavate the material and dispose of properly. See the waste management BMPs in this chapter for specific information.

Reporting

- Report spills to local agencies, such as the Fire Department; they can assist in the cleanup.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur on-site, use a designated area, located away from drainage courses, to prevent the runon of storm water and the runoff of spills.
- Regularly inspect on-site vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment on site.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under pacing equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down or burying the spill. Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trash cans or dumpsters; can leak oil and contaminate storm water. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur on-site, use designated areas, located away from drainage courses, to prevent the runon of storm water and the runoff of spills.
- Discourage "topping-off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/leaks.

Requirements

Costs (Capital, O & M)

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance

- Keep ample supplies of spill control and cleanup materials on-site, near storage, unloading, and maintenance areas.
- Update your spill cleanup materials as changes occur in the types of chemicals on site.

Limitations

- If necessary, use a private spill cleanup company.

BMP: Material Use

Description

Prevent or reduce the discharge of pollutants to storm water from material use by using alternative products, minimizing hazardous material use on-site, and training employees and subcontractors.

Approach

The following materials are commonly used on construction sites:

- Pesticides and herbicides,
- Fertilizers,
- Detergents,
- Petroleum products such as fuel, oil, and grease, and
- Other hazardous chemicals such as acids, lime, glues, paints, solvents, and curing compounds.

Use of these materials on-site can pose the following risks:

- Storm water contamination,
- Injury to workers or visitors,
- Groundwater contamination, and
- Soil contamination.

Therefore, the following steps should be taken to minimize your risk:

- Use less hazardous, alternative materials as much as possible.
- Use as few hazardous materials on-site as possible.
- Limit material usage to designated areas only.
- Follow manufacturer's instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- For pesticides in particular, personnel who use pesticides should be trained in their use. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct on-site inspections.
- Do-not over apply fertilizers, herbicides, and pesticides. Prepare only the amount needed.
- Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Till fertilizers and lime into the soil rather than hydroseeding.

Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried off-site by runoff. Do not apply these chemicals just before it rains.

- Train employees and subcontractors in proper material use.

Requirements

Costs (Capital, O & M)

- All of the above are low cost measures.

Maintenance

- Maintenance of this best management practice is minimal.

Limitations

- Alternative materials may not be available, suitable, or effective in every case.

BMP: Material Delivery and Storage

Description

Prevent or reduce the discharge of pollutants to storm water from material delivery and storage by minimizing the storage of hazardous materials on-site, storing materials in a designated area, installing secondary containment, conducting regular inspection, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see Material Use, or Spill Prevention and Control. For information on wastes, see the waste management BMPs in this appendix.

Approach

The following materials are commonly stored on construction sites:

- Pesticides and herbicides,
- Fertilizers,
- Detergents,
- Petroleum products such as fuel, oil, and grease, and
- Other hazardous chemicals such as acids, lime, glues, paints, solvents, and curing compounds.

Storage of these materials on-site can pose the following risks:

- Storm water contamination,
- Injury to workers or visitors,
- Groundwater contamination, and
- Soil contamination.

Therefore, the following steps should be taken to minimize your risk:

- Designate an area of the construction site for material delivery and storage.
  - Place near the construction entrance, away from waterways
  - Avoid transport near drainage paths or waterways
  - Surround with earth berms (see DRI, Earth, Dika)
  - Place in an area which will used to stabilize any residential materials
- Storage of reactive, ignitible, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.

- Keep an accurate, up-to-date inventory in your SWPPP of the materials delivered and stored on site.
- Keep your inventory down. Store only the amount you need, for only as long as you need it.
- Store as few hazardous materials on-site as possible.
- Handle hazardous materials as infrequently as possible.
- Designate a secure material storage area away from drainage courses and near the site entrance.
- Whenever possible, store materials in a covered area with secondary containment such as an earthen dike, horse trough, or even kid's wading pool for non-reactive materials such as detergents, oil, grease and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containment.
- If drums must be kept in an uncovered area, store them at a slight angle to reduce ponding of rainwater in the lids and to reduce corrosion.
- Try to keep chemicals in their original containers, and keep them well labeled.
- Train employees and subcontractors.
- Employees trained in emergency spill cleanup procedures should be present when dangerous materials or liquid chemicals are unloaded.

Requirements

Cost (Capital, O & M)

- All of the above are low cost measures.

Maintenance

- Keep the designated storage area clean and well organized.
- Conduct routine weekly inspections and check for external corrosion of material containers.
- Keep an ample supply of spill cleanup materials near the Storage area.

Limitations

- Storage sheds often must meet building and fire code requirements.

BMP: Employee/Subcontractor Training

Description

Employee/subcontractor training, like maintenance or equipment, is not so much a best management practice as it is a method by which to implement BMPs. This fact sheet highlights the importance of training and of integrating the elements of employee/subcontractor training from the individual source controls into a comprehensive training program as part of a company's Storm Water Pollution Prevention Plan (SWPPP). It includes the overall objectives and approach for assuring employee/subcontractor training in storm water pollution prevention.

Objectives

Employee/subcontractor training should be based on four objectives:

- Promote a clear identification and understanding of the problem, including activities with the potential to pollute storm water,
- Identify solutions (BMPs),
- Promote employee-subcontractor ownership of the problems and the solutions, and
- Integrate employee/subcontractor feedback into training and BMP implementation.

Approach

- Integrate training regarding storm water quality management with existing training programs that may be required for your business by other regulations such as: the Illness and Injury Prevention Program (11PP) (SB 198) (California Code of Regulations Title 8, Section 3203), the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (29 CFR 1910.120), the Spill Prevention Control and Countermeasure (SPCC) Plan (40 CFR 112), and the Hazardous Materials Management Plan (Business Plan) (California Health and Safety Code, Section 6.95).
- Businesses, particularly smaller ones that may not be regulated by Federal, State, or local regulations should develop a training program to reduce their potential to pollute storm water.
- Train employee/subcontractors in proper and consistent methods for disposal.
- Consider posting the quick reference table around the job site or in the on-site office trailer to reinforce training.
- Train employee/subcontractors in standard operating procedures and spill cleanup techniques described in the BMP fact sheets. Employee/subcontractors trained in spill

containment and cleanup should be present during the loading/unloading and handling of materials.

- Personnel who use pesticides should be trained in their use. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct on-site inspections.
- Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employee/subcontractors can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do on-site.

BMP: Scheduling

Description

Sequencing the construction project to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project. Use of other, more costly yet less effective, erosion and sedimentation controls, may often be reduced through proper construction sequencing.

Approach

- Project design considerations: Design project to integrate into existing land contours. Significant regrading of a site will require more costly erosion and sedimentation control measures and may require that on-site drainage facilities be installed.
- Incorporate existing, natural areas: Inventory and evaluate the existing site terrain and vegetation. Disturbance of highly erosive natural areas (e.g., steep, unstable slope areas, watercourses) should be minimized, while protecting other areas may enhance site aesthetics. Construction should not disturb these areas (see ESC2).
- Avoid rainy periods: Schedule major grading operations during dry months. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means (see ESC 10 to 24) or to install temporary sediment trapping devices (see ESC 50 to 56).
- Practice erosion and sediment control year round: Erosion may be caused during dry seasons by "freak" rainfall, wind and vehicle tracking. Therefore, keep the site stabilized year-round, and retain wet season sediment trapping devices.
- Minimize soil exposed at one time! Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding--revegetate cut and fill slopes as the work progresses.
- Trenching: Close and stabilize open trenches as soon as possible. Sequence trenching projects so that most open portions of the trench are closed before new trenching is begun.

Requirements

Cost

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost-effectiveness of scheduling techniques should be compared with the other, less effective erosion and sedimentation controls to achieve a cost-effective balance.

Limitations

There are no significant limitations to the use of this BMP.

BMP: Silt Fence

General Description

A silt fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of the fabric used, supported with wire fence. Silt fences trap sediment in two ways: (1) by intercepting and detaining small amounts of sediment from disturbed areas during construction operations in order to promote sediment from behind the fence: and (2) by decreasing the velocity of flows up to 0.5 cfs in swales.

Silt fences may be used for perimeter control, placed upstream of the point(s) of discharge of runoff from a site, but before the flow becomes concentrated. They may also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion, and perpendicular to minor swales or ditch lines for up to one acre contributing drainage areas. Silt fences are not intended for use in detaining concentrated flows, and are only applicable for sheet or overland flows.

Suitable Applications

- Along the perimeter of the site
- Along streams and channels
- Across swales with small catchments
- Below the toe of a cleared slope
- Around temporary spoil areas
- Below other small cleared areas

Installation/Application

Planning:

Silt fences are preferable to straw barriers in many cases. Laboratory work at the Virginia Highway and Transportation research Council has shown that silt fences can trap a much higher percentage of suspended sediments than can straw bales. While the failure rate of silt fences is lower than that of straw barriers, there are many instances where silt fences have been improperly installed. The following installation methods can improve performance and should be followed:

- Construct along a level contour.
- Silt fences should remain in place until the disturbed area is permanently stabilized.
- Provide sufficient room for sediment removal equipment between the silt fences and toes of slopes or other obstructions.

- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately downslope from the fence.
- Do not place in live steams or intermittently flowing channels.

Design:

Limit the upstream drainage area to 1 acre or less when used alone or in combination-with-sediment basin in a larger site..

Limit the maximum slope perpendicular to the fence line, should be 1:1.

Limit the maximum sheet or overland flow path length to any point along the fence to 100 feet.

Limit the concentrated flows reaching the fence to 0.5

Selection of a filter fabric is based on soil conditions at the construction site (which affect the equivalent opening size (EOS) fabric specification) and characteristics of the support fence (which affect the choice of tensile strength). The designer shall specify a filter fabric that retains the soils found on the construction site yet will have openings large enough to permit drainage and prevent clogging. The following criteria is recommended for selection for the equivalent opening size:

a. If 50 percent or less of the soil, by weight, will pass the U.S. Standard Sieve No. 200, select the EOS to retain 85 percent of the soil. The EOS should not be finer than EOS 70.

b. For all other soil types, the EOS should be no larger than the openings in the U.S. Standard Sieve No. 70 (0.0083 in. [0.21 mm.]) except where direct discharge to a stream, lake or wetland will occur, then the EOS shall be no larger than Standard Sieve No. 100.

To reduce the chance of clogging, it is preferable to specify a fabric with openings as large as allowed by the criteria. No fabric should be specified with an EOS smaller than U. S. Standard Sieve No. 100 (0.0059 in. (0. 15 mm)). If 85 percent or more of a soil, by weight, passes through the openings in a No. 200 sieve (0.0029 in. (0.074 mm)), filter fabric shall not be used. Most of the particles in such a soil would not be retained if the EOS was too large, and they would clog the fabric quickly if the EOS was small enough to capture the soil.

The fence should be supported by a wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F to 120°F.

Installation Guidelines:

Filter fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

a. Posts should be spaced a maximum of 6 feet apart and driven securely into the ground a minimum of 30 inches.

b. A trench should be excavated approximately 8 inches wide and 12 inches deep along the line of posts and upslope from the barrier.

c. When standard strength filter fabric is used, a wire mesh support fence should be fastened securely to the upslope side of the posts using heavy-duty wire staples at least 1 inch long, tie wires or hog rings. The wire should extend into the trench a minimum of 4 inches.

d. The standard strength filter fabric should be stapled or wired to the fence, and 20 inches of the fabric should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated and filter fabric stapled or wired directly to the posts.

e. The filter fabric should be purchased in a continuous, cut to the length of the barrier to avoid use of joints. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 6 inch overlap, and both ends securely fastened to the post.

f. The trench should be backfield with 3/4-inch minimum diameter washed gravel or compacted native material.

Requirements

Maintenance

- Inspect monthly during dry periods and immediately after each rainfall. Repair as necessary. Sediment must be removed when it reaches approximately one third the height of the fence, especially if heavy rains are expected.
- Filter fences should not be removed until the upslope area has been permanently stabilized.

Limitations

- Filter fences will create a temporary sedimentation pond on the upstream side of the fence which may cause temporary flooding. Fences not constructed on a level contour will be overtopped by concentrated flow resulting in failure of the filter fence.
- Filter fences are not practical where large flows of water are involved, hence the need to restrict their use to drainage areas of one acre or less, and flow rates of less than 0.5 cfs.
- Problems may arise from incorrect selection of pore size and/or improper installation.
- Do not allow water depth to exceed 1.5 feet at any point.
- Improperly installed fences are subject to failure from undercutting, overlapping, or collapsing.

BMP: Straw Bale Barriers

General Definition

A straw bale barrier consists of a series of secured anchored bales placed to intercept sediment-laden runoff from small drainage areas of disturbed soil. The barrier ponds runoff and allow sediment to settle. Straw bale dikes should not be used for extended periods of time because they tend to rot and fall apart.

The straw bale dike is used where there are no concentrations of water in a channel or drainage way, and where erosion would occur from sheet flow. These barriers are typically constructed, below disturbed areas subject to sheet flow of runoff to intercept and detain sediment.

Suitable Applications

- Along the perimeter of the site
- Along streams and channels
- Across swales, with small catchments
- Around temporary spoil areas
- Below other small, cleared areas

Installation/Application Criteria

Straw bale barriers should be used for drainage areas no more than 1/4 acre per 100 feet of barrier length in any size, with no more than 100 ft upstream of any port along the barrier. The barrier should be placed along a level contour no greater than 2:1. When installed and maintained according to the guidelines on this fact sheet, straw bale dikes remove approximately 67% of the sediment transported in construction site runoff. This optimum efficiency can only be achieved through careful maintenance with special attention to replacing rotted or broken bales. Barrier should be constructed on a level contour to prevent concentration of flow against a small portion of the barrier.

An effective straw bale barrier should be installed in the following manner:

1. Bales should be placed on the contour and in a row with ends tightly abutting the adjacent bales.
2. Leave area for runoff to pond upstream of the barrier by locating barrier away from the toe of the slopes. This also provides access for maintenance.
3. Each bale should be embedded in the soil a minimum of (4) inches and placed so the bindings are horizontal. Bindings placed on soil will soon disintegrate and cause the barrier to fail.

4. Bales should be securely anchored in place be either two stakes or re-bars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale at an angle to force the bale together. Stakes should be driven flush with the bale.
5. Remove when it has served its usefulness so as not to block or impede storm flow or drainage.

Requirements

Costs

- Straw bale typically cost about $4 per lineal foot

Maintenance

- Inspect weekly and after each rain
- Replace bales which have decomposed or whose bindings have broken
- Remove sediment -behind the barrier when it-reaches-a depth of 6 inches

Limitations

- Straw bale dikes are not to be used for extended periods of time because they tend to rot and fall apart.
- Suitable only for sheet flow on slopes of 2% or flatter.
- Not appropriate for large drainage areas, limit to one acre or less.
- Straw bales lose their effectiveness rapidly due to rotting, thus constant maintenance is required.
- Not recommended for concentrated flow, channel flow, and live streams.
- Bale bindings of jute or cotton not recommended.
- Straw bale barriers have not been as effective as expected due to improper use. These barriers have been placed in streams and drainage ways where runoff volumes and velocities have caused the barriers to wash out. In addition, failure to stake and entrench the straw bale has allowed undercutting and end flow.

BMP: Sand Bag Barrier

General Definition

Stacking sandbags along a level contour creates a barrier which detains sediment-laden water, ponding water upstream of the barrier and promoting sedimentation.

Suitable Applications

Sandbag berms may be used during construction activities in stream beds and utility construction in channels, temporary channel crossing for construction equipment, etc. Sandbag berms may also be installed parallel to roadway construction. Sandbag berms may also be used to create temporary sediment traps, retention basins and in place of straw bales or silt fences. Examples of applications include:

- Check dams across stream channels
- Barrier for utility trenches or other construction in a stream channel
- Temporary channel crossing
- Barrier on a slope in place of straw bales or silt fences
- Direct or divert flow
- Create temporary sediment basin or retention basin
- Near the toe of slopes
- At construction perimeter

Advantages

- Provides a semi-permeable barrier in potentially wet areas
- More permanent than silt fences or straw bales
- Allows for easy relocation on site to meet changing needs during construction

Installation/Application

Sandbag berms are appropriate to use when construction of check dams or sumps in a stream is undesirable. The sandbag berms can provide the same function as a check dam without disturbing the stream or vegetation. The sandbag berm will also allow a small sediment retention area to be created prior to construction of final detention basins. For installation of a sandbag berm, the following criteria should be observed:

- Drainage Area - Up to -five (5) acres
- Height of Berm - 18 inches minimum height, measured from the top of the existing ground at the upslope toe to the toe of the barrier
- Width of Berm - 48 inches minimum width measured at the bottom of the barrier; 18 inches at the top

- Sandbag Size – length: 24 to 30 inches, width: 16 to 18 inches, and thickness: 6 to 8 inches. Weight: 90 to 125 pounds.
- Sandbag Material - Polypropylene, polyethylene or polyamide woven fabric, minimum unit weight four (4) ounces per square yard, mullen burst strength exceeding 300 psi and ultraviolet stability exceeding 70 percent. Use of burlap is discouraged since it rots and deteriorates easily.
- Grade of Sand - Coarse sand, gravel.
- Runoff water shall flow over the tops of the sandbags or through four (4) inch polyvinyl chloride.

Requirements

Maintenance

- Inspect after each rain
- Reshape or replace damaged sandbags immediately
- Remove sediment when it reaches six inches in depth

Limitations

- Sandbags are more expensive than other barriers, but also more durable
- Burlap should not be used for sandbags

BMP: Stabilized Construction Entrance

General Description

The construction entrance practice is a stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area.

Suitable Applications

- All points of construction ingress and egress
- Unpaved areas where sediment tracking occurs from site onto paved roads

Installation/Application Criteria

- Construct on level ground where possible
- Stones should be 2-3 inches
- Minimum depth of stones should be 8 inches or as recommended by soils engineer
- Length should be 50-foot minimum, and width should be 15-foot minimum
- Provide ample turning radii as part of entrance

Requirements

Cost

- Ranges from $750 to $1200 depending upon region and availability of material

Maintenance

- Inspect monthly and after each rainfall
- Replace gravel material when surface voids are visible
- Remove all sediment deposited on paved roadways within 24 hours
- Remove gravel and filter fabric at completion of construction

Limitations

The stabilized construction entrance plan should be reviewed as part of the project traffic control plan.

- Construct on level ground.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

- Requires periodic top dressing with additional stones
- Should be used in conjunction with Wash Rack BMP, if appropriate
- Should be used in conjunction with street sweeping on adjacent public right-of-way

Additional Information - Stabilized Construction Entrance

A stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets. Reducing trackout of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving, a stabilized construction entrance should be used at all points of construction ingress and egress. NPDES permits require that appropriate measures be implemented to prevent track out of sediments onto paved roadways, which is a significant source of sediments derived from mud and dirt carryout from the unpaved roads and construction sites.

Stabilized construction entrances are not very effective in removing sediment from equipment leaving a construction site. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations.

Design & sizing considerations include the aggregate for stabilized construction entrance aprons shell be 2 to 3 inches in sized, washed, well-grades gravel or crushed rock. The minimum apron dimensions will be 15 feet by 50 feet and 8 inches deep for one-way ingress/egress traffic.

Entrance must be properly graded to prevent runoff from leaving the construction site. When wash areas are provided, washing shall be done on an area stabilized with crushed stone which drains into a properly constructed sediment trap or basin (pond). Sediment barriers shall be provided to prevent sediments from entering into the stormwater sewer system, ditch, or waterway.

BMP: Dust Controls

General Description

Dust control measures are used to stabilize soil from wind erosion, and reduce dust generated by construction activities. Dust which settles on surfaces both on-site and off-site may be washed by storm water into waterways.

California's Mediterranean climate, with short wet seasons and long, hot, dry seasons, allows the soils to thoroughly dry out. During these dry seasons, construction activities are at their peak, and disturbance and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment.

Dust control, as a BMP, is a practice that is already in place for many construction activities. Los Angeles, the North Coast and Sacramento, among others have enacted dust control ordinances for construction activities that cause dust to be transported beyond the construction property line. Recently, the State Air Resources Control Board has, under the authority of the Clean Air Act, started to address air quality in relation to inhalable particulate matter less than 10 microns (PM-10). Ninety percent of the SC particles are considered to be dust. Existing dust control regulations by local agencies, municipal departments, public works department, and/or public health departments are in place in some regions within California. For jurisdictions that have no formal dust control regulations and/or standards, Section 10, 17 and 18 of Caltrans' Standard Specifications provide detailed provisions for dust control practices.

Many local agencies require dust control in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. The following are measures that local agencies may have already implemented as requirements for dust control form contractors:

- Construction & Grading Permits: Require provisions for dust control plans;
- Opacity Emission Limits: Enforce compliance with California air pollution control laws;
- Increase overall enforcement activities: Priority given to cases involving citizen complaints;
- Maintain Field Application Records: Require records of dust control measures from contractor;
- Stormwater Pollution Prevention Plan: (SWPPP): Integrate dust control measures into SWPPP.

Dust Control Practices

Dust control BMP's generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel or asphalt surfacing, temporary gravel

construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control, applications. Permanent or temporary vegetation and mulching, and sand fences can be employed for areas of occasional or no construction traffic. Preventive measures would include minimizing surface areas to be disturbed.

Many of the reasonably available control measures for controlling dust from construction sites can also be implemented as BMPs for storm water pollution prevention. Those BMPs include:

- Pave, vegetate, or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads,
- Provide covers for haul trucks transporting materials that contribute to dust,
- Provide for wet suppression or chemical stabilization of exposed soils,
- Provide for rapid clean-up of sediments deposited on paved roads,
- Furnish stabilized construction road entrances and vehicle wash down areas,
- Stabilize unpaved haul roads, parking and staging areas,
- Reduce speed and trips on unpaved roads,
- Implement dust control measures for material stockpiles,
- Prevent drainage of sediment laden storm water onto paved surfaces,
- Stabilize abandoned construction sites using vegetation or chemical stabilization methods, and
- Limit the amount of areas disturbed by clearing and earth moving operations by scheduling these activities in phases.

For the chemical stabilization, there are many products available as dust palliatives for chemically stabilizing gravel roadways and stockpiles.

Suitable Applications

- Clearing and grading activities
- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Sediment tracking onto paved roads
- Soil and debris storage piles
- Batch drop from front end loaders
- Areas with unstabilized soil

Installation/Application Criteria

- Schedule construction activities to minimize the area where, and time period when soils are exposed
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling , and stone/gravel layering
- Identify and stabilize key access points prior to commencement of construction
- Minimizing the impact of dust by anticipating the direction of prevailing winds
- Direct most construction traffic to stabilized roadways within the project site

Requirements

Cost

- Reference Caltrans Cost Schedule for regional cost ranges.

Maintenance

- Most dust control measures require frequent, often daily, attention.

Limitations

- Oil treated subgrades should not be used because the oil may migrate into drainageways and/or seep into the soil.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration, and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- Asphalt, as a mulch tack or chemical mulch, requires a 24 hour curing time to avoid adherence to equipment, worker shoes, etc. Application should be limited because asphalt surfacing may eventually migrate into the drainage system.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.

BMP: Oil / Water Separators

General Description

Oil/water separators are baffled chambers designed to remove petroleum compounds and greases from storm water. Oil/water separators also remove floatable debris and settled solids (sediment). These separators will mainly be used in the following activities:

- Aircraft/Vehicle/Equipment Fueling
- Aircraft/Vehicle/Equipment Washing
- Fuel/Chemical Storage
- Installing, Cleaning, and Maintaining Oil/Water Separators

Approach

Design of New Facilities and Existing Facility Upgrades:

Oil/water separators are typically used in areas where the concentrations of petroleum hydrocarbons, floatables, or sediment may be abnormally high and source control techniques are not very effective. There are two types of oil/water separators: the American Petroleum Institute (API) separator and the coalescing plate separator (CPS). Design, sizing, and placement of oil/water separators is dependent on several factors including: tributary area, type of activity, pollutant type and concentration, and water temperature. General sizing guidelines for API separators include the following:

- Horizontal velocity: 3 feet per minute.
- Depth of 3 to 8 feet.
- Depth-to-width ratio of 0.3 to 0.5.
- Width of 6 to 16 feet.
- Baffle height-to-depth ratios of 0.85 for top baffles and 0.15 for bottom baffles.

CPS separator sizing is more complex. Sizing calculations require the inclusion of information such as packing plate surface areas and plate angles. CPS separators can, due to their packed plate design, remove the same quantities of oils and greases while occupying less space than API separators.

Contingency Response

- Maintain adequate supplies of spill response equipment and materials in accessible locations near areas where spills may be likely to occur.

Inspection and Training

- Provide the appropriate level of employee training in the following areas: spill response and prevention, storm water pollution prevention education (see SC-10 for storm water pollution education approaches), right-to-know awareness training, and hazardous materials management.

- Perform and document in a log book all inspections and maintenance operations.
- Develop a written operating, sampling, and reporting procedure under local storm water authority guidelines. Train appropriate employees to implement these procedures.

Requirements

Costs (Capital, O&M)

- Capital and O&M Costs increase as the tributary area increases.

Maintenance

- Separators must be inspected and cleaned frequently of accumulated oil, grease, floating debris and sediments to be effective storm water quality controls.
- Oil absorbent pads are to be replaced as needed but will always be replaced prior to the wet season.
- The effluent shutoff valve will be closed during cleaning operations.
- Any standing water removed during the cleaning operation must be disposed of in accordance with federal, state, and local requirements.
- Any standing water removed during the cleaning operation must be replaced with clean water to prevent oil carry-over through the outlet.

Limitations

- Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades.
- Sending vehicles/equipment off-site should be done in conjunction with PS7 (Stabilized Construction Entrance).

Fitzgerald, Maggie/SCO

From: Guillermo Jaimes [gjaimes@rb4.swrcb.ca.gov]
Sent: January 10, 2003 4:46 PM
To: Lagloire2@aol.com; knguyen@asianhc.org; Deane, Kellie/SCO; Fitzgerald, Maggie/SCO; Llew@chw.edu; vek@chw.edu; almenge@ci.long-beach.ca.us; Stnakau@ci.long-beach.ca.us; delmar@concentric.net; cperkins@cscla.org; Aujihara@dhs.ca.gov; DLee1@dhs.ca.gov; gmargill@dhs.ca.gov; HCornejo@dhs.ca.gov; Mhernan1@dhs.ca.gov; Mhori@dhs.ca.gov; mmack@dhs.ca.gov; JScully@dhs.co.la.ca.us; Lane.Jackie@epa.gov; Schauffler.frederick@epa.gov; Lin.Sharon@epamail.epa.gov; Adrian Perez; lolas@guamcomnet.org; Bolson@hca.co.orange.ca.us; mfennessy@hca.co.orange.ca.us; jalamillo@healthebay.org; Mgold@healthebay.org; Cindyfig@hotmail.com; Peoples_core@hotmail.com; Inbo@Krcla.org; Mahec@msn.com; rle_mahec@msn.com; Debra@nakatomipr.com; Joni@nakatomipr.com; john.cubit@noaa.gov; Kolleen.bannon@noaa.gov; Pam.Castens@noaa.gov; RBRODBER@oehha.ca.gov; Pvelez@ospr.dfg.ca.gov; emastro@RAP.LACITY.ORG; Lchilton@RAP.LACITY.ORG; Guillermo Jaimes; Guangyu Wang; Stefanie Hada; FASGI@sbcglobal.net; jima@sccwrp.org
Subject: FCE Task Force Meeting 1-21-03



FCEMeetingAgenda 1-21-03.doc

** High Priority **

Hi everyone,

This is to inform you that the next Fish Contamination Education Task Force meeting will be held on January 21, 2003 from 1 pm to 4 pm at the NOAA Damage Assessment Center in downtown Long Beach. Attached you will find the agenda along with directions. The meeting facility is small but it is able to accommodate phone conferencing, so if anyone is unable to attend in person, you can participate by calling in. The information for doing so is provided at the bottom of the attached agenda.

If you have any questions or problems opening the attachments, please contact me via phone or email.

Thank you,

Guillermo Jaimes
Health Education Program Assistant
CA Department of Health Services
320 W. 4th St., Suite 560
Los Angeles, CA 90013
Phone: (213) 576-6634
Fax: (213) 620-2586
email: gjaimes@rb4.swrcb.ca.gov

Agenda for the
Southern California
Fish Contamination Outreach and Education Committee
Task Force Meeting

January 21, 2003
1 p.m. – 4 p.m.

NOAA MSRP conference room
501 W. Ocean Blvd. #4470
Long Beach, CA 90802

Meeting topics

1. Introduction of new CBOs (Gina)
2. Discussion of Project (Gina)
3. EPA Palos Verdes Shelf Public Outreach and Education Contract Status (EPA)
2. EPA/NOAA MSRP fish in ocean laboratory analysis status (EPA/MSRP)
3. EPA RI/FS related activities (EPA)
4. Message status (Gina)
5. Logo (Kellie)

Phone conferencing

If you would like to participate in this meeting via phone, please call

Toll free (877) 804-2050

The pass code is 250838

Updated 01/10/03

BMP: OIL / WATER SEPERATORS

DESCRIPTION

Oil/water separators are baffled chambers designed to remove petroleum compounds and greases from storm water. Oil/water separators also remove floatable debris and settled solids (sediment). These separators will mainly be used in the following activities:

- Aircraft/Vehicle/ Equipment Fueling
- Aircraft/Vehicle/ Equipment Washing
- Fuel/Chemical Storage
- Installing, Cleaning, and Maintaining Oil/Water Separators

APPROACH

The key approaches are to frequently inspect and clean separators and to replace absorbent pads as needed

Design of New Facilities and Existing Facility Upgrades:
Oil/water separators are typically used in areas where the concentrations of petroleum hydrocarbons, floatables, or sediment may be abnormally high and source control techniques are not very effective. There are two types of oil/water separators: the American Petroleum Institute (API) separator and the coalescing plate separator (CPS). Design, sizing, and placement of oil/water separators is dependent on several factors including: tributary area, type of activity, pollutant type and concentration, and water temperature. General sizing guidelines for API separators include the following:

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- Width of 6 to 16 feet.
- Baffle height-to-depth ratios of 0.85 for top baffles and 0.15 for bottom baffles.

CPS separator sizing is more complex. Sizing calculations require the inclusion of information such as packing plate surface areas and plate angles. CPS separators can, due to their packed plate design, remove the same quantities of oils and greases while occupying less space than API separators.

Existing Facility Activities:

Operational Considerations:

- Separators must be inspected and cleaned frequently of accumulated oil, grease, floating debris and sediments to be effective storm water quality controls.
- Oil absorbent pads are to be replaced as needed but will always be replaced prior to the wet season.
- The effluent shutoff valve will be closed during cleaning operations.
- Any standing water removed during the cleaning operation must be disposed of in accordance with federal, state, and local requirements.
- Any standing water removed during the cleaning operation must be replaced with clean water to prevent oil carry-over through the outlet.

Contingency Response

- Maintain adequate supplies of spill response equipment and materials in accessible locations near areas where spills may be likely to occur.

Inspection and Training

- Provide the appropriate level of employee training in the following areas: spill response and prevention, storm water pollution prevention education (see SC-10 for storm water pollution education approaches), right-to-know awareness training, and hazardous materials management.
- Perform and document in a log book all inspections and maintenance operations.
- Develop a written operating, sampling, and reporting procedure under local storm water authority guidelines. Train appropriate employees to implement these procedures.

REQUIREMENTS

Capital and O&M Costs increase as the tributary area increases.

LIMITATIONS

Oil/water separator installations should be designed and installed by experienced individuals. Little data on the characteristics of petroleum hydrocarbons in storm water leads to considerable uncertainty about separator performance.

APPENDIX E

General Construction Activity Storm Water Permit

Winston H. Hickox
Secretary for Environmental Protection

State Water Resources Control Board

Division of Water Quality
901 P Street • Sacramento, California 95814 • (916) 657-0757
Mailing Address: P.O. Box 1977 • Sacramento, California • 95812-1977
FAX (916) 657-1011 • Internet Address: http://www.swrcb.ca.gov

Gray Davis
Governor

To: STORM WATER DISCHARGER

SUBJECT: CHECKLIST FOR SUBMITTING A NOTICE OF INTENT

In order for the State Water Resources Control Board to expeditiously process your Notice of Intent (NOI), the following items must be submitted:

1._____ NOI with all applicable sections filled out and signed by the owner/operator;

2._____ Check made out to the "State Water Resources Control Board" with the appropriate fee; and

- County Fees: $250.00 or $500.00
- Dairy Farms: $2000.00

3._____ Site map displaying the layout of premises (see NOI instructions) (Vicinity Map)
DO NOT SEND BLUEPRINTS

Please return the above items to the address below. If you have any questions regarding this matter, please contact us at (916) 657-0757.

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

FACT SHEET
FOR
WATER QUALITY ORDER 99-08-DWQ

STATE WATER RESOURCES CONTROL BOARD (SWRCB)
901 P STREET, SACRAMENTO, CALIFORNIA 95814

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT FOR
STORM WATER DISCHARGES ASSOCIATED WITH
CONSTRUCTION ACTIVITY (GENERAL PERMIT)

BACKGROUND

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with an NPDES permit. The 1987 amendments to the CWA added Section 402(p) which establishes a framework for regulating municipal and industrial storm water discharges under the NPDES Program. On November 16, 1990, the U.S. Environmental Protection Agency (USEPA) published final regulations that establish storm water permit application requirements for specified categories of industries. The regulations provide that discharges of storm water to waters of the United States from construction projects that encompass five (5) or more acres of soil disturbance are effectively prohibited unless the discharge is in compliance with an NPDES Permit.

While federal regulations allow two permitting options for storm water discharges (individual permits and General Permits), the SWRCB has elected to adopt only one statewide General Permit at this time that will apply to all storm water discharges associated with construction activity, except from those on Tribal Lands, in the Lake Tahoe Hydrologic Unit, and those performed by the California Department of Transportation (Caltrans). Construction on Tribal Lands is regulated by an USEPA permit, the Lahontan Regional Water Control Board adopted a separate NPDES permit for the Lake Tahoe Hydrologic Unit, and the SWRCB adopted a separate NPDES permit for Caltrans projects. This General Permit requires all dischargers where construction activity disturbs five acres or more to:

1. Develop and implement a Storm Water Pollution Prevention Plan (SWPPP) which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters.

2. Eliminate or reduce nonstorm water discharges to storm sewer systems and other waters of the nation.

3. Perform inspections of all BMPs.

This General Permit shall be implemented and enforced by the nine California Regional Water Quality Control Boards (RWQCBs).

The General Permit accompanying this fact sheet regulates storm water runoff from construction sites. Regulating many storm water discharges under one permit will greatly reduce the otherwise overwhelming administrative burden associated with permitting individual storm water discharges. Dischargers shall submit a Notice of Intent (NOI) to obtain coverage under this General Permit. It is expected that as the storm water program develops, the RWQCBs may issue General Permits or individual permits containing more specific permit provisions. When this occurs, those dischargers will no longer be regulated by this General Permit.

TYPES OF CONSTRUCTION ACTIVITY COVERED BY THIS GENERAL PERMIT

Construction activity subject to this General Permit includes clearing, grading, disturbances to the ground such as stockpiling, or excavation that results in soil disturbances of at least five acres of total land area. Construction activity that results in soil disturbances of less than five acres is subject to this General Permit if the construction activity is part of a larger common plan of development that encompasses five or more acres of soil disturbance or if there is significant water quality impairment resulting from the activity. Construction activity does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility, nor does it include emergency construction activities required to protect public health and safety. Dischargers should confirm with the local RWQCB whether or not a particular routine maintenance activity is subject to this General Permit.

A construction project which includes a dredge and/or fill discharge to any jurisdictional surface water (e.g., wetland, channel, pond, or marine water) will also need a CWA Section 404 permit from the U.S. Army Corps of Engineers and a CWA Section 401 Water Quality Certification from the RWQCB/SWRCB. Storm water discharges from dredge spoil placement which occurs outside of Corps jurisdiction (upland sites) and are part of construction activity which disturbs five or more acres of land are covered by this general permit. Proponents of construction projects which disturb five or more acres of land within the jurisdictional boundaries of a CWA Section 404 permit should contact the local RWQCB to determine the applicability of this permit to the project.

NOTIFICATION REQUIREMENTS

It is the responsibility of the landowner to obtain coverage under this General Permit prior to commencement of construction activities. To obtain coverage, the landowner must file an NOI with a vicinity map and the appropriate fee with the SWRCB. In addition, coverage under this permit shall not occur until the applicant develops an adequate SWPPP for the project. Section A of the General Permit outlines the required contents of a SWPPP. For proposed construction activity on easements or on nearby property by agreement or permission, the entity responsible for the construction activity shall file an NOI and filing fee and shall be responsible for development of the SWPPP, all of which must occur prior to commencement of construction activities.

A separate NOI shall be submitted to the SWRCB for each construction site. Owners of new construction shall file an NOI prior to the commencement of construction. Owners of an ongoing construction site that is covered under the previous General Construction Permit (WQ Order No.92-08-DWQ) (1) shall continue to implement their existing SWPPP and monitoring program and (2) shall implement any necessary revisions to their SWPPP in a timely manner but in no case later than 90-calender days from adoption of this General Permit in accordance with Section A of this General Permit.

The NOI requirements of the General Permit are intended to establish a mechanism which can be used to clearly identify the responsible parties, locations, and scope of operations of dischargers covered by the General Permit and to document the discharger's knowledge of the requirements for a SWPPP.

The NOI must be sent to the following address:

State Water Resources Control Board
Division of Water Quality
Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

The current annual fee for this General Permit is either $500 or $250 depending on the location of the project.

When construction is complete or ownership has been transferred, dischargers shall file a Notice of Termination with the RWQCB certifying that all State and local requirements have been met in accordance with Special Provisions for Construction Activity, C.7, of the General Permit.

Dischargers who fail to obtain coverage under this General Permit for storm water discharges to surface waters will be in violation of the CWA and the California Water Code.

CONSTRUCTION ACTIVITY NOT COVERED BY THIS GENERAL PERMIT

This General Permit does not apply to storm water discharges from (1) those areas on Tribal Lands; (2) the Lake Tahoe Hydrologic Unit; (3) construction by municipal entities with a population under 100,000[1]; (4) construction under five acres, unless part of a larger common plan of development or sale; (5) projects covered by an individual NPDES Permit for storm water discharges associated with construction activity; and (6) landfill construction that is subject to the general industrial permit.

Storm water discharges in the Lake Tahoe Hydrologic Unit are regulated by a separate permit(s) adopted by the California Regional Water Quality Control Board, Lahontan Region (LRWQCB).

[1] These construction activities are addressed by USEPA under the Phase II regulations. Construction activities conducted by municipalities with a population less than 100,000 may be required to apply for a permit under the Phase II regulations by August 7, 2001. (CFR Section 122.26(g)(l)(ii)).(40 CFR Part 122.26(g)(l)(ii))

USEPA regulates storm water discharges on Tribal Lands. Permit applications for storm water discharges that will be conducted in the Lake Tahoe Hydrologic Unit must be submitted directly to the LRWQCB.

DESCRIPTION OF GENERAL PERMIT CONDITIONS

The following is a brief description of the major provisions of the General Permit and the basis for the General Permit.

Prohibitions

This General Permit authorizes the discharge of storm water to surface waters from construction activities that result in the disturbance of five or more acres of land. It prohibits the discharge of materials other than storm water and authorized storm water discharges and all discharges which contain a hazardous substance in excess of reportable quantities established at 40 Code of Federal Regulations (CFR) 117.3 or 40 CFR 302.4 unless a separate NPDES Permit has been issued to regulate those discharges. In addition, this General Permit contains provisions that uphold discharge prohibitions contained in water quality control plans, as implemented through the nine RWQCBs.

Effluent Limitations

Permits for storm water discharges associated with construction activity shall meet all applicable provisions of Sections 301 and 402 of the CWA. These provisions require controls of pollutant discharges that utilize best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT) to reduce pollutants and any more stringent controls necessary to meet water quality standards.

It is not feasible at this time for the SWRCB to establish numeric effluent limitations. The reasons why it is not feasible to establish numeric effluent limitations are discussed in detail in SWRCB Order Nos. WQ 91-03 and WQ 91-04. Therefore, the effluent limitations contained in this General Permit are narrative and include the requirement to implement appropriate BMPs. The BMPs shall primarily emphasize source controls such as erosion control and pollution prevention methods. The discharger shall also install structural controls, as necessary, such as sediment control which will constitute BAT and BCT and will achieve compliance with water quality standards. The narrative effluent limitations constitute compliance with the requirements of the CWA.

Elimination or reduction of nonstorm water discharges is a major goal of this General Permit. Nonstorm water discharges include a wide variety of sources, including improper dumping, spills, or leakage from storage tanks or transfer areas. Nonstorm water discharges may contribute a significant pollutant load to receiving waters. Measures to control spills, leakage, and dumping and to prevent illicit connections during construction shall be addressed through structural as well as non-structural BMPs.

This General Permit prohibits the discharge of materials other than storm water and authorized nonstorm water discharges. It is recognized that certain nonstorm water discharges may be necessary for the completion of construction projects. Such discharges include, but are not limited to irrigation of vegetative erosion control measures, pipe flushing and testing, street cleaning, and dewatering. Such discharges are allowed by this General Permit provided they are not relied upon to clean up failed or inadequate construction or post-construction BMPs designed to keep materials onsite. These authorized nonstorm water discharges shall (1) be infeasible to eliminate, (2) comply with BMPs as described in the SWPPP, and (3) not cause or contribute to a violation of water quality standards. Additionally, these discharges may be required to be permitted by the local RWQCB (e.g., some RWQCBs have adopted General Permits for dewatering discharges). This General Permit is performance-based to the extent that it prohibits the discharge of storm water that causes or threatens to cause pollution, contamination, or nuisance; but it also allows the owner/developer to determine the most economical, effective, and possibly innovative BMPs.

The requirements of this General Permit are intended to be implemented on a year-round basis, not just during the part of the year when there is a high probability of a precipitation event which results in storm water runoff. The permit should be implemented at the appropriate level and in a proactive manner during all seasons while construction is ongoing.

Weather and storm predictions or weather information concerning the 10-year, 6-hour storm event and mean annual rainfall can be obtained by calling the Western Regional Climate Center at 702- 677-3106 or via the internet at www.wrcc.dri.edu/precip.html and/or www.wrcc.dri.edu/pcpnfreq.html. Other rainfall information is available at www.cdec.water.ca.gov.

Receiving Water Limitations Language

The receiving water limitations language is fundamentally different from the language adopted in the SWRCB General Industrial Activities Storm Water Permit on April 17, 1997. Construction related activities which cause or contribute to an exceedance of water quality standards must be corrected immediately and cannot wait for the RWQCB to approve a plan of action to correct. The dynamic nature of construction activity allows the discharger the ability to more quickly identify and correct the source of the exceedances. Therefore, the owner is required to take immediate corrective action and to provide a report to the appropriate RWQCB within 14-calendar days of the violation describing the corrective action.

Storm Water Pollution Prevention Plan (SWPPP)

This General Permit requires development and implementation of a SWPPP. This document emphasizes the use of appropriately selected, correctly installed and maintained pollution reduction BMPs. This approach provides the flexibility necessary to establish BMPs which can effectively address source control of pollutants during changing construction activities.

All dischargers shall prepare and implement a SWPPP prior to disturbing a site. The SWPPP must be implemented at the appropriate level to protect water quality at all times throughout the life of the project. Nonstorm water BMPs must be implemented year round. The SWPPP shall remain on the site while the site is under construction, commencing with the initial mobilization and ending with the termination of coverage under the permit.

The SWPPP has two major objectives: (1) to help identify the sources of sediment and other pollutants that affect the quality of storm water discharges and (2) to describe and ensure the implementation of BMPs to reduce or eliminate sediment and other pollutants in storm water as well as nonstorm water discharges. The SWPPP shall include BMPs which address source control and, if necessary, shall also include BMPs which address pollutant control.

Required elements of a SWPPP include: (1) site description addressing the elements and characteristics specific to the site, (2) descriptions of BMPs for erosion and sediment controls, (3) BMPs for construction waste handling and disposal, (4) implementation of approved local plans, (5) proposed post-construction controls, including description of local post-construction erosion and sediment control requirements, and (6) nonstorm water management.

To ensure that the preparation, implementation, and oversight of the SWPPP is sufficient for effective pollution prevention, individuals responsible for creating, revising, overseeing, and implementing the SWPPP should participate in applicable training programs and document such training in the SWPPP.

SWPPPs are reports that are available to the public under Section 308(b) of the CWA and will be made available by the RWQCB upon request.

Monitoring Program

Another major feature of the General Permit is the development and implementation of a monitoring program. All dischargers are required to conduct inspections of the construction site prior to anticipated storm events and after actual storm events. During extended storm events, inspections must be made during each 24-hour period. The goals of these inspections are (1) to identify areas contributing to a storm water discharge; (2) to evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate and properly installed and functioning in accordance with the terms of the General Permit; and (3) whether additional control practices or corrective maintenance activities are needed. Equipment, materials, and workers must be available for rapid response to failures and emergencies. All corrective maintenance to BMPs shall be performed as soon as possible, depending upon worker safety.

Each discharger shall certify annually that the construction activities are in compliance with the requirements of this General Permit. Dischargers who cannot certify annual compliance shall notify the appropriate RWQCB. A well-developed monitoring program will provide a good method for checking the effectiveness of the SWPPP.

Retention of Records

The discharger is required to retain records of all monitoring information, copies of all reports required by this General Permit, and records of all data used to complete the NOI for all construction activities to be covered by the General Permit for a period of at least three years from the date generated. This period may be extended by request of the SWRCB and/or RWQCB. With the exception of reporting noncompliance to the appropriate RWQCB, dischargers are not required to submit the records, except upon specific request by the RWQCB.

STATE WATER RESOURCES CONTROL BOARD (SWRCB)
ORDER NO. 99 - 08 - DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT NO. CAS000002

WASTE DISCHARGE REQUIREMENTS (WDRS) FOR DISCHARGES OF STORM WATER RUNOFF ASSOCIATED WITH CONSTRUCTION ACTIVITY

The State Water Resources Control Board finds that:

1. Federal regulations for controlling pollutants in storm water runoff discharges were promulgated by the U.S. Environmental Protection Agency (USEPA) on November 16, 1990 (40 Code of Federal Regulations (CFR) Parts 122, 123, and 124). The regulations require discharges of storm water to surface waters associated with construction activity including clearing, grading, and excavation activities (except operations that result in disturbance of less than five acres of total land area and which are not part of a larger common plan of development or sale)[1] to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or eliminate storm water pollution.

2. This General Permit regulates pollutants in discharges of storm water associated with construction activity (storm water discharges) to surface waters, except from those areas on Tribal Lands; Lake Tahoe Hydrologic Unit; construction projects which disturb less than five acres, unless part of a larger common plan of development or sale; and storm water discharges which are determined ineligible for coverage under this General Permit by the California Regional Water Quality Control Boards (RWQCBs). Attachment 1 contains addresses and telephone numbers of each RWQCB office.

3. This General Permit does not preempt or supersede the authority of local storm water management agencies to prohibit, restrict, or control storm water discharges to separate storm sewer systems or other watercourses within their jurisdiction, as allowed by State and Federal law.

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[1] *Construction activities under five acres are not covered by this permit. Construction activities with less than five acres of disturbance are required to apply for a permit under Phase II regulations by August 7, 2001. (CFR Section 122.26(g)(l)(ii).)*

4. To obtain authorization for proposed storm water discharges to surface waters, pursuant to this General Permit, the landowner (discharger) must submit a Notice of Intent (NOI) with a vicinity map and the appropriate fee to the SWRCB prior to commencement of construction activities. In addition, coverage under this General Permit shall not occur until the applicant develops a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the requirements of Section A of this permit for the project. For proposed construction activity conducted on easements or on nearby property by agreement or permission, or by an owner or lessee of a mineral estate (oil, gas, geothermal, aggregate, precious metals, and/or industrial minerals) entitled to conduct the activities, the entity responsible for the construction activity must submit the NOI and filing fee and shall be responsible for development of the SWPPP.

5. If an individual NPDES Permit is issued to a discharger otherwise subject to this General Permit or if an alternative General Permit is subsequently adopted which covers storm water discharges regulated by this General Permit, the applicability of this General Permit to such discharges is automatically terminated on the effective date of the individual permit or the date of approval for coverage under the subsequent General Permit.

6. This action to adopt an NPDES permit is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21100, et seq.) in accordance with section 13389 of the California Water Code.

7. The SWRCB adopted the California Ocean Plan, and the RWQCBs have adopted and the SWRCB has approved Water Quality Control Plans (Basin Plans). Dischargers regulated by this General Permit must comply with the water quality standards in these Basin Plans and subsequent amendments thereto.

8. The SWRCB finds storm water discharges associated with construction activity to be a potential significant sources of pollutants. Furthermore, the SWRCB finds that storm water discharges associated with construction activities have the reasonable potential to cause or contribute to an excursion above water quality standards for sediment in the water bodies listed in Attachment 3 to this permit.

9. It is not feasible at this time to establish numeric effluent limitations for pollutants in storm water discharges from construction activities. Instead, the provisions of this General Permit require implementation of Best Management Practices (BMPs) to control and abate the discharge of pollutants in storm water discharges.

10. Discharges of non-storm water may be necessary for the completion of certain construction projects. Such discharges include, but are not limited to: irrigation of vegetative erosion control measures, pipe flushing and testing, street cleaning, and dewatering. Such discharges are authorized by this General Permit as long as they (a) do comply with Section A.9 of this General Permit, (b) do not cause or contribute to violation of any water quality standard, (c) do not violate any other provision of this General Permit, (d) do not require a non-storm water permit as issued by some RWQCBs,

and (e) are not prohibited by a Basin Plan. If a non-storm water discharge is subject to a separate permit adopted by a RWQCB, the discharge must additionally be authorized by the RWQCB permit.

11. Following adoption of this General Permit, the RWQCBs shall enforce the provisions herein including the monitoring and reporting requirements.

12. Following public notice in accordance with State and Federal laws and regulations, the SWRCB in a public meeting on June 8, 1998, heard and considered all comments. The SWRCB has prepared written responses to all significant comments.

13. This Order is an NPDES permit in compliance with section 402 of the Clean Water Act (CWA) and shall take effect upon adoption by the SWRCB provided the Regional Administrator of the USEPA has no objection. If the USEPA Regional Administrator objects to its issuance, the General Permit shall not become effective until such objection is withdrawn.

14. This General Permit does not authorize discharges of fill or dredged material regulated by the U.S. Army Corps of Engineers under CWA section 404 and does not constitute a waiver of water quality certification under CWA section 401.

IT IS HEREBY ORDERED that all dischargers who file an NOI indicating their intention to be regulated under the provisions of this General Permit shall comply with the following:

A. DISCHARGE PROHIBITIONS:

1. Authorization pursuant to this General Permit does not constitute an exemption to applicable discharge prohibitions prescribed in Basin Plans, as implemented by the nine RWQCBs.

2. Discharges of material other than storm water which are not otherwise authorized by an NPDES permit to a separate storm sewer system (MS4) or waters of the nation are prohibited, except as allowed in Special Provisions for Construction Activity, C.3.

3. Storm water discharges shall not cause or threaten to cause pollution, contamination, or nuisance.

4. Storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of a reportable quantity listed in 40 CFR Part 117 and/or 40 CFR Part 302.

B. RECEIVING WATER LIMITATIONS:

1. Storm water discharges and authorized nonstorm water discharges to any surface or ground water shall not adversely impact human health or the environment.

2. The SWPPP developed for the construction activity covered by this General Permit shall be designed and implemented such that storm water discharges and authorized nonstorm water discharges shall not cause or contribute to an exceedance of any applicable water quality standards contained in a Statewide Water Quality Control Plan and/or the applicable RWQCB's Basin Plan.

3. Should it be determined by the discharger, SWRCB, or RWQCB that storm water discharges and/or authorized nonstorm water discharges are causing or contributing to an exceedance of an applicable water quality standard, the discharger shall:

   a. Implement corrective measures immediately following discovery that water quality standards were exceeded, followed by notification to the RWQCB by telephone as soon as possible but no later than 48 hours after the discharge has been discovered. This notification shall be followed by a report within 14-calender days to the appropriate RWQCB, unless otherwise directed by the RWQCB, describing (1) the nature and cause of the water quality standard exceedance; (2) the BMPs currently being implemented; (3) any additional BMPs which will be implemented to prevent or reduce pollutants that are causing or contributing to the exceedance of water quality standards; and (4) any maintenance or repair of BMPs. This report shall include an implementation schedule for corrective actions and shall describe the actions taken to reduce the pollutants causing or contributing to the exceedance.

   b. The discharger shall revise its SWPPP and monitoring program immediately after the report to the RWQCB to incorporate the additional BMPs that have been and will be implemented, the implementation schedule, and any additional monitoring needed.

   c. Nothing in this section shall prevent the appropriate RWQCB from enforcing any provisions of this General Permit while the discharger prepares and implements the above report.

C. SPECIAL PROVISIONS FOR CONSTRUCTION ACTIVITY:

1. All dischargers shall file an NOI and pay the appropriate fee for construction activities conducted at each site as required by Attachment 2: Notice of Intent--General Instructions.

2. All dischargers shall develop and implement a SWPPP in accordance with Section A: Storm Water Pollution Prevention Plan. The discharger shall implement controls to reduce pollutants in storm water discharges from their construction sites to the BAT/BCT performance standard.

3. Discharges of non-storm water are authorized only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants. Implementation of appropriate BMPs is a condition for authorization of non-storm water discharges. Non-storm water discharges and the BMPs appropriate for their control must be described in the SWPPP. Wherever feasible, alternatives which do not result in discharge of nonstorm water shall be implemented in accordance with Section A.9. of the SWPPP requirements.

4. All dischargers shall develop and implement a monitoring program and reporting plan in accordance with Section B: Monitoring Program and Reporting Requirements.

5. All dischargers shall comply with the lawful requirements of municipalities, counties, drainage districts, and other local agencies regarding discharges of storm water to separate storm sewer systems or other watercourses under their jurisdiction, including applicable requirements in municipal storm water management programs developed to comply with NPDES permits issued by the RWQCBs to local agencies.

6. All dischargers shall comply with the standard provisions and reporting requirements contained in Section C: Standard Provisions.

7. The discharger may terminate coverage for a portion of the project under this General Permit when ownership of a portion of this project has been transferred or when a phase within this multi-phase project has been completed. When ownership has transferred, the discharger must submit to its RWQCB a Change of Information Form (COI) Attachment 4 with revised site map and the name, address and telephone number of the new owner(s). Upon transfer of title, the discharger should notify the new owner(s) of the need to obtain coverage under this General Permit. The new owner must comply with provisions of Sections A. 2. (c) and
B. 2. (b) of this General Permit. To terminate coverage for a portion of the project when a phase has been completed, the discharger must submit to its RWQCB a COI with a revised map that identifies the newly delineated site.

8. The discharger may terminate coverage under this General Permit for a complete project by submitting to its RWQCB a Notice of Termination Form (NOT), and the post-construction BMPs plan according to Section A.10 of this General

Permit. Note that a construction project is considered complete only when all portions of the site have been transferred to a new owner; or the following conditions have been met:

a. There is no potential for construction related storm water pollution,

b. All elements of the SWPPP have been completed,

c. Construction materials and waste have been disposed of properly,

d. The site is in compliance with all local storm water management requirements, and

e. A post-construction storm water management plan is in place as described in the site's SWPPP.

9. This General Permit expires five years from the date of adoption.

D. REGIONAL WATER QUALITY CONTROL BOARD (RWQCB) AUTHORITIES:

1. RWQCBs shall:

a. Implement the provisions of this General Permit. Implementation of this General Permit may include, but is not limited to requesting the submittal of SWPPPS, reviewing SWPPPs, reviewing monitoring reports, conducting compliance inspections, and taking enforcement actions.

b. Issue permits as they deem appropriate to individual dischargers, categories of dischargers, or dischargers in a geographic area. Upon issuance of such permits by a RWQCB, the affected dischargers shall no longer be regulated by this General Permit.

2. RWQCBs may require, on a case-by-case basis, the inclusion of an analysis of potential downstream impacts on receiving waterways due to the permitted construction.

3. RWQCBs may provide information to dischargers on the development and implementation of SWPPPs and monitoring programs and may require revisions to SWPPPs and monitoring programs.

4. RWQCBs may require dischargers to retain records for more than three years.

5. RWQCBs may require additional monitoring and reporting program requirements including sampling and analysis of discharges to water bodies listed in

Attachment 3 to this permit. Additional requirements imposed by the RWQCB should be consistent with the overall monitoring effort in the receiving waters.

6. RWQCBs may issue individual NPDES permits for those construction activities found to be ineligible for coverage under this permit.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on August 19, 1999.

AYE: James M. Stubchaer
Mary Jane Forster
John W. Brown
Arthur G. Baggett, Jr.

NO: None

ABSENT: None

ABSTAIN: None

/s/
Maureen Marché
Administrative Assistant to the Board

SECTION A: STORM WATER POLLUTION PREVENTION PLAN

1. Objectives

A Storm Water Pollution Prevention Plan (SWPPP) shall be developed and implemented to address the specific circumstances for each construction site covered by this General Permit. The SWPPP shall be certified in accordance with the signatory requirements of section C, Standard Provision for Construction Activities (9). The SWPPP shall be developed and amended or revised, when necessary, to meet the following objectives:

a. Identify all pollutant sources including sources of sediment that may affect the quality of storm water discharges associated with construction activity (storm water discharges) from the construction site, and

b. Identify non-storm water discharges, and

c Identify, construct, implement in accordance with a time schedule, and maintain Best Management Practices (BMPs) to reduce or eliminate pollutants in storm water discharges and authorized nonstorm water discharges from the construction site during construction, and

d Develop a maintenance schedule for BMPs installed during construction designed to reduce or eliminate pollutants after construction is completed (post-construction BMPs).

2. Implementation Schedule

a. For construction activity commencing on or after adoption of this General Permit, the SWPPP shall be developed prior to the start of soil-disturbing activity in accordance with this Section and shall be implemented concurrently with commencement of soil-disturbing activities.

b. Existing permittees engaging in construction activities covered under the terms of the previous General Construction Permit SWPPP (WQ Order No.92-08-DWQ) shall continue to implement their existing SWPPP and shall implement any necessary revisions to their SWPPP in accordance with this Section of the General Permit in a timely manner, but in no case more than 90-calender days from the date of adoption of this General Permit.

c. For ongoing construction activity involving a change of ownership of property, the new owner shall review the existing SWPPP and amend if necessary, or develop a new SWPPP within 45-calender days.

3. Availability

The SWPPP shall remain on the construction site while the site is under construction during working hours, commencing with the initial construction activity and ending with termination of coverage under the General Permit.

4. Required Changes

a. The discharger shall amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, ground waters, or a municipal separate storm sewer system (MS4). The SWPPP shall also be amended if the discharger violates any condition of this General Permit or has not achieved the general objective of reducing or eliminating pollutants in storm water discharges. If the RWQCB determines that the discharger is in violation of this General Permit, the SWPPP shall be amended and implemented in a timely manner, but in no case more than 14-calendar days after notification by the RWQCB. All amendments should be dated and directly attached to the SWPPP.

b. The RWQCB or local agency with the concurrence of the RWQCB may require the discharger to amend the SWPPP.

5. Source Identification

The SWPPP shall include: (a) project information and (b) pollutant source identification combined with an itemization of those BMPs specifically chosen to control the pollutants listed.

a. Project Information

(1) The SWPPP shall include a vicinity map locating the project site with respect to easily identifiable major roadways, geographic features, or landmarks. At a minimum, the map must show the construction site perimeter, the geographic features surrounding the site, and the general topography.

(2) The SWPPP shall include a site map(s) which shows the construction project in detail, including the existing and planned paved areas and buildings.

(a) At a minimum, the map must show the construction site perimeter; existing and proposed buildings, lots, roadways, storm water collection and discharge points; general topography both before and after construction; and the anticipated discharge location(s)

where the storm water from the construction site discharges to a municipal storm sewer system or other water body.

(b) The drainage patterns across the project area must clearly be shown on the map, and the map must extend as far outside the site perimeter as necessary to illustrate the relevant drainage areas. Where relevant drainage areas are too large to depict on the map, map notes or inserts illustrating the upstream drainage areas are sufficient.

(c) Temporary on-site drainages to carry concentrated flow shall be selected to comply with local ordinances, to control erosion, to return flows to their natural drainage courses, and to prevent damage to downstream properties.

3. Information presented in the SWPPP may be represented either by narrative or by graphics. Where possible, narrative descriptions should be plan notes. Narrative descriptions which do not lend themselves to plan notes can be contained in a separate document which must be referenced on the plan.

b. Pollutant Source and BMP Identification

The SWPPP shall include a description of potential sources which are likely to add pollutants to storm water discharges or which may result in nonstorm water discharges from the construction site. Discharges originating from off-site which flow across or through areas disturbed by construction that may contain pollutants should be reported to the RWQCB.

The SWPPP shall:

(1) Show drainage patterns and slopes anticipated after major grading activities are completed. Runoff from off-site areas should be prevented from flowing through areas that have been disturbed by construction unless appropriate conveyance systems are in place. The amount of anticipated storm water run-on must be considered to determine the appropriateness of the BMPs chosen. Show all calculations for anticipated storm water run-on, and describe all BMPs implemented to divert off-site drainage described in section A. 5 a. (2) (c) around or through the construction project.

(2) Show the drainage patterns into each on-site storm water inlet point or receiving water. Show or describe the BMPs that will protect operational storm water inlets or receiving waters from contaminated discharges other than sediment discharges, such as, but not limited to: storm water with

elevated pH levels from contact with soil amendments such as lime or gypsum; slurry from sawcutting of concrete or asphalt ;washing of exposed aggregate concrete; concrete rinse water; building washing operations; equipment washing operations; minor street washing associated with street delineation; and/or sealing and paving activities occurring during rains.

(3) Show existing site features that, as a result of known past usage, may contribute pollutants to storm water, (e.g., toxic materials that are known to have been treated, stored, disposed, spilled, or leaked onto the construction site). Show or describe the BMPs implemented to minimize the exposure of storm water to contaminated soil or toxic materials.

(4) Show areas designated for the (a) storage of soil or waste, (b) vehicle storage and service areas, (c) construction material loading, unloading, and access areas, (d) equipment storage, cleaning, and maintenance areas.

(5) Describe the BMPs for control of discharges from waste handling and disposal areas and methods of on-site storage and disposal of construction materials and construction waste. Describe the BMPs designed to minimize or eliminate the exposure of storm water to construction materials, equipment, vehicles, waste storage areas, or service areas. The BMPs described shall be in compliance with Federal, State, and local laws, regulations, and ordinances.

(6) Describe all post-construction BMPs for the project, and show the location of each BMP on the map. (Post-construction BMPs consist of permanent features designed to minimize pollutant discharges, including sediment, from the site after construction has been completed.) Also, describe the agency or parties to be the responsible party for long-term maintenance of these BMPs.

c. Additional Information

(1) The SWPPP shall include a narrative description of pollutant sources and BMPs that cannot be adequately communicated or identified on the site map. In addition, a narrative description of preconstruction control practices (if any) to reduce sediment and other pollutants in storm water discharges shall be included.

(2) The SWPPP shall include an inventory of all materials used and activities performed during construction that have the potential to contribute to the discharge of pollutants other than sediment in storm water. Describe the BMPs selected and the basis for their selection to eliminate or reduce these pollutants in the storm water discharges.

(3) The SWPPP shall include the following information regarding the construction site surface area: the size (in acres or square feet), the runoff coefficient before and after construction, and the percentage that is impervious (e.g., paved, roofed, etc.) before and after construction.

(4) The SWPPP shall include a copy of the NOI, and the Waste Discharge Identification (WDID) number. Should a WDID number not be received from the SWRCB at the time construction commences, the discharger shall include proof of mailing of the NOI, e.g., certified mail receipt, copy of check, express mail receipt, etc.

(5) The SWPPP shall include a construction activity schedule which describes all major activities such as mass grading, paving, lot or parcel improvements at the site and the proposed time frame to conduct those activities.

(6) The SWPPP shall list the name and telephone number of the qualified person(s) who have been assigned responsibility for prestorm, poststorm, and storm event BMP inspections; and the qualified person(s) assigned responsibility to ensure full compliance with the permit and implementation of all elements of the SWPPP, including the preparation of the annual compliance evaluation and the elimination of all unauthorized discharges.

6. Erosion Control

Erosion control, also referred to as "soil stabilization" is the most effective way to retain soil and sediment on the construction site. The most efficient way to address erosion control is to preserve existing vegetation where feasible, to limit disturbance, and to stabilize and revegetate disturbed areas as soon as possible after grading or construction. Particular attention must be paid to large mass-graded sites where the potential for soil exposure to the erosive effects of rainfall and wind is great. Mass graded construction sites may be exposed for several years while the project is being built out. Thus, there is potential for significant sediment discharge from the site to surface waters.

At a minimum, the discharger/operator must implement an effective combination of erosion and sediment control on all disturbed areas during the rainy season. These disturbed areas include rough graded roadways, slopes, and building pads. Until permanent vegetation is established, soil cover is the most cost-effective and expeditious method to protect soil particles from detachment and transport by rainfall. Temporary soil stabilization can be the single-most important factor in reducing erosion at construction sites. The discharger shall consider measures such as: covering with mulch, temporary seeding, soil stabilizers, binders, fiber rolls or blankets, temporary vegetation, permanent seeding, and a variety of other measures.

The SWPPP shall include a description of the erosion control practices, including a time schedule, to be implemented during construction to minimize erosion on disturbed areas of a construction site. The discharger must consider the full range of erosion control BMPs. The discharger must consider any additional site-specific and seasonal conditions when selecting and implementing appropriate BMPs. The above listed erosion control measures are examples of what should be considered and are not exclusive of new or innovative approaches currently available or being developed.

a. The SWPPP shall include:

(1) An outline of the areas of vegetative soil cover or native vegetation onsite which will remain undisturbed during the construction project.

(2) An outline of all areas of soil disturbance including cut or fill areas which will be stabilized during the rainy season by temporary or permanent erosion control measures, such as seeding, mulch, or blankets, etc.

(3) An outline of the areas of soil disturbance, cut, or fill which will be left exposed during any part of the rainy season, representing areas of potential soil erosion where sediment control BMPs are required to be used during construction.

(4) A proposed schedule for the implementation of erosion control measures.

b. The SWPPP shall include a description of the BMPs and control practices to be used for both temporary and permanent erosion control measures.

c. The SWPPP shall include a description of the BMPs to reduce wind erosion at all times, with particular attention paid to stock-piled materials.

7. Stabilization

(1) All disturbed areas of the construction site must be stabilized. Final stabilization for the purposes of submitting a NOT is satisfied when:

-All soil disturbing activities are completed AND EITHER OF THE TWO FOLLOWING CRITERIA ARE MET:

-A uniform vegetative cover with 70 percent coverage has been established OR:

-equivalent stabilization measures have been employed. These measures include the use of such BMPs as blankets, reinforced

channel liners, soil cement, fiber matrices, geotextiles, or other erosion resistant soil coverings or treatments.

(2) Where background native vegetation covers less than 100 percent of the surface, such as in arid areas, the 70 percent coverage criteria is adjusted as follows: If the native vegetation covers 50 percent of the ground surface, 70 percent of 50 percent (.70 X .50=.35) would require 35 percent total uniform surface coverage.

8. Sediment Control

The SWPPP shall include a description or illustration of BMPs which will be implemented to prevent a net increase of sediment load in storm water discharge relative to preconstruction levels. Sediment control BMPs are required at appropriate locations along the site perimeter and at all operational internal inlets to the storm drain system at all times during the rainy season. Sediment control practices may include filtration devices and barriers (such as fiber rolls, silt fence, straw bale barriers, and gravel inlet filters) and/or settling devices (such as sediment traps or basins). Effective filtration devices, barriers, and settling devices shall be selected, installed and maintained properly. A proposed schedule for deployment of sediment control BMPs shall be included in the SWPPP. These are the most basic measures to prevent sediment from leaving the project site and moving into receiving waters. Limited exemptions may be authorized by the RWQCB when work on active areas precludes the use of sediment control BMPs temporarily. Under these conditions, the SWPPP must describe a plan to establish perimeter controls prior to the onset of rain.

During the nonrainy season, the discharger is responsible for ensuring that adequate sediment control materials are available to control sediment discharges at the downgrade perimeter and operational inlets in the event of a predicted storm. The discharger shall consider a full range of sediment controls, in addition to the controls listed above, such as straw bale dikes, earth dikes, brush barriers, drainage swales, check dams, subsurface drain, sandbag dikes, fiber rolls, or other controls. At a minimum, the discharger/operator must implement an effective combination of erosion and sediment control on all disturbed areas during the rainy season.

If the discharger chooses to rely on sediment basins for treatment purposes, sediment basins shall, at a minimum, be designed and maintained as follows:

Option 1: Pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 3.

OR

Option 2: Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet of storage per acre draining into the sediment basin. The length of the basin shall be more than twice the width of the basin. The length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than three feet nor greater than five feet for safety reasons and for maximum efficiency.

OR

Option 3: Sediment basin(s) shall be designed using the standard equation:

$$As=1.2Q/Vs$$

Where: As is the minimum surface area for trapping soil particles of a certain size; Vs is the settling velocity of the design particle size chosen; and Q=C x I x A where Q is the discharge rate measured in cubic feet per second; C is the runoff coefficient; I is the precipitation intensity for the 10-year, 6-hour rain event and A is the area draining into the sediment basin in acres. The design particle size shall be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01mm) particle, and the Vs used shall be 100 percent of the calculated settling velocity.

The length is determined by measuring the distance between the inlet and the outlet; the length shall be more than twice the dimension as the width; the depth shall not be less than three feet nor greater than five feet for safety reasons and for maximum efficiency (two feet of storage, two feet of capacity). The basin(s) shall be located on the site where it can be maintained on a year-round basis and shall be maintained on a schedule to retain the two feet of capacity;

OR

Option 4: The use of an equivalent surface area design or equation, provided that the design efficiency is as protective or more protective of water quality than Option 3.

A sediment basin shall have a means for dewatering within 7-calendar days following a storm event. Sediment basins may be fenced if safety (worker or public) is a concern.

The outflow from a sediment basin that discharges into a natural drainage shall be provided with outlet protection to prevent erosion and scour of the embankment and channel.

The discharger must consider any additional site-specific and seasonal conditions when selecting and designing sediment control BMPs. The above listed sediment control measures are examples of what should be considered and are not exclusive of new or innovative approaches currently available or being developed.

The SWPPP shall include a description of the BMPs to reduce the tracking of sediment onto public or private roads at all times. These public and private roads shall be inspected and cleaned as necessary. Road cleaning BMPs shall be discussed in the SWPPP and will not rely on the washing of accumulated sediment or silt into the storm drain system.

9. Non-Storm Water Management

Describe all non-storm water discharges to receiving waters that are proposed for the construction project. Non-storm water discharges should be eliminated or reduced to the extent feasible. Include the locations of such discharges and descriptions of all BMPs designed for the control of pollutants in such discharges. Onetime discharges shall be monitored during the time that such discharges are occurring. A qualified person should be assigned the responsibility for ensuring that no materials other than storm water are discharged in quantities which will have an adverse effect on receiving waters or storm drain systems (consistent with BAT/BCT), and the name and contact number of that person should be included in the SWPPP document.

Discharging sediment-laden water which will cause or contribute to an exceedance of the applicable RWQCB's Basin Plan from a dewatering site or sediment basin into any receiving water or storm drain without filtration or equivalent treatment is prohibited.

10. Post-Construction Storm Water Management

The SWPPP shall include descriptions of the BMPs to reduce pollutants in storm water discharges after all construction phases have been completed at the site (Post-Construction BMPs). Post-Construction BMPs include the minimization of land disturbance, the minimization of impervious surfaces, treatment of storm water runoff using infiltration, detention/retention, biofilter BMPs, use of efficient irrigation systems, ensuring that interior drains are not connected to a storm sewer system, and appropriately designed and constructed energy dissipation devices. These must be consistent with all local post-construction storm water management requirements, policies, and guidelines. The discharger must consider site-specific and seasonal conditions when designing the control practices. Operation and maintenance of control practices after construction is completed shall be addressed, including short-and long-term funding sources and the responsible party.

11. Maintenance, Inspection, and Repair

The SWPPP shall include a discussion of the program to inspect and maintain all BMPs as identified in the site plan or other narrative documents throughout the entire duration of the project. A qualified person will be assigned the responsibility to conduct inspections. The name and telephone number of that person shall be listed in the SWPPP document. Inspections will be performed before and after storm events and once each 24-hour period during extended storm events to identify BMP effectiveness and implement repairs or design changes as soon as feasible depending upon field conditions. Equipment, materials, and workers must be available for rapid response to failures and emergencies. All corrective maintenance to BMPs shall be performed as soon as possible after the conclusion of each storm depending upon worker safety.

For each inspection required above, the discharger shall complete an inspection checklist. At a minimum, an inspection checklist shall include:

a. Inspection date.

b. Weather information: best estimate of beginning of storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall (inches).

c. A description of any inadequate BMPs.

d. If it is possible to safely access during inclement weather, list observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list result of visual inspection at relevant outfall, discharge point, or downstream location and projected required maintenance activities.

e. Corrective actions required, including any changes to SWPPP necessary and implementation dates.

f. Inspectors name, title, and signature.

The dischargers shall prepare their inspection checklists using the inspection checklist form provided by the SWRCB or RWQCB or on forms that contain the equivalent information.

12. Training

Individuals responsible for SWPPP preparation, implementation, and permit compliance shall be appropriately trained, and the SWPPP shall document all training. This includes those personnel responsible for installation, inspection, maintenance, and repair of BMPs. Those responsible for overseeing, revising, and amending the SWPPP shall also document their training. Training should be both formal and informal, occur on an

ongoing basis when it is appropriate and convenient, and should include training/workshops offered by the SWRCB, RWQCB, or other locally recognized agencies or professional organizations.

13. List of Contractors/Subcontractors

The SWPPP shall include a list of names of all contractors, (or subcontractors) and individuals responsible for implementation of the SWPPP. This list should include telephone numbers and addresses. Specific areas of responsibility of each subcontractor and emergency contact numbers should also be included.

14. Other Plans

This SWPPP may incorporate by reference the appropriate elements of other plans required by local, State, or Federal agencies. A copy of any requirements incorporated by reference shall be kept at the construction site.

15. Public Access

The SWPPP shall be provided, upon request, to the RWQCB. The SWPPP is considered a report that shall be available to the public by the RWQCB under section 308(b) of the Clean Water Act.

16. Preparer Certification

The SWPPP and each amendment shall be signed by the landowner (discharger) or his representative and include the date of initial preparation and the date of each amendment.

SECTION B: MONITORING PROGRAM AND REPORTING REQUIREMENTS

1. Required Changes

The RWQCB may require the discharger to conduct additional site inspections, to submit reports and certifications, or perform sampling and analysis.

2. Implementation

a. The requirements of this Section shall be implemented at the time of commencement of construction activity (see also Section A. 2. Implementation Schedule). The discharger is responsible for implementing these requirements until construction activity is complete and the site is stabilized.

b. For ongoing construction activity involving a change in ownership of property covered by this General Permit, the new owner must complete a NOI and

implement the requirements of this Section concurrent with the change of ownership. For changes of information, the owner must follow instructions in C. 7. Special Provisions for Construction Activity of the General Permit.

3. Site Inspections

Qualified personnel shall conduct inspections of the construction site prior to anticipated storm events, during extended storm events, and after actual storm events to identify areas contributing to a discharge of storm water associated with construction activity. The name(s) and contact number(s) of the assigned inspection personnel shall be listed in the SWPPP. Pre-storm inspections are to ensure that BMPs are properly installed and maintained; post-storm inspections are to assure that the BMPs have functioned adequately. During extended storm events, inspections shall be required each 24-hour period. Best Management Practices (BMPs) shall be evaluated for adequacy and proper implementation and whether additional BMPs are required in accordance with the terms of the General Permit (see language in Section A. 11. Maintenance, Inspection, and Repair). Implementation of nonstorm water discharge BMPs shall be verified and their effectiveness evaluated. One time discharges of non-storm water shall be inspected when such discharges occur.

4. Compliance Certification

Each discharger or qualified assigned personnel listed by name and contact number in the SWPPP must certify annually that construction activities are in compliance with the requirements of this General Permit and the SWPPP. This Certification shall be based upon the site inspections required in Item 3 of this Section. The certification must be completed by July 1 of each year.

5. Noncompliance Reporting

Dischargers who cannot certify compliance, in accordance with Item 4 of this Section and/or who have had other instances of noncompliance excluding exceedances of water quality standards as defined in section B. 3. Receiving Water Limitations Language, shall notify the appropriate RWQCB within 30 days. Corrective measures should be implemented immediately following discovery that water quality standards were exceeded. The notifications shall identify the noncompliance event, including an initial assessment of any impact caused by the event; describe the actions necessary to achieve compliance; and include a time schedule subject to the modifications by the RWQCB indicating when compliance will be achieved. Noncompliance notifications must be submitted within 30-calendar days of identification of noncompliance.

6. Monitoring Records

Records of all inspections, compliance certifications, and noncompliance reporting must be retained for a period of at least three years from the date generated. With the exception of noncompliance reporting, dischargers are not required to submit these records.

SECTION C: STANDARD PROVISIONS FOR CONSTRUCTION ACTIVITY

1. Duty to Comply

The discharger must comply with all of the conditions of this General Permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action and/or removal from General Permit coverage.

The discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not yet been modified to incorporate the requirement.

2. General Permit Actions

This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the discharger for a General Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not annul any General Permit condition.

If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the dischargers so notified.

3. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this General Permit.

4. Duty to Mitigate

The discharger shall take all responsible steps to minimize or prevent any discharge in violation of this General Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

5. Proper Operation and Maintenance

The discharger shall at all times properly operate and maintain any facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of this General Permit and with the requirements of Storm Water Pollution Prevention Plans (SWPPP). Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance may require the operation of backup or auxiliary facilities or similar systems installed by a discharger when necessary to achieve compliance with the conditions of this General Permit.

6. Property Rights

This General Permit does not convey any property rights of any sort or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor does it authorize any infringement of Federal, State, or local laws or regulations.

7. Duty to Provide Information

The discharger shall furnish the RWQCB, State Water Resources Control Board, or USEPA, within a reasonable time, any requested information to determine compliance with this General Permit. The discharger shall also furnish, upon request, copies of records required to be kept by this General Permit.

8. Inspection and Entry

The discharger shall allow the RWQCB, SWRCB, USEPA, and/or, in the case of construction sites which discharge through a municipal separate storm sewer, an authorized representative of the municipal operator of the separate storm sewer system receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the discharger's premises at reasonable times where a regulated construction activity is being conducted or where records must be kept under the conditions of this General Permit;

b. Access and copy at reasonable times any records that must be kept under the conditions of this General Permit;

c. Inspect at reasonable times the complete construction site, including any off-site staging areas or material storage areas, and the erosion/sediment controls; and

d. Sample or monitor at reasonable times for the purpose of ensuring General Permit compliance.

9. Signatory Requirements

a. All Notice of Intents (NOIs), Notice of Terminations (NOTs), SWPPPs, certifications, and reports prepared in accordance with this Order submitted to the SWRCB shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means: (a) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or (b) the manager of the construction activity if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer, ranking elected official, or duly authorized representative. The principal executive officer of a Federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of USEPA).

b. All SWPPPs, reports, certifications, or other information required by the General Permit and/or requested by the RWQCB, SWRCB, USEPA, or the local storm water management agency shall be signed by a person described above or by a duly authorized representative. A person is a duly authorized representative if:

(1) The authorization is made in writing by a person described above and retained as part of the SWPPP; or

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the construction activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

c. If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the construction activity, a new authorization must be attached to the SWPPP prior to submittal of any reports, information, or certifications to be signed by the authorized representative.

10. Certification

Any person signing documents under Section C, Provision 9 above, shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Anticipated Noncompliance

The discharger will give advance notice to the RWQCB and local storm water management agency of any planned changes in the construction activity which may result in noncompliance with General Permit requirements.

12. Penalties for Falsification of Reports

Section 309(c)(4) of the CWA provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit, including reports of compliance or noncompliance shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years or by both.

13. Oil and Hazardous Substance Liability

Nothing in this General Permit shall be construed to preclude the institution of any legal action or relieve the discharger from any responsibilities, liabilities, or penalties to which the discharger is or may be subject to under Section 311 of the CWA.

14. Severability

The provisions of this General Permit are severable; and, if any provision of this General Permit or the application of any provision of this General Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

15. Reopener Clause

This General Permit may be modified, revoked and reissued, or terminated for cause due to promulgation of amended regulations, receipt of USEPA guidance concerning regulated activities, judicial decision, or in accordance with 40 Code of Federal Regulations (CFR) 122.62, 122.63, 122.64, and 124.5.

16. Penalties for Violations of Permit Conditions

a. Section 309 of the CWA provides significant penalties for any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the CWA or any permit condition or limitation implementing any such section in a permit issued under Section 402. Any person who violates any permit condition of this General Permit is subject to a civil penalty not to exceed $27,500 per calendar day of such violation, as well as any other appropriate sanction provided by Section 309 of the CWA.

b. The Porter-Cologne Water Quality Control Act also provides for civil and criminal penalties which in some cases are greater than those under the CWA.

17. Availability

A copy of this General Permit shall be maintained at the construction site during construction activity and be available to operating personnel.

18. Transfers

This General Permit is not transferable. A new owner of an ongoing construction activity must submit a NOI in accordance with the requirements of this General Permit to be authorized to discharge under this General Permit. An owner who sells property covered by this General Permit shall inform the new owner of the duty to file a NOI and shall provide the new owner with a copy of this General Permit.

19. Continuation of Expired Permit

This General Permit continues in force and effect until a new General Permit is issued or the SWRCB rescinds this General Permit. Only those dischargers authorized to discharge under the expiring General Permit are covered by the continued General Permit.

SWRCB AND RWQCB CONTACT LIST

STATE WATER RESOURCES CONTROL BOARD
Division of Water Quality
Attention: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977
(916) 657-1146 FAX:(916) 657-1011
Contact: Bruce Fujimoto

1) NORTH COAST REGION
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403
Contact: Nathan Quarles
(707) 576-2220 FAX: (707) 523-0135
Email: quarn@rb1.swrcb.ca.gov

2) SAN FRANCISCO BAY REGION
1515 Clay Street, Suite 1400
Oakland, CA 94612
Contact: Gayleen Perriera
(510) 622-2407 FAX: (510) 622-2460
Email: gp@rb2.swrcb.ca.gov

3) CENTRAL COAST REGION
81 Higuera Street, Suite 200
San Luis Obispo, CA 93401-5427
Contact: Jennifer Bitting
(805) 549-3147 FAX: (805) 543-0397
Email: jbitting@rb3.swrcb.ca.gov

4) LOS ANGELES REGION
320 W. 4th Street, Suite 200
Los Angeles, CA 90013
Contact: **Wayne Chiou** *(Inland Los Angeles)*
(213) 576-6664 FAX: (213) 576-6686
Email: wchiou@rb4.swrcb.ca.gov
Contact: **Mark Pumford** *(Ventura County)*
(213) 576-6657 FAX: (213) 576-6686
Email: mpumford@rb4.swrcb.ca.gov
Contact: **Carlos Urrunaga** *(Coastal)*
(213) 576-6655 FAX (213) 576-6686
Email: currunag@rb4.swrcb.ca.gov

5S) CENTRAL VALLEY REGION
Sacramento Office
3443 Routier road, Suite A
Sacramento, CA 95827-3098
Contact: Leo Sarmiento
(916) 255-3049 FAX: (916) 255-3015
Email: sarmienl@rb5s.swrcb.ca.gov

5F) CENTRAL VALLEY REGION
Fresno Branch Office
3614 East Ashlan Avenue
Fresno, CA 93726
Contact: Jarma Bennett *(Tulare & Kern Counties)*
(559) 445-5919 FAX: (559) 445-5910
Email: bennettj@rb5f.swrcb.ca.gov
Contact: **Greg Kelly** (Madera, Mariposa, Merced, Fresno, & Kings Counties)
(559) 445-5500 FAX: (559) 445-5910
Email: kellyg@rb5f.swrcb.ca.gov

5R) CENTRAL VALLEY REGION
Redding Branch Office
415 Knollcrest Drive
Redding, CA 96002
Contact: Carole Crowe
(530) 224-4849 FAX: (530) 224-4857
Email: crowec@rb5r.swrcb.ca.gov

6SLT) LAHONTAN REGION
South Lake Tahoe Office
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150
Contact: Chris Adair
(530) 542-5433 FAX: (530) 544-2271
Email: adaic@rb6s.swrcb.ca.gov

6V) LAHONTAN REGION
Victorville Office
15428 Civic Drive, Suite 100
Victorville, CA 92392
Contact: Jehiel Cass
(760) 241-7377 FAX: (760) 241-7308
Email: jcass@rb6v.swrcb.ca.gov

7) COLORADO RIVER BASIN REGION
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
Contact: Abdi Haile
(760) 776-8935 FAX: (760) 341-6820
Email: haila@rb7.swrcb.ca.gov
Contact: Rosalyn Fleming
(760) 241-7364 FAX: (760) 341-6820
Email: flemr@rb7.swrcb.ca.gov

8) SANTA ANA REGION
3737 Main Street, Suite 500
Riverside, CA 92501-3339
Contact: Michael Roth *(Riverside County)*
(909) 320-2027 FAX: (909) 781-6288
Email: mroth@rb8.swrcb.ca.gov
Contact: Mark Smythe *(Orange County)*
(909) 782-4998 FAX: (909) 781-6288
Email: msmythe@rb8.swrcb.ca.gov
Contact: Bob Whitaker *(San Bernardino County)*
(909) 782-4993 FAX: (909) 781-6288
Email: bwhitake@rb8.swrcb.ca.gov

9) SAN DIEGO REGION
9771 Clairemont Mesa Boulevard, Suite A
San Diego, CA 92124
Contact: Jane Ledford
(619) 467-3272 FAX: (619) 571-6972
Email: ledfj@rb9.swrcb.ca.gov

NOTICE OF INTENT (NOI) TO COMPLY WITH THE TERMS OF THE GENERAL PERMIT TO DISCHARGE STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY

GENERAL INSTRUCTIONS

Who Must Submit

Discharges of storm water associated with construction that results in the disturbance of five acres or more of land must apply for coverage under the General Construction Activities Storm Water Permit (General Permit). Construction activity which is a part of a larger common area of development or sale must also be permitted. (For example, if 4 acres of a 20-acre subdivision is disturbed by construction activities, and the remaining 16 acres is to be developed at a future date, the property owner must obtain a General Storm Water Permit for the 4-acre project). Construction activity includes, but is not limited to: clearing, grading, demolition, excavation, construction of new structures, and reconstruction of existing facilities involving removal and replacement that results in soil disturbance. This includes construction access roads, staging areas, storage areas, stockpiles, and any off-site areas which receive run-off from the construction project such as discharge points into a receiving water. Construction activity does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

The owner of the land where the construction activity is occurring is responsible for obtaining a permit. Owners may obtain coverage under the General Permit by filing a NOI in accordance with the following instructions. Coverage for construction activity conducted on easements (e.g., pipeline construction) or on nearby properties by agreement or permission, or by an owner or lessee of a mineral estate (oil, gas, geothermal, aggregate, precious metals, and/or industrial minerals) entitled to conduct the activities, shall be obtained by the entity responsible for the construction activity. Linear construction projects which will have construction activity occurring in one or more than one Region should contact the State Water Resources Control Board at the number listed below prior to submitting an NOI application for specific information related to the use of the NOI form.

Construction Activity Not Covered By This General Permit

Storm water discharges in the Lake Tahoe Hydrologic Unit will be regulated by a separate permit(s) adopted by the California Regional Water Quality Control Board, Lahontan Region, and will not be covered under the State Water Resources Control Board's (SWRCB) General Permit. Storm water discharges on Indian Lands will be regulated by the U.S. Environmental Protection Agency.

Where to Apply

The NOI form, vicinity map, and appropriate fee must be mailed to the SWRCB at the following address:

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

When to Apply

Property owners proposing to conduct construction activities subject to this General Permit must file a Notice of Intent prior to the commencement of construction activity.

Fees

The annual fee is either $250 or $500 depending on the construction site location. See Enclosure 1 of the Permit to determine your fee. Checks should be made payable to: SWRCB.

Completing the Notice of Intent (NOI)

The submittal to obtain coverage under the General Permit must include a completed NOI Form (Notice of Intent, attached), a vicinity map, and the appropriate annual fee. The NOI must be completely and accurately filled out; the vicinity map and annual fee must be included with the NOI or the submittal is considered incomplete and will be rejected. A construction site is considered to be covered by the General Permit upon filing a complete NOI submittal, and implementation of a defensible Storm Water Pollution Prevention Plan (SWPPP). Upon receipt of a complete NOI submittal, each discharger will be sent a receipt letter containing the waste discharger's identification (WDID) number.

Questions?

If you have any questions on completing the NOI please call the SWRCB at (916) 657-1146.

NOI-LINE-BY-LINE INSTRUCTIONS

Please type or print when completing the NOI Form and vicinity map.

SECTION I--NOI STATUS

Mark one of the two boxes at the top portion of the NOI. Check box 1 if the NOI is being completed for new construction. Check box 2 if the NOI is being submitted to report changes for a construction site already covered by the General Permit. An example of a change that warrants a resubmittal of the NOI is a change of total area of the construction site. The permit is non-transferable, a change of ownership requires a Notice of Termination (NOT) submittal and a new NOI. Complete only those portions of the NOI that apply to the changes (the NOI must always be signed). If box 2 is checked, the WDID number must be included.

SECTION II--PROPERTY OWNER

Enter the construction site owner's official or legal name and address; contact person (if other than owner), title, and telephone number.

SECTION III--DEVELOPER / CONTRACTOR INFORMATION

Enter the name of the developer's (or general contractor's) official or legal name, address, contact person, title, and telephone number. The contact person should be someone who is familiar with the construction site and is responsible for compliance and oversight of the general permit.

SECTION IV-CONSTRUCTION PROJECT INFORMATION

Enter the project name, site address, county, city, (or nearest city if construction is occurring in an unincorporated area), zip code, and telephone number (if any) of the construction site. Include an emergency contact telephone or pager number. Construction site information should include latitude and longitude designations, tract numbers, and/or mile post markers, if applicable. The site contact person should be someone who is familiar with the project, site plans, SWPPP, and monitoring program. All NOIs must be accompanied by a vicinity map.

Part A: Enter the total size in acres of all areas associated with construction activity, including all access roads.

Part B: Enter the total size in acres of the area to be disturbed by construction activity and the percentage of the area listed in Part A above that this represents.

Part C: Enter the percentage of the site that is impervious (areas where water cannot soak into the ground, such as concrete, asphalt, rooftops, etc.) before and after construction.

Part D: Include tract numbers, if available.

Part E: Enter the mile post marker number at the project site location.

Part F: Indicate whether the construction site is part of a larger common plan of development or sale. For example, if the construction activity is occurring on a two-acre site which is within a development that is five acres or greater, answer yes.

Part G: Enter the name of the development (e.g. "Quail Ridge Subdivision", "Orange Valley Estates", etc.).

Part H: Indicate when construction will begin (month, day, year). When a NOI is being submitted due to a change in ownership, the commencement date should be the date the new ownership took effect.

Part I: Indicate the percentage of the total project area to be mass graded.

Part J: Enter the estimated completion dates for the mass grading activities and for the project completion.

Part K: Indicate the type(s) of construction taking place. For example, "Transportation" should be checked for the construction of roads; "Utility" should be checked for installation of sewer, electric, or telephone systems. Include a description of the major construction activities, (e.g., 20 single family homes, a supermarket, an office building, a factory, etc.)

SECTION V--BILLING ADDRESS

To continue coverage under the General Permit, the annual fee must be paid. Indicate where the annual fee invoice should be mailed by checking one of the following boxes:

Owner: sent to the owners address as it appears in Section II.

Developer/Contractor: sent to the developer's address as it appears in Section III.

Other: sent to a different address and enter that address in the spaces provided.

SECTION VI--REGULATORY STATUS

Indicate whether or not the site is subject to local erosion/sediment control ordinances. Indicate whether the erosion/sediment control plan designed to comply with the ordinance addresses the construction of infrastructure and structures in addition to grading. Identify the name and telephone number of the local agency, if applicable.

SECTION VII--RECEIVING WATER INFORMATION

Part A: Indicate whether the storm water runoff from the construction site discharges indirectly to waters of the United States, directly to waters of the United States, or to a separate storm drain system.

Indirect discharges include discharges that may flow overland across adjacent properties or rights-of-way prior to discharging into waters of the United States.

Enter the name of the owner/operator of the relevant storm drain system, if applicable. Storm water discharges directly to waters of the United States will typically have an outfall structure directly from the facility to a river, lake, creek, stream, bay, ocean, etc. Discharges to separate storm sewer systems are those that discharge to a collection system operated by municipalities, flood control districts, utilities, or similar entities.

Part B: Enter the name of the receiving water. Regardless of point of discharge, the owner must determine the receiving water for the construction site's storm water discharge. Enter the name of the receiving water.

SECTION VIII--IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

Part A: Indicate the status of the SWPPP, date prepared, or availability for review. Also indicate if a tentative construction schedule has been included in the SWPPP (the inclusion of a construction activity schedule is a mandatory SWPPP requirement).

Part B: Provide information concerning the status of the development of a monitoring program, a component of the SWPPP which outlines an inspection and maintenance schedule for the proposed Best Management Practices (BMPs). Provide name and phone number of program preparer.

Part C: Provide the name and phone numbers of the responsible party or parties designated to insure compliance with all elements of the General Permit and SWPPP.

SECTION IX--VICINITY MAP AND FEE

Provide a "to scale" or "to approximate scale" drawing of the construction site and the immediate surrounding area. Whenever possible, limit the map to an 8.5" x 11' or 11" x 17" sheet of paper. At a minimum, the map must show the site perimeter, the geographic features surrounding the site, and general topography, and a north arrow. The map must also include the location of the construction project in relation to named streets, roads, intersections, or landmarks. A NOI containing a map which does not clearly indicate the location of the construction project will be rejected. Do not submit blueprints unless they meet the above referenced size limits.

SECTION X--CERTIFICATIONS

This section must be completed by the owner or signatory agent of the construction site*. The certification provides assurances that the NOI and vicinity map were completed in an accurate and complete fashion and with the knowledge that penalties exist for providing false information. Certification also requires the owner to comply with the provisions in the General Permit.

* For a corporation: a responsible corporate officer (or authorized individual). For a partnership or sole proprietorship: a general partner or the proprietor, respectively. For a municipality, State, Federal, or other public agency: either a principal executive officer, ranking elected official, or duly authorized representative.

Attachment 2

State Water Resources Control Board

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

I. NOI STATUS (SEE INSTRUCTIONS)

MARK ONLY ONE ITEM 1. ☐ New Construction 2. ☐ Change of Information for WDID# _____

II. PROPERTY OWNER

Name	Contact Person		
Mailing Address	Title		
City	State	Zip	Phone ( ) --

III. DEVELOPER/CONTRACTOR INFORMATION

Developer/Contractor	Contact Person		
Mailing Address	Title		
City	State	Zip	Phone ( ) --

IV. CONSTRUCTION PROJECT INFORMATION

Site/Project Name	Site Contact Person		
Physical Address/Location	Latitude °	Longitude °	County
City (or nearest City)	Zip	Site Phone Number ( ) --	Emergency Phone Number ( ) --

A. Total size of construction site area: _____ Acres

B. Total area to be disturbed: _____ Acres (% of total _____)

C. Percent of site imperviousness (including rooftops):
Before Construction: _____%
After Construction: _____%

D. Tract Number(s): _____, _____

E. Mile Post Marker: _____

F. Is the construction site part of a larger common plan of development or sale?
☐ YES ☐ NO

G. Name of plan or development:

H. Construction commencement date: ____/____/____

I. % of site to be mass graded: _____

J. Projected construction dates:
Complete grading: ____/____/____ Complete project: ____/____/____

K. Type of Construction (Check all that apply):

1. ☐ Residential 2. ☐ Commercial 3. ☐ Industrial 4. ☐ Reconstruction 5. ☐ Transportation
6. ☐ Utility Description: _____ 7. ☐ Other (Please List): _____

V. BILLING INFORMATION

SEND BILL TO:	Name	Contact Person	
☐ OWNER (as in II. above)			
☐ DEVELOPER (as in III. above)	Mailing Address	Phone/Fax	
☐ OTHER (enter information at right)	City	State	Zip

VI. REGULATORY STATUS

A. Has a local agency approved a required erosion/sediment control plan? ☐ YES ☐ NO

Does the erosion/sediment control plan address construction activities such as infrastructure and structures? ☐ YES ☐ NO

Name of local agency: _____ Phone: ( ) --

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification? ☐ YES ☐ NO

If yes, provide details: _____

VII. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☐ **Indirectly to waters of the U.S.**
2. ☐ **Storm drain system - Enter owner's name:** _____
3. ☐ **Directly to waters of U.S. (e.g. , river, lake, creek, stream, bay, ocean, etc.)**

B. Name of receiving water: (river, lake, creek, stream, bay, ocean): _____

VIII. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ____/____/____ Date Amended: ____/____/____

☐ A SWPPP will be prepared and ready for review by (enter date): ____/____/____

☐ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

B. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes. ☐ YES ☐ NO

Name: _____ Phone: ( ) --

C. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation. ☐ YES ☐ NO

Name: _____ Phone: ( ) --

2. Eliminating all unauthorized discharges. ☐ YES ☐ NO

IX. VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

Have you included a vicinity map with this submittal? ☐ YES ☐ NO

Have you included payment of the annual fee with this submittal? ☐ YES ☐ NO

X. CERTIFICATIONS

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. In addition, I certify that the provisions of the permit, including the development and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

Printed Name: _____

Signature: _____ Date: _____

Title: _____

State of California
State Water Resources Control Board

NOTICE OF TERMINATION

OF COVERAGE UNDER THE NPDES GENERAL PERMIT NO. CAS000002
FOR DISCHARGES OF STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY

Submission of this Notice of Termination constitutes notice that the owner (and his/her agent) of the site identified on this form is no longer authorized to discharge storm water associated with construction activity by NPDES General Permit No. CAS000002.

I. WDID NO. _____

II. OWNER

COMPANY NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ STATE _____ ZIP _____ PHONE _____

III. CONSTRUCTION SITE INFORMATION

A. DEVELOPER NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ CA ZIP _____ PHONE _____

B. SITE ADDRESS _____ COUNTY _____

CITY _____ CA ZIP _____ PHONE _____

IV. BASIS OF TERMINATION

_____ 1. The construction project is complete and the following conditions have been met.

- All elements of the Storm Water Pollution Prevention Plan have been completed.
- Construction materials and waste have been disposed of properly.
- The site is in compliance with all local storm water management requirements.
- A post-construction storm water operation and management plan is in place.

Date of project completion _____/_____/_____

_____ 2. Construction activities have been suspended, either temporarily _____ or indefinitely _____ and the following conditions have been met.

- All elements of the Storm Water Pollution Prevention Plan have been completed.
- Construction materials and waste have been disposed of properly.
- All denuded areas and other areas of potential erosion are stabilized.
- An operation and maintenance plan for erosion and sediment control is in place.
- The site is in compliance with all local storm water management requirements.

Date of suspension _____/_____/_____ Expected start up date _____/_____/_____

_____ 3. Site can not discharge storm water to waters of the United States (check one).

_____ All storm water is retained on site.

_____ All storm water is discharged to evaporation or percolation ponds offsite.

_____ 4. Discharge of storm water from the site is now subject to another NPDES general permit or an individual NPDES permit.

NPDES Permit No._____ Date coverage began _____/_____/_____

_____ 5. There is a new owner of the identified site. Date of owner transfer _____/_____/_____

Was the new owner notified of the General Permit requirements? YES ____ NO ____

NEW OWNER INFORMATION

COMPANY NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ STATE ____ ZIP ____ PHONE _____

V. **EXPLANATION OF BASIS OF TERMINATION** (Attach site photographs - see instructions).

VI. **CERTIFICATION:**

I certify under penalty of law that all storm water discharges associated with construction activity from the identified site that are authorized by NPDES General Permit No. CAS000002 have been eliminated or that I am no longer the owner of the site. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with construction activity under the general permit, and that discharging pollutants in storm water associated with construction activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this Notice of Termination does not release an owner from liability for any violations of the general permit or the Clean Water Act.

PRINTED NAME _____ TITLE _____

SIGNATURE: _____ DATE ____/____/____

REGIONAL WATER BOARD USE ONLY

This Notice of Termination has been reviewed, and I recommend termination of coverage under the subject NPDES general permit.

Printed Name _____ Region No. _____

Signature _____ Date _____/_____/_____

State of California
State Water Resources Control Board

INSTRUCTIONS FOR COMPLETING NOTICE OF TERMINATION FOR CONSTRUCTION ACTIVITY

Who May File

Dischargers who are presently covered under NPDES General Permit No. CAS000002 for discharge of storm water associated with construction activity may submit a Notice of Termination when they meet one of the following criteria.

1. The construction project has been completed and the following conditions have been met: all elements of the Stormwater Pollution Prevention Plan have been completed; construction materials and equipment maintenance waste have been disposed of properly; the site is in compliance with all local storm water management requirements including erosion/sediment control requirements and the appropriate use permits have been obtained; and a post-construction storm water operation and management plan is in place.

2. Construction activities have been suspended, either temporarily or indefinitely and the following conditions have been: all elements of the Stormwater Pollution Prevention Plan have been completed; construction materials and equipment maintenance waste have been disposed of properly; all denuded areas and other areas of potential erosion are stabilized; an operation and maintenance plan for erosion and sediment control is in place; and the site is in compliance with all local storm water management requirements including erosion/sediment control requirements. The date construction activities were suspended, and the expected date construction activities will start up again should be provided.

3. Construction site can not discharge storm water to waters of the United States. Please indicate if all storm water is retained on site or if storm water is collected offsite.

4. Discharge of construction storm water from the site is now subject to another NPDES general permit or an individual NPDES permit. The general permit or individual permit NPDES number and date coverage began should be provided.

5. There is a new owner of the identified site. If ownership or operation of the facility has been transferred then the previous owner must submit a Notice of Termination and the new owner must submit a Notice of Intent for coverage under the general permit. The date of transfer and information on the new owner should be provided. Note that the previous owner may be liable for discharge from the site until the new owner files a Notice of Intent for coverage under the general permit.

Where to File

The Notice of Termination should be submitted to the Executive Officer of the Regional Water Board responsible for the area in which the facility is located. See attached. If the Executive Officer, or his designated staff, agrees with the basis of termination, the Notice of Termination will be transmitted to the State Water Board for processing. If the Executive Officer, or his designated staff, does not agree with the basis of termination, the Notice of Termination will be returned. The Regional Water Board may also inspect your site prior to accepting the basis of termination.

LINE-BY-LINE INSTRUCTIONS

All necessary information must be provided on the form. Type or print in the appropriate areas only. Submit additional information, if necessary, on a separate sheet of paper.

SECTION I--WDID NO.

The WDID No. is a number assigned to each discharger covered under the General Permit. If you do not know your WDID No., please call the State Water Board or Regional Water Board and request it prior to submittal of the Notice of Termination.

SECTION II--OWNER

Enter the owner of the construction site's official or legal name (This should correspond with the name on the Notice of Intent submitted for the site), address of the owner, contact person, and contact person's title and telephone number.

SECTION III--CONSTRUCTION SITE INFORMATION

In Part A, enter the name of the developer (or general contractor), address, contact person, and contact person's title and telephone number. The contact person should be the construction site manager completely familiar with the construction site and charged with compliance and oversight of the general permit. This information should correspond with information on the Notice of Intent submitted for the site.

In Part B, enter the address, county, and telephone number (if any) of the construction site. Construction sites that do not have a street address must attach a legal description of the site.

SECTION IV--BASIS OF TERMINATION

Check the category which best defines the basis of your termination request. See the discussion of the criteria in the Who May File section of these instructions. Provide dates and other information requested. Use the space under Explanation of Basis of Termination heading.

SECTION V--EXPLANATION OF BASIS OF TERMINATION

Please explain the basis or reasons why you believe your construction site is not required to comply with the General Permit. To support your explanation, provide a site map and photograph of your site.

SECTION VI--CERTIFICATION

This section must be completed by the owner of the site.

The Notice of Termination must be signed by:

For a Corporation: a responsible corporate officer

For a Partnership or Sole Proprietorship: a general partner or the proprietor, respectively.

For a Municipality, State, or other Non-Federal Public Agency: either a principal executive officer or ranking elected official.

For a Federal Agency: either the chief or senior executive officer of the agency.

CONSTRUCTION NOI

1. **How do I know if I need this permit?**
Discharges of storm water associated with construction activity (storm water discharges) that results in the disturbance of five acres or more of total land area or which is a part of a larger common area of development or sale must be permitted. Construction activity includes clearing, grading, excavation, and reconstruction of existing facilities involving removal and replacement. Construction activity does not include routine maintenance maintain original line and grade, hydraulic capacity, or original purpose of the facility.

2. **Who must apply?**
The owner of the land where the construction activity is occurring is responsible for obtaining a permit. Owners may obtain coverage under the General Storm Water Permit to Discharge Storm Water Associated With Construction Activity (General Permit) by filing a NOI in accordance with the following instructions. Coverage for construction activity conducted on easements (e.g., pipeline construction), or on nearby properties by agreement or permission, shall be obtained by the entity responsible for the construction activity.

3. **Are there other requirements when applying for this permit?**
Storm water discharges in the Lake Tahoe Hydrologic Unit will be regulated by a separate permit(s) adopted by the California Regional Water Quality Control Board, Lahontan Region, and may not seek coverage under the State Water Board's general permit. Storm water discharges on Indian lands will be regulated by the U.S. Environmental Protection Agency.

4. **What is the application fee?**
The current annual fee is $250.00 for each construction site which discharges into a municipal separate storm sewer system regulated by an areawide urban storm water permit and $500.00 for all other construction sites.

5. **Where is the Primary Permit Location?**
The NOI should be mailed to the State Water Resources Control Board at the following address:

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

6. **What are the timelines for applications/renewals?**

Owners of ongoing construction must file a NOI, along with the appropriate annual fee, by September 30, 1992. Owners of new construction (those beginning construction after September 30, 1992) must file a NOI prior to the commencement of construction. For ongoing construction activity involving a change of ownership, the new owner must submit a new NOI within 30 days of the date of change of ownership. Preferably, the NOI should be sent with the revocation prepared by the previous owner.

7. **What is the annual fee?**
The annual fee will be pro-rated in the second year to account for any overpayment from the application fee. Otherwise the annual fee is the same as the application fee.

8. **How long is this permit in effect?**
Your coverage under the general permit is in effect until you submit a Notice Of Termination (NOT) along with the accompanying information.

9. How can I avoid the most common mistakes made in applying for this permit?

10. What are the regulations that apply to this permit? Where can I get copies?

11. **Questions? Call....**
If you have any questions on completing the NOI after reading the following line-by-line instructions, please call us at (916) 657-1146.

AREAS OF THE STATE IN WHICH THE $250.00 ANNUAL FEE APPLIES

Alameda County: The entire county except for the area east of **Altamont Pass**.

Contra Costa County: The entire county.

El Dorado County: The area draining into **Lake Tahoe**.

Fresno County: The cities of **Clovis** and **Fresno** and unincorporated areas for the County within the city limits of **Fresno/Clovis**.

Kern County: The city of **Bakersfield** and unincorporated areas of the County within the city limits.

Los Angeles County: The entire county except for the cities of **Avalon, Lancaster, Palmdale**, and areas with zip codes 93523, 93534, 93535, 93536, 93543, 93544, 93550, 93551, 93553, 93560, and 93563.

Orange County: The entire county.

Placer County: The area draining into **Lake Tahoe**.

Riverside County: The entire county except for the area east of the **Santa Ana Regional Board** boundary line (this area is east of the mountain crest and does not drain into the Pacific Ocean) and the **Coachella Valley**.

Sacramento County: The entire county except for the city of **Isleton**.

San Bernardino County: The entire county except for the area north and east of the **Santa Ana Regional Board** boundary line (this area is north and east of the mountain crest and does not drain into the Pacific Ocean).

San Diego County: The entire county except for the area east of the **San Diego Regional Board** boundary line (this area is east of the mountain crest and does not drain into the Pacific Ocean).

San Mateo County: The entire county.

Santa Clara County: The entire county except for the area south of and including the city of **Morgan Hill** (this area does not drain into **South San Francisco Bay**).

Solano County: The cities of **Fairfield, Suisun City and Vallejo City**

Sonoma County: The city of **Santa Rosa**.

Stanislaus County: The city of **Modesto** and unincorporated areas within the city limits.

Ventura County: The entire county.

ATTACHMENT 3

303d Listed Water Bodies for Sedimentation

REGION	WATER BODY NAME	CODE	POLLUTANT
1	MATTOLE RIVER	1100	Sedimentation/Siltation
1	TRINITY RIVER, SOUTH FORK	1100	Sedimentation/Siltation
1	REDWOOD CREEK	1100	Sedimentation/Siltation
1	MAD RIVER	1100	Sedimentation/Siltation
1	ELK RIVER	1100	Sedimentation/Siltation
1	EEL RIVER, SOUTH FORK	1100	Sedimentation/Siltation
1	EEL RIVER, NORTH FORK	1100	Sedimentation/Siltation
1	TRINITY RIVER	1100	Sedimentation/Siltation
1	EEL RIVER, MIDDLE FORK	1100	Sedimentation/Siltation
1	MAD RIVER	2500	Turbidity
1	TEN MILE RIVER	1100	Sedimentation/Siltation
1	NOYO RIVER	1100	Sedimentation/Siltation
1	BIG RIVER	1100	Sedimentation/Siltation
1	ALBION RIVER	1100	Sedimentation/Siltation
1	NAVARRO RIVER	1100	Sedimentation/Siltation
1	GARCIA RIVER	1100	Sedimentation/Siltation
1	GUALALA RIVER	1100	Sedimentation/Siltation
1	RUSSIAN RIVER	1100	Sedimentation/Siltation
1	TOMKI CREEK	1100	Sedimentation/Siltation
1	VAN DUZEN RIVER	1100	Sedimentation/Siltation
1	EEL RIVER DELTA	1100	Sedimentation/Siltation
1	EEL RIVER, MIDDLE MAIN FORK	1100	Sedimentation/Siltation
1	ESTERO AMERICANO	1100	Sedimentation/Siltation
1	NAVARRO RIVER DELTA	1100	Sedimentation/Siltation
1	EEL RIVER, UPPER MAIN FORK	1100	Sedimentation/Siltation
1	FRESHWATER CREEK	1100	Sedimentation/Siltation
1	SCOTT RIVER	1100	Sedimentation/Siltation
2	TOMALES BAY	1100	Sedimentation/Siltation
2	NAPA RIVER	1100	Sedimentation/Siltation
2	SONOMA CREEK	1100	Sedimentation/Siltation
2	PETALUMA RIVER	1100	Sedimentation/Siltation
2	LAGUNITAS CREEK	1100	Sedimentation/Siltation
2	WALKER CREEK	1100	Sedimentation/Siltation

2	SAN GREGORIO CREEK	1100	Sedimentation/Siltation
2	SAN FRANCISQUITO CREEK	1100	Sedimentation/Siltation
2	PESCADERO CREEK (REG 2)	1100	Sedimentation/Siltation
2	BUTANO CREEK	1100	Sedimentation/Siltation
3	MORRO BAY	1100	Sedimentation/Siltation
3	SAN LORENZO RIVER ESTUARY	1100	Sedimentation/Siltation
3	SHINGLE MILL CREEK	1100	Sedimentation/Siltation
3	MOSS LANDING HARBOR	1100	Sedimentation/Siltation
3	WATSONVILLE SLOUGH	1100	Sedimentation/Siltation
3	SAN LORENZO RIVER	1100	Sedimentation/Siltation
3	ELKHORN SLOUGH	1100	Sedimentation/Siltation
3	SALINAS RIVER LAGOON (NORTH)	1100	Sedimentation/Siltation
3	GOLETA SLOUGH/ESTUARY	1100	Sedimentation/Siltation
3	CARPINTERIA MARSH (EL ESTERO MARSH)	1100	Sedimentation/Siltation
3	LOMPICO CREEK	1100	Sedimentation/Siltation
3	MORO COJO SLOUGH	1100	Sedimentation/Siltation
3	VALENCIA CREEK	1100	Sedimentation/Siltation
3	PAJARO RIVER	1100	Sedimentation/Siltation
3	RIDER GULCH CREEK	1100	Sedimentation/Siltation
3	LLAGAS CREEK	1100	Sedimentation/Siltation
3	SAN BENITO RIVER	1100	Sedimentation/Siltation
3	SALINAS RIVER	1100	Sedimentation/Siltation
3	CHORRO CREEK	1100	Sedimentation/Siltation
3	LOS OSOS CREEK	1100	Sedimentation/Siltation
3	SANTA YNEZ RIVER	1100	Sedimentation/Siltation
3	SAN ANTONIO CREEK (SANTA BARBARA COUNTY)	1100	Sedimentation/Siltation
3	CARBONERA CREEK	1100	Sedimentation/Siltation
3	SOQUEL LAGOON	1100	Sedimentation/Siltation
3	APTOS CREEK	1100	Sedimentation/Siltation
4	MUGU LAGOON	1100	Sedimentation/Siltation
5	HUMBUG CREEK	1100	Sedimentation/Siltation
5	PANOCHE CREEK	1100	Sedimentation/Siltation
5	FALL RIVER (PIT)	1100	Sedimentation/Siltation
6	BEAR CREEK (R6)	1100	Sedimentation/Siltation
6	MILL CREEK (3)	1100	Sedimentation/Siltation
6	HORSESHOE LAKE (2)	1100	Sedimentation/Siltation

6	BRIDGEPORT RES	1100	Sedimentation/Siltation
6	TOPAZ LAKE	1100	Sedimentation/Siltation
6	LAKE TAHOE	1100	Sedimentation/Siltation
6	PINE CREEK (2)	1100	Sedimentation/Siltation
6	TRUCKEE RIVER	1100	Sedimentation/Siltation
6	CLEARWATER CREEK	1100	Sedimentation/Siltation
6	GRAY CREEK (R6)	1100	Sedimentation/Siltation
6	WARD CREEK	1100	Sedimentation/Siltation
6	BLACKWOOD CREEK	1100	Sedimentation/Siltation
6	GOODALE CREEK	1100	Sedimentation/Siltation
6	EAST WALKER RIVER	1100	Sedimentation/Siltation
6	HEAVENLY VALLEY CREEK	1100	Sedimentation/Siltation
6	WOLF CREEK (1)	1100	Sedimentation/Siltation
6	WEST WALKER RIVER	1100	Sedimentation/Siltation
6	HOT SPRINGS CANYON CREEK	1100	Sedimentation/Siltation
6	BRONCO CREEK	1100	Sedimentation/Siltation
6	SQUAW CREEK	1100	Sedimentation/Siltation
7	IMPERIAL VALLEY DRAINS	1100	Sedimentation/Siltation
7	NEW RIVER (R7)	1100	Sedimentation/Siltation
7	ALAMO RIVER	1100	Sedimentation/Siltation
8	SAN DIEGO CREEK, REACH 1	1100	Sedimentation/Siltation
8	RATHBONE (RATHBUN) CREEK	1100	Sedimentation/Siltation
8	SAN DIEGO CREEK, REACH 2	1100	Sedimentation/Siltation
8	UPPER NEWPORT BAY ECOLOGICAL RESERVE	1100	Sedimentation/Siltation
8	BIG BEAR LAKE	1100	Sedimentation/Siltation
8	ELSINORE, LAKE	1100	Sedimentation/Siltation
9	SAN ELIJO LAGOON	1100	Sedimentation/Siltation
9	LOS PENASQUITOS LAGOON	1100	Sedimentation/Siltation
9	AGUA HEDIONDA LAGOON	1100	Sedimentation/Siltation
9	BUENA VISTA LAGOON	1100	Sedimentation/Siltation

NEW OWNER INFORMATION AND CHANGE OF INFORMATION (COI) FORM FOR THE GENERAL CONSTRUCTION PERMIT NO. CAS000002

Owners Name: _____ Date: _____

WDID No.: _____ Date of Last NOI Change: _____

Prepared By: _____ Signature of Preparer: _____

	Area Transferred (acres)[1] column 1	Area Remaining (acres)[2] column 2	Lot/Tract Numbers Transferred	Contact Person and Company Name of NewOwner(s)	Address(es) of the New Owner(s)	Phone # of New Owner	Is Const/Post Construction Complete? Yes/No	Date of Ownership Transfer
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

[1]Use approximate area (in acres) if no exact figure is available.

[2]Calculate running total in this column as follows:

Enter in column 2, line 1, the area from NOI minus the area in column 1.

Enter in column 2, line 2, the area in column 2, line 1, minus the area in line 2, column 1.

Enter in column 2, line 3, the area in column 2, line 2, minus the area in line 3, column 1, and so forth.

SUMMARY OF
IMPORTANT REVISIONS
GENERAL CONSTRUCTION STORM WATER PERMIT

DRAFT PERMIT	REVISED DRAFT PERMIT
Non-Storm Water Discharges	
Specifically states that non-storm water BMPs be implemented year-round. Provides better discussion of compliance concerning non-storm water discharges.	Same expanded discussion of non-storm water BMPs with the addition of requiring filtration for dewatering sediment basins in instances which could cause or contribute to an exceedance of the applcable RWQCB's Basin Plan.
Storm Water Pollution Prevention Plan (SWPPP)	
Specifies that a new owner may maintain the SWPPP only if it is current and applicable; otherwise it must be amended or redone.	Provides a time frame for SWPPP revision
Provides more specific requirements for SWPPP. Erosion control BMPs are to be described separately from sediment control BMPs. Design storms were specified for both erosion control BMPs and sediment control BMPs.	Design storm criteria has been removed for erosion control BMPs and minor sediment control BMPs. Trapping efficiency performance standards are specified for sediment basin design and maintenance pursuant to either local county ordinance, EPA criteria, standard surface area equation, or equivalent method. The 10-year, 6-hour rain event is specified for the standard equation design.
The term "final stabilization" is defined.	"Final stabilization" is defined, options for equivalent stabilization measures are discussed.
Post-construction language is broadened to include construction design decisions.	Post construction language has been altered to exclude design decisions, but addresses irrigation systems, illegal connections to storm drains, and down-stream effects from diverted flows.
Receiving Water Limitations Language	
Contains the same general narrative language as the 1992 permit, but also specifies a process to be followed if the permittee determines that their storm water discharges are causing or contributing to the exceedance of an applicable water quality standard	Same with minor changes.
Monitoring Program	
Requires inspections before and after storm events and every 24 hours during extended storm events.	Requires inspections before and after storm events and every 24 hours during extended storm events with language addressing safety considerations for entry following storms.
Minimum inspection requirements are listed. A sample inspection form has been developed as guidance.	The inspection form has been altered to reflect safety considerations.
Termination	
Allows and provides a mechanism to terminate or add coverage for parcels or tracts sold or transferred	Termination language in permit is minimal. Guidance will be developed to address mechanism for information changes such as sales or tranfers.

APPENDIX F

Copy of Notice of Termination Form

State of California
State Water Resources Control Board

NOTICE OF TERMINATION

OF COVERAGE UNDER THE NPDES GENERAL PERMIT NO. CAS000002
FOR DISCHARGES OF STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY

Submission of this Notice of Termination constitutes notice that the owner (and his/her agent) of the site identified on this form is no longer authorized to discharge storm water associated with construction activity by NPDES General Permit No. CAS000002.

I. WDID NO. _____

II. OWNER

COMPANY NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ STATE _____ ZIP _____ PHONE _____

III. CONSTRUCTION SITE INFORMATION

A. DEVELOPER NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ CA ZIP _____ PHONE _____

B. SITE ADDRESS _____ COUNTY _____

CITY _____ CA ZIP _____ PHONE _____

IV. BASIS OF TERMINATION

_____ 1. The construction project is complete and the following conditions have been met.

- All elements of the Storm Water Pollution Prevention Plan have been completed.
- Construction materials and waste have been disposed of properly.
- The site is in compliance with all local storm water management requirements.
- A post-construction storm water operation and management plan is in place.

Date of project completion _____/_____/_____

_____ 2. Construction activities have been suspended, either temporarily _____ or indefinitely _____ and the following conditions have been met.

- All elements of the Storm Water Pollution Prevention Plan have been completed.
- Construction materials and waste have been disposed of properly.
- All denuded areas and other areas of potential erosion are stabilized.
- An operation and maintenance plan for erosion and sediment control is in place.
- The site is in compliance with all local storm water management requirements.

Date of suspension _____/_____/_____ Expected start up date _____/_____/_____

_____ 3. Site can not discharge storm water to waters of the United States (check one).

_____ All storm water is retained on site.

_____ All storm water is discharged to evaporation or percolation ponds offsite.

_____ 4. Discharge of storm water from the site is now subject to another NPDES general permit or an individual NPDES permit.

NPDES Permit No._____ Date coverage began _____/_____/_____

_____ 5. There is a new owner of the identified site. Date of owner transfer _____/_____/_____

Was the new owner notified of the General Permit requirements? YES ____ NO ____

NEW OWNER INFORMATION

COMPANY NAME _____ CONTACT PERSON _____

STREET ADDRESS _____ TITLE _____

CITY _____ STATE _____ ZIP _____ PHONE _____

V. **EXPLANATION OF BASIS OF TERMINATION** (Attach site photographs - see instructions).

VI. CERTIFICATION:

I certify under penalty of law that all storm water discharges associated with construction activity from the identified site that are authorized by NPDES General Permit No. CAS000002 have been eliminated or that I am no longer the owner of the site. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with construction activity under the general permit, and that discharging pollutants in storm water associated with construction activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this Notice of Termination does not release an owner from liability for any violations of the general permit or the Clean Water Act.

PRINTED NAME _____ TITLE _____

SIGNATURE: _____ DATE ____/____/____

REGIONAL WATER BOARD USE ONLY

This Notice of Termination has been reviewed, and I recommend termination of coverage under the subject NPDES general permit.

Printed Name _____ Region No. _____

Signature _____ Date _____/_____/_____

State of California
State Water Resources Control Board

INSTRUCTIONS FOR COMPLETING NOTICE OF TERMINATION FOR CONSTRUCTION ACTIVITY

Who May File

Dischargers who are presently covered under NPDES General Permit No. CAS000002 for discharge of storm water associated with construction activity may submit a Notice of Termination when they meet one of the following criteria.

1. The construction project has been completed and the following conditions have been met: all elements of the Stormwater Pollution Prevention Plan have been completed; construction materials and equipment maintenance waste have been disposed of properly; the site is in compliance with all local storm water management requirements including erosion/sediment control requirements and the appropriate use permits have been obtained; and a post-construction storm water operation and management plan is in place.

2. Construction activities have been suspended, either temporarily or indefinitely and the following conditions have been: all elements of the Stormwater Pollution Prevention Plan have been completed; construction materials and equipment maintenance waste have been disposed of properly; all denuded areas and other areas of potential erosion are stabilized; an operation and maintenance plan for erosion and sediment control is in place; and the site is in compliance with all local storm water management requirements including erosion/sediment control requirements. The date construction activities were suspended, and the expected date construction activities will start up again should be provided.

3. Construction site can not discharge storm water to waters of the United States. Please indicate if all storm water is retained on site or if storm water is collected offsite.

4. Discharge of construction storm water from the site is now subject to another NPDES general permit or an individual NPDES permit. The general permit or individual permit NPDES number and date coverage began should be provided.

5. There is a new owner of the identified site. If ownership or operation of the facility has been transferred then the previous owner must submit a Notice of Termination and the new owner must submit a Notice of Intent for coverage under the general permit. The date of transfer and information on the new owner should be provided. Note that the previous owner may be liable for discharge from the site until the new owner files a Notice of Intent for coverage under the general permit.

Where to File

The Notice of Termination should be submitted to the Executive Officer of the Regional Water Board responsible for the area in which the facility is located. See attached. If the Executive Officer, or his designated staff, agrees with the basis of termination, the Notice of Termination will be transmitted to the State Water Board for processing. If the Executive Officer, or his designated staff, does not agree with the basis of termination, the Notice of Termination will be returned. The Regional Water Board may also inspect your site prior to accepting the basis of termination.

LINE-BY-LINE INSTRUCTIONS

All necessary information must be provided on the form. Type or print in the appropriate areas only. Submit additional information, if necessary, on a separate sheet of paper.

SECTION I--WDID NO.

The WDID No. is a number assigned to each discharger covered under the General Permit. If you do not know your WDID No., please call the State Water Board or Regional Water Board and request it prior to submittal of the Notice of Termination.

SECTION II--OWNER

Enter the owner of the construction site's official or legal name (This should correspond with the name on the Notice of Intent submitted for the site), address of the owner, contact person, and contact person's title and telephone number.

SECTION III--CONSTRUCTION SITE INFORMATION

In Part A, enter the name of the developer (or general contractor), address, contact person, and contact person's title and telephone number. The contact person should be the construction site manager completely familiar with the construction site and charged with compliance and oversight of the general permit. This information should correspond with information on the Notice of Intent submitted for the site.

In Part B, enter the address, county, and telephone number (if any) of the construction site. Construction sites that do not have a street address must attach a legal description of the site.

SECTION IV--BASIS OF TERMINATION

Check the category which best defines the basis of your termination request. See the discussion of the criteria in the Who May File section of these instructions. Provide dates and other information requested. Use the space under Explanation of Basis of Termination heading.

SECTION V--EXPLANATION OF BASIS OF TERMINATION

Please explain the basis or reasons why you believe your construction site is not required to comply with the General Permit. To support your explanation, provide a site map and photograph of your site.

SECTION VI--CERTIFICATION

This section must be completed by the owner of the site.

The Notice of Termination must be signed by:

For a Corporation: a responsible corporate officer

For a Partnership or Sole Proprietorship: a general partner or the proprietor, respectively.

For a Municipality, State, or other Non-Federal Public Agency: either a principal executive officer or ranking elected official.

For a Federal Agency: either the chief or senior executive officer of the agency.

Storm Water Treatment Certification

FORM **P2**

Site Name and Address

CITY OF PASADENA WATER & POWER DEPT.
43 & 85 E. STATE STREET
PASADENA, CA 91105

Approximate Project* Characteristics

Roofed Area	12,000 sq. ft.
Roadway/Parking Area (exposed)	42,000 sq. ft.
Landscaped/Vegetation	10,000 sq. ft.
Other Ground Level Impervious Areas (Ex: outdoor work or storage areas)	81,250 sq. ft.
Other: (describe)	sq. ft.
Total:	145,750 sq. ft.

Structural/Treatment BMP's

Area Designation (must correspond to designation on plans)	Area (Square Feet)	Average Impervious Factor	Estimated Runoff from 0.2" Rainfall	Anticipated Potential Pollutants	Type of BMP (Include model number if any)	BMP Location (Briefly describe)	Design Treatment Capacity	Design Overflow or Bypass Capacity
CB-1 (DWG.04)	2250	.98	37	Oil & Grease Sediments Floatables	Ultra Drain Guard Oil & Sediment Model # 9222 *	Inside Catch Basin		
CB-2 (DWG.04)	5375	.98	88	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-3 (DWG.04)	3200	1.0	53	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-4 (DWG.04)	2025	1.0	34	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		

Attach additional sheets as necessary.

Total Project Area: sq. ft.

* If project alters 50% or more of the existing site, the total area subject to treatment must equal that of the entire site.

* See Attached detail sheet.

Affix Registered Engineer Wet Ink Stamp Here.

I certify that I am a Professional Engineer or Licensed Architect registered in the State of California, and that the treatment methods and capacities herein comply with the requirements established by the California Regional Water Quality Control Board, Los Angeles Region, and the State Water Resources Control Board for Standard Urban Stormwater Mitigation Plans (SUSMP).

REGISTERED PROFESSIONAL ENGINEER ★ ERIC D. SOSNOWSKI ★ No. 45056 Exp. 3/31/06 CIVIL ★ STATE OF CALIFORNIA ★

Eric D. Sosnowski
Print Name

Eric D. Sosnowski
Signature

02/03/03
Date

Storm Water Treatment Certification

FORM **P2**

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43 & 85 E. STATE STREET
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CB-5 (DWG.04)	5525	1.0	92	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222 *	Inside Catch Basin		
CB-6 (DWG.03)	9000	0.4	60	Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-7 (DWG.03)	4250	1.0	68	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-8 (DWG.03)	5400	0.4	36	Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		

Attach additional sheets as necessary.

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Eric D. Sosnowski
Print Name

Eric D Sosnowski
Signature

02/03/03
Date

Storm Water Treatment Certification

FORM **P2**

Site Name and Address

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43 & 85 E. STATE STREET
PASADENA, CA 91105

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CB-9 (DWG.03)	8460	1.0	141	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222 *	Inside Catch Basin		
CB-10 (DWG.03)	15,400	1.0	257	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-11 (DWG.04)	8025	1.0	134	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-12 (DWG.03)	3150	1.0	53	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		

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Eric D. Sosnowski
Print Name

Eric D Sosnowski
Signature

02/03/03
Date

REGISTERED PROFESSIONAL ENGINEER
ERIC D. SOSNOWSKI
No. 45056
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

Storm Water Treatment Certification

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CB-13 (DWG.04)	900	1.0	15	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222 *	Inside Catch Basin		
CB-14 (DWG.06)	1100	.97	18	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-15 (DWG.04)	1400	1.0	23	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-16 (DWG.04)	1500	1.0	25	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		

Attach additional sheets as necessary.

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REGISTERED PROFESSIONAL ENGINEER
ERIC D. SOSNOWSKI
No. 45056
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

Eric D. Sosnowski
Print Name

Eric D. Sosnowski
Signature

02/03/03
Date

Storm Water Treatment Certification

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43 & 85 E. STATE STREET
PASADENA, CA 91105

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CB-17 (DWG.04)	4800	1.0	80	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222 *	Inside Catch Basin		
CB-18 (DWG.07)	9000	.96	144	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-19 (DWG.08)	12,075	.96	193	Oil & Grease Sediments Ammonia	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-20 (DWG.07)	1800	.96	29	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		

Attach additional sheets as necessary.

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Eric D. Sosnowski
Print Name

Eric D Sosnowski
Signature

02/03/03
Date

REGISTERED PROFESSIONAL ENGINEER
ERIC D. SOSNOWSKI
No. 45056
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

Storm Water Treatment Certification

FORM **P2**

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43 & 85 E. STATE STREET
PASADENA, CA 91105

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CB-21 (DWG.07)	1650	.96	26	Oil & Grease Sediments pH, COD, Toxics	Ultra Drain* Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-22 (DWG.07)	9400	.96	150	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
CB-23 (DWG.08)	1950	.96	20	Oil & Grease Sediments	Ultra Drain Guard Oil & Sediment Model # 9222	Inside Catch Basin		
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Attach additional sheets as necessary.

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REGISTERED PROFESSIONAL ENGINEER
ERIC D. SOSNOWSKI
No. 45056
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

Eric D. Sosnowski
Print Name

Eric D Sosnowski
Signature

02/03/03
Date

Strom Water Treatment Certification

City of Pasadena Water and Power Department

Power Plant Upgrade

43 and 85 E. State Street, Pasadena, CA 91105

February 3, 2003

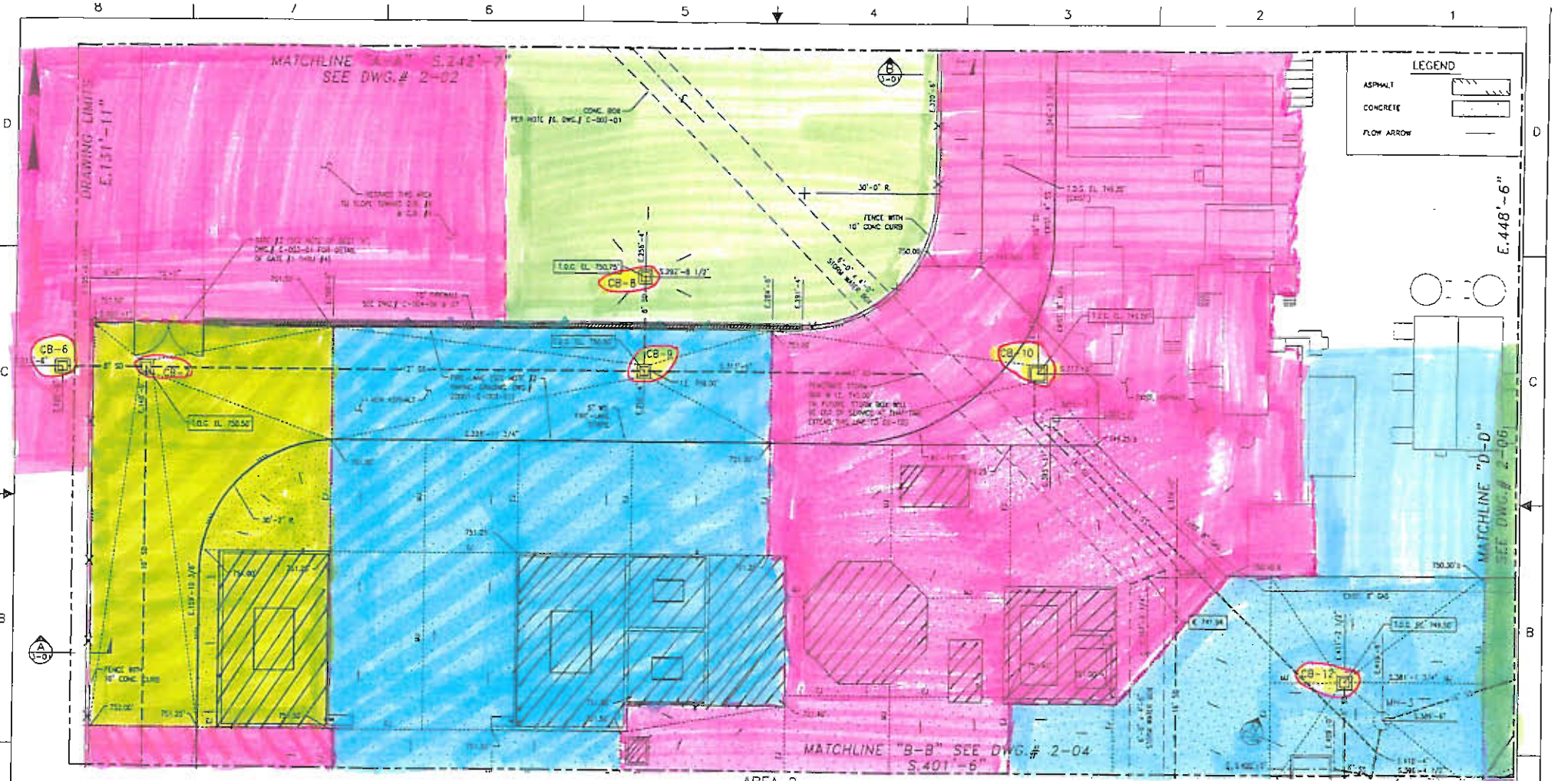
Notes associated with Form P2 :

1) The drawings exhibit cross-hatched areas, which delineate pieces of equipment. Each piece of equipment has a self-contained rainwater collection pan to contain water that falls on the equipment. The collected water is then discharged through piping into an oil/water separator. The wastewater from the oil/water separator is discharged into a sanitary outfall permitted by the County Sanitation District of Los Angeles County. The separated products will be disposed off-site.

2) A filtration device will be installed in each storm water catch basin. This filter will prevent sediments and oil /grease from entering the storm drain catch basin. The device will be inspected and maintained in accordance with the manufacturer's instructions. The device is Ultra Drain Guard – for Oil and Sediment, Model#9222. A manufacturer's data sheet has been included as an attachment to the SUSMP.

3) General site grading across the facility will be established in a manner such that storm water runoff will not leave the site. All site areas drain to existing or new storm drain catch basins, where the identified BMP will be in place.

4) There is no significance to the color scheme utilized on the drawings, except to delineate the areas serviced by each storm drain catch basin identified.



AREA 2
PLAN
SCALE 1" = 10'-0"

FOR APPROVAL
12-12-02

REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. S 003725
12/10/02
STRUCTURAL
STATE OF CALIFORNIA

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-01	CIVIL KEY PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:
1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS
PROJ. NO 2115
FILE NAME 20001c002-03.dwg
XREF DWG

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
F	ISSUED FOR APPROVAL	JLG	12/12/02	P.L.E	Y.H.	
E	ISSUED FOR APPROVAL	JLG	11/22/02		Y.H.	
D	ISSUED FOR BID	JLG	9/23/02		Y.H.	
C	ISSUED FOR APPROVAL	JLG	9/9/02		JLG	
B	ISSUED FOR BID	JLG	8/30/02		JLG	
A	ISSUED FOR REVIEW	JLG	8/12/02		JLG	

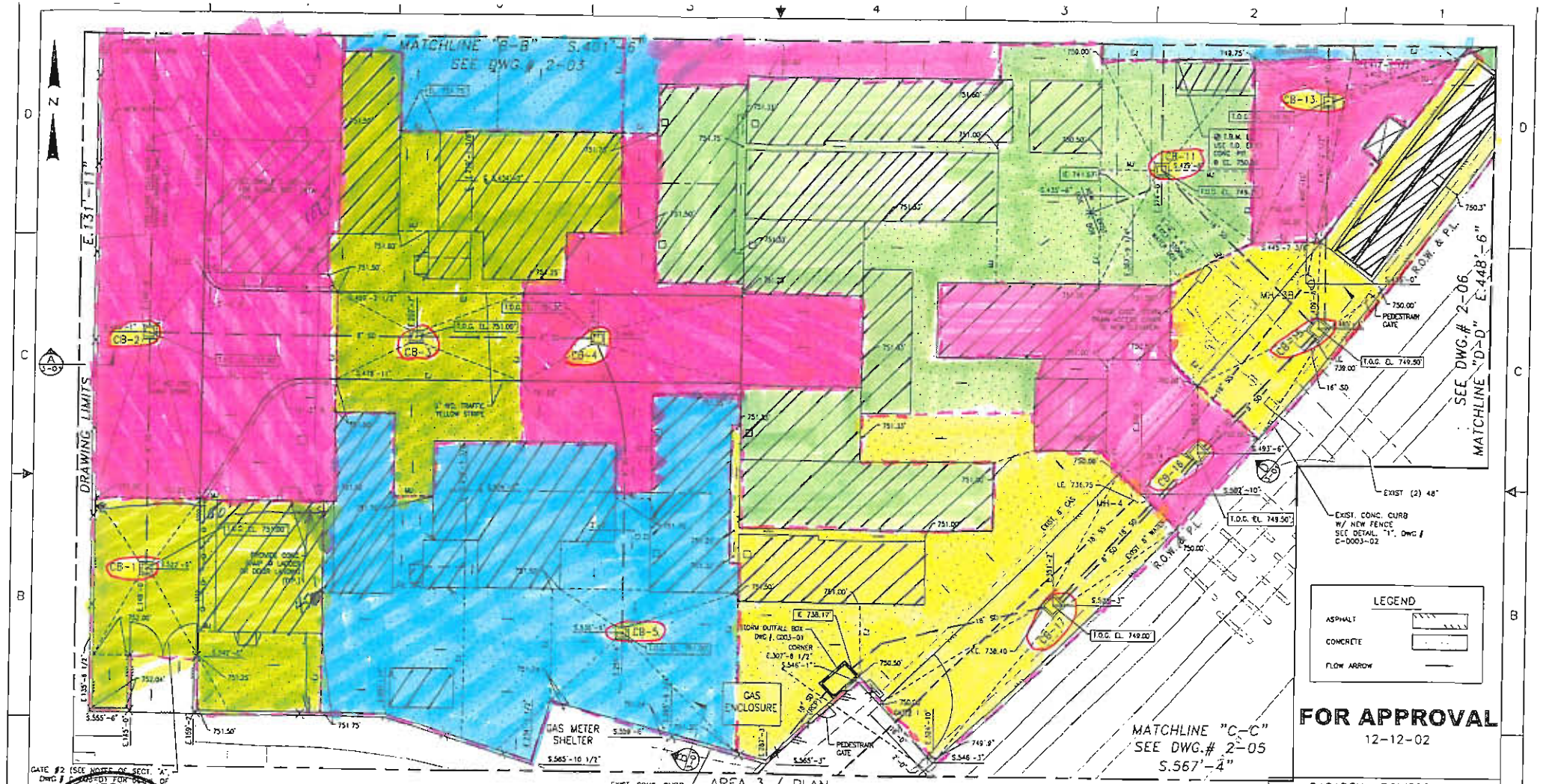
PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.
WORK ORDER NO 20001

TITLE
AREA 2
CIVIL PLAN PAVING / GRADING & U.G SEWER

DWG NO.
20001-C-002-03

SCALE 1"=10'-0" SHEET OF



REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. S 003725
12/10/02
STRUCTURAL
STATE OF CALIFORNIA

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-01	CIVIL KEY PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:
1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES

CHEMIC ENGINEERS

PROJ NO: 2115
FILE NAME: 20001-C002-04.dwg
XREF DWG:

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REVISIONS

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D	ISSUED FOR BID	JLG	9/23/02			Y.H.
C	ISSUED FOR APPROVAL	JLG	9/9/02			JLG
B	ISSUED FOR BID	JLG	8/30/02			JLG
A	ISSUED FOR REVIEW	JLG	8/12/02			JLG

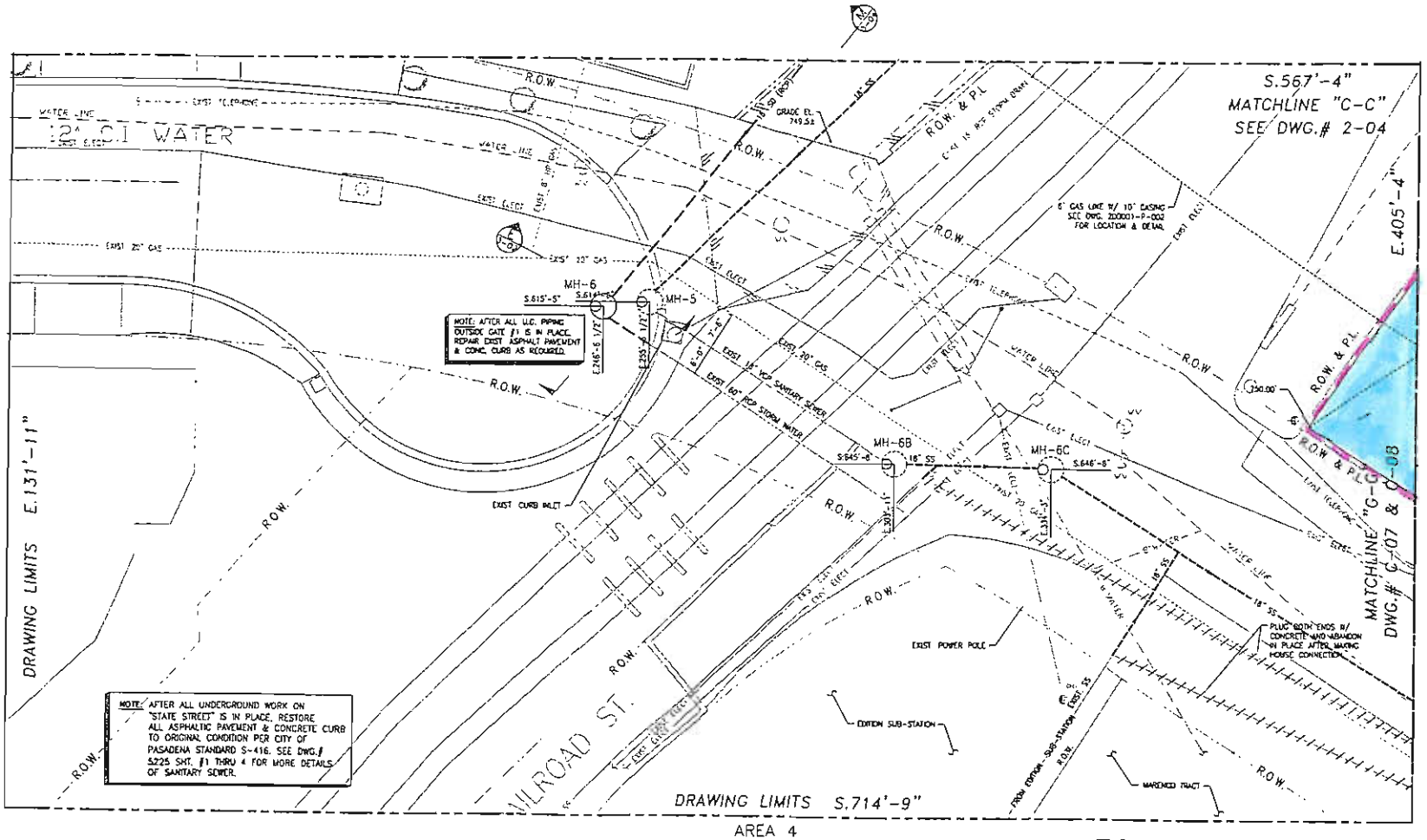
PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE: AREA 3 CIVIL PLAN PAVING / GRADING & U.G. SEWER

DWG NO: 20001-C-002-04



AREA 4

PLAN

SCALE: 1" = 10'-0"

FOR APPROVAL

12-12-02

REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. 6 003725
12/12/02
STRUCTURAL
STATE OF CALIFORNIA

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20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:

1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c002-05.dwg
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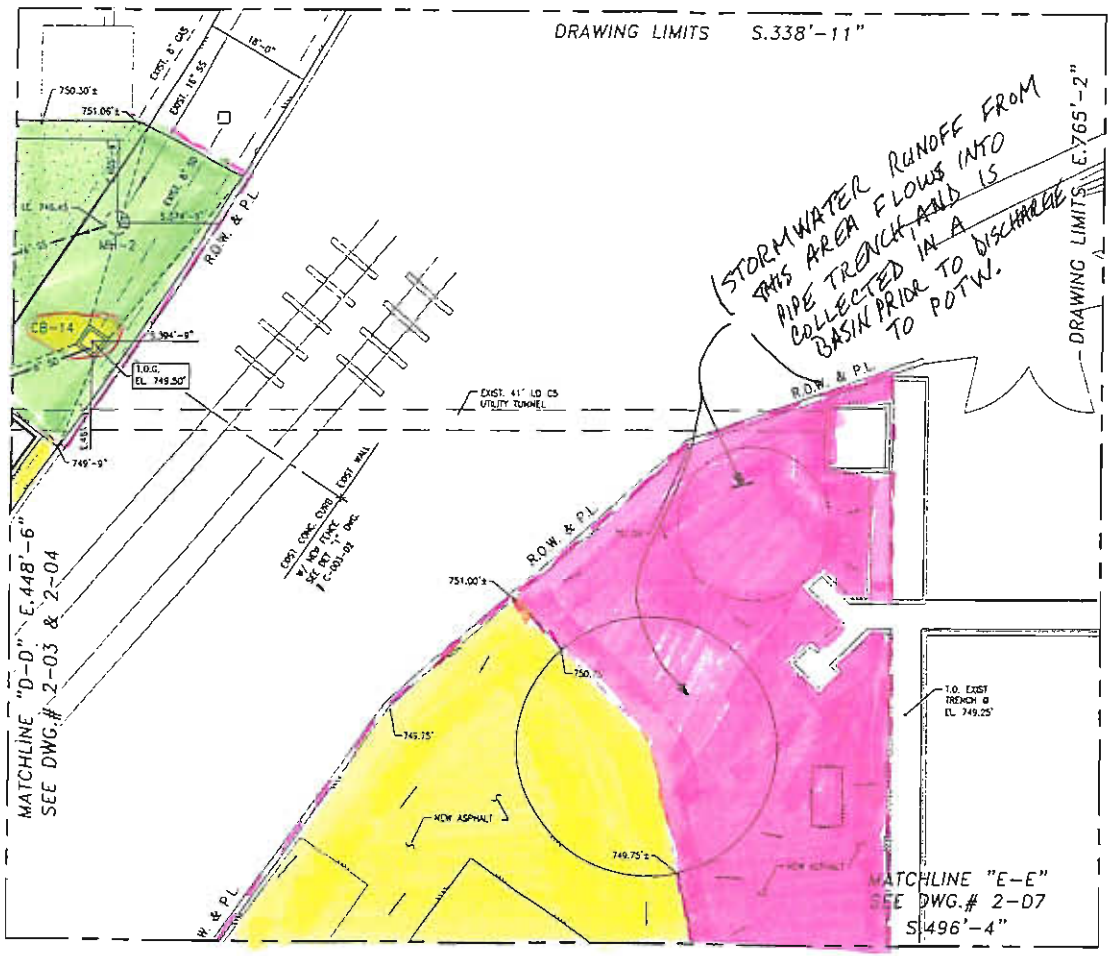
PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO 20001

AREA 4
CIVIL PLAN PAVING / GRADING & U.G. SEWER

DWG NO.
20001-C-002-05



AREA 5
PLAN
SCALE: 1" = 10'-0"

FOR APPROVAL
12-12-02

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.
WORK ORDER NO. 20001

TITLE
AREA 5
CIVIL PLAN PAVING / GRADING & U.G. SEWER

DWG NO
20001-C-002-06

SCALE 1"=10'-0" SHEET OF

REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. S 003725
12/10/02
STRUCTURAL
STATE OF CALIFORNIA

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-01	CIVIL KEY PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

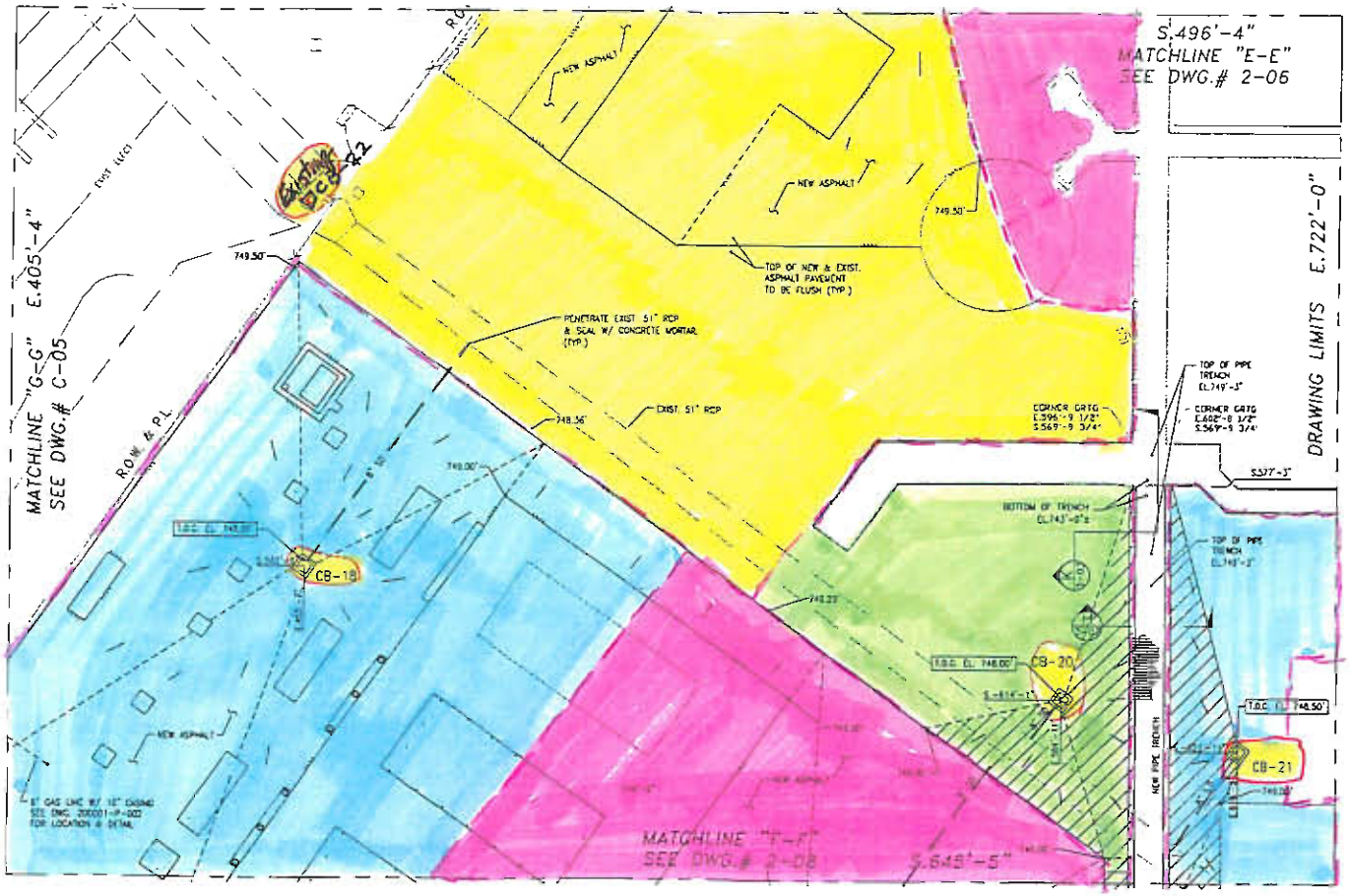
NOTES:
1 SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION.
2 SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

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PROJ NO 2113
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AREA 6
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SCALE: 1" = 10'-0"

FOR APPROVAL
12-12-02

REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. S 003725
12/10/02
STRUCTURAL
STATE OF CALIFORNIA

REFERENCE DRAWINGS:

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20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:
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2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES

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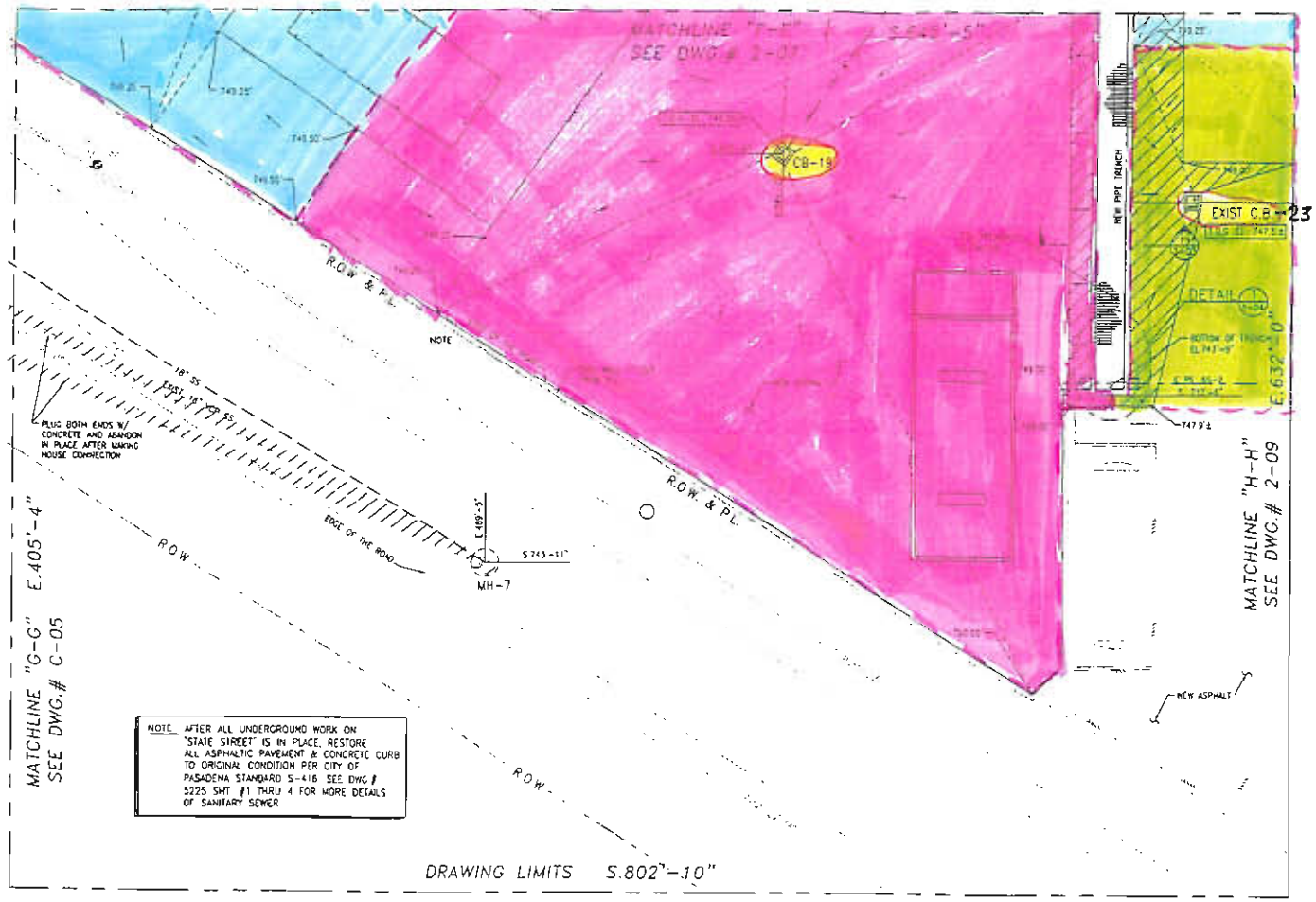
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PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.
WORK ORDER NO. 20001

TITLE
AREA 6
CIVIL PLAN PAVING / GRADING & U.G. SEWER

DWG NO.
20001-C-002-07



AREA 7 - PAVING, GRADING & U.G SEWER / PLAN

SCALE 1" = 10'-0"

FOR APPROVAL

12-12-02

REGISTERED PROFESSIONAL ENGINEER
PAUL B. SUMMERS
No. S 003725
12/10/02
STRUCTURAL
STATE OF CALIFORNIA

REFERENCE DRAWINGS

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20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G SEWER
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20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G SEWER

NOTES

1. SEE DWG # C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION
2. SEE DWG # C-002-001 FOR U.G PIPING GENERAL NOTES

CHEMIC ENGINEERS

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PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO 20001

TITLE: AREA 7 CIVIL PLAN PAVING / GRADING & U.G SEWER

DWG NO: 20001-C-002-08

SCALE 1"=10'-0" | SHEET OF

DRAFT

STANDARD URBAN STORMWATER MITIGATION PLAN
For
CITY OF PASADENA POWER PLANT UPGRADE

Project Site Address:
43 E. State Street, Pasadena, CA 91105

Prepared for
Mr. Sarkis Nazerian, C.B.O.
City of Pasadena Planning and Permitting Department
175 N. Garfield Avenue
Pasadena, CA 91101-7215

Submitted By:
Joe Awad
City of Pasadena Water & Power Department
43 E. Glenarm Street
Pasadena, CA 91105
Ph. 626 744-6258

SUSMP Prepared By:

Gurcharan S. Bawa
City of Pasadena Water & Power Department
45 E. Glenarm Street
Pasadena, CA 91105
Ph. 626 744-6562

Preparation Date
February 3, 2003

STANDARD URBAN STORMWATER MITIGATION PLAN
For
CITY OF PASADENA POWER PLANT UPGRADE

Table of Contents

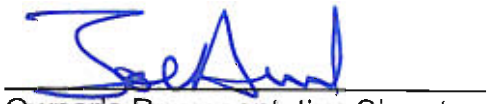
1. CERTIFICATIONS 3
2. AMENDMENT LOG 4
3. OBJECTIVES 5
4. VICINITY MAP 5
5. INTRODUCTION AND PROJECT DESCRIPTION 5
6. DESCRIPTION OF STORM DRAINAGE SYSTEM AND OUTFALL 6
7. CONTACT INFORMATION/LIST OF RESPONSIBLE PARTIES 6
   7.1 Owners Responsible Person 6
   7.2 Contractors Responsible Person 6
8. POLLUTANT SOURCE IDENTIFICATION AND BMP SELECTION 7
   8.1 Non-Stormwater Control 7
   8.2 Material Storage Areas 7
      8.2.1 Aqueous Ammonia Storage 8
      8.2.3 Cooling Tower Water Treatment Chemicals 9
      8.2.4 Water Treatment Chemicals at Broadway 10
      8.2.5 Waste Disposal Areas 10
      8.2.6 Miscellaneous Materials Storage 10
   8.3 Trash Storage Areas 10
   8.4 Natural Gas Compressors for Gas Turbines GT3 & 4 11
   8.5 Loading/Unloading of Materials 11
   8.6 Gas turbines GT3 & GT4, and ancillary equipment 12
   8.7 Cooling Towers for GT3 & GT4 13
   8.8 Parking Lots 13
   8.9 Strom water System Signage and Stenciling 13
   8.9 Maintenance, Inspection, and Repair of Site BMPs 13
9. Training 15

Figure 1: Regional Location and Vicinity Map
Figure 1.1: Power Generating Plant
Figure 2: Site Plan
Figure 3: Pasadena Power Plant On-Site and Surrounding Uses
Figure 4: GT1 & 2 SCR and New GT3&4 Isometric View
Figure 5: Pasadena Power Plant Upgrade Project- Civil Key Plan Paving/Grading and U.G. Sewer
Figure 6: Pasadena Power Plant Upgrade Project- General Arrangement Plan- Gas Turbine Generator Units 3 and 4

1. CERTIFICATIONS

General Project Certification

I certify that this Standard Urban Storm Water Mitigation Plan and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. The information contained herein is, to the best of my knowledge and belief, true, accurate and complete.



Owner's Representative Signature

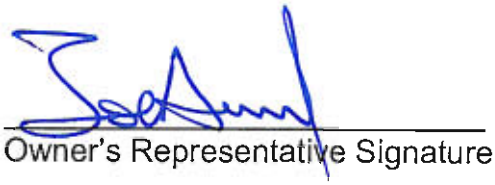
Engineering Manager
Owner's Representatives Title

Joe Awad
Owner's Representative Name

February 3, 2003
Date

Post Construction/Maintenance Certification

Proper operation of Best Management Practices (BMPs) is an important component of reducing pollutants in urban and storm water runoff. As a responsible party, I certify that the BMPs will be implemented, monitored and maintained to ensure their continued effectiveness. In the event of a property transfer, the new owner will be notified of the BMPs in use at this site and must include written conditions in the sales or lease agreement, which requires the recipient to assume responsibility for maintenance and conduct a maintenance inspection at least once a year.



Owner's Representative Signature

Engineering Manager
Owner's Representatives Title

Joe Awad
Owner's Representative Name

February 3, 2003
Date

2. AMENDMENT LOG

Amend the SUSMP when conditions related to the project i.e. site, operation, and construction change that may affect the stormwater quality. The amendment shall be logged in the following table.

Amendment No.	Date	Brief Description of Amendment	Prepared By

3. OBJECTIVES

This Standard Urban Stormwater Mitigation Plan (SUSMP) has the following primary objectives.

- Identify and effectively eliminate non-stormwater discharges
- Identify sources for stormwater pollutants of concern after the project is constructed
- Identify, construct, implement and maintain appropriate post construction Best Management Practices (BMPs) to reduce the discharge of pollutants of concern from entering stormwater conveyance systems to the Maximum Extent Practicable
- Develop a maintenance program for BMPs to ensure storm water quality control.

This SUSMP conforms to the required elements of NPDES Permit No. CAS004001 adopted by California Regional Water Quality Control Board, Los Angeles on December 13, 2001, and governing municipal stormwater and urban run off discharges within Los Angeles County.

This SUSMP is prepared based on the currently available project information. This SUSMP would be modified appropriately if actual construction or operational practices affecting quality of stormwater discharges vary from those currently planned.

4. VICINITY MAP

The project vicinity map showing project location, stormwater conveyance systems, and general topography, is shown in Figure 1 and 1.1. The project is located on a generally flat area.

5. INTRODUCTION AND PROJECT DESCRIPTION

The City of Pasadena Power Plant Upgrade Project (is located on two contiguous properties i.e. 43 East State Street and 85 East State Street, Pasadena, California 91105 separated by Gold Line rail and Wallis Street as shown in Figure 2 and 3. The project consists of construction and operation of two simple cycle gas turbines named GT3 and GT4, and associated ancillary equipment at

the City's existing power plant facility. These gas turbines will use pipeline quality natural gas as fuel. Each gas turbine rated at 47.3 Megawatts is a necessary part of local electrical generation to provide electricity and maintain electrical system reliability in the City of Pasadena. The new gas turbines are expected to be operational in July 2003. Presently, the site is being cleared and graded for construction of the project. A Storm Water Pollution Prevention Plan (SWPPP) for construction is being prepared and Notice of Intent is submitted to the State of California, State Water Resources Control Board. Figure 3 shows current on-site and surrounding uses. Figure 4 illustrates a post construction asometric view of the subject project as proposed. Currently, the power plant facility operates under a General Industrial Activities Storm Water Permit, Facility ID (WDID) 419S000994. As the facility is modified, the existing facility SWPPP will also be modified.

6. DESCRIPTION OF STORM DRAINAGE SYSTEM AND OUTFALL

The Stormwater drainage system consisting of storm drains, pipes, catch basins and boundaries of the areas that drain to each catch basin is shown in Figure 5. Each catch basin will be equipped with sediment-oil/grease filter. Additionally, design of basins provides a secondary treatment.

7. CONTACT INFORMATION/LIST OF RESPONSIBLE PARTIES

7.1 Owners Responsible Person

Joe Awad
Engineering Manager
City of Pasadena Water & Power Department
150 S. Los Robles Avenue, Suite 200
Pasadena, CA 91101
Phone:(626) 744-6258, (626) 744-4019
Fax: (626) 395-7594

7.2 Contractors Responsible Person

To Be Determined (Contract is not awarded yet)

8. POLLUTANT SOURCE IDENTIFICATION AND BMP SELECTION

8.1 Non-Stormwater Control

Potential Sources of non-stormwater discharges include.

- Wash water generated by plant wash, pavement wash etc.
- Wastewater from concrete/asphalt cutting operation.
- Wastewater from water blasting for painting.
- Fluids from refuse dumpsters/bins.
- Eyewash or emergency first aid shower waters.
- Other operations or activities that generate waste water.

The risk of non-stormwater discharges in to the storm drain is minimized due to the following mitigation measures.

- Wash water generated by plant wash or any repair/maintenance activity will be contained, collected and discharged into the oil-water separator that will discharge in a permitted sanitary outfall or disposed off site.
- Paved areas will be dry swept or vacuumed
- Refuse dumpsters/bins will be maintained in good condition and emptied weekly. In the unlikely case of leaking fluids, the spills/leaks will be promptly cleaned and source disposed off-site.
- Discharge from eye wash and emergency showers will be either directed to sanitary system, or to a sump.
- The entire facility is fenced and all gates normally locked. Therefore, unauthorized non - stormwater discharges from outside sources are not expected.

8.2 Material Storage Areas

The following are the main material storage areas.

- Aqueous Ammonia Storage tanks
- Lubricants and maintenance supplies
- Cooling tower water treatment chemicals
- Water treatment chemicals
- Waste disposal
- Miscellaneous storage area for large parts, steel plates, pipes, scrap metal etc.

Areas where materials are to be stored will:

- be placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or
- be protected by secondary containment structures such as berms, dikes, or curbs.
- be paved and sufficiently impervious to contain leaks and spills.
- have a roof or awning to minimize collection of storm water within the secondary containment area, if feasible.

The main material storage areas are described below

8.2.1 Aqueous Ammonia Storage

The aqueous ammonia will be stored in aboveground storage tanks. Presently, a 12,000 gallons tank located at Broadway (figure 6) stores 29% ammonia concentration. This tank serves emission control equipment for steam electric generating unit Broadway 3. A new tank of 12,000 gallons capacity is proposed to be installed adjacent to the existing tank to store 19% aqueous ammonia for serving emissions control equipments for units GT3 & GT4. These tanks will be loaded from Glenarm site by tanker trucks through a piping system. Each tank will have its own independent delivery and supply system.

There is a minimal potential for aqueous ammonia to be discharged into storm drain in case of leaks. Each tank will have its independent secondary containment. Each containment would be equipped with a manually operated mechanical drain valve to drain storm water. These valves would be normally

kept closed. After each storm, plant personnel would visually inspect the quality of water and any evidence of aqueous ammonia leakage. If the storm water quality is not affected, the operator will open the valve, wait on-site until the water is drained and close the valve before leaving the site. In case, the stored storm water quality is suspected to be impacted by aqueous ammonia release, the water would be tested for presence of ammonia. If detectable of ammonia is found in the contained storm water, it would be disposed off-site to a permitted facility.

8.2.2 Storage of Lubricants and maintenance Supplies

Lubricants & maintenance supplies such as solvents, adhesives, paints, thinners, etc. will be stored in the designated covered structures designed with adequate containments both at Glenarm and Broadway sites.

Storage and handling of lubricants and maintenance supplies are minimal potential source of storm water pollution. The storage facilities will be covered, paved with concrete and secondarily contained. Major maintenance activities such as assembly, disassembly of parts, parts washing etc. are performed in enclosed structures, on paved areas covered with plastic sheeting, and in controlled environment. Leaks and drips are captured in drip pans or oil absorbing pads. A good housekeeping will further minimize sources of storm water pollution.

8.2.3 Cooling Tower Water Treatment Chemicals

The cooling tower water treatment chemicals stored in 55-gallon drums and 300-gallon portable totes will be placed underneath the cooling towers, and will have secondary containments.

The chemical storage area will not be exposed to storm water and have its secondary containment to prevent any spills entering storm drains. Loading of new chemical containers and unloading of empty containers for off-site disposal will be either done by PWP personnel or under their direct supervision. PWP employees performing such activities will be trained for safe handling, spill clean up and storm water pollution prevention.

8.2.4 Water Treatment Chemicals at Broadway

The water treatment system located at the northwest side of Broadway Plant (Figure 6) would use mainly antiscalant Polymers, inhibitors, caustic soda, sulfuric acid, brine solution that would be stored in 55 – 300 gallon containers.

Storage and handling of these chemicals is a potential source of stormwater pollution if not mitigated. The stormwater run off has the potential to wash away any spills or leaked fluids located at water treatment areas 5 & 6 (Figure 5) subsequently drain into the storm drains through catch basins servicing these drainage areas.

To prevent discharge of these chemicals into storm drains. The containers will be stored in enclosed area(s) to prevent storm water contact. Additionally, the storage area will have a secondary containment. The plant personnel transporting and storing these chemicals will be trained for safe handling and spill clean up procedures. Spill clean up kits will be located in the vicinity of water treatment system as well as at designated loading/unloading areas.

8.2.5 Waste Disposal Areas

The designated waste disposal area will be used for temporary storage of regulated wastes and empty chemical or lube containers for off-site disposal. The area will have a secondary containment and covered. The roof drain will divert storm water away from storage area. Non-compatible materials will not be stored together.

8.2.6 Miscellaneous Materials Storage

Bulk materials i.e. soil, sand etc. or large size materials i.e. pipes, equipment under repairs, scrap metal, etc. that are stored outdoors will be covered with plastic sheeting to prevent contact with storm water.

8.3 Trash Storage Areas

There will be several enclosed type small size trash receptacles located through out Broadway and Glenarm site. Plant personnel will periodically empty them in large trash bin or dumpster located on Glenarm site. The trash bins/dumpsters

will be on wheels for ease of movement for trash disposal without tipping them over. A Refuse contractor will empty the trash bins/dumpsters on weekly basis or more frequently if necessary. These large trash storage area(s) will meet the following requirements.

- Trash bin areas will have drainage from adjoining roofs and pavements diverted around the areas.
- Trash bin areas will be screened to prevent off-site transport of trash.

The trash containers will be checked for leaking fluids and repaired/replaced as necessary. Additionally, periodic dry sweeping and good housekeeping of the site will ensure that the trash storage areas pose minimal threat to storm water quality.

8.4 Natural Gas Compressors for Gas Turbines GT3 & 4

The natural gas compressors for gas turbines GT3 & 4 will be fully enclosed in a building. Therefore, the storm water will not come in contact of any machinery or lubricants.

8.5 Loading/Unloading of Materials

All materials used for usual operations and maintenance will be received from the contractor at Glenarm site at a designated location (Figure 6). The same area will be used for delivery of waste materials to the contractor for off site disposal. The plant personnel will be present at the time of actual receiving or delivery of materials. After physically taking delivery, all materials except aqueous ammonia will be transported by the plant personnel to appropriate locations. Materials destined for Broadway will be transported across private rail crossing between two sites.

Aqueous ammonia will be delivered by truck tankers at the Glenarm site and loaded into above ground tanks located at the Broadway through piping system. The delivery tanker will be parked in the contained loading area. As a standard procedure a plant operator and tanker driver will be physically present at the unloading station during unloading operation. Another operator will be present at the aqueous ammonia tank being filled at the Broadway location. Any leakages from connections for unloading would also be captured in the containment area.

The loading/unloading area would have a containment whose floor would slope towards a sump. The sump would be equipped with a manually operated sump pump. Any spills n this are will be promptly cleaned. After each storm event, a

plant personnel will visually inspect the quality of water such as oil sheen, discoloration and smell. If the water quality is found good it will be discharged into storm drain. Otherwise will be disposed off-site or into permitted sanitary outfall.

The plant vehicles used for transporting materials will be appropriately equipped for transporting these materials including navigation through rail crossing. All personnel handling these materials will be trained in driving, material handling, spill containment and clean up procedures.

Both operators and delivery drivers will be trained for spill detection, containment and cleanup without discharging into storm drain. In case of any spills the aqueous ammonia and rinsate will be pumped and disposed off site to a permitted facility.

8.6 Gas turbines GT3 & GT4, and ancillary equipment

The gas turbines and associated ancillary equipment such as blowers, pumps, heaters, ammonia injection skid, lube oil cooling water pump skids, gas fuel waste sump, water treatment module, air compressors, transformers, water wash collection tank, piping etc. are planned to be located on Glenarm site (figure 6). These equipment would be multi tiered open grated steel structures exposed to elements of environment including storm water. Thus creating a potential to affect storm water quality in drain areas 2 and 3 (figure 5) with pollutants including oil/grease, metals, chemical oxygen demand, Biochemical oxygen demand, sediments and suspended solids.

The potential to pollute storm water is minimized by the following mitigation measures.

- All equipment that has potential to contribute oil/grease and wash-water is equipped with secondary containments piped to an oil-water separator. The storm water coming in contact with these equipments will be captured in their individual containments to be directed to oil/water separator. The wastewater effluent from oil/water separator will be discharged into a sanitary outfall to be permitted by County Sanitation Districts of Los Angeles County. The separated waste oil will be dispose off-site to a permitted facility.

- Sediment and oil filters will be placed in all catch basins in the newly developed area.

- Paved areas will be dry swept.

- Lube oil drums including empty will be stored on secondary contained pallets in enclosed areas.

- Enclosed trash receptacles will be placed through out the site.

8.7 Cooling Towers for GT3 & GT4

The cooling towers for GT3 & GT4 would be located on west side of the gas turbines on Glenarm site (figure 6). Blow down from the cooling tower will be discharged in to a sewer out fall permitted by County Sanitation Districts of Los Angeles County. Therefore, cooling towers are a minimal potential risk to affect storm water quality.

8.8 Parking Lots

The modified parts of the facility are not proposed to be used as parking lot.

8.9 Strom water System Signage and Stenciling

Storm drain stencils will be placed directly adjacent to all catch basins with prohibitive language (such as: "NO DUMPING-DRAINS TO OCEAN") and/or graphical icons to discourage illegal dumping. Where stenciling is not practical, signs with similar prohibitive language will be posted. Legibility of stencils and signs will be maintained.

8.9 Maintenance, Inspection, and Repair of Site BMPs

The City of Pasadena Water & Power Department will be responsible for maintenance, inspection, repair and implementation of BMPs as the following schedule.

Best Management Practices (BMPs)	Inspection Frequency	Maintenance/Repair Program
Catch basin filters Catch basins Catch Basin Signage	Prior to forecast of first storm or before beginning of wet season, (October 1st) which ever occurs first. Once a month during wet season (October to May)	• Remove, dispose, and replace damaged, deteriorated, or otherwise unsuitable BMPs • Remove retained sediments before they reach ⅔ of the filter sediment holding capacity • Replace filter saturated with oil • Replace torn filters • Clean and dispose of accumulated debris and sediment deposited in catch basins • Restencil or post new signs if existing stencils or signs damaged or illegible.
Material Delivery and Storage Material Use Spill Prevention and Control Solid Waste Management Sanitary/Septic Waste Management	Weekly Prior to forecast storm At 24-hour intervals during extended rain events	• Keep storage areas clean, well organized, and equipped with ample clean-up supplies as appropriate for the materials stored • Repair or replace containment structures, covers and liners as needed to maintain proper function and protection • Properly remove and dispose accumulated rainwater from containment facilities • Cover any stockpiles with appropriate mats or covers. • Maintain waste fluid containers in leak proof condition. Repair or replace dumpsters that leak • Provide timely service and removal to prevent dumpsters and sanitary facilities from overflowing. • Schedule Refuse Contractor to pick up waste containers weekly.
Paved area sweeping and/or vacuuming	Quarterly or more frequently as needed	• Inspect site access points • Sweep sediments, trash, etc.
Oil/Water separators	Monthly	• Inspect and remove accumulated oil, grease, and floating debris before container reach ¾ of the holding capacity.

Best Management Practices (BMPs)	Inspection Frequency	Maintenance/Repair Program
Illicit Connection/Illegal Discharge Detection	Semi Annually	• Inspect site for evidence of illicit discharges or illegal dumping. • Observe site perimeter for evidence or potential of illicitly discharged or illegally dumped material that may enter the job site. • Eliminate illicit or illegal discharges or sewers.
Plastic Covers for outdoor stored materials	Prior to forecast of first storm or beginning or wet season (October 1st) whichever occurs first and monthly thereafter	• Replace and dispose torn or missing sections of plastic covers. Replace or supplement anchors as necessary to keep covers in place.

9. Training

Individuals for SWPPP preparation, implementation and compliance will be trained. This includes those personnel responsible for installation, inspection, maintenance and repair of BMPs. The training will include formal classroom training, web based on-line video training or combination of these.

FIGURE 1



PCR

Figure 1
Regional Location
and Vicinity Map

FIGURE 1.1

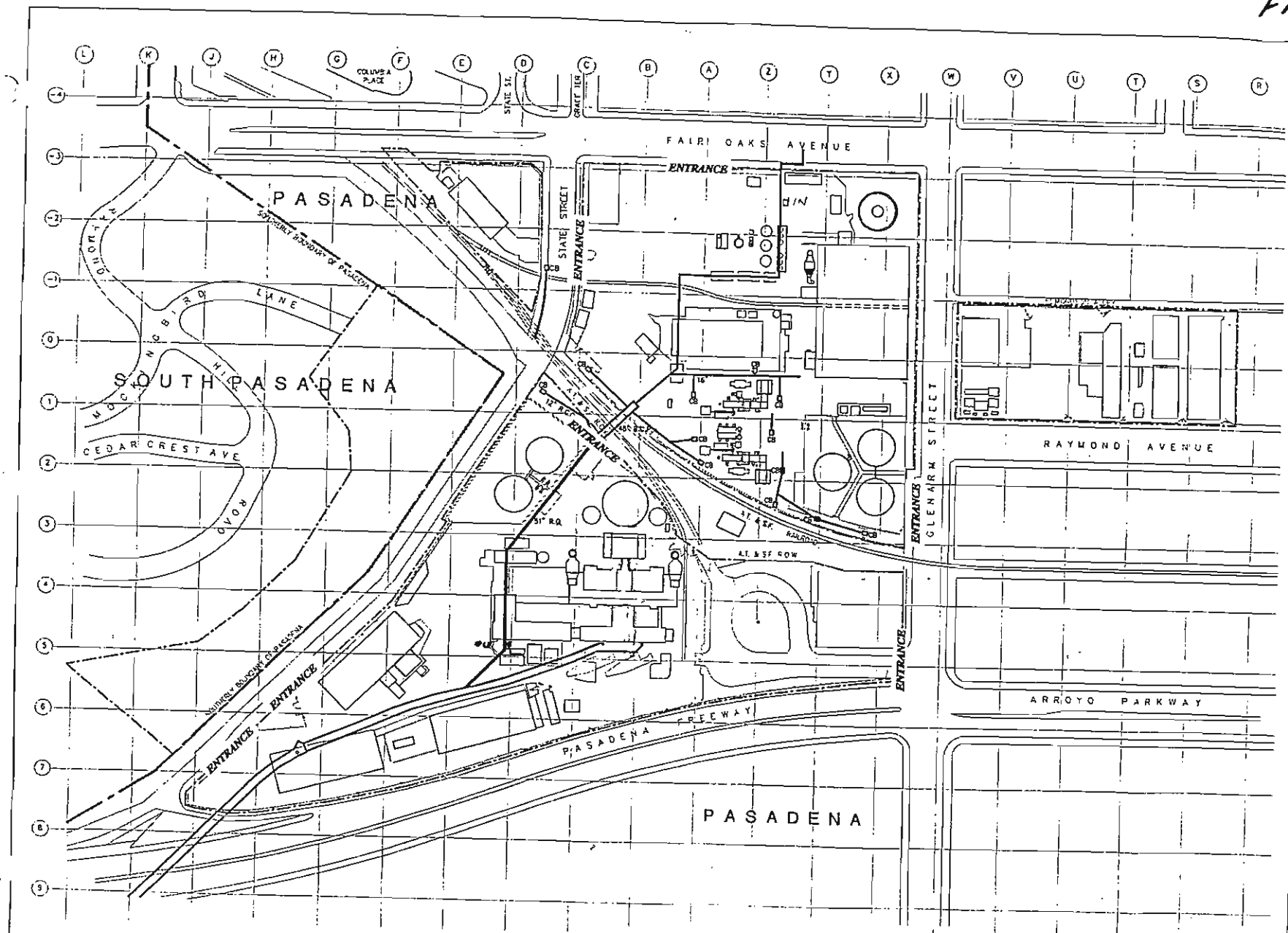


FIGURE 1 - SITE LOCATION

FIGURE 2

CITY OF PASADENA
SITE PLAN
BROADWAY & GLENARM POWER PLANT

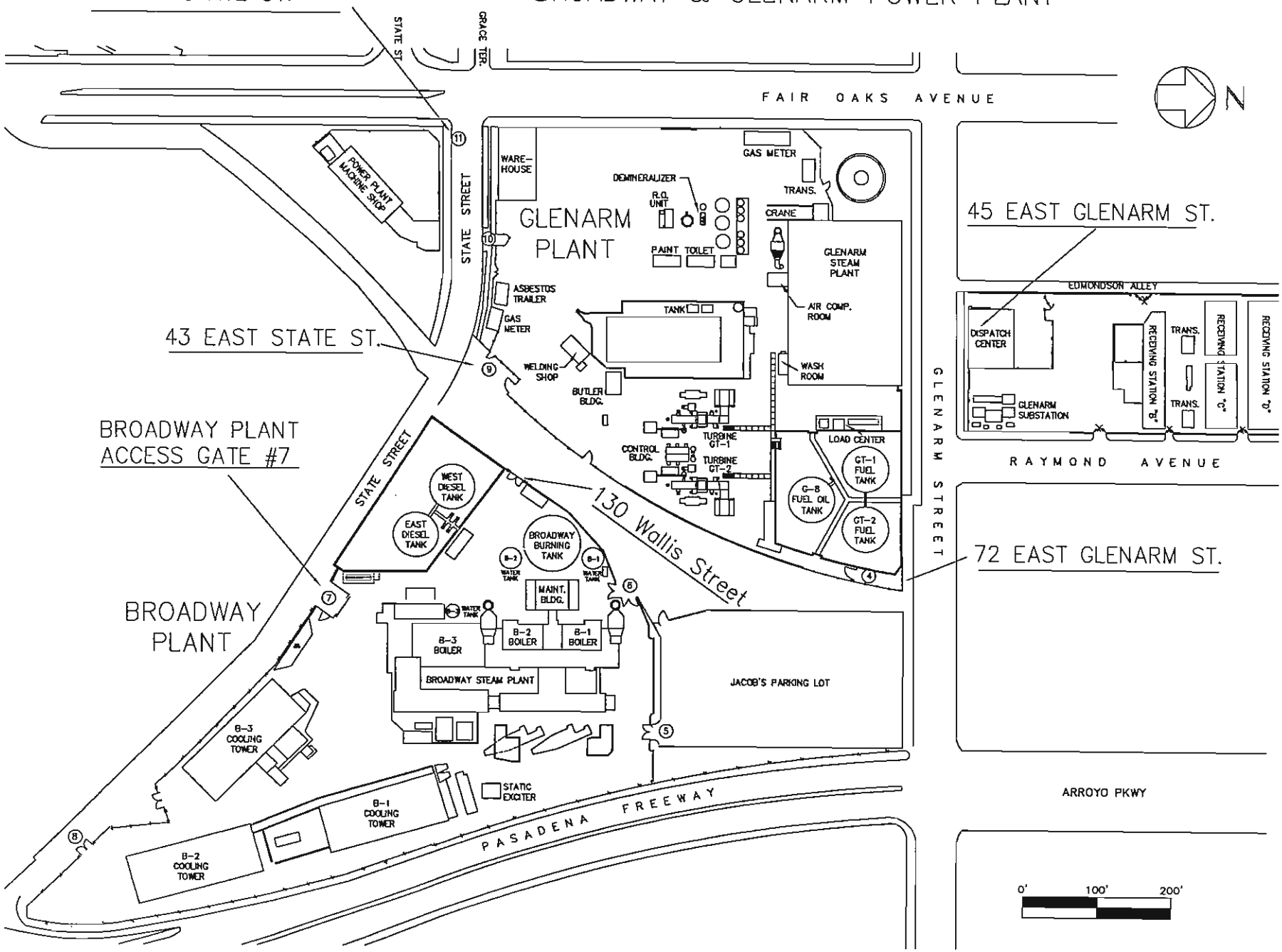
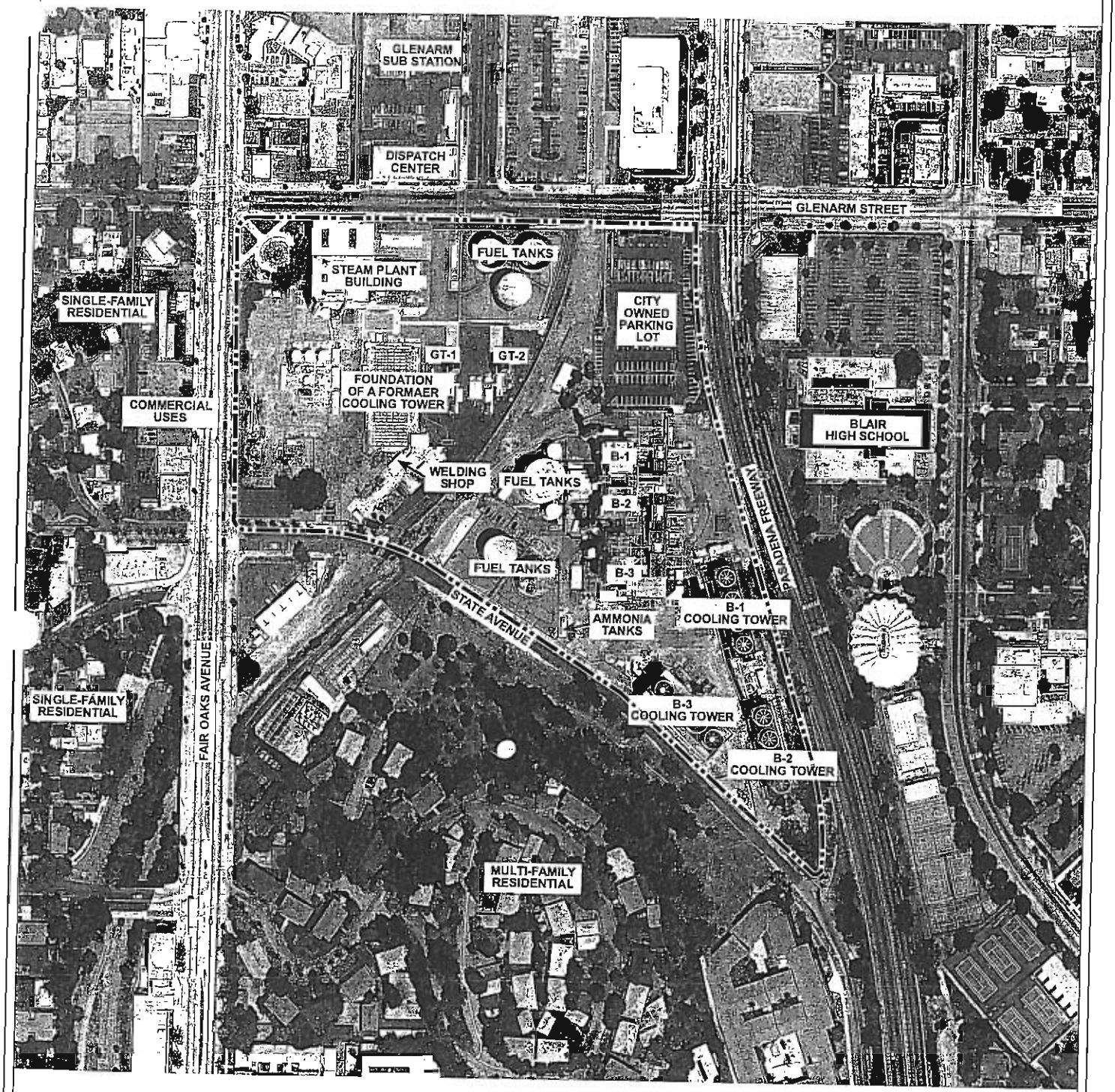


FIGURE 3



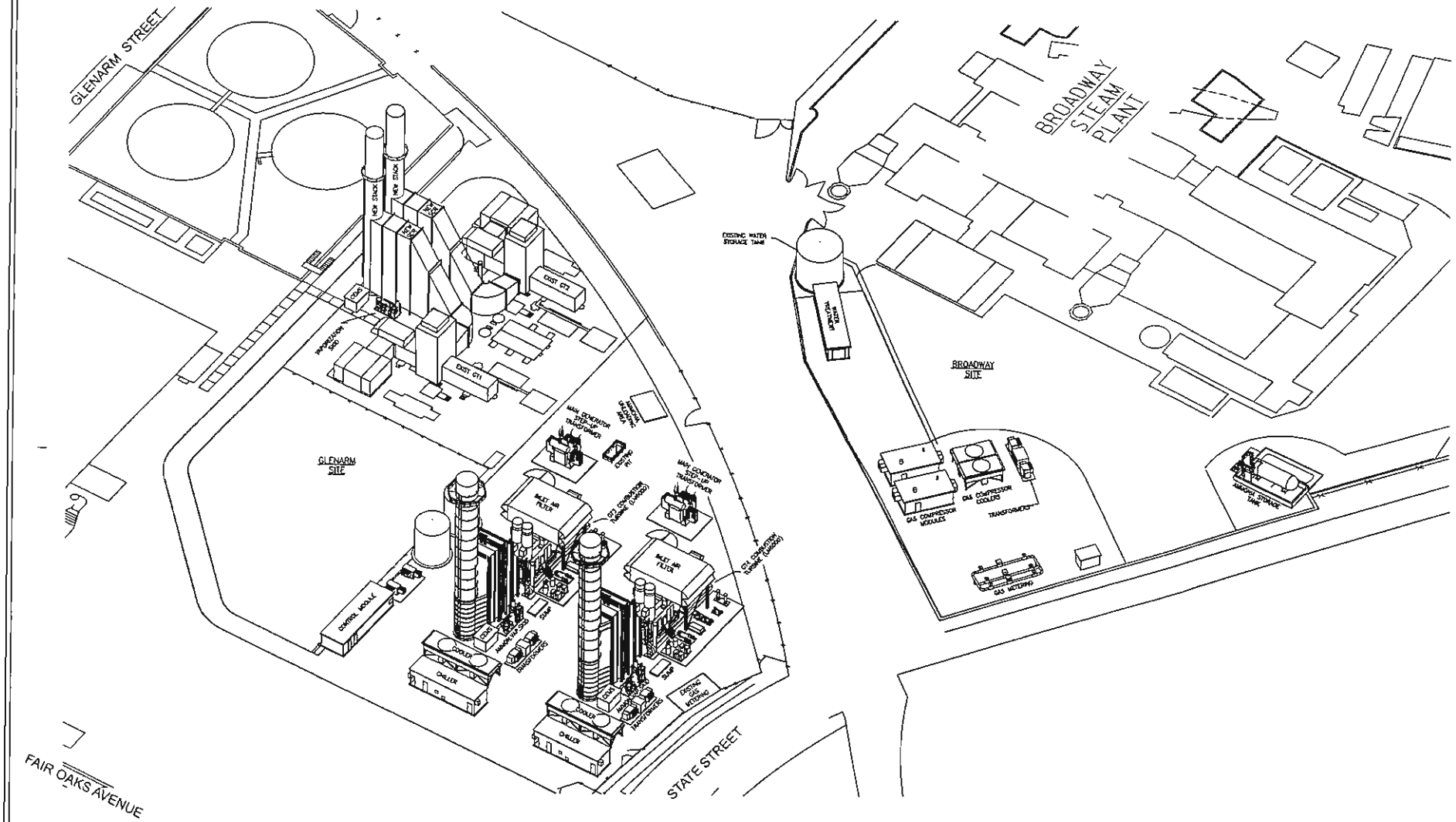
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SCALE NOT PROVIDED

Figure 3
Pasadena Power Plant
On-Site and Surrounding Uses

FIGURE 4

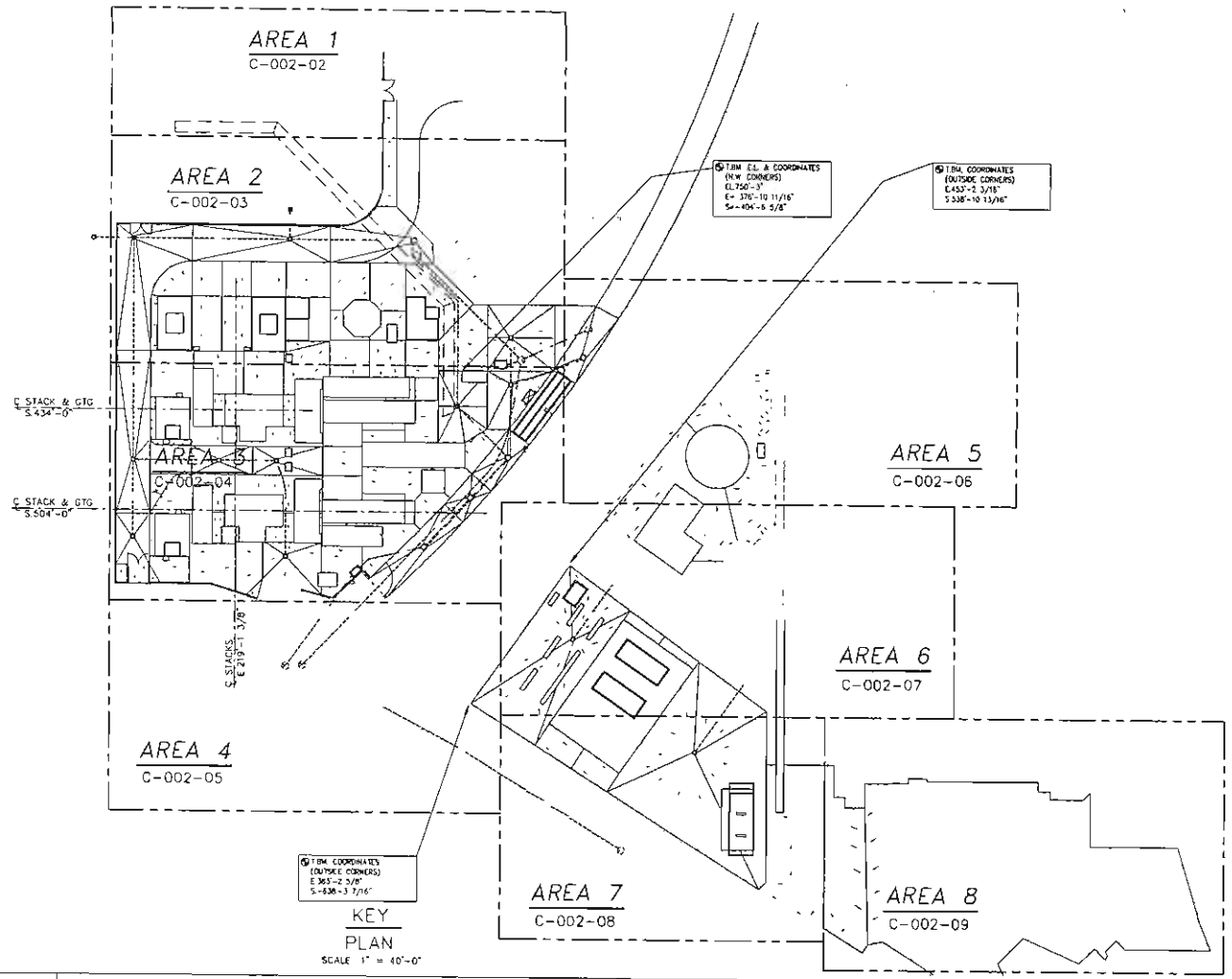


PGR

Source: CH2MILL, 2002

Figure 3
GT1& 2 SCR and
New GT3&4 Isometric View

FIGURE 5



UNDERGROUND PIPING GENERAL NOTES

1. GENERAL CONTRACTOR SHALL SUBMIT CONSTRUCTION SCHEDULE AND PLAN TO THE OWNER FOR REVIEW CONSTRUCTION SCHEDULE & PLAN SHALL BE BASED ON "NO SERVICE INTERUPTION" ON SANITARY SEWER AND STORMDRAIN FOLLOWING ARE SOME SUGGESTED SEQUENCE BUT NOT LIMIT TO:
   -COORDINATE BETWEEN ALL TRADES
   -WEATHER
   -PROVIDE ADEQUATE PUMPS TO DIVERT THE FLOWS
   -MAKE THE TIE-INS LAST
   -INSTALL NEW MANHOLE AROUND EXISTING LINE, DO NOT BREAK THE LINE UNTIL THE NEW LINE IS READY FOR SERVICE THEN PLUG UP THE OLD OUTLET OF THE EXISTING LINE
   (M.H #1 & 2 FOR EXAMPLE)
2. All WORK SHALL BE DONE IN ACCORDANCE WITH THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSRTUCTION" AND "STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION", LATEST EDITION (GREEN BOOK)
3. ALL PIPING & FITTINGS FOR SANITARY SEWERS SHALL BE VITRIFIED CLAY PIPE (VCP AND IN ACCORDANCE WITH ASTM-C700 AND STANDARD SPEC GREEN BOOK ITEM 207-8 AND 208-2
4. ALL PIPING & FITTINGS FOR STORMDRAIN UNLESS NOTED OTHERWISE SHALL BE DRISCOPIPE 1000-SDR21 OR EQUAL AND IN ACCORDANCE WITH THE "GREEN BOOK" STANDARD SPEC ITEM 207-19 PIPE BEDDING, BACKFILL AND FIELD INSPECTION SHALL CONFIRM TO ITEM 306-1 2 12, 306-1 2 13, 306-1 2 12 306-1 2 12, 306-1 2 13
5. REINFORCED CONCRETE PIPE (RCP) FOR STORM DRAIN SHALL BE IN ACCORDANCE WITH ASTM-C497M AND SID. SPEC GREEN BOOK ITEM 207-2
6. REINFORCED BOX CULVERT SHALL BE IN ACCORDANCE WITH ASTM C-789 AND GREEN BOOK ITEM 207-2
   BOOK" STANDARD SPEC ITEM 207-19 PIPE BEDDING, BACKFILL AND FIELD INSPECTION SHALL CONFIRM TO ITEM 306-1 2 12, 306-1 2 13, 306-1 2 12
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TEST (EXFILTRATION TEST) WHICH ARE REQUIRED BY THE CITY OF PASADENA FOR SANITARY SEWER AND STORM DRAIN. BEDDING, BACKFILL AND FIELD INSPECTION SHALL CONFIRM TO ITEM 306-1 2 12, 306-1 2 13, 306-1 2 12
8. EXCAVATION OF 5 FEET OR MORE IN DEPTH SHALL REQUIRE SHORING AND BRACING. SHORING AND BRACING SHALL BE STANDARD SPEC GREEN BOOK ITEM 7-10-4-1
9. EXCAVATION SHALL BE DONE CAUTIOUSLY DUE TO EXISTING UNDERGROUND PIPING AND CONDUIT PROBING AND HAND EXCAVATING MAY BE REQUIRED
10. FOR CONSTRUCTION ON STATE STREET, ALL TRAFFIC CONTROL OPERATIONS SHALL CONFORM TO THE PROVISION OF THE SECTION 7-10, "PUBLIC CONVENIENCE AND SAFTY", OF THE PASADENA SUPPLEMENTS
11. BEDDING MATERIAL SHALL BE SAND AND, GRAVEL CRUSHED AGGREGATED OR NATIVE FREE- DRAINING GRANULAR MATERIAL HAVING A SAND EQUIVALENT OF NOT LESS THAN 30 BEDDING MATERIAL SHALL BE COMPACTED TO 85% RELATIVE COMPACTION

PAVING & GRADING NOTES

1. SEE DWG #20001-C-001-01 FOR GENERAL NOTES OF CONCRETE AND ASPHALT PAVEMENT
2. THE STRIPING ON BOTH SIDES OF FIRE LANE (ON PAVEMENT) ON THE CURB OR ON ONE SIDE OF WALL SHALL CONFORM TO THE CITY OF PASADENA STANDARDS.

NOTE COORDINATES OF THREE TBM'S SHALL BE USED TO SET LOCATION SYSTEM FOR THIS PROJECT.

9-23-02

RESERVED

LEGEND

ASPHALT
CONCRETE
GRAVEL
FLOW ARROW

P B SUMMERS P E
CA LIC 53725
C44211

REFERENCE DRAWINGS

20001-C-001	GENERAL NOTES
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:

1. SEE DWG # C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION
2. SEE THIS DWG. FOR U.G. PIPING GENERAL NOTES

CHEMIC ENGINEERS

PROJ. NO. 2115
FILE NAME 20001c002-01.dwg
XREF DWG

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
D	ISSUED FOR BID	JLG	9/23/02		YH	
C	ISSUED FOR APPROVAL	JLG	9/9/02		PLE	
B	ISSUED FOR BID	JLG	8/30/02		PLE	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO 20001

TITLE

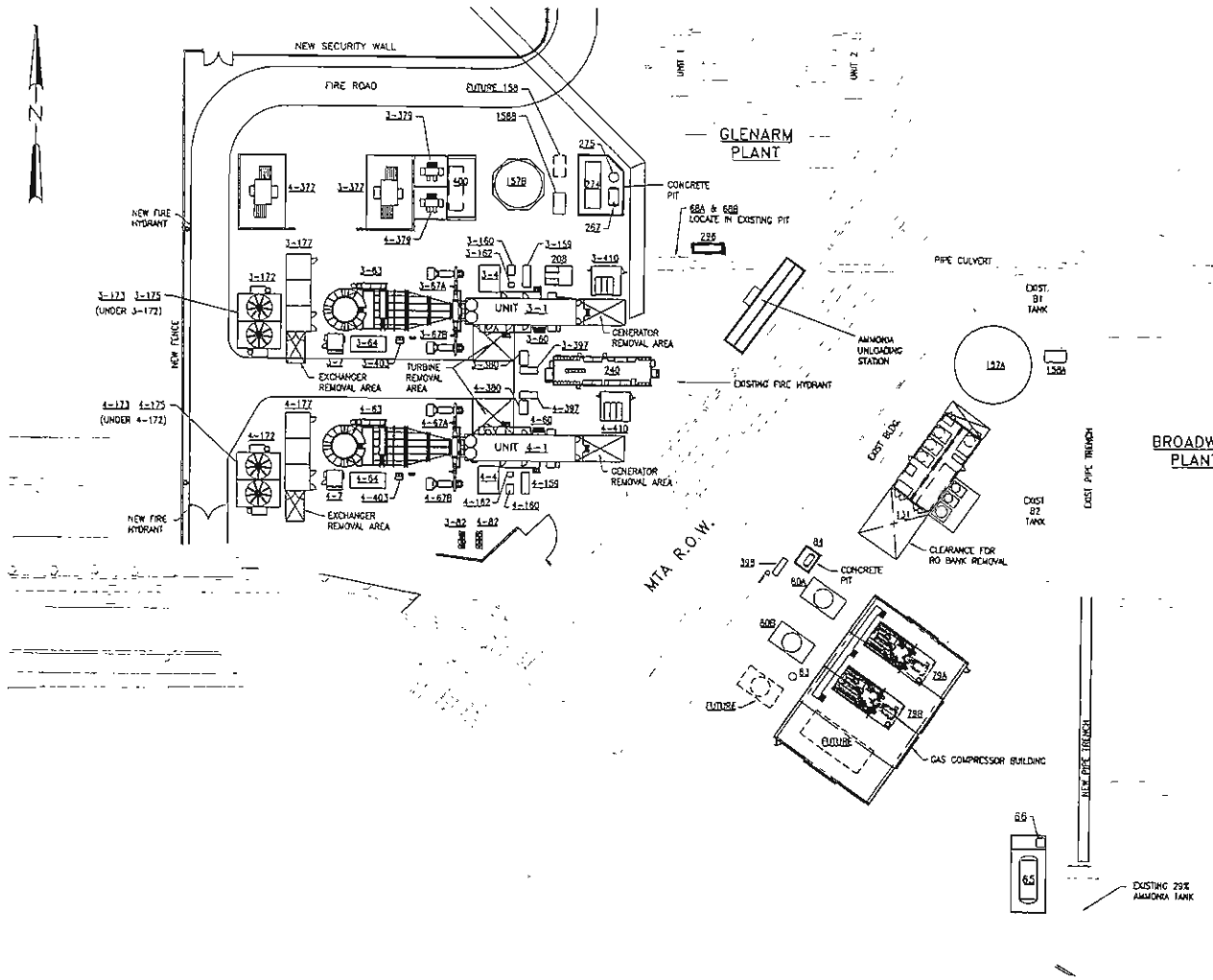
CIVIL KEY PLAN
PAVING / GRADING
& U.G. SEWER

DWG NO

20001-C-002-01

SCALE 1"=40'-0" | SHEET OF

FIGURE 6



EQUIP. NO.	EQUIPMENT DESCRIPTION	QTY	COMMENTS
1	GAS TURBINE GENERATOR	2	
4	AUXILIARY SKID	2	
7	GENS	2	
60	CO2 BOTTLE RACK	2	
63	SCR	2	
64	SCR AMMONIA INJECTION SKID	2	
65	AMMONIA TANK	1	
66	AMMONIA FORWARDING PUMP SKID	1	
67	SCR AIR TEMPERING FANS	4	
68	AMMONIA RETURN PUMPS	2	(BY CONTRACTOR)
79	GAS FUEL COMPRESSOR SKID	2	
80	GAS FUEL COOLER	2	
82	GAS FUEL FILTER/COALESCER SKID	2	
83	GAS FUEL ACCUMULATOR	1	
84	GAS FUEL WASTE SUMP	1	
131	WATER TREATMENT MODULE	1	
157	DEMIN WATER STORAGE TANK	2	
158	DEMIN WATER FORWARDING PUMP SKID	2	
159	WATER INJECTION BOOST PUMP SKID	2	
160	SPRINT SKID	2	
162	HIGH PRESS DEMIN WATER FILTER	2	
172	COOLING TOWER	2	
173	COOLING TOWER CHEMICAL TREATMENT SKID	2	
175	LUBE OIL COOLING WATER PUMP SKID	2	
177	CHILLER MODULE	2	
208	AIR COMPRESSOR SKID	1	
240	POWER CONTROL MODULE	1	
267	WASTE TANK - WATER WASH	1	
268	WASTE TANK - OILY WATER COLLECTION	1	
269	OILY WATER COLLECTION TRANSFER PUMP	1	
274	OILY WATER SEPARATOR	1	
275	WASTE OIL TANK	1	
296	SEWER OUTFALL BOX	1	(BY CONTRACTOR)
326	24VDC BATTERY SYSTEM	1	LOCATED INSIDE PCM (240)
328	125VDC BATTERY SYSTEM	1	LOCATED INSIDE PCM (240)
348	120VAC UPS PANEL (PART OF SCS)	1	LOCATED INSIDE PCM (240)
349	GAS FUEL MCC DISTR. PANEL 120/208V	1	LOCATED NEAR GAS COMPR.
350	BOP MCC LIGHTING PANEL	1	LOCATED INSIDE PCM (240)
377	GENERATOR STEP-UP TRANSFORMER	2	
379	GAS COMPRESSOR & CHILLER XFMR (13.8KV / 4.16KV)	2	
380	AUXILIARY XFMR (13.8KV / 480V)	2	
392	34KV RELAY PANEL	1	LOCATED INSIDE PCM (240)
393	TURBINE CONTROL PANEL	2	LOCATED INSIDE PCM (240)
395	MCC (BOP)	1	LOCATED INSIDE PCM (240)
396	MCC (GTG)	2	LOCATED INSIDE PCM (240)
397	480V UNIT DISTRIBUTION SWITCHBOARD	2	
398	480V GAS COMPRESSOR MCC	1	
400	4160V SWITCHGEAR	1	
403	SCR MCC	2	
406	YARD LIGHTING PANEL AND CONTACTOR	2	
410	13.8 KV SWITCHGEAR	2	
412	SUPERVISORY CONTROL SYSTEM (SCS)	1	LOCATED INSIDE PCM (240)

FOR BID
8/30/02

SCALE 0 30' 60' 90' 120'

NOTES:
1. EQUIPMENT LAYOUT IS BASED ON PRELIMINARY INFORMATION
2. GTG INLET AIR FILTER OMITTED FOR CLARITY

RESERVED

JOE D. TRISNA, P.E.
CA LIC 32239

CHEMIC ENGINEERS

PROJ NO 2115
FILE NAME 20001M002.DWG
XREF DWG _GAPLAN.DWG
_PASABACD.DWG

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
G	ISSUED FOR BID	CJS	8/30/02	EAR	EAR	JT
F	ISSUED FOR APPROVAL	CJS	8/22/02	EAR	EAR	JT
E	ISSUED FOR BID REVIEW	KAC	8/12/02	JT	EAR	JT
D	ISSUED FOR APPROVAL	EAR	7/26/02	EAR	EAR	JT
C	ISSUED FOR REVIEW	EAR			EAR	
B	ISSUED FOR REVIEW	EAR	7/15/02		EAR	
A	ISSUED FOR REVIEW	EAR	7/12/02		EAR	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
GENERAL ARRANGEMENT PLAN
GAS TURBINE GENERATOR
UNITS 3 & 4

DWG NO
20001-M-002

SCALE 1"=30' SHEET

Table of Contents - Broadway

Permit Application Form

Form A – Applicants Questionnaire
- Attachment 1 – Form A Supplemental Responses

Form B – Calculation of Industrial Wastewater Discharge Flow Rate
- Attachment 2 – Form B Supplemental Calculations

Form C – Tank Schedule and Spill Containment Calculations

Form D – Check List

Attachment 3 – Process Description

Attachment 4 – Wastewater Analyses

Attachment 5 – Plans and Equipment Drawings
- Broadway Sewerage Plan (Drawing Number SKM 1-7)
- Process Flow Diagram Broadway Industrial Wastewater (Drawing Number M2-2-3 Rev B)

PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE
COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY
1955 Workman Mill Road / Whittier, CA
Mailing Address: P.O. Box 4998 / Whittier, California 90607-4998
Stephen R. Maguin, Chief Engineer and General Manager
(562) 699-7411

PERMIT NO: 5171

01 CHECK ONE: New Sewer Connection ☐ Existing Sewer Connection ☒

02 Applicant City of Pasadena, Water and Power Department
(Legal Company Name)

03 Check one and fill in appropriate information

☒ Corporation Name City of Pasadena
Year Incorporated 1886 State of Incorporation CA ID# 4350

☐ Partnership Name _____ Partners _____

☐ Sole Proprietor Name _____ Business Names _____

04 Situs Address 85 East State Street Pasadena, CA 91105
(Street) (City) (State) (Zip)

05 Mailing Address 85 East State Street Pasadena, CA 91105
(Street) (City) (State) (Zip)

06 Point of Discharge Permit #5171

07 Number of years applicant has been in business at present location 56 (yrs) _____ (months)

08 Name of Property Owner City of Pasadena
Address of Property Owner 45 East Glenarm Street Pasadena 91105 _____
(Street) (City) (Zip) (Telephone Number)

09 Assessors Map Book No. 5 3 1 7 Page No. 0 2 9 Parcel No. 9 0 0

10 Type of Industry Electric Utility 4 9 3 1 , _ _ _ _
(General Description) (Federal SIC No.)

11 Number of Employees (Full Time) 31 (Part Time) _____

12 Raw Materials Used Municipal water, natural gas, and water treatment chemicals (refer to file)
(General Description – Add Additional Sheets as Needed)

(Daily Amount Used)

13 Products Produced Demineralized water, 128,000 gpd
(General Description – Add Additional Sheets as Needed)

(Daily Amount Produced)

14 Wastewater Producing Operations Wastewater from demineralization water treatment plant (multimedia filtration, ion exchange, reverse osmosis, electrodeionization/demineralization)
(Full Description – Add Additional Sheets as Needed)

15 Time of Discharge 12:00 AM☒ PM☐ 11:59 AM ☐ PM☒, Shifts per day 3 Days per Week M☒ T☒ W☒ Th☒ F☒ Sa☒ Su☒

16 Wastewater Flow Rate 75,190 Gallons per Day (Average) 200 Gallons per Minute (Peak)

17 Constituents of Wastewater Discharge Concentrated municipal water with pH adjusted to approximately 7.4 to 7.8 with traces of chemicals (see attached wastewater analyses)
(General Description – Attach Chemical Analysis Results to the Application)

18 Person in company responsible for industrial wastewater discharge

Dan Angeles	Principal Engineer	(626) 744-6240
(Name)	(Position)	(Telephone Number)

I affirm that all information furnished is true and correct and that the applicant will comply with the conditions stated on the back of this permit form.

Date _____,20 _____

19 Signature for Applicant _____ _____
(Company Administrative Official) (Name) (Position)

20 Approved/Reviewed by City or County Official
Date _____
For L.A. County Dept. of Public Works . . . ☐
City of _____
Name _____
Position _____

Approved by Sanitation Districts of Los Angeles County
Date _____
Expiration Date _____
Stephen R. Maguin, Chief Engineer and General Manager
By _____
Position _____

Note: Please submit application first to the applicable City or County agency in which the point of discharge is located. Please contact the local agency for the required permit-processing fee. Submit the **original application** (Do not send copies).

CONTINUED ON NEXT PAGE

APPLICANT FOR PERMIT MUST READ THIS MATERIAL

IN CONSIDERATION OF THE GRANTING OF THIS PERMIT, the applicant agrees:

1. To furnish any additional information on industrial wastewater discharges as required by the Districts,

2. To accept and abide by all provisions of ordinances, policies and guidelines of the Districts,

3. To operate and maintain any required industrial wastewater treatment devices in a satisfactory approved manner,

4. To cooperate at all times with Districts' personnel, or their representatives, in the inspection, sampling and study of industrial wastewater facilities and discharges,

5. To immediately notify the Districts at (562) 699-7411 during normal working hours or (562) 437-6520 or 437-1881 after 4:00 P.M. or on weekends in the event of any accident, negligence or other occurrence that causes the discharge to the sewer of any material whose nature and quantity might be reasonably judged to constitute a hazard to the public health, environment, Districts' personnel or wastewater treatment facilities,

6. To pay to the Districts annually the required surcharge or user charge fee for industrial wastewater treatment,

7. To submit, as required by the Districts, accurate data on industrial wastewater discharge flows and wastewater constituents,

8. To operate only one industrial wastewater discharge point to the sewerage system under the authority granted by this permit,

9. To submit additional pages as required for furnish the necessary information if there is inadequate room on the reverse side of this permit form to complete submittal of requested data,

10. To apply for a revised Districts' Industrial Wastewater Discharge Permit if any change in industrial processes, production, method of wastewater treatment or operations creates a significant change in industrial wastewater quality, or if the quantity of wastewater discharged changes by more than 25% or other threshold level as specified in industrial waste permit requirements,

11. To provide immediate access to authorized personnel of the Districts to any facility directly or indirectly connected to the Districts' sewerage system under emergency conditions and at all other reasonable times.

FORM A: APPLICANT QUESTIONNAIRE

Name Of Company City of Pasadena, Water and Power Department

Company Contact Name Dan Angeles, Principal Engineer, dangeles@cityofpasadena.net

Company Contact E-mail _____ Phone Number (626) 744-6240

FORM A: APPLICANT QUESTIONNAIRE

1. Reason for Submittal - Circle A – New Permit, B – Permit Revision, C – Permit Addendum, or D – Permit Renewal and complete the corresponding questions.

A. New Permit (for new companies and for changes in ownership)

Type of business _____

Is the facility: ☐ New or ☐ Existing (please check)

If existing, previous company name _____

Type of business _____

Industrial Wastewater Discharge Permit No. _____

Provide a description of all manufacturing processes and wastewater producing operations in an attachment.

Are any changes being made to the facility's existing wastewater pretreatment/conveyance systems?
☐ Yes ☐ No If yes, briefly explain these modifications in attachments.

Is there more than one company discharging industrial wastewater at your facility? ☐ Yes ☐ No If yes, provide for each company its name, a separate address and a description of its operations. If feasible, each company must apply for a separate permit and must have its own incoming water meter and a separate industrial wastewater sampling point.

If your facility will involve a new connection to the public sewer, please check the point of connection:
☐ Local city sewer, ☐ Sanitation Districts' Trunk sewer.

If you are relocating, and had a previous Industrial Wastewater Discharge Permit, give your previous address _____, and permit number _____.
If you have received a temporary permit, give permit number _____.

All submittals for new permits **must** include a permit application, plans (if changes have occurred) and pertinent supporting information.

B. Revision of Existing Permit (for a 25 percent or more change in wastewater quantity/quality)

Permit number 5171 R-2.
Has your wastewater quantity and/or quality changed over 25 percent? ☒ Yes ☐ No If yes, documentation addressing the magnitude and reason(s) for the change must be submitted. If no, a revision is not required at this time.

Have there been any changes in production processes, wastewater pretreatment systems or sewerage plumbing?
☒ Yes ☐ No If yes, submit plans and describe these changes in attachments.

All submittals for a revised permit **must** include a permit application, plans (if changes have occurred) and supporting information.

C. Addendum to Permit (for modifications to the wastewater conveyance/pretreatment system)

Permit Number _____.

Attach a brief summary of the existing conditions and the proposed changes. All submittals for a permit addendum **must** include plans and supporting information. Applicant must also answer the questions on the back of this form (**2. Supporting Information Required**).

D. Permit Renewal (for permits with expiration dates)

Permit Number _____.

Have there been any changes in production processes, wastewater pretreatment systems or sewerage plumbing? ☐ Yes ☐ No If yes, submit plans and describe these changes in attachments.

All submittals for a permit renewal **must** include a permit application, plans (if changes have occurred) and supporting information.

1. Supporting Information Required

All submittals **must** include the following forms, which are included in Appendix 6.1:

Form A - Applicant Questionnaire
Form B - Calculation of Industrial Wastewater Discharge Flow Rate
Form C - Tank Schedule and Spill Containment Calculations
Form D - Check List

Furthermore, your company must answer the questions below to determine the additional supporting information that must be provided:

A. Waste Minimization (refer to Sections 2.4 and 3.3 E)
Please describe below or in an attachment all of your company's existing/proposed pollution prevention measures (e.g., reuse, product reformulation, process changes, housekeeping measures, etc.):

Has your company previously submitted a waste minimization plan to the Districts? ☐ Yes ☒ No If no, please read Sections 2.4 and 3.3E and submit the appropriate plan (if applicable). Your company is encouraged to obtain information on source reduction measures and options for your industrial processes by calling the Districts' Industrial Waste Section at (562) 908-4288, ext. 2900.

B. Wastewater Quality (refer to Sections 3.3G and H)
Please provide the results of at least two 24-hour composite analyses attesting to concentrations of chemical oxygen demand, suspended solids and any priority or regulated pollutants that may be found in your wastewater. Your company must also provide material safety data sheets of all chemicals used in the facility that may directly or indirectly contaminate your wastewater.

C. New Equipment (refer to Sections 3.3 F, J and K)
Is your company installing new pretreatment, monitoring, conveyance or industrial equipment that may have an impact on the quality or quantity of your wastewater? ☐ Yes ☒ No If yes, please provide catalog cuts of all units and important details such as: number of units, sizes, hours of operation, pump rating curves, operating parameters, etc.

D. Baseline Monitoring Report (refer to Sections 2.1 and 3.3 I)
Does your company currently fall under one of EPA's categories? ☒ Yes ☐ No If yes, your company must submit a Baseline Monitoring Report, unless it was submitted one in the past and there have been no changes in operations that may change your categorical standards.

E. Rainwater Management (refer to Section 3.2)
Are there any outdoor drains, trenches or sumps at your facility that are connected to the sewerage system? ☐ Yes ☒ No If yes, your company must submit plans and information that describe the existing means to divert rainwater from the sewerage system or a proposal to comply with the Districts' rainwater guidelines. Please be informed that new automatic rainwater diversion systems will not be approved unless the applicant proves that this is the only feasible alternative.

Attachment 1 – Form A Supplemental Responses

1B. Revision of Existing Permit: Change in wastewater quantity

The City of Pasadena is decommissioning the B3 steam power generating system presently located at the Broadway Power Plant. The B3 steam power plant is being replaced with a more efficient, cleaner burning new combined cycle power plant (GT-5) and associated ancillary systems to be located at the adjacent Glenarm facility. As with B3, GT-5 will also require demineralized water for its operation. The demineralized water treatment system will continue to operate at the Broadway facility. As a result, the annual average discharge to the Broadway sewer outfall box will be approximately 75,190 gpd (current permit limit is 17,500 gpd). The peak flow rate to the sewer outfall will not increase above the current permit limit of 200 gpm.

The B3 cooling tower will be decommissioned; wastewater will no longer be piped to the B3 cooling tower for temporary storage. All wastewater from the demineralization water treatment system will be piped either to Tank B2, the "marina" sump, or the Broadway sewer outfall box. The changes in sewerage piping may be found in the Broadway Industrial Wastewater Process Flow Diagram (M2-2-3) in Attachment 5.

Supporting Information

A. Waste Minimization

Refer to existing permit file.

B. Wastewater Quality

See wastewater analyses included in Attachment 4.

C. New Equipment

No new equipment will be installed, with the exception of new piping connecting the "marina" sump to Tank B2 and the Broadway sewer outfall box. The wastewater from the "marina" sump was previously piped to the B3 cooling tower. Refer to the Broadway Industrial Wastewater Process Flow Diagram (M2-2-3) in Attachment 5.

D. Baseline Monitoring Report

Baseline Monitoring Report on file with LACSD.

E. Rainwater Management

No changes to rainwater management facilities. Refer to existing permit file.

FORM B: CALCULATION OF INDUSTRIAL WASTEWATER DISCHARGE FLOW RATE

COMPANY NAME: City of Pasadena, Water and Power Department (Broadway 5171)

Calculation of flow rate is based on: (Check one)

_____ Adjusted metered water supply (Company must complete the calculations below)

X Direct measurement through a Districts' approval effluent flow measurement system *

_____ Estimate for a facility not yet in operation **

ADJUSTED METERED WATER SUPPLY CALCULATIONS (Round all figures to two decimals)

			MILLION GALLONS PER YEAR
I	Incoming Water		
1.	Metered Water Supply from Purveyor (Water Company). Use most recent 12 consecutive months and attach copies of water bills.		MGY
2.	Water Supply from Company Well. Attach meter or water master data for most recent 12 consecutive months.	0.00	MGY
3.	Water Received in Raw Materials, or by other means. Explain in attachments.	0.00	MGY
4.	Rainwater/Groundwater Discharged to the Sewerage System. Explain in attachments.		MGY
5.	Total Incoming Water. (add lines 1 to 4)	0.00	MGY
II	Water Losses		
6	Wastewater Discharged to Stormwater Drainage System. Explain in attachments. (NPDES Permit No. _____)		MGY
7	Water Lost Through Evaporation and Irrigation. (add lines a + b + c + d at the bottom of this form)	0.00	MGY
8	Water Lost in Products. Explain in attachments.		MGY
9	Sanitary Flow Deduction. (from line "e" on the back of this form)	0.00	MGY
10	Total Water Losess. (add lines 6 to 9)	0.00	MGY
III	Industrial Wastewater Discharged		
11	Calculated Industrial Wastewater Discharged to the public sewer. (subtract line 10 from line 5)	0.00	MGY
12	Any Proposed increase (+) or decrease (-) in industrial waste-water discharge to the public sewer? (explain in attachments) Enter or Circle one (+) (-)		MGY
13	Total proposed yearly industrial wastewater discharge. (add lines 11 and 12)	0.00	MGY
14	Average industrial wastewater flow. (use line 13 to calculate below)		

NOT USED
SEE ATTACHED
SUPPLEMENTAL CALCULATIONS

MILLION GALLONS PER YEAR	x	1,000,000	÷	Number of Discharge Days per Year	=	Gallons per Day
27.44	x	1,000,000	÷	365	=	75,190.00

This is the average daily flow rate that must be used on the application for industrial wastewater discharge. (It may be rounded to two significant figures).

Note: The applicant must also complete the calculations on the back of this page.

* If your company currently has an **approved effluent wastewater flow measurement system**, please submit effluent totalizer readings for the last twelve months. Your company does not have to complete the rest of this form.

** The company must submit detailed information that substantiates how the flow rate was estimated.

WATER LOSSES

a. COOLING TOWER LOSSES

Tonnage	x	Hours of Operation Per Year	x	Load[1]	x	1.38[2]	÷	1,000,000	=	Mil. Gal. Per Year	
	x		x		x	1.38	÷	1,000,000	=	0.00	
	x		x		x	1.38	÷	1,000,000	=	0.00	
									=	0.00	a

[1] Load = 0.5 to 0.80
[2] 1.38 = Gallons evaporated per hour per ton

b. BOILER LOSSES

Horse-power	x	Hours of Operation Per Year	x	Load[3]	x	% Evaporation[4]	x	3.82[5]	÷	1,000,000	=	Mil. Gal. Per Year	
	x		x		x		x	3.82	÷	1,000,000	=	0.00	
	x		x		x		x	3.82	÷	1,000,000	=	0.00	
											=	0.00	b

[3] Load = 0.50 to 0.80
[4] % Evaporation = (100 - % condensate returned)/100
[5] 3.82 = Gallons evaporated per hour per horsepower

c. OTHER EVAPORATE LOSSES
(Explain in attachments)

Million Gallons Per Year	
	c

d. IRRIGATION LOSSES

Square Feet of Land Irrigated	x	18.7[6]	÷	1,000,000	=	Mil. Gal. Per Year	
	x	18.70	÷	1,000,000	=	0.00	d

[6] 18.7 = Gallons irrigated per square foot per year

e. SANITARY FLOW DEDUCTION

No. Employees	x	Working Days Per Year	x	Gallons Per Employee Per Day	÷	1,000,000	=	Mil. Gal. Per Year	
	x	365	x	15	÷	1,000,000	=	0.00	e

NOT USED
SEE ATTACHED
SUPPLEMENTAL CALCULATIONS

INCOMING WATER METERS

Please list all the accounts (or other identification) for all the meters that measure the water supplied to this facility.

Meter #	Location	Account #
1560779	65 E State St, Pasadena	80145-6
1556580	130 Wallis St, Pasadena	80175-3

Abbreviations and Conversion Factors
MGY = million gallons per year
1 cubic foot = 7.48 gallons
1 acre foot = 325,900 gallons
1 acre = 43,560 square feet
1 CCF = 748 gallons

Attachment 2
Form B Supplemental Calculation of Broadway Industrial Wastewater Discharge

Broadway Industrial Wastewater Discharge 2011

Month	Gallons
January	773,800
February	321,800
March	442,600
April	989,900
May	664,000
June	492,400
July	932,500
August	1,036,000
September	701,300
October	892,600
November	733,700
December	320,600

Total	**8,301,200**

Attachment 2
Form B Supplemental Calculation of Broadway Industrial Wastewater Discharge

Demineralized Water Treatment System Wastewater	**Normal Average Flow (GPD)**	**Peak Flow (GPM)**
Softener Wastewater	10,560	270
Multimedia Filter Wastewater	2,350	485
Reverse Osmosis Dump and E-Cell Rinse Water	1,660	200
Drain Reverse osmosis and E-Cell Reject Water	59,910	84
Floor Drain	710	N/A
TOTAL	**75,190**	**200**

Refer to Power Engineers Drawing No M2-2-3, "Process Flow Diagram Broadway Industrial Wastewater" in Attachment 5.
Based on proposed GT5 8760 operating hours per year excluding scheduled maintenance and 750 start/stop cycles per year.

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]

No Changes - See File

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☐ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☐
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☐ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = _____ + _____

(1) = _____ (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = _____ — _____

(2) = _____ (specify units)

Subtract (1) from (2)

(2) — (1) = _____ (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

No Changes - See File

FORM D: CHECK LIST FOR AN INDUSTRIAL WASTEWATER DISCHARGE PERMIT SUBMITTAL

COMPANY NAME: Pasadena Water and Power - Broadway Plant

1. Permit Application Form ..... [x]

2. Plans (Minimum size: 11" x 17"; maximum size 30" x 42") ..... [x]

   a. Required Plans:

      Sewerage Plan (location of equipment, process tanks and sewer lines) ..... [x]

      Plot Plan (location of facility, sampling point and connection to the public sewer) ..... On File [ ]

      Plans of Pretreatment Facilities ..... On File [ ]

   b. Additional Plans (if needed)

      Spill Containment System ..... [ ]

      Flow Monitoring System ..... [ ]

      Rainwater Management ..... [ ]

      Combustible Gas Monitoring System ..... [ ]

3. Supporting Information:

ALWAYS REQUIRED

- Applicant's Questionnaire (Form A) ..... [x]
- Estimation of Discharge Flow Rate and Water Bills (Form B) ..... [x]
- Tank Schedule and Spill Containment Calculations (Form C) ..... [x]
- Checklist (Form D) ..... [x]
- Process Description ..... [x]

COMPLETE FORM A TO DETERMINE WHICH OF THESE ARE NECESSARY

- Waste Minimization Plan ..... [ ]
- Material Safety Data Sheets ..... [ ]
- Wastewater Analyses ..... [x]
- Baseline Monitoring Report (for EPA categorical companies) ..... [ ]
- Pump Curves ..... [ ]
- Catalog Cuts of Pretreatment Equipment ..... [ ]
- Baseline Credit Information ..... [ ]
- Equipment Costs ..... [ ]
- Notification Report of the Discharge of Hazardous Wastes (if applicable) ..... [ ]

Attachment 3 – Process Description

The Broadway Plant will produce high quality demineralized water for use in power production at the adjacent Glenarm Plant. The demineralized water treatment system includes reverse osmosis and electrodeionization processes. The wastewater from the demineralized water treatment system will be discharged to the Broadway sewer outfall box.

Attachment 4 – Wastewater Analyses

DATE: October 14, 2011 Page 1 of 1

CLIENT: City of Pasadena Power Plant
85 E. State St., Gate 7
Pasadena, CA 91105

ATTENTION: Art Silva

REFERENCE: Broadway Weir

REPORT NO: 147355

DATE COLLECTED: October 7, 2011 at 9:30am by Greg Stewart

DATE RECEIVED: October 7, 2011

DATE ANALYZED: October 7 and 13, 2011

ACCREDIDATION: California Department of Health Services (ELAP 1119)
County Sanitation District of LA#10120

SUBJECT: ANALYSIS AS REQUESTED

The sample analyses and results are as follows:

Analyte	Method	Result	Detection Limit
*pH, units	SM4500HB	7.40	N/A
Dissolved Sulfides, mg/l	SM4500-SE	<0.10	0.10
COD, mg/l	EPA 410.4	77	10
Oil & Grease, mg/l	EPA 1664 A	<6.4	6.4
Total Suspended Solids, mg/l	SM2540D	11	2
Total Dissolved Solids, mg/l	SM2540C	2560	10

*Sample exceeded holding time for pH analysis (15 minutes)

NA = Not applicable
mg/l = milligram per liter

Respectfully submitted,
EMS Laboratories, Inc.

Barbara Przybylski
Chemist

A. J. Kolk Jr.
Technical Director

AJK/mt

Note: The report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc.
Note: The results of the analysis are based upon the sample submitted to the laboratory. No representation is made regarding the sampling area other than that implied by the analytical results for the immediate vicinity of the samples analyzed as calculated from the data presented with those samples.
Any deviation or exclusion from the test method is noted in this cover letter. All the analytical quality control data meet the requirement of the procedure, unless otherwise indicated.
Unless otherwise noted in this cover letter the samples were received properly packaged, clearly identified and intact.

DATE: November 14, 2011 Page 1 of 1

CLIENT: City of Pasadena Power Plant
85 E. State St., Gate 7
Pasadena, CA 91105

ATTENTION: Art Silva

REFERENCE: Broadway Weir

REPORT NO: 147939

DATE COLLECTED: November 8, 2011 at 11:50am by R. Rariff

DATE RECEIVED: November 8, 2011

DATE ANALYZED: November 8 and 9, 2011

ACCREDIDATION: California Department of Health Services (ELAP 1119)
County Sanitation District of LA#10120

SUBJECT: ANALYSIS AS REQUESTED

The sample analyses and results are as follows:

Analyte	Method	Result	Detection Limit
*pH, units	SM4500HB	8.03	N/A
Dissolved Sulfides, mg/l	SM4500-SE	<0.10	0.10
COD, mg/l	EPA 410.4	24	10
Oil & Grease, mg/l	EPA 1664 A	<6.4	6.4
Total Suspended Solids, mg/l	SM2540D	<2	2
Total Dissolved Solids, mg/l	SM2540C	1700	5
Hexavalent Chromium, mg/l	SM 3500 CrD	<0.01	0.01

*Sample exceeded holding time for pH analysis (15 minutes)

NA = Not applicable
mg/l = milligram per liter

Respectfully submitted,
EMS Laboratories, Inc.

Barbara Przybylski
Chemist
AJK/mt

A. J. Kolk Jr.
Technical Director

Note: The report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc.
Note: The results of the analysis are based upon the sample submitted to the laboratory. No representation is made regarding the sampling area other than that implied by the analytical results for the immediate vicinity of the samples analyzed as calculated from the data presented with those samples.
Any deviation or exclusion from the test method is noted in this cover letter. All the analytical quality control data meet the requirement of the procedure, unless otherwise indicated.

Unless otherwise noted in this cover letter the samples were received properly packaged, clearly identified and intact.

Attachment 5 – Plans and Equipment Drawings



LEGEND

1. – DEMIN WATER TREATMENT SYSTEM
2. – MARINA SUMP
3. – TANK B2 (WASTEWATER STORAGE)
4. – BROADWAY SEWER OUTFALL BOX

NOTES

1. WASTEWATER PIPE ROUTING BETWEEN MARINA SUMP AND TANK B2 AND BROADWAY SEWER OUTFALL BOX TO BE COMPLETED BY CONTRACTOR. PLANS TO BE SUBMITTED AT A LATER DATE. REFER TO M2-2-3 FOR PROCESS FLOW DIAGRAM OF PROPOSED CHANGES TO WASTEWATER SYSTEM.

0 20 40 80 120 FEET
1"= 40'

dblades 02/24/2012 08:42 AM q:\118788\dwg\mech\SKM1-7.dgn

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR PERMIT	02/16/12	DPB	DPB	SEG	

DSGN	DPB	02/16/12
DRN	DPB	02/16/12
CKD	SEG	02/16/12

SCALE: 1" = 40'-0"
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

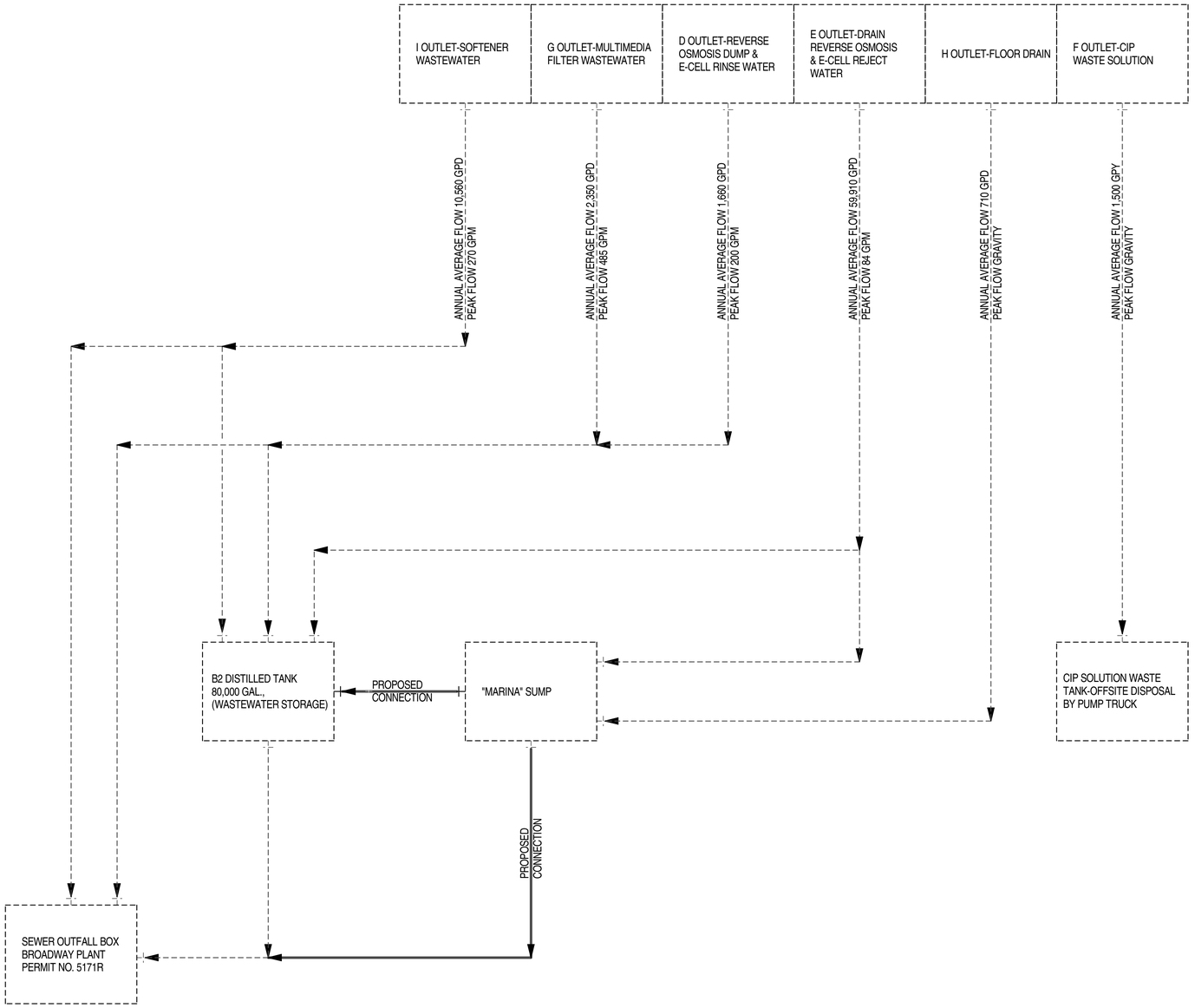
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PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
BROADWAY SEWERAGE PLAN
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374
REV A
DRAWING NUMBER SKM1-7

GLENARM REPOWERING PROJECT
BROADWAY WASTEWATER PERMIT

REV. B 07/31/12



NOTES

1. ANNUAL AVERAGE DISCHARGE FROM BROADWAY SEWER OUTFALL WILL DECREASE BY 39,800 GPD WITH THE DECOMMISSIONING OF UNIT B3.
2. THE ANNUAL AVERAGE RATE OF PRODUCTION OF DEMINERALIZED WATER IS 101,900 GPD, BASED ON WASTEWATER FLOWS SHOWN AT OUTLET "E" AND A PRODUCTION RATE OF 170 GPM OF DEMINERALIZED WATER PER 270 GPM OF RAW WATER (DOES NOT INCLUDE REGENERATION WATER).
3. PROPOSED MARINA SUMP CONNECTION TO TANK B2 AND SEWER OUTFALL BOX DUE TO THE DECOMMISSIONING OF UNIT B3 INCLUDING THE B3 COOLING TOWER.
4. DUE TO ROUNDING DECIMAL PLACES, VALUES MAY NOT SUM UP EXACTLY.
5. VALUES BASED ON BROADWAY POWER PLANT INDUSTRIAL WASTEWATER FLOW DIAGRAM PREPARED BY CH2M HILL (DASHED LINES). BOLD ITEMS ARE PROPOSED ADDITIONS TO THE WASTEWATER SYSTEM.

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ISSUED FOR PERMIT	07/31/12	DPB	SEG	ADD	TRC
A	ISSUED FOR REVIEW	06/06/11	VBD	SEG	ADD	TRC

DSGN	SEG	05/26/11
DRN	VBD	05/26/11
CKD	ADD	05/26/11
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PROCESS FLOW DIAGRAM
BROADWAY INDUSTRIAL WASTEWATER

JOB NUMBER 123374
REV B
DRAWING NUMBER M2-2-3

Table of Contents – Glenarm

Permit Application Form
- Attachment 1 – Application Form Supplemental Responses

Form A – Applicants Questionnaire
- Attachment 2 – Form A Supplemental Responses

Form B – Calculation of Industrial Wastewater Discharge Flow Rate
- Attachment 3 – Form B Supplemental Calculations

Form C – Tank Schedule and Spill Containment Calculations
- Attachment 4 – Form C Supplemental Calculations

Form D – Check List

Attachment 5 – Process Description

Attachment 6 – Material Safety Data Sheets

Attachment 7 – Wastewater Analyses

Attachment 8 – Plans and Equipment Drawings
- Glenarm Plot Plan (Drawing Number SKM1-6 Rev A)
- GT-5 Plot Plan (Drawing Number SKM1-4 Rev A)
- GT-5 Sewerage Plan (Drawing Number SKM1-5 Rev A)
- Process Flow Diagram Glenarm Industrial Wastewater (Drawing Number M2-2-4 Rev C)
- Heat and Mass Balance (M2-1-1 Rev D)
- Water Balance (M2-2-1 Rev D)
- GT-5 Equipment Drawings (available in future revisions)
    - Cooling Tower
    - Condensate Polisher

PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE
COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY
1955 Workman Mill Road / Whittier, CA
Mailing Address: P.O. Box 4998 / Whittier, California 90607-4998
Stephen R. Maguin, Chief Engineer and General Manager
(562) 699-7411

PERMIT NO: 16373

01 CHECK ONE: New Sewer Connection ☐ Existing Sewer Connection ☒

02 Applicant City of Pasadena, Water and Power Department
(Legal Company Name)

03 Check one and fill in appropriate information

☒ Corporation Name City of Pasadena
Year Incorporated 1886 State of Incorporation CA ID# 4350

☐ Partnership Name _____ Partners _____

☐ Sole Proprietor Name _____ Business Names _____

04 Situs Address 43 East State Street Pasasdena, CA 91105
(Street) (City) (State) (Zip)

05 Mailing Address 85 East State Street Pasadena, CA 91105
(Street) (City) (State) (Zip)

06 Point of Discharge Sewer trunk line on eastern side of Glenarm facility

07 Number of years applicant has been in business at present location 56 (yrs) _____ (months)

08 Name of Property Owner City of Pasadena
Address of Property Owner 45 East Glenarm Street Pasadena, CA 91105 626.744.4480
(Street) (City) (Zip) (Telephone Number)

09 Assessors Map Book No. 5 3 1 7 Page No. 0 2 9 Parcel No. 9 0 0

10 Type of Industry Electric Utility 4 9 3 1 , _____
(General Description) (Federal SIC No.)

11 Number of Employees (Full Time) 31 (Part Time) _____

12 Raw Materials Used Municipal water, natural gas, demineralized water, and water treatment chemicals (see attached)
(General Description – Add Additional Sheets as Needed)

(Daily Amount Used)

13 Products Produced Electricity
(General Description – Add Additional Sheets as Needed)
191 MW-hrs
(Daily Amount Produced)

14 Wastewater Producing Operations GT-3, GT-4, and GT-5 Cooling Towers, GT-1 and GT-2 Evaporative Coolers, Oily Water Separator, GT-5 Condensate Polisher, miscellaneous equipment drains
(Full Description – Add Additional Sheets as Needed)

M☒ T☒ W☒ Th☒

15 Time of Discharge 12:00 AM☒ PM☐ 11:59 AM ☐ PM☒, Shifts per day 3 Days per Week F☒ Sa☒ Su☒

16 Wastewater Flow Rate 99,411 Gallons per Day 191 Gallons per Minute
(Average) (Peak)

17 Constituents of Wastewater Discharge Concentrated municipal water with pH adjusted to approximately 7.4 to 7.8 with trace amounts of chemicals (see attached)
(General Description – Attach Chemical Analysis Results to the Application)

18 Person in company responsible for industrial wastewater discharge
Dan Angeles Principal Engineer (626) 744-6240
(Name) (Position) (Telephone Number)

I affirm that all information furnished is true and correct and that the applicant will comply with the conditions stated on the back of this permit form.

Date _____,20 _____

19 Signature for Applicant _____ _____
(Company Administrative Official) (Name) (Position)

20 Approved/Reviewed by City or County Official
Date _____
For L.A. County Dept. of Public Works . . . ☐
City of _____
Name _____
Position _____

Approved by Sanitation Districts of Los Angeles County
Date _____
Expiration Date _____
Stephen R. Maguin, Chief Engineer and General Manager
By _____
Position _____

Note: Please submit application first to the applicable City or County agency in which the point of discharge is located. Please contact the local agency for the required permit-processing fee. Submit the **original application** (Do not send copies).

CONTINUED ON NEXT PAGE

APPLICANT FOR PERMIT MUST READ THIS MATERIAL

IN CONSIDERATION OF THE GRANTING OF THIS PERMIT, the applicant agrees:

1. To furnish any additional information on industrial wastewater discharges as required by the Districts,

2. To accept and abide by all provisions of ordinances, policies and guidelines of the Districts,

3. To operate and maintain any required industrial wastewater treatment devices in a satisfactory approved manner,

4. To cooperate at all times with Districts' personnel, or their representatives, in the inspection, sampling and study of industrial wastewater facilities and discharges,

5. To immediately notify the Districts at (562) 699-7411 during normal working hours or (562) 437-6520 or 437-1881 after 4:00 P.M. or on weekends in the event of any accident, negligence or other occurrence that causes the discharge to the sewer of any material whose nature and quantity might be reasonably judged to constitute a hazard to the public health, environment, Districts' personnel or wastewater treatment facilities,

6. To pay to the Districts annually the required surcharge or user charge fee for industrial wastewater treatment,

7. To submit, as required by the Districts, accurate data on industrial wastewater discharge flows and wastewater constituents,

8. To operate only one industrial wastewater discharge point to the sewerage system under the authority granted by this permit,

9. To submit additional pages as required for furnish the necessary information if there is inadequate room on the reverse side of this permit form to complete submittal of requested data,

10. To apply for a revised Districts' Industrial Wastewater Discharge Permit if any change in industrial processes, production, method of wastewater treatment or operations creates a significant change in industrial wastewater quality, or if the quantity of wastewater discharged changes by more than 25% or other threshold level as specified in industrial waste permit requirements,

11. To provide immediate access to authorized personnel of the Districts to any facility directly or indirectly connected to the Districts' sewerage system under emergency conditions and at all other reasonable times.

Attachment 1 – Application Form Supplemental Responses

12. Raw Materials Used for Unit GT-5

Natural gas, municipal water, and demineralized water are used at the Glenarm facility. Additional chemicals currently used are listed in the following table.

Product Name	Chemical Constituents
Oil and Grease	
SL10-046	Synthetic Hydrocarbon
Mobil Jet Oil II (Turbine Oil)	Synthetic Esters and Additives
MobilGear 629 (Gear Oil)	Base Oil and Additives
Mobil SHC 629 (Lubricant)	Synthetic Base Stocks and Additives
Mobil SHC 630 (Lubricant)	Synthetic Base Stocks and Additives
Mobil Rarus 427 (Compressor Oil)	Base Oil and Additives
MobilFluid 350 (Hydraulic Fluid)	Base Oil and Additives
MobilGear 632 (Gear Oil)	Base Oil and Additives
MobilGrease Special (Grease)	Base Oil and Additives
Mobil DTE 797 Oil (Turbine Oil)	Base Oil and Additives
Mobil DTE Oil Heavy Medium (Turbine Oil)	Base Oil and Additives
Exxon XD-3 50 (Engine Oil)	Base Oil and Additives
Mobilube HD 80W-90 (Gear Oil)	Base Oil and Additives
Hyvolt II (Transformer Oil)	Severely Hydrotreated Light Naphthenic Petroleum Oil, Butylated Hydroxytoluene (BHT) or 2,6-Di-tert-butyl-p-cresol (DBPC)
Water Treatment Chemicals	
Sulfuric Acid	Sulfuric Acid
ChemTreat CT-9006 Reverse Osmosis Treatment	Polyelectrolyte solution
ChemTreat BL124 (Boiler Water Treatment)	Sodium bisulfite
ChemTreat BL1260 (Boiler Water Treatment)	Carbohydrazide
ChemTreat BL1283 (Boiler Water Treatment)	Diethylhydroxylamine
ChemTreat BL1302 (Boiler Water Treatment)	Sodium Hydroxide
ChemTreat BL1551 (Steam Line Treatment)	Morpholine
ChemTreat BL1794 (Boiler Water Treatment)	Sodium Phosphate, tribasic
ChemTreat C2189G (Cooling Water Microbiocide)	1-Bromo-3-chloro-5,5-dimethylhydantoin
ChemTreat CL49 (Cooling Water Microbiocide)	Stabilized halogen biocide, Sodium hydroxide
ChemTreat CL2030 (Cooling	N,N-Dioctyl-N,N-dimethylammonium chloride,

Water Microbiocide and Algicide)	Ethanol
ChemTreat CL2150 (Cooling Water Microbiocide and Paper Slimicide)	5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one
ChemTreat CL2156 (Cooling Water Microbiocide)	5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one, Magnesium nitrate, Magnesium chloride
ChemTreat CL2871 (Closed System Treatment)	Sodium Molybdate, Nitrous Acid, sodium salt
ChemTreat CL3858 (Iron Cleaner)	1-Hydroxyethylidene-1,1-diphosphonic acid, Tetrapotassium salt
ChemTreat 4830 (Cooling Water Treatment)	2-Phosphono-1,2,4-butane tricarboxylic acid, sodium salt, Tetrapotassium pyrophosphate, Potassium hydroxide, Tolyltriazole, sodium salt, Potassium phosphate, tribasic
Quadrasperse CL4819 (Cooling Water Treatment)	2-Phosphono-1,2,4-butane tricarboxylic acid, Zinc chloride, Sodium hydroxide, Tolyltriazole, Sodium salt
Quadrasperse CL4855 (Cooling Water Treatment)	2-Phosphono-1,2,4-butane tricarboxylic acid, sodium salt, Sodium hydroxide, Tolyltriazole, Sodium salt
ChemTreat CL4910 (Cooling Water Microbiocide)	Sodium hypochlorite, Sodium bromide, Sodium hydroxide
ChemTreat CL6033 (Closed System Treatment)	Sodium tetraborate pentahydrate, Potassium hydroxide, Tolyltriazole, sodium salt
ChemTreat P828L (Water Clarification Agent)	Ferric sulfate
ChemTreat RL100 (Reverse Osmosis Treatment)	Sodium hydroxide
ChemTreat RL2000 (Reverse Osmosis Treatment)	Citric acid, Sodium citrate
Hydro Solv (Cleaning Agent)	Polyethylene glycol phenyl ether phosphate, Sodium tripolyphosphate, Ethanol, 2-butoxy-, phosphate, Amines, coco alkyl, ethoxylated compounds with polyethylene glycol monooleyl ether phosphate
Potassium Hydroxide Solution 8N	Potassium hydroxide
Green Clean (General purpose cleaner)	Dipropylene Glycol Methyl Ether, Sodium Carbonate
CalClean, Special HD (Detergent)	Sodium metasilicate, Potassium hydroxide
Evap-Green 4191 (Evaporator Coil Cleaner/Degreaser)	Alcohols, C9-11, ethoxylated
Transformer Chemicals	
C.F.E. P-9 (Epoxy Poliamide – Organic Zinc Primer)	Xilene, Zinc powder, Epoxy resin, catalyst

PEMEX RP – 5 Type B (Catalyzed epoxic tar coal primer)	Epoxy resin, catalyst, Xilene, MIBK, Tar Coal
C.F.E. A-12 (Polyurethane finish)	Titanium dioxide, Polyurethane resin, catclyst, Xilene, Tixogel, Extender
Other	
19% Aqueous Ammonia	Ammonia
Rochem Fyrewash 3 or similar	2-(2-butoxyethoxy)ethanol, Non ionic surfactants

The following additional chemicals will likely be used in Unit GT-5. MSDS are not available for all chemicals at this time as final determination of products has not been completed. MSDS will be provided to LACSD once final product selection is completed.

Product Name	**Chemical Constituents**	**Usage Location**
Cation Resin	To be determined by vendor	Condensate Polish units
Anion Resin	To be determined by vendor	Condensate Polish units
Mixed Bed Resin	To be determined by vendor	Condensate Polish units
Ammonia/Amine	Ammonia/TBD	OTSG (Steam Cycle Treatment)
Hydrazine or Eliminox	Hydrazine	OTSG (Steam Cycle Treatment)
R123	2,2-Dichloro-1,1,1-trifluoroethane	Gas turbine inlet chiller
R-134a	1,1,1,2-Tetrafluoroethane	Gas turbine inlet chiller

14. Wastewater Producing Operations

The following operations will contribute wastewater to be discharged to the sewer:

- Blowdown from cooling towers for Units GT-3, GT-4, and GT-5.
- Blowdown from inlet air coolers for Units GT-1 and GT-2.
- Drips and leaks from equipment skids for Units GT-3, GT-4, and GT-5. Collected wastewater will be treated in an existing oily water separator prior to discharge to sewer.

Additional details regarding these operations are included in the Process Description (Attachment 5).

17. Constituents of Wastewater Discharge

Wastewater analyses are included in Attachment 7. After the addition of Unit GT-5, the concentrations of chemicals in wastewater and the water chemistry parameters are expected to be similar to the analysis results presented in Attachment 7.

FORM A: APPLICANT QUESTIONNAIRE

Name Of Company City of Pasadena, Water and Power Department

Company Contact Name Dan Angeles, Principal Engineer, dangeles@cityofpasadena.net

Company Contact E-mail _____ Phone Number (626) 744-6240

FORM A: APPLICANT QUESTIONNAIRE

1. Reason for Submittal - Circle A – New Permit, B – Permit Revision, C – Permit Addendum, or D – Permit Renewal and complete the corresponding questions.

A. New Permit (for new companies and for changes in ownership)

Type of business _____

Is the facility: ☐ New or ☐ Existing (please check)

If existing, previous company name _____

Type of business _____

Industrial Wastewater Discharge Permit No. _____

Provide a description of all manufacturing processes and wastewater producing operations in an attachment.

Are any changes being made to the facility's existing wastewater pretreatment/conveyance systems?
☐ Yes ☐ No If yes, briefly explain these modifications in attachments.

Is there more than one company discharging industrial wastewater at your facility? ☐ Yes ☐ No If yes, provide for each company its name, a separate address and a description of its operations. If feasible, each company must apply for a separate permit and must have its own incoming water meter and a separate industrial wastewater sampling point.

If your facility will involve a new connection to the public sewer, please check the point of connection:
☐ Local city sewer, ☐ Sanitation Districts' Trunk sewer.

If you are relocating, and had a previous Industrial Wastewater Discharge Permit, give your previous address _____, and permit number _____.
If you have received a temporary permit, give permit number _____.

All submittals for new permits **must** include a permit application, plans (if changes have occurred) and pertinent supporting information.

B. Revision of Existing Permit (for a 25 percent or more change in wastewater quantity/quality)

Permit number 016373.
Has your wastewater quantity and/or quality changed over 25 percent? ☒ Yes ☐ No If yes, documentation addressing the magnitude and reason(s) for the change must be submitted. If no, a revision is not required at this time.

Have there been any changes in production processes, wastewater pretreatment systems or sewerage plumbing?
☒ Yes ☐ No If yes, submit plans and describe these changes in attachments.

All submittals for a revised permit **must** include a permit application, plans (if changes have occurred) and supporting information.

C. Addendum to Permit (for modifications to the wastewater conveyance/pretreatment system)

Permit Number _____.

Attach a brief summary of the existing conditions and the proposed changes. All submittals for a permit addendum **must** include plans and supporting information. Applicant must also answer the questions on the back of this form (**2. Supporting Information Required**).

D. Permit Renewal (for permits with expiration dates)

Permit Number _____.

Have there been any changes in production processes, wastewater pretreatment systems or sewerage plumbing? ☐ Yes ☐ No If yes, submit plans and describe these changes in attachments.

All submittals for a permit renewal **must** include a permit application, plans (if changes have occurred) and supporting information.

1. Supporting Information Required

All submittals **must** include the following forms, which are included in Appendix 6.1:

Form A - Applicant Questionnaire
Form B - Calculation of Industrial Wastewater Discharge Flow Rate
Form C - Tank Schedule and Spill Containment Calculations
Form D - Check List

Furthermore, your company must answer the questions below to determine the additional supporting information that must be provided:

A. Waste Minimization (refer to Sections 2.4 and 3.3 E)

Please describe below or in an attachment all of your company's existing/proposed pollution prevention measures (e.g., reuse, product reformulation, process changes, housekeeping measures, etc.):

Has your company previously submitted a waste minimization plan to the Districts? ☐ Yes ☒ No If no, please read Sections 2.4 and 3.3E and submit the appropriate plan (if applicable). Your company is encouraged to obtain information on source reduction measures and options for your industrial processes by calling the Districts' Industrial Waste Section at (562) 908-4288, ext. 2900.

B. Wastewater Quality (refer to Sections 3.3G and H)

Please provide the results of at least two 24-hour composite analyses attesting to concentrations of chemical oxygen demand, suspended solids and any priority or regulated pollutants that may be found in your wastewater. Your company must also provide material safety data sheets of all chemicals used in the facility that may directly or indirectly contaminate your wastewater.

C. New Equipment (refer to Sections 3.3 F, J and K)

Is your company installing new pretreatment, monitoring, conveyance or industrial equipment that may have an impact on the quality or quantity of your wastewater? ☒ Yes ☐ No If yes, please provide catalog cuts of all units and important details such as: number of units, sizes, hours of operation, pump rating curves, operating parameters, etc.

D. Baseline Monitoring Report (refer to Sections 2.1 and 3.3 I)

Does your company currently fall under one of EPA's categories? ☒ Yes ☐ No If yes, your company must submit a Baseline Monitoring Report, unless it was submitted one in the past and there have been no changes in operations that may change your categorical standards.

E. Rainwater Management (refer to Section 3.2)

Are there any outdoor drains, trenches or sumps at your facility that are connected to the sewerage system? ☒ Yes ☐ No If yes, your company must submit plans and information that describe the existing means to divert rainwater from the sewerage system or a proposal to comply with the Districts' rainwater guidelines. Please be informed that new automatic rainwater diversion systems will not be approved unless the applicant proves that this is the only feasible alternative.

Attachment 2 – Form A Supplemental Responses

1B. Revision of Existing Permit: Change in wastewater quantity

The City of Pasadena is decommissioning the B3 steam power generating system presently located at an adjacent facility known as the Broadway Power Plant. The B3 steam power plant is being replaced with a more efficient, clean burning, new combined cycle power plant (GT-5) and associated ancillary systems to be located at the Glenarm facility. The new combined cycle unit will be rated at 71 MW. The wastewater from unit GT-5 will be sent to the existing Glenarm sewer outfall. The quality of the wastewater is not expected to change significantly after the addition of unit GT-5, however, the quantity of discharge will be an annual average of approximately 99,411 gpd (current permit limit is 4,300 gpd). The peak flow rate to the sewer outfall will not increase above the current permit limit of 191 gpm.

Additional details regarding the changes in production processes, wastewater pretreatment, and sewerage plumbing may be found in the Process Description (Attachment 5) and in the Plans and Drawings (Attachment 8).

Supporting Information

A. Waste Minimization

All existing and proposed equipment skids include drip pans to collect any oily leaks. Drip pans have a relatively small footprint, limiting the surface area which can be contaminated with oily water. Any wastewater captured by the drip pans will be drained to an existing oily water separator to remove oil before water is discharged to the sewer. Waste oil is disposed of offsite.

The proposed Unit GT-5 includes a once through steam generator (OTSG) as the heat recovery steam generator (HRSG). In typical drum-type HRSGs, small amounts of water (blowdown) are continuously discarded to prevent the buildup of dissolved and suspended solids in the feedwater. The proposed OTSG, however, is a drum-free once-through HRSG. The OTSG has minimal blowdown requirement and therefore water consumption is reduced as compared to conventional type HRSGs.

A high efficiency cooling tower was selected for Unit GT-5. The cooling tower will include drift eliminators to reduce the drift to less than 0.0005% of the inlet water flow. The drift eliminators capture water droplets prior to their release into the atmosphere and return them to the cooling tower basin, reducing the losses in the cooling tower.

For additional waste minimization practices refer to existing permit file.

B. Wastewater Quality

See wastewater analyses included in Attachment 7.

C. New Equipment

New equipment for Unit GT-5 is shown on the GT-5 Plot Plan (SKM1-4, Attachment 8). The following equipment will impact the quantity and quality of wastewater:

- GT-5 Cooling Tower
- GT-5 Condensate Polish unit
- Drains from equipment skids

GT-5 will operate for a proposed maximum of 8,760 hours per year. Final equipment selection has not been completed at this time. Preliminary data sheets and drawings for the cooling tower and condensate polish unit are presented in Attachment 8. Final equipment data sheets and drawings will be submitted after final design has been completed.

D. Baseline Monitoring Report

See baseline monitoring report on file with LACSD.

E. Rainwater Management

There are no outdoor drains, trenches, or sumps at the facility that are connected to the sewer with the following exception: the new combined cycle unit will include several ancillary system equipment skids. Drip pans are provided beneath each of these skids to catch any drips or leaks. The drip pans are outdoors and, as such, they will also collect rainfall. The volume of potential rainfall is very small due to the small footprint area. All liquid collected in the drip pans will flow to an oily water separator prior to discharge to the Glenarm sewer outfall box. If the final design results in a drip pan area greater than 400 square feet, rain covers will be provided.

An updated Standard Urban Stormwater Mitigation Plan will be submitted before construction of GT-5 begins.

FORM B: CALCULATION OF INDUSTRIAL WASTEWATER DISCHARGE FLOW RATE

COMPANY NAME: City of Pasadena, Water and Power Department (Glenarm 16373)

Calculation of flow rate is based on: (Check one)

- ____ Adjusted metered water supply (Company must complete the calculations below)
- X Direct measurement through a Districts' approval effluent flow measurement system *
- X Estimate for a facility not yet in operation **

ADJUSTED METERED WATER SUPPLY CALCULATIONS (Round all figures to two decimals)

		MILLION GALLONS PER YEAR
I	Incoming Water	
1.	Metered Water Supply from Purveyor (Water Company). Use most recent 12 consecutive months and attach copies of water bills.	MGY
2.	Water Supply from Company Well. Attach meter or water master data for most recent 12 consecutive months.	0.00 MGY
3.	Water Received in Raw Materials, or by other means. Explain in attachments.	0.00 MGY
4.	Rainwater/Groundwater Discharged to the Sewerage System. Explain in attachments.	MGY
5.	Total Incoming Water. (add lines 1 to 4)	0.00 MGY
II	Water Losses	
6	Wastewater Discharged to Stormwater Drainage System. Explain in attachments. (NPDES Permit No. ____)	MGY
7	Water Lost Through Evaporation and Irrigation. (add lines a + b + c + d at the bottom of this form)	0.00 MGY
8	Water Lost in Products. Explain in attachments.	MGY
9	Sanitary Flow Deduction. (from line "e" on the back of this form)	0.00 MGY
10	Total Water Losess. (add lines 6 to 9)	0.00 MGY
III	Industrial Wastewater Discharged	
11	Calculated Industrial Wastewater Discharged to the public sewer. (subtract line 10 from line 5)	0.00 MGY
12	Any Proposed increase (+) or decrease (-) in industrial waste-water discharge to the public sewer? (explain in attachments)	Enter or Circle one (+) (-) MGY
13	Total proposed yearly industrial wastewater discharge. (add lines 11 and 12)	0.00 MGY
14	Average industrial wastewater flow. (use line 13 to calculate below)	

NOT USED SEE ATTACHED SUPPLEMENTAL CALCULATIONS

MILLION GALLONS PER YEAR	x	1,000,000	÷	Number of Discharge Days per Year	=	Gallons per Day
	x	1,000,000	÷	365	=	0.00

This is the average daily flow rate that must be used on the application for industrial wastewater discharge. (It may be rounded to two significant figures).

Note: The applicant must also complete the calculations on the back of this page.

* If your company currently has an **approved effluent wastewater flow measurement system**, please submit effluent totalizer readings for the last twelve months. Your company does not have to complete the rest of this form.

** The company must submit detailed information that substantiates how the flow rate was estimated.

WATER LOSSES

a. COOLING TOWER LOSSES

Tonnage	x	Hours of Operation Per Year	x	Load[1]	x	1.38[2]	÷	1,000,000	=	Mil. Gal. Per Year	
	x		x		x	1.38	÷	1,000,000	=	0.00	
	x		x		x	1.38	÷	1,000,000	=	0.00	
									=	0.00	a

[1] Load = 0.5 to 0.80
[2] 1.38 = Gallons evaporated per hour per ton

b. BOILER LOSSES

Horse-power	x	Hours of Operation Per Year	x	Load[3]	x	% Evaporation[4]	x	3.82[5]	÷	1,000,000	=	Mil. Gal. Per Year	
	x		x		x		x	3.82	÷	1,000,000	=	0.00	
	x		x		x		x	3.82	÷	1,000,000	=	0.00	
											=	0.00	b

[3] Load = 0.50 to 0.80
[4] % Evaporation = (100 - % condensate returned)/100
[5] 3.82 = Gallons evaporated per hour per horsepower

c. OTHER EVAPORATE LOSSES
(Explain in attachments)

Million Gallons Per Year	
	c

d. IRRIGATION LOSSES

Square Feet of Land Irrigated	x	18.7[6]	÷	1,000,000	=	Mil. Gal. Per Year	
	x	18.70	÷	1,000,000	=	0.00	d

[6] 18.7 = Gallons irrigated per square foot per year

e. SANITARY FLOW DEDUCTION

No. Employees	x	Working Days Per Year	x	Gallons Per Employee Per Day	÷	1,000,000	=	Mil. Gal. Per Year	
	x	365	x	15	÷	1,000,000	=	0.00	e

NOT USED
SEE ATTACHED
SUPPLEMENTAL CALCULATIONS

INCOMING WATER METERS

Please list all the accounts (or other identification) for all the meters that measure the water supplied to this facility.

Meter #	Location	Account #
1560779	65 E State St, Pasadena	80145-6
1556580	130 Wallis St, Pasadena	80175-3

Abbreviations and Conversion Factors
MGY = million gallons per year
1 cubic foot = 7.48 gallons
1 acre foot = 325,900 gallons
1 acre = 43,560 square feet
1 CCF = 748 gallons

Attachment 3 - Form B Supplemental Calculations - GT-5 Industrial Wastewater Discharge Rate

GT-5 Permitted Annual Operating Hours	**8760**

GT-5 Wastewater Flows during GTG Operation At Full Load	**Normal Flow at Annual Average Conditions**	**Peak Flow at Maximum Ambient Temperature**
Cooling Tower Blowdown (gpm)	37	55
Condensate Polisher (gpm)	2	10
Miscellaneous Drains (gpm)	2	11
Hose Bibs (gpm)	0	20
Cooling Tower Blowdown (gpd)	40,949	-
Condensate Polisher (gpd)	2,206	-
Miscellaneous Drains (gpd)	2,206	-

Note 1: Because of rounding decimal places, values may not match exactly.

Note 2: Flow rates based on GT Pro version 20 output/process calculations (see Drawing M2-2-1 in Attachment 8).

GT-5 Wastewater Flows during Start-Up and Shut-Down	**Normal Flow at Annual Average Conditions**	**Peak Flow at Maximum Ambient Temperature**
Cooling Tower Blowdown @ 100% Load (gpm)	37	55
Cooling Tower Blowdown @ 75% Load (gpm)	29	38
Cooling Tower Blowdown @ 50% Load (gpm)	25	33
Cooling Tower Blowdown @ 25% Load (gpm)	21	31
Condensate Polisher (gpm)	2	10
Miscellaneous Drains (gpm)	2	11
Cooling Tower Blowdown (gpd)	8,515	-
Condensate Polisher (gpd)	608	-
Miscellaneous Drains (gpd)	608	-

Note 3: Cooling tower flow (gpd) based on assumption that each load scenario occupies 25% of the total start-up and shut-down time.

Glenarm Industrial Wastewater Discharge Rates	**Annual Average Flow (gpd)**	**Peak Flow (gpm)**
Cooling Tower GT-3	16,200	26
Cooling Tower GT-4	16,200	26
Cooling Tower GT-5 (without fountain)	49,464	55
Existing Fountain (Note 4)	64	25-40
Cooling Tower GT-5 (with fountain)	49,528	55
Condensate Polisher GT-5	2,814	10
Oil Water Separator	14,614	100
Inlet Air Cooling Blowdown GT-1	27	25-40
Inlet Air Cooling Blowdown GT-2	27	25-40
Total	**99,411**	**191**

Total Wastewater (gal/year)	36,284,995
Sanitary Deduction (gal/year) (31 employees, 15 gpd)	169,725
Total Proposed Wastewater Discharge (gal/year)	**36,115,270**

Note 4: Fountain will drain to the GT-5 Cooling Tower and be used as process water.

Note 5: Refer to Drawings M2-2-1 and M2-2-4 for additional details.

Attachment 3 - Form B Supplemental Calculations - GT-5 Industrial Wastewater Monthly Discharge

Glenarm Industrial Wastewater Discharge 2011

Month	Gallons
January	26,700
February	67,700
March	52,000
April	21,100
May	21,500
June	24,000
July	37,900
August	15,500
September	20,900
October	11,800
November	7,100
December	26,900

Total	**333,100**

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]
	Condensate Storage Tank	~15 ft diam, ht TBD	Demineralized Water	approx 7	No; no containment required
	Demineralized Water Tank	~25 ft diam, ht TBD	Demineralized Water	approx 7	No; no containment required
	Waste Water Storage Tank	~25 ft diam, ht TBD	Waste Water	approx 7	No; no containment required
	GT5 Wash Water Waste Tank	~1000 gal (dimensions TBD)	Waste wash water from periodic interior washing of turbines	approx 7	No, located in concrete containment pit

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☒ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☒
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☒ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = 1000 gal + TBD

(1) = TBD (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = TBD — TBD

(2) = TBD (specify units)

Subtract (1) from (2)

(2) — (1) = TBD (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]
NA	Cooling Tower Scale and Corrosion Inhibitor Storage Tank	6'6" Ht x 4' Diam (540 gallon tank)	Cooling tower water treatment chemical (Quadrasperse CL4819)	13.7	No
NA	Cooling Tower Biocide A Storage Tank	6'6" Ht x 4' Diam (540 gallon tank)	Cooling tower water treatment chemical (ChemTreat CL49)	13.6	No
NA	Acid Storage Tank	6'6" Ht x 4' Diam (540 gallon tank)	Cooling tower water treatment chemical (Sulfuric Acid)	<1	No

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☒ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☒
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☒ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = 540 gallons + 0 gallons

(1) = 540 gallons (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = TBD — TBD

(2) = TBD (specify units)

Subtract (1) from (2)

(2) — (1) = TBD (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]
NA	Cooling Tower Biocide B Storage Tank	40" Ht, 22" Diam (60 gallon)	Cooling tower water treatment chemical (ChemTreat CL2156)	3.8	No
NA	Cooling Tower Biocide C Storage Tank	40" Ht, 22" Diam (60 gallon)	Cooling tower water treatment chemical (ChemTreat CL2130)	8.8	No

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☒ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☒
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☒ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = 60 gallons + 0 gallons

(1) = 60 gallons (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = 17.1 cu. ft. (128 gal) — 3.9 cu. ft (29 gal)

(2) = 13.2 cu. ft. (99 gal) (specify units)

Subtract (1) from (2)

(2) — (1) = 39 gal (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]
NA	OTSG Ammonia Tank	42" Ht, 50" W, 44" L (400 gallon)	Steam cycle water treatment chemical (Ammonia)	Approx 11.6 for 1N soln	Yes, approx 6 inches
NA	OTSG Hydrazine Tank	42" Ht, 50" W, 44" L (400 gallon)	Steam cycle water treatment chemical (Hydrazine or Eliminox)	<1 for Eliminox	Yes, approx 6 inches

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☒ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☒
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☒ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = 400 gallons + 0 gallons

(1) = 400 gallons (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = TBD — TBD

(2) = TBD (specify units)

Subtract (1) from (2)

(2) — (1) = TBD (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

FORM C: TANK SCHEDULE & SPILL CONTAINMENT CALCULATIONS

Please complete one form for each containment area (make additional copies if necessary).

TANK I.D. NUMBER	TANK NAME	TANK DIMENSIONS[1]	TANK CONTENTS	pH	IS TANK ELEVATED[2]
	Fuel Gas Compressor Drains Tank	100 gal (dimensions TBD)	Water with hydrocarbons	approx 7	No, located inside concrete containment
	Fuel Gas Final Filter Skid Drains Tank	100 gal (dimensions TBD)	Water with hydrocarbons	approx 7	No, located inside concrete containment

[1] Specify height and diameter if tank is round; or length, width and height if tank is rectangular.

[2] If the tank is elevated above the ground on legs, specify the location (elevation) of the bottom of the tank. If the tank is located on a pad or solid platform, specify dimensions of the pad or platform.

2. Spill Containment Calculations (make additional copies if necessary).

Answer the following questions:

	Check One
a) If this is your company's first permit submittal to the Districts, do you store hazardous or restricted materials?	YES ☒ NO ☐
b) Does your company currently have tanks/equipment with hazardous or restricted solutions that lack adequate spill containment?	YES ☐ NO ☒
c) Is your company proposing any additions/modifications of tanks or equipment that will need spill containment?	YES ☒ NO ☐

If the answer to any of the questions above is "YES," your company must submit plans that describe and propose an adequate spill containment system and must complete the calculations below:

1. Containment Volume Required:

The required containment volume is equal to the capacity of the largest tank containing a solution that requires containment plus the volume of six inches of rain over the containment area (if the area is not roofed).

(1) = Volume of largest tank (assumed to spill) + volume of 6 inches of rain over contain area (if area is outdoors)

(1) = 100 gal + TBD

(1) = TBD (specify units)

2. Containment Volume Provided:

The containment provided is equal to the volume of the dike, berm, sump or other containment structure minus the volume displaced by tanks, pads and other equipment within the containment area.

(2) = Volume of containment dike - volume displaced by tanks and other equipment

(2) = TBD — TBD

(2) = TBD (specify units)

Subtract (1) from (2)

(2) — (1) = TBD (must be greater than zero to satisfy spill containment requirements)

Note: All drains, sumps and associated plumbing within spill containment areas must be clearly shown on submitted drawings.

Attachment 4 – Form C Supplemental Information

1. The small water treatment chemical storage tanks for the cooling tower and OTSG do not have tank numbers as they are small, replaceable units.

2. GT-5 Wash water waste tank (1,000 gallons, dimensions to be determined by vendor) will be located in a concrete containment pit with a minimum volume of 1,100 gallons plus the volume of six inches of rain over containment area. Plans will be submitted at a later date.

3. Cooling Tower Scale and Corrosion Inhibitor (540 gal, ChemTreat CL4819), Biocide A (540 gal, ChemTreat CL49), and Sulfuric Acid (540 gal) will be stored together in a concrete bermed area with a containment volume greater than 594 gallons (110% of largest tank). Tanks and containment area will be located under a roof or cover to prevent rainfall from entering containment area. Containment design has not been completed; plans will be submitted at a later date.

4. Cooling Tower Biocide B (ChemTreat CL2156) and Biocide C (ChemTreat CL2130) will each be stored in identical 60 gallon tanks inside individual secondary containment units with containment volume of 99 gallons. Tanks and containment will be located under a roof or cover to prevent rainfall from entering containment area.

5. OTSG chemicals (ammonia and hydrazine or Eliminox) will be stored in 400 gallon tanks inside a common secondary containment unit. Containment design and dimensions to be determined by vendor; minimum containment volume will be 440 gallons. Tanks and containment will be located under a roof or cover to prevent rainfall from entering containment area. Plans will be submitted at a later date.

6. Fuel gas compressor drains tank and final filter skid drains tank will be located in concrete containment pits with a minimum containment volume of 110 gallons plus the volume of six inches of rain over containment area. Plans will be submitted at a later date.

FORM D: CHECK LIST FOR AN INDUSTRIAL WASTEWATER DISCHARGE PERMIT SUBMITTAL

COMPANY NAME: Pasadena Water and Power - Broadway Plant

1. Permit Application Form ..... [x]

2. Plans (Minimum size: 11" x 17"; maximum size 30" x 42") ..... [x]

   a. Required Plans:

      Sewerage Plan (location of equipment, process tanks and sewer lines) ..... [x]

      Plot Plan (location of facility, sampling point and connection to the public sewer) ..... On File [ ]

      Plans of Pretreatment Facilities ..... On File [ ]

   b. Additional Plans (if needed)

      Spill Containment System ..... [ ]

      Flow Monitoring System ..... [ ]

      Rainwater Management ..... [ ]

      Combustible Gas Monitoring System ..... [ ]

3. Supporting Information:

ALWAYS REQUIRED

- Applicant's Questionnaire (Form A) ..... [x]
- Estimation of Discharge Flow Rate and Water Bills (Form B) ..... [x]
- Tank Schedule and Spill Containment Calculations (Form C) ..... [x]
- Checklist (Form D) ..... [x]
- Process Description ..... [x]

COMPLETE FORM A TO DETERMINE WHICH OF THESE ARE NECESSARY

- Waste Minimization Plan ..... [ ]
- Material Safety Data Sheets ..... [ ]
- Wastewater Analyses ..... [x]
- Baseline Monitoring Report (for EPA categorical companies) ..... [ ]
- Pump Curves ..... [ ]
- Catalog Cuts of Pretreatment Equipment ..... [ ]
- Baseline Credit Information ..... [ ]
- Equipment Costs ..... [ ]
- Notification Report of the Discharge of Hazardous Wastes (if applicable) ..... [ ]

Attachment 5 - Process Description

The proposed Glenarm Power Plant expansion includes a combined cycle unit, GT-5, and associated infrastructure. An overall site plan and a detailed general arrangement of Unit GT-5 are included in Attachment 8. The new combined cycle unit is rated for a maximum output of 71 MW at the annual average condition. Detailed design and final equipment selection has not yet been completed. Preliminary design results include the following equipment:

- Gas turbine rated for approximately 56 MW
- Steam turbine rated for approximately 15 MW
- Once Through Steam Generator (OTSG) to generate steam
- Gas turbine inlet air filter
- Condenser
- Chiller for cooling the gas turbine combustion air to maximize power output
- Cooling tower to provide cooling water to the steam condenser, chiller, and auxiliary cooling water system
- Gas turbine water injection system to inject demineralized water for gas turbine intercooling
- Auxiliary cooling water system including heat exchanger and lube oil coolers
- Selective Catalytic Reduction (SCR) NOx control system, CO Catalyst, and stack
- Ammonia vaporization skid
- Water injection skid for NOx control
- Fuel gas filter and compressor skid
- Demineralized water storage tank, wastewater storage tank, condensate storage tank, and associated forwarding pumps
- Condensate polish skid to maintain water quality in the steam cycle
- Pumps associated with the above equipment

Gas turbine systems generate electric power by compressing chilled ambient air, heating the air through natural gas combustion, and then expanding the hot gas over a power turbine which turns the generator. The hot gas turbine exhaust is directed into the OTSG to produce steam for the steam turbine.

The cooling water system, the auxiliary cooling water system, and the chilled water system are closed loop systems with service water used for make-up water. Cooling water will be used to cool the turbine lube oil, generator lube oil, and the condenser. Chilled water will be used to cool the gas turbine inlet air. Cooling tower water will be sampled at the chemical injection skid to maintain the water chemistry and keep the cooling tower clean. Due to deposit build-up, the cooling tower will need to periodically blowdown. Blowdown from the cooling tower will be pumped to the proposed Glenarm wastewater storage tank prior to discharge to the Glenarm sewer outfall box.

SCR NOx control systems will use two methods to reduce NOx emissions from the gas turbines to the atmosphere. First, demineralized water will be injected into the gas turbine to control NOx formation in the combustion chamber. Second, ammonia will be injected downstream into the gas turbine exhaust.

Ammonia will be supplied from the existing ammonia storage tanks located on the adjacent Broadway site to the ammonia vaporizer skid located near the SCR control system.

The closed loop steam cycle will utilize demineralized water generated at the adjacent Broadway site. The steam turbine uses steam generated in the OTSG to generate additional power. After expansion in the turbine, the steam is condensed in the condenser and pumped to the condensate polish units to remove trace dissolved minerals and suspended matter thus ensuring the high purity of the water in the loop. The water is then returned to the OTSG via the boiler feedwater tank. Steam cycle make-up water will be added from the new demineralized water storage tank. Blowdown from the condensate polish unit will be pumped to the proposed Glenarm wastewater storage tank prior to discharge to the Glenarm sewer outfall box.

The various ancillary components of combined cycle unit are provided on equipment skids that include drip pans to collect any leaks or drips. The collected liquid will be piped to the existing oil water separator. Waste oil will be recovered from the OWS and disposed of offsite. The treated water will be pumped to the proposed Glenarm wastewater storage tank prior to discharge to the Glenarm sewer outfall box.

Raw Materials

Natural gas, municipal water, demineralized water, water treatment chemicals, oils, grease, and refrigerants will be used at the Glenarm power plant. The complete list of materials is presented in Attachment 1.

Operating Hours

Unit GT-5 will be permitted to operate up to 8,760 hours per year. Actual operating hours will be less than 8,760 due to startup and shutdown cycles and scheduled maintenance.

Wastewater Producing Operations

Wastewater will be produced by various plant processes as described above and as shown in the Process Flow Diagram Glenarm Industrial Wastewater (M2-2-4, Attachment 8). Wastewater producing operations include:

- Cooling towers for Units GT-3 and GT-4
- Drips and leaks from Units GT-3 and GT-4 equipment skids
- Cooling tower for Unit GT-5
- Condensate polish equipment for Unit GT-5
- Drips and leaks from Unit GT-5 equipment skids and hose bibs for equipment cleaning
- Periodic drainage of evaporative coolers for Units GT-1 and GT-2
- GSU and Auxiliary Transformer Containments (drained to grade, or pumped out if contaminated)

Estimates of flow rates for each of these operations are presented in Attachment 3 – Form B Supplemental Calculations. The following paragraphs present a detailed description of the new sources of wastewater.

GT-5 Cooling Tower

The cooling tower for GT-5 will generate approximately 37 gpm of blowdown during normal operating conditions and 55 gpm during the maximum ambient conditions. This blowdown rate is based on 6 cycles of concentration and the use of the City's potable water as make-up water. Unit GT-5 will operate a proposed maximum of 8,760 hours per year, with an annual average of flow of 49,464 gallons per day (gpd) at normal conditions. The water treatment equipment for the cooling tower will include chemical totes and metering pumps. Chemical totes will be stored on a spill containment skid, similar to that used for the GT-3 and GT-4 cooling towers, and in concrete containment pits. Water treatment chemicals will include pH adjustment chemicals, anti-scalant and corrosion inhibitors, and biocides. The GT-5 cooling tower will use the same chemicals as those used in the treatment of cooling towers for Units GT-3 and GT-4, resulting in wastewater with chemical concentrations similar to that being discharged from the operating cooling towers. Cooling tower blowdown will be sent directly to the Glenarm sewer outfall box by gravity flow or to the proposed Glenarm wastewater storage tank for temporary storage.

Condensate Polish Equipment

The condensate polish equipment is used to reclaim the high purity water from the condenser. The condensate polishing process includes filtration to remove suspended solids, such as corrosion products, and ion exchange to remove contaminant ions. Wastewater is generated by the condensate polish units during blowdown, filter backwashing, and resin regeneration. The rate of wastewater generation is expected to be 2 to 10 gpm, with an annual average discharge rate of 2,814 gpd. Wastewater from the condensate polish unit will be sent directly to the Glenarm sewer outfall box by gravity flow or to the proposed Glenarm wastewater storage tank for temporary storage. Demineralized water generated by the water treatment equipment at the Broadway plant will be used as steam cycle make-up water.

Drips and Leaks and Hoses

Drips and leaks from process equipment will be collected in the drip pans located below all equipment skids. Hose bibs located near equipment skids provide water to wash equipment periodically. Wastewater from equipment cleaning will also be directed to the drip pans of equipment skids. Water collected in the drip pans of equipment skids will be fed to a common header and sent by gravity flow to the existing OWS for pre-treatment, prior to discharge to the Glenarm sewer outfall box. Any oil or grease in the wastewater will be removed in the OWS and pumped to the waste oil storage tank for offsite disposal. The oil-free water from the OWS will be pumped to the proposed Glenarm wastewater storage tank prior to discharge to the Glenarm sewer outfall box. The amount of wastewater collected in the drip pans will vary. The total flow rate due to drips and leaks into drip pans for GT-5 equipment skids is expected to range from 2 to 11 gpm. The maximum flow rate for the hoses is expected to be 20 gpm. The anticipated annual average discharge rate from the GT-5 equipment drip pans is 2,814 gpd.

Periodically, the gas turbine will undergo a compressor water wash. Water or a water & detergent combination are mixed in a tank external to the gas turbine and then sprayed through various nozzles inside the turbine. Wash water is collected in various drain hubs on the gas turbine skid and, based upon water chemistry, is either sent to the wash water drains tank or oily water separator. Water collected in the wash water drains tank is pumped out and disposed of offsite.

Attachment 7 – Wastewater Analyses

DATE: October 14, 2011 Page 1 of 1

CLIENT: City of Pasadena Power Plant
85 E. State St., Gate 7
Pasadena, CA 91105

ATTENTION: Art Silva

REFERENCE: Glenarm Weir

REPORT NO: 147356

DATE COLLECTED: October 7, 2011 at 9:00am by Greg Stewart

DATE RECEIVED: October 7, 2011

DATE ANALYZED: October 7 and 13, 2011

ACCREDIDATION: California Department of Health Services (ELAP 1119)
County Sanitation District of LA#10120

SUBJECT: ANALYSIS AS REQUESTED

The sample analyses and results are as follows:

Analyte	Method	Result	Detection Limit
*pH, units	SM4500HB	7.10	N/A
Dissolved Sulfides, mg/l	SM4500-SE	<0.10	0.10
COD, mg/l	EPA 410.4	125	10
Oil & Grease, mg/l	EPA 1664 A	<6.4	6.4
Total Suspended Solids, mg/l	SM2540D	28	2
Total Dissolved Solids, mg/l	SM2540C	1200	10

*Sample exceeded holding time for pH analysis (15 minutes)

NA = Not applicable
mg/l = milligram per liter

Respectfully submitted,
EMS Laboratories, Inc.

Barbara Przybylski
Chemist
AJK/mt

A. J. Kolk Jr.
Technical Director

Note: The report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc.
Note: The results of the analysis are based upon the sample submitted to the laboratory. No representation is made regarding the sampling area other than that implied by the analytical results for the immediate vicinity of the samples analyzed as calculated from the data presented with those samples.
Any deviation or exclusion from the test method is noted in this cover letter. All the analytical quality control data meet the requirement of the procedure, unless otherwise indicated.
Unless otherwise noted in this cover letter the samples were received properly packaged, clearly identified and intact.

DATE: November 14, 2011 Page 1 of 1

CLIENT: City of Pasadena Power Plant
85 E. State St., Gate 7
Pasadena, CA 91105

ATTENTION: Art Silva

REFERENCE: Glenarm Weir

REPORT NO: 147938

DATE COLLECTED: November 8, 2011 at 12:00pm by R. Rariff

DATE RECEIVED: November 8, 2011

DATE ANALYZED: November 8 and 9, 2011

ACCREDIDATION: California Department of Health Services (ELAP 1119)
County Sanitation District of LA#10120

SUBJECT: ANALYSIS AS REQUESTED

The sample analyses and results are as follows:

Analyte	Method	Result	Detection Limit
*pH, units	SM4500HB	7.17	N/A
Dissolved Sulfides, mg/l	SM4500-SE	0.20	0.10
COD, mg/l	EPA 410.4	109	10
Oil & Grease, mg/l	EPA 1664 A	<6.4	6.4
Total Suspended Solids, mg/l	SM2540D	27	2
Total Dissolved Solids, mg/l	SM2540C	1460	5

*Sample exceeded holding time for pH analysis (15 minutes)

NA = Not applicable
mg/l = milligram per liter

Respectfully submitted,
EMS Laboratories, Inc.

Barbara Przybylski
Chemist

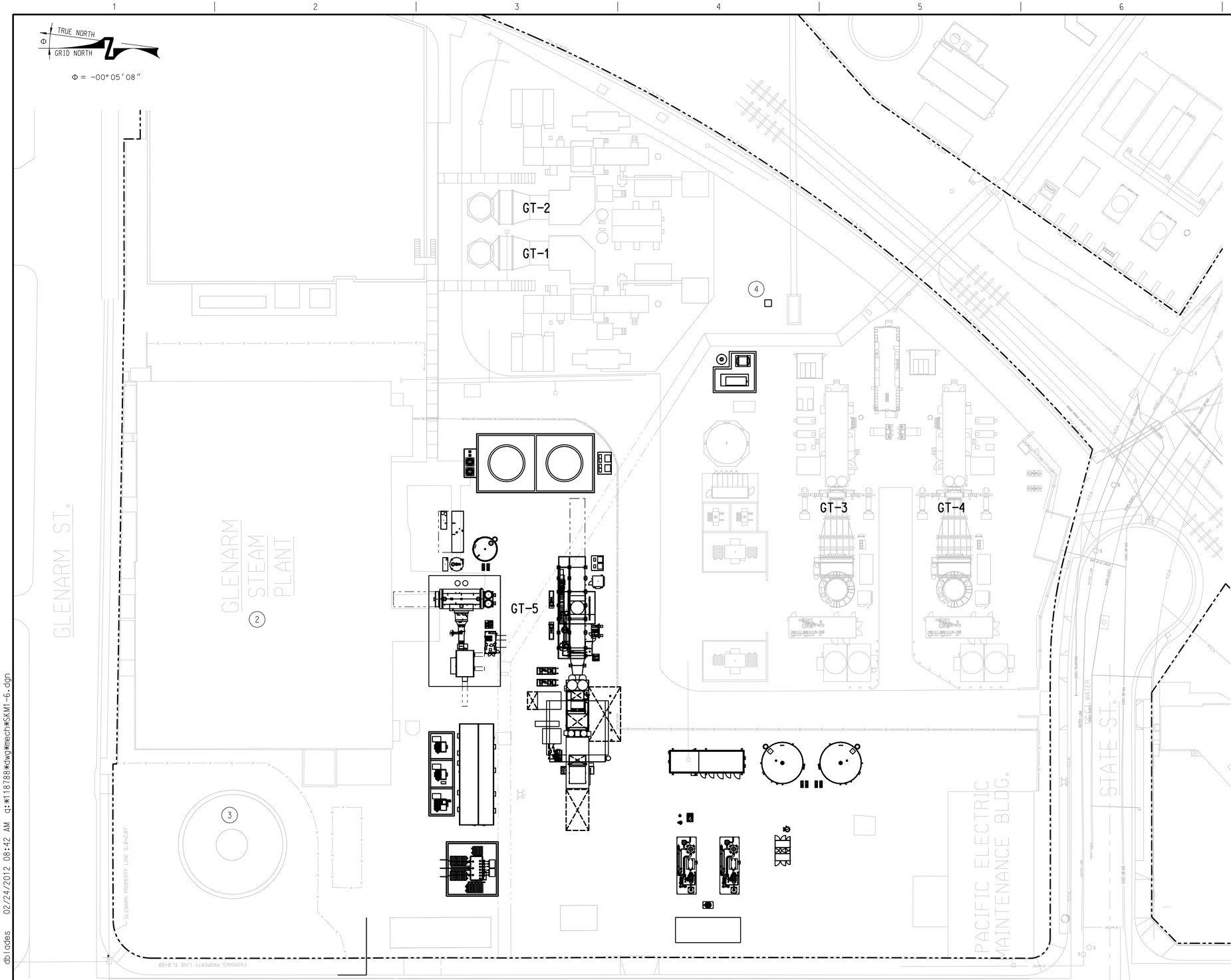
A. J. Kolk Jr.
Technical Director

AJK/mt

Note: The report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc.
Note: The results of the analysis are based upon the sample submitted to the laboratory. No representation is made regarding the sampling area other than that implied by the analytical results for the immediate vicinity of the samples analyzed as calculated from the data presented with those samples.
Any deviation or exclusion from the test method is noted in this cover letter. All the analytical quality control data meet the requirement of the procedure, unless otherwise indicated.

Unless otherwise noted in this cover letter the samples were received properly packaged, clearly identified and intact.

Attachment 8 – Plans and Equipment Drawings



LEGEND

(1) - MAINTENCE BLDG.
(2) - GLENARM BLDG.
(3) - FOUNTAIN
(4) - GLENARM SEWER OUTFALL BOX

NOTES

1. MAINTENANCE BUILDING AND GLENARM BUILDING HAVE SANITARY SEWER CONNECTIONS.

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DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR PERMIT	02/16/12	DPB	DPB	SEG	

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DRN	DPB	02/16/12
CKD	SEG	02/16/12

SCALE: 1" = 30'-0"
FOR 22x34 DWG ONLY

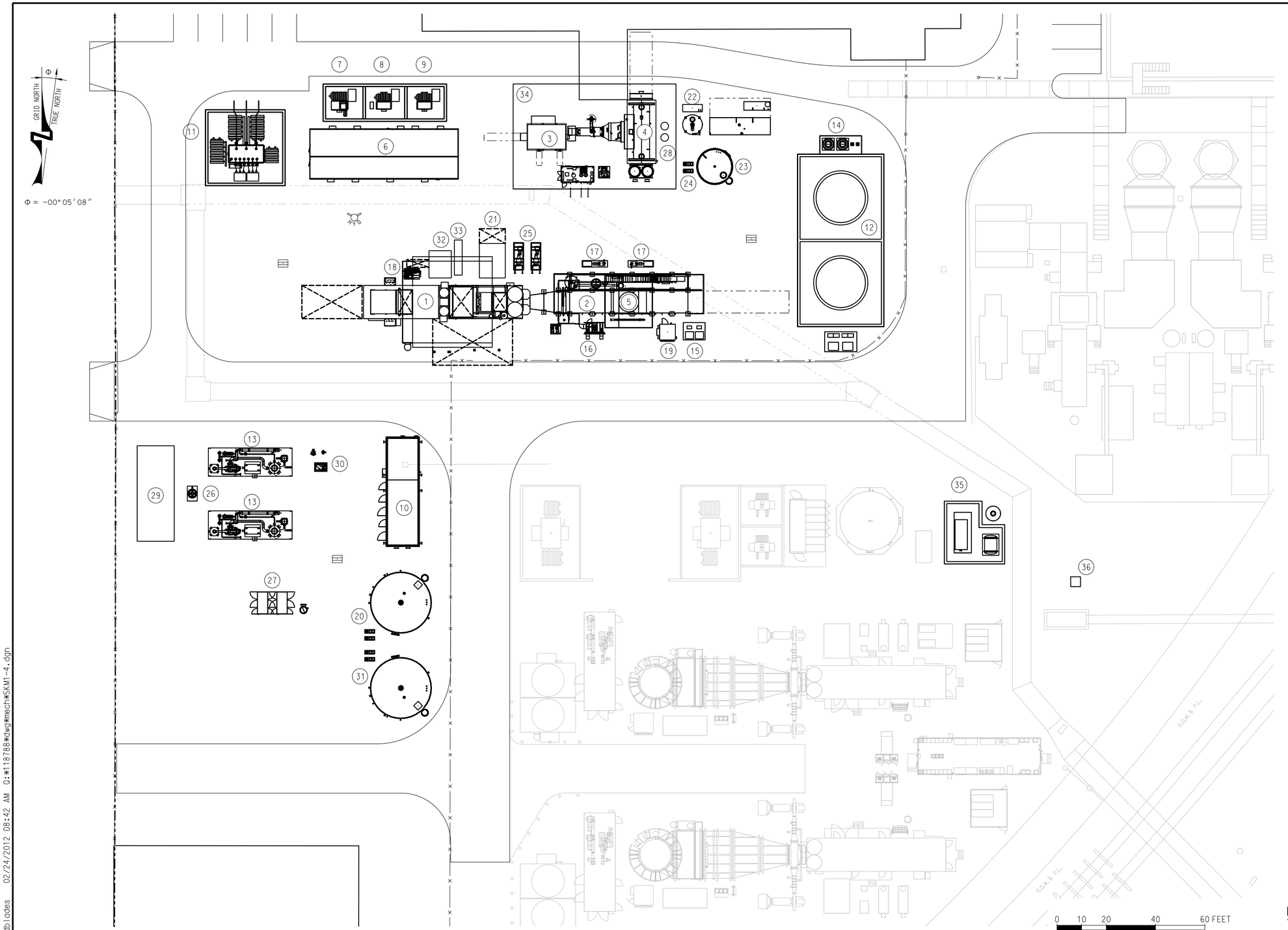
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PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
GLENARM PLOT PLAN
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374
REV A
DRAWING NUMBER SKM1-6

GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV. C 07/18/13



LEGEND

1. GAS TURBINE GENERATOR (GTG)
2. ONCE THROUGH STEAM GENERATOR (OTSG)
3. STEAM TURBINE GENERATOR (STG)
4. SURFACE CONDENSER
5. OTSG STACK
6. POWER DISTRIBUTION CENTER (PDC)
7. 4.16KV AUX. TRANSFORMER
8. 480V AUX. TRANSFORMER
9. 480V AUX. TRANSFORMER
10. INLET AIR CHILLER
11. GSU TRANSFORMER
12. COOLING TOWER
13. FUEL GAS COMPRESSOR SKID
14. CIRCULATING WATER PUMPS
15. OTSG CHEMICAL FEED SKID
16. AMMONIA FLOW CONTROL UNIT
17. BOILER FEEDWATER PUMPS
18. GTG CO2 BOTTLES
19. CEMS SKID
20. DEMINERALIZED WATER TANK AND PUMPS
21. GTG AUXILIARY SKID
22. CONDENSATE POLISHERS
23. CONDENSATE STORAGE TANK
24. CONDENSATE MAKE UP PUMPS
25. GTG NOX WATER INJECTION SKIDS
26. FUEL GAS COMPRESSOR DRAINS TANK
27. AIR COMPRESSOR AND RECEIVER
28. CONDENSATE PUMPS
29. FUEL GAS METERING
30. GTG FUEL GAS FINAL FILTER SKID
31. WASTE WATER TANK
32. GENERATOR/GEARBOX LUBE OIL SKID
33. LUBE OIL COOLER SKID
34. STEAM TURBINE ENCLOSURE
35. OIL-WATER SEPARATOR (EXISTING)
36. GLENARM SEWER OUTFALL BOX (EXISTING)

NOTES

1. CONCEPTUAL

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DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR PERMIT		DPB	DPB	SEG	

DSGN	DPB	02/16/12
DRN	DPB	02/16/12
CKD	SEG	02/16/12

SCALE: 1" = 20'-0"

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GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

GT-5 PLOT PLAN
GAS TURBINE/AXIAL EXHAUST

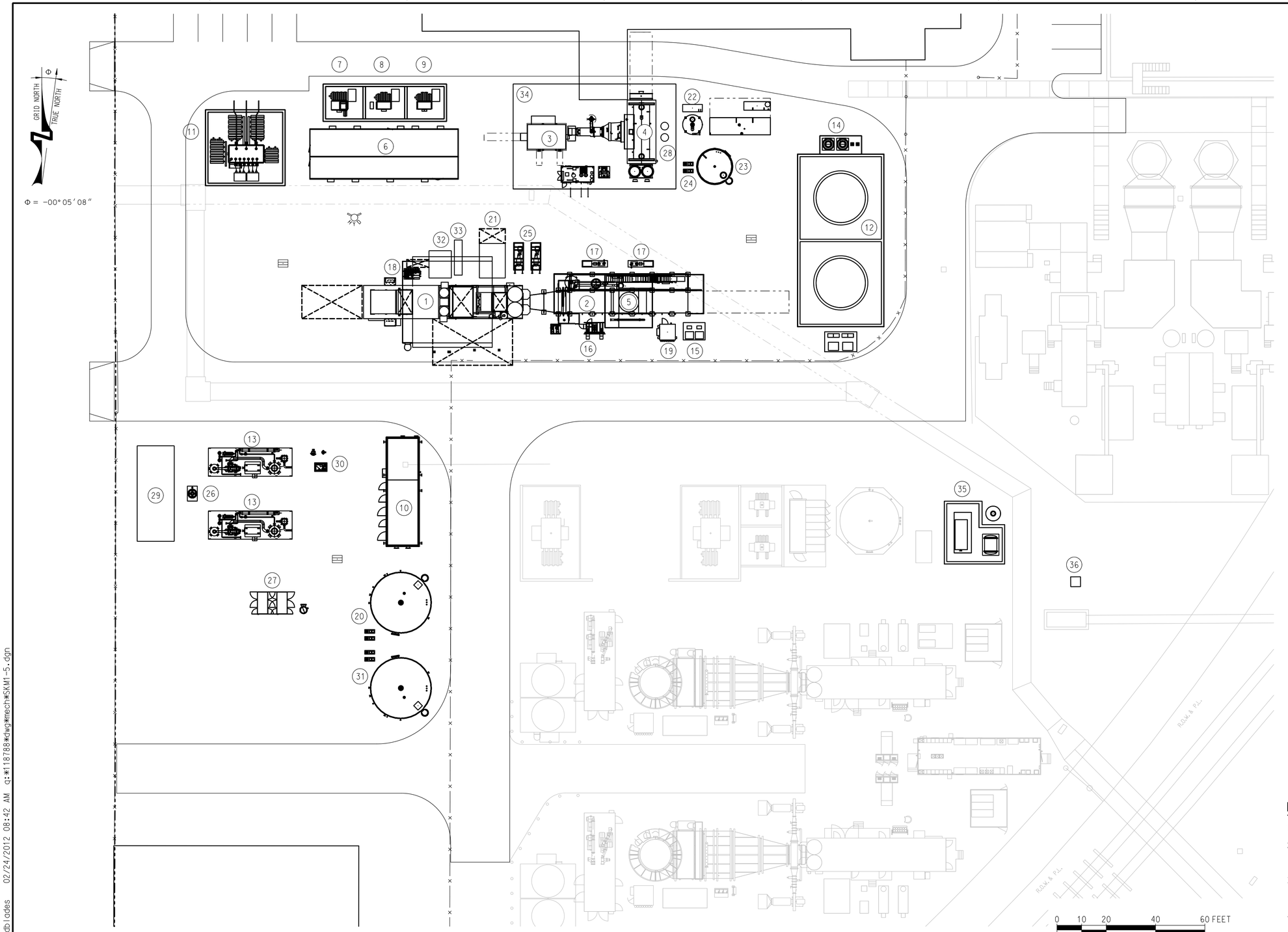
JOB NUMBER 123374 REV A

DRAWING NUMBER SKM1-4

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GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: C 07/18/13



LEGEND

1. GAS TURBINE GENERATOR (GTG) (SEE NOTE 2)
2. ONCE THROUGH STEAM GENERATOR (OTSG) (SEE NOTE 2)
3. STEAM TURBINE GENERATOR (STG) (SEE NOTE 2)
4. SURFACE CONDENSER
5. OTSG STACK
6. POWER DISTRIBUTION CENTER (PDC)
7. 4.16KV AUX. TRANSFORMER
8. 480V AUX. TRANSFORMER
9. 480V AUX. TRANSFORMER
10. INLET AIR CHILLER (SEE NOTE 2)
11. GSU TRANSFORMER
12. COOLING TOWER (SEE NOTE 3)
13. FUEL GAS COMPRESSOR SKID (SEE NOTE 2)
14. CIRCULATING WATER PUMPS
15. OTSG CHEMICAL FEED SKID
16. AMMONIA FLOW CONTROL UNIT
17. BOILER FEEDWATER PUMPS
18. GTG CO2 BOTTLES
19. CEMS SKID
20. DEMINERALIZED WATER TANK AND PUMPS
21. GTG AUXILIARY SKID (SEE NOTE 2)
22. CONDENSATE POLISHERS (SEE NOTE 3)
23. CONDENSATE STORAGE TANK
24. CONDENSATE MAKE UP PUMPS
25. GTG NOX WATER INJECTION SKIDS (SEE NOTE 2)
26. FUEL GAS COMPRESSOR DRAINS TANK (SEE NOTE 2)
27. AIR COMPRESSOR AND RECEIVER (SEE NOTE 2)
28. CONDENSATE PUMPS
29. FUEL GAS METERING
30. GTG FUEL GAS FINAL FILTER SKID (SEE NOTE 2)
31. WASTE WATER TANK
32. GENERATOR/GEARBOX LUBE OIL SKID
33. LUBE OIL COOLER SKID
34. STEAM TURBINE ENCLOSURE
35. OIL-WATER SEPARATOR (EXISTING)
36. GLENARM SEWER OUTFALL BOX (EXISTING)

NOTES

1. CONCEPTUAL.
2. EQUIPMENT DRAINS AND ASSOCIATED DRIP PAN FOR THIS EQUIPMENT WILL BE PIPED TO THE EXISTING OIL-WATER SEPARATOR.
3. THIS EQUIPMENT WILL BE PIPED TO THE PROPOSED GLENARM WASTEWASTER STORAGE TANK (31) AS WELL AS THE GLENARM SEWER OUTFALL BOX (36).
4. WASTEWATER PIPE ROUTING TO BE COMPLETED BY CONTRACTOR. PLANS TO BE SUBMITTED AT A LATER DATE. REFER TO M2-2-4 FOR PROCESS FLOW DIAGRAM OF PROPOSED CHANGES TO WASTEWATER SYSTEM.

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INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR PERMIT		DPB	DPB	SEG	

DSGN	DPB	02/16/12
DRN	DPB	02/16/12
CKD	SEG	02/16/12

SCALE: 1" = 20'-0"
FOR 22x34 DWG ONLY

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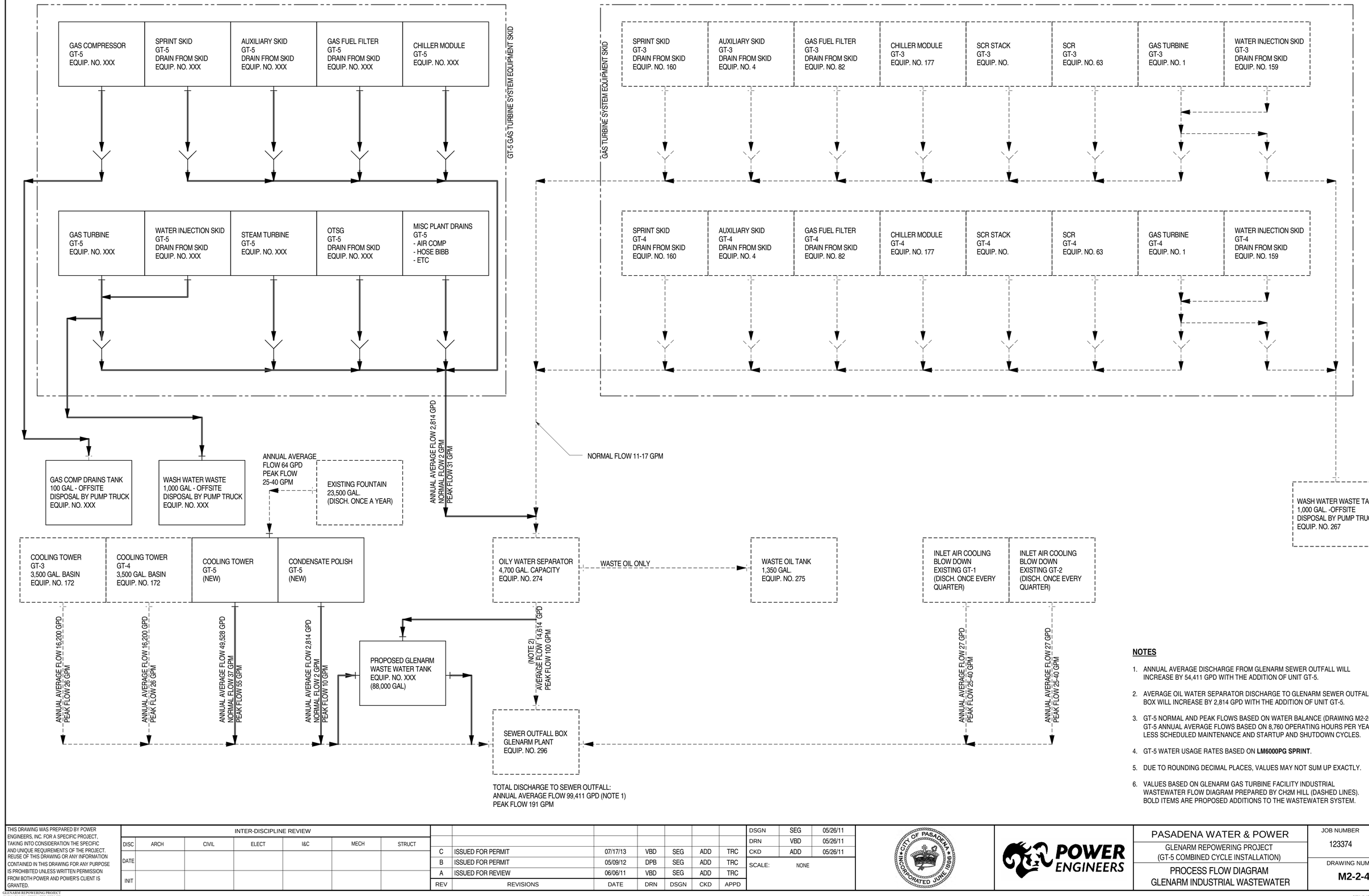
PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
GT-5 SEWERAGE PLAN
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374 | REV A
DRAWING NUMBER SKM1-5

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GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: C 07/18/13



NOTES

1. ANNUAL AVERAGE DISCHARGE FROM GLENARM SEWER OUTFALL WILL INCREASE BY 54,411 GPD WITH THE ADDITION OF UNIT GT-5.
2. AVERAGE OIL WATER SEPARATOR DISCHARGE TO GLENARM SEWER OUTFALL BOX WILL INCREASE BY 2,814 GPD WITH THE ADDITION OF UNIT GT-5.
3. GT-5 NORMAL AND PEAK FLOWS BASED ON WATER BALANCE (DRAWING M2-2-1). GT-5 ANNUAL AVERAGE FLOWS BASED ON 8,760 OPERATING HOURS PER YEAR LESS SCHEDULED MAINTENANCE AND STARTUP AND SHUTDOWN CYCLES.
4. GT-5 WATER USAGE RATES BASED ON **LM6000PG SPRINT**.
5. DUE TO ROUNDING DECIMAL PLACES, VALUES MAY NOT SUM UP EXACTLY.
6. VALUES BASED ON GLENARM GAS TURBINE FACILITY INDUSTRIAL WASTEWATER FLOW DIAGRAM PREPARED BY CH2M HILL (DASHED LINES). BOLD ITEMS ARE PROPOSED ADDITIONS TO THE WASTEWATER SYSTEM.

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
C	ISSUED FOR PERMIT	07/17/13	VBD	SEG	ADD	TRC
B	ISSUED FOR PERMIT	05/09/12	DPB	SEG	ADD	TRC
A	ISSUED FOR REVIEW	06/06/11	VBD	SEG	ADD	TRC

DSGN	SEG	05/26/11
DRN	VBD	05/26/11
CKD	ADD	05/26/11
SCALE:	NONE	

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)
PROCESS FLOW DIAGRAM GLENARM INDUSTRIAL WASTEWATER

JOB NUMBER 123374 | REV C
DRAWING NUMBER M2-2-4

GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: C 07/18/13

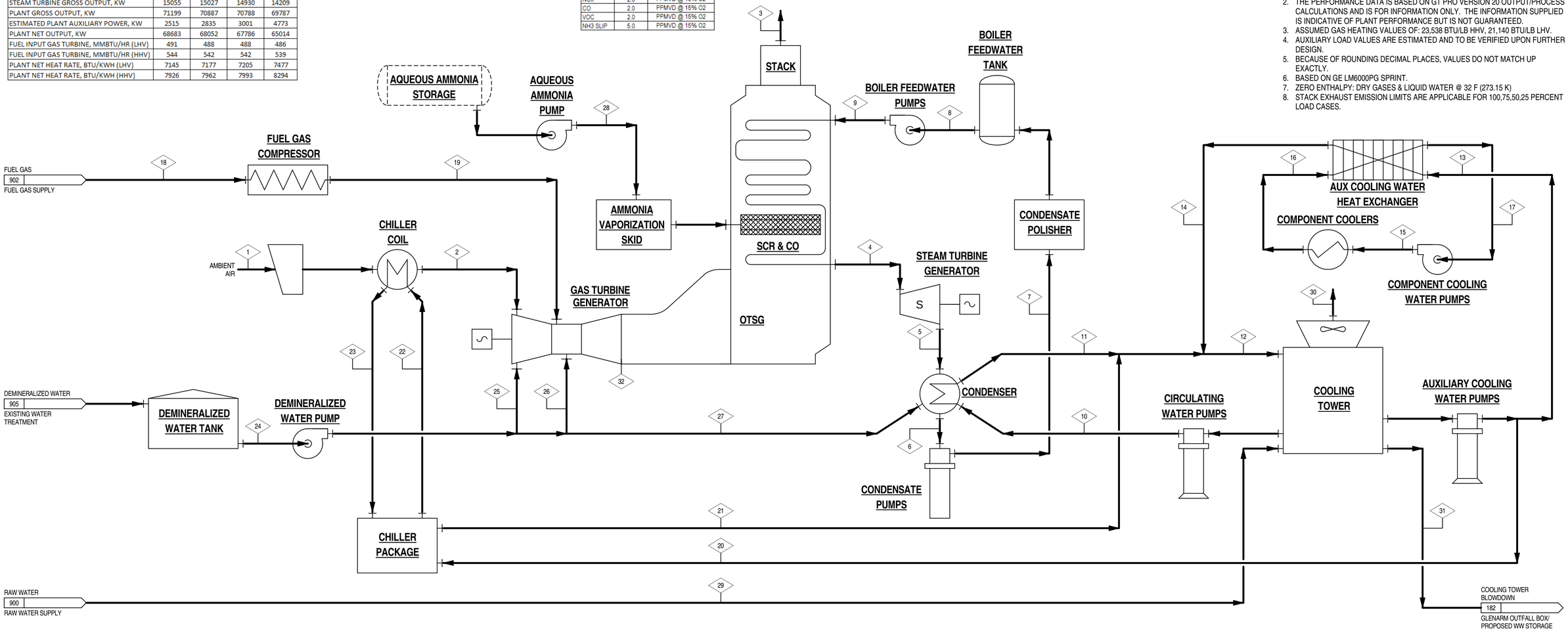
PLANT PERFORMANCE SUMMARY

	CASE 1	CASE 2	CASE 3	CASE 4
GAS TURBINE GROSS OUTPUT, KW	56143	55859	55857	55578
STEAM TURBINE GROSS OUTPUT, KW	15055	15027	14930	14209
PLANT GROSS OUTPUT, KW	71199	70887	70788	69787
ESTIMATED PLANT AUXILIARY POWER, KW	2515	2835	3001	4773
PLANT NET OUTPUT, KW	68683	68052	67786	65014
FUEL INPUT GAS TURBINE, MMBTU/HR (LHV)	491	488	488	486
FUEL INPUT GAS TURBINE, MMBTU/HR (HHV)	544	542	542	539
PLANT NET HEAT RATE, BTU/KWH (LHV)	7145	7177	7205	7477
PLANT NET HEAT RATE, BTU/KWH (HHV)	7926	7962	7993	8294

STACK EMISSION LIMITS		
NOx	2.0	PPMVD @ 15% O2
CO	2.0	PPMVD @ 15% O2
VOC	2.0	PPMVD @ 15% O2
NH3 SLIP	5.0	PPMVD @ 15% O2

NOTES

1. DESIGN ELEVATION IS 751 FT. REFER TO STREAM TABLE FOR AMBIENT TEMPERATURE, RELATIVE HUMIDITY, AND LOAD SCENARIO.
2. THE PERFORMANCE DATA IS BASED ON GT PRO VERSION 20 OUTPUT/PROCESS CALCULATIONS AND IS FOR INFORMATION ONLY. THE INFORMATION SUPPLIED IS INDICATIVE OF PLANT PERFORMANCE BUT IS NOT GUARANTEED.
3. ASSUMED GAS HEATING VALUES OF: 23,538 BTU/LB HHV, 21,140 BTU/LB LHV.
4. AUXILIARY LOAD VALUES ARE ESTIMATED AND TO BE VERIFIED UPON FURTHER DESIGN.
5. BECAUSE OF ROUNDING DECIMAL PLACES, VALUES DO NOT MATCH UP EXACTLY.
6. BASED ON GE LM6000PG SPRINT.
7. ZERO ENTHALPY: DRY GASES & LIQUID WATER @ 32 F (273.15 K)
8. STACK EXHAUST EMISSION LIMITS ARE APPLICABLE FOR 100,75,50,25 PERCENT LOAD CASES.



	STREAM NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	DESCRIPTION	UNITS	AMBIENT AIR	CHILLED AIR	STACK EXHAUST	HP STEAM	STEAM TURBINE EXHAUST	CDS PUMP SUCTION	CDS PUMP DISCHARGE	BFW PUMP SUCTION	BFW PUMP DISCHARGE	CONDEN-SER CWS SUPPLY	CONDEN-SER CWS RETURN	COOLING TOWER INLET	ACW SUPPLY TO HEX	ACW RETURN TO COOLING TOWER	CCW PUMP DISCHARGE	CCW COOLER OUTLET	CCW PUMP SUCTION	FUEL GAS SUPPLY	FUEL GAS CMP DISCHARGE	ACW CHILLER SUPPLY	ACW CHILLER RETURN	CHILLER COIL INLET	CHILLER COIL OUTLET	DWS PUMP SUCTION	INTER-COOLING WATER	NOX WATER INJECTION	STEAM CYCLE MAKE-UP	NH3 PUMP DISCHARGE	COOLING TOWER MAKE-UP	EVAP & DRIFT	COOLING TOWER BLOWDOWN	GAS TURBINE EXHAUST
CASE 1 32 °F 70 % RH — 100% GTG LOAD CHILL: OFF	PRESSURE	PSIA	14.30	14.16	14.30	637	0.442	6	114	34	972	54	44	44	54	44	94	84	74	150	690	-	-	-	-	24	150	650	50	-	65	14.30	54	14.84
	TEMPERATURE	* F	32	32	358	825	75.9	76	76	76	77	51	70	70	51	71	58	78	58	77	270	-	-	-	-	60	77	57	59	-	60	65	51	874
	ENTHALPY	BTU/LBM	2.90	2.90	165.50	1420.60	965.90	43.95	44.28	44.06	47.84	19.24	38.28	38.34	19.30	38.77	26.42	45.99	26.36	23538	23645	-	-	-	-	28.16	45.09	27.06	27.20	-	28.28	-	19.30	-
	TOTAL FLOW	KPPH	1115	1115	1159	116	116	116	116	116	116	5602	5602	6002	400	400	300	300	300	23	23	-	-	-	-	34	0	34	0.04	0.023	76	64	13	1159
CASE 2 59°F 60% RH — 100% GTG LOAD CHILL: ON	PRESSURE	PSIA	14.30	14.16	14.30	645	0.695	6	114	34	965	54	44	44	54	44	94	84	74	150	690	54	44	59	34	24	150	650	50	-	65	14.30	54	14.83
	TEMPERATURE	* F	59	46	361	831	89.9	90	90	90	91	65	85	84	64	85	71	91	71	77	270	64	76	42	45	60	77	57	59	-	60	79	64	883
	ENTHALPY	BTU/LBM	13.51	10.36	174.60	1423.50	973.90	57.94	58.26	58.05	61.80	33.11	52.93	52.43	32.61	53.07	39.72	59.27	39.67	23538	23645	32.62	43.85	10.61	12.78	28.16	45.09	27.06	27.20	-	28.28	-	32.61	-
	TOTAL FLOW	KPPH	1092	1092	1139	117	117	117	117	117	117	5393	5393	6159	400	400	300	300	300	23	23	367	367	1542	1542	37	7	30	0.04	0.023	104	87	17	1139
CASE 3 64° F 61% RH — 100% GTG LOAD CHILL: ON	PRESSURE	PSIA	14.30	14.16	14.30	645	0.761	6	114	34	964	54	44	44	54	44	94	84	74	150	690	54	44	59	34	24	150	650	50	-	65	14.30	54	14.83
	TEMPERATURE	* F	64	46	362	831	92.8	93	93	93	94	68	88	88	68	88	75	95	75	77	270	68	88	41	45	60	77	57	59	-	60	82	68	883
	ENTHALPY	BTU/LBM	16.22	10.66	175.20	1423.50	976.90	60.80	61.17	60.96	64.66	36.16	55.98	56.00	36.18	56.12	43.29	62.84	43.23	23538	23645	36.18	56.14	9.22	13.10	28.16	45.09	27.06	27.20	-	28.28	-	36.18	-
	TOTAL FLOW	KPPH	1093	1092	1139	117	117	117	117	117	117	5397	5397	6164	400	400	300	300	300	23	23	367	367	1542	1542	37	7	30	0.04	0.023	111	92	18	1139
CASE 4 97°F 42% RH — 100% GTG LOAD CHILL: ON	PRESSURE	PSIA	14.30	14.15	14.30	644	1.189	6	114	34	961	54	44	44	54	44	94	84	74	150	690	54	44	59	34	24	150	650	50	-	65	14.30	54	14.83
	TEMPERATURE	* F	97	48	368	831	107.6	108	108	108	109	83	103	107	87	103	94	114	94	77	270	87	171	34	49	60	77	57	59	-	60	98	87	883
	ENTHALPY	BTU/LBM	33.05	11.54	176.90	1423.50	997.50	75.58	75.97	75.76	79.44	51.44	71.39	75.18	55.25	71.49	62.34	81.89	62.29	23538	23645	55.28	139.32	1.87	17.16	28.16	45.09	27.06	27.20	-	28.28	-	55.25	-
	TOTAL FLOW	KPPH	1098	1088	1135	117	117	117	117	117	117	5416	5416	6182	400	400	300	300	300	23	23	367	367	1542	1542	36	7	30	0.04	0.023	165	137	27	1135

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR REVIEW	02/28/12	VBD	SEG	ADD	TRC
C	ISSUED FOR REVIEW	11/04/11	VBD	SEG	ADD	TRC
B	ISSUED FOR REVIEW	05/13/11	VBD	SEG	ADD	TRC
A	ISSUED FOR REVIEW	04/28/11	VBD	SEG	ADD	RVK

DSGN	SEG	04/26/11
DRN	VBD	04/26/11
CKD	ADD	04/26/11

SCALE: NONE

CITY OF PASADENA • INCORPORATED JUNE 1886 •

POWER ENGINEERS

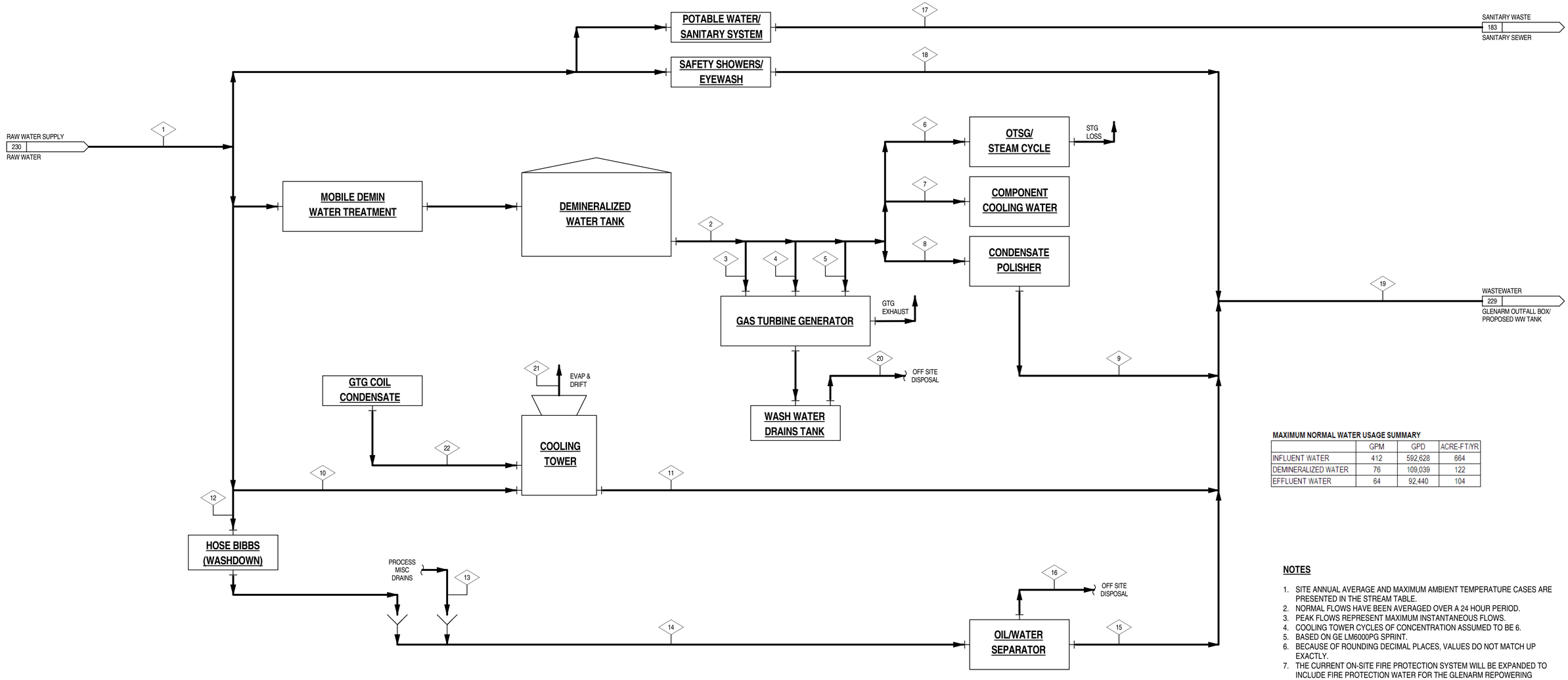
PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PROCESS FLOW DIAGRAM
HEAT & MASS BALANCE (W/ INLET CHILLER)

JOB NUMBER 123374 | REV D

DRAWING NUMBER M2-1-1

GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: C 07/18/13



MAXIMUM NORMAL WATER USAGE SUMMARY

	GPM	GPD	ACRE-FT/YR
INFLUENT WATER	412	592,628	664
DEMINERALIZED WATER	76	109,039	122
EFFLUENT WATER	64	92,440	104

NOTES

1. SITE ANNUAL AVERAGE AND MAXIMUM AMBIENT TEMPERATURE CASES ARE PRESENTED IN THE STREAM TABLE.
2. NORMAL FLOWS HAVE BEEN AVERAGED OVER A 24 HOUR PERIOD.
3. PEAK FLOWS REPRESENT MAXIMUM INSTANTANEOUS FLOWS.
4. COOLING TOWER CYCLES OF CONCENTRATION ASSUMED TO BE 6.
5. BASED ON GE LM6000PG SPRINT.
6. BECAUSE OF ROUNDING DECIMAL PLACES, VALUES DO NOT MATCH UP EXACTLY.
7. THE CURRENT ON-SITE FIRE PROTECTION SYSTEM WILL BE EXPANDED TO INCLUDE FIRE PROTECTION WATER FOR THE GLENARM REPOWERING PROJECT.

	STREAM NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	DESCRIPTION	UNITS	RAW WATER SUPPLY	DEMIN WATER	GT WASH WATER	INTER-COOLING WATER	NOX WATER INJECTION	STEAM CYCLE MAKE-UP	CCW MAKE-UP	CONDEN-SATE POLISHER MAKE-UP	CONDEN-SATE POLISHER DRAIN	COOLING TOWER MAKE-UP	COOLING TOWER BLOWDOWN	HOSE BIBBS	PROCESS MISC DRAINS	OWS INLET	OWS WATER OUTLET	COLLECTED OIL	SANITARY WASTE	SAFETY WASH WATER	WASTE-WATER DISCHARGE	WASH WATER DRAINS	CT EVAP-ORATION & DRIFT	GT COIL CONDEN-SATE
AVERAGE	NORMAL FLOW	GAL/MIN	303.4	75.7	0	13.7	60.0	0.07	0	2	2	222.7	37.1	0	2	2	2	0.00	5	0	41.1	0	185.7	2.4
64°F 61% RH	PEAK FLOW	GAL/MIN	402.4	129.7	20	13.7	60.0	25.07	1	10	10	222.7	37.1	20	11	31	31	0.03	10	20	98.1	20	185.7	2.4
MAXIMUM	NORMAL FLOW	GAL/MIN	411.5	75.3	0	13.7	59.6	0.07	0	2	2	331.2	55.2	0	2	2	2	0.00	5	0	59.2	0	276.0	19.5
97°F 42% RH	PEAK FLOW	GAL/MIN	510.5	129.3	20	13.7	59.6	25.07	1	10	10	331.2	55.2	20	11	31	31	0.03	10	20	116.2	20	276.0	19.5

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR REVIEW	02/28/12	VBD	SEG	ADD	TRC
C	ISSUED FOR REVIEW	07/19/11	VBD	SEG	ADD	TRC
B	ISSUED FOR REVIEW	05/16/11	VBD	SEG	ADD	TRC
A	ISSUED FOR REVIEW	05/04/11	VBD	SEG	ADD	RVK

DSGN	SEG	04/28/11
DRN	VBD	04/28/11
CKD	ADD	04/28/11
SCALE:	NONE	

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

PROCESS FLOW DIAGRAM WATER BALANCE (W/ INLET CHILLING)

JOB NUMBER 123374

REV D

DRAWING NUMBER M2-2-1

GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: C 07/18/13

GEOVision
geophysical services

September 16, 2011

Project Number 11195

Dr. Seyed Mortazavi
Hydrologue Incorporated
2827 East Foothill Boulevard
Pasadena, CA 91107
626 – 585 – 9696

Subject: **Soil Thermal Resistivity Tests**
Pasadena Water & Power, Pasadena, California

Dear Dr. Mortazavi:

In-Situ soil thermal resistivity tests were conducted on July 19, 2011 at the Pasadena Water & Power facility in Pasadena, California in accordance with ASTM Standard D5334. Additional soil thermal resistivity tests were conducted in the laboratory on soil core samples acquired from the site. Laboratory data were collected from July 19, 2011 to August 08, 2011 by Hydrologue, Inc.

The site consisted of open ground partially covered with weathered asphalt and reinforced concrete. Obstructions in the survey areas consisted of above-ground piping, several storm drains and culverts, storage containers and vehicles.

In-situ soil thermal resistivity data were collected at 3 locations (Figure 1). Test locations were identified as RT-1, RT-2 and RT-3 which were located near boreholes BH-1, BH-3 and BH-5, respectively. Thermal resistivity test and borehole location data were taken with a Trimble ProXRS GPS system using Beacon differential corrections (Table 1).

Table 1: Resistivity Sounding Locations

Sounding ID Borehole ID	Northing	Easting
RT-1	1,868,574	6,516,289
RT-2	1,868,539	6,516,418
RT-3	1,868,515	6,516,344
BH-1	1,868,585	6,516,275
BH-3	1,868,582	6,516,427
BH-5	1,868,519	6,516,341

Note: Coordinates in California State Plane, NAD 83, Zone V (0405), US Feet

EQUIPMENT AND METHODOLOGY

Generally, thermal measurements are made to assess the thermal properties of soil or soft rock where an underground power cable system has been or will be installed. The concern is that electricity flowing in a conductor generates heat. A resistance to heat flow between the cable and ambient environment causes a rise in the cable temperature. Excessive temperature shortens cable life, reduces efficiency and can lead to catastrophic failure. Therefore, soil thermal properties are an important part of the overall design (Decagon Devices Application Note 13943-01, 2009).

The Decagon Devices KD-2 Pro portable meter and associated TR-1 soil and rock sensor were used for this investigation. As provided by the manufacturer, a delrin cylinder of known thermal properties was used to verify sensor performance.

The KD-2 Pro portable meter works in accordance with ASTM D 5334-08 by providing a linear hear source and temperature measuring element. Typically a heating element and a temperature sensor are placed inside a small needle tube with length around 30 times its diameter. The needle is firmly placed in the test material and allowed to equilibrate. Subsequently, temperature is monitored while the needle is heated and then again after the heating element is turned off, each for a predetermined amount of time dependent on material type and needle size (Decagon Devices Application Note 13943-01, 2009).

The relationship between water content and thermal resistivity is often termed the thermal dryout curve. Soil thermal properties depend strongly on water content and also temperature, density and composition. In-situ soil has fixed composition and density and typically exhibits small variations in temperature only slightly affecting thermal resistivity values. Therefore, the main variable is moisture content. Values from the dryout curve represent the effect of moisture content on thermal resistivity and are an integral part of the overall design for underground power cable systems (Decagon Devices Application Note 13994-01, 2011).

FIELD PROCEDURES

Before conducting thermal measurements, batteries in the thermal meter were checked to ascertain appropriate levels. A quick site reconnaissance was performed and general site conditions recorded on the field log.

Thermal measurements were made with the Decagon Devices KD-2 Pro unit using the soil and rock sensor (TR-1). Sensor performance verification was conducted before taking measurements using a Delrin calibration cylinder, as provided by the manufacturer. Performance verification results were recorded on the field log and stored on internal memory.

In-situ thermal measurements were made at predetermined locations and depths. Typically the sensor is pushed into the material and shaded from direct sunlight or possible wind gusts to minimize potential temperature fluctuations at the sensor. Data acquisition with the soil and rock sensor requires approximately 5 minutes per reading. A

minimum of two readings per location were acquired to ascertain consistency and repeatability. A minimum of 15 minutes between measurements is recommended to allow the sensor and surrounding material to reestablish temperature equilibrium. Practically, 20-30 minutes were allowed between readings.

Laboratory thermal measurements were made on previously acquired soil core samples. Hydrologue, Inc. determined the dry density and moisture content of select soil samples. After collecting thermal measurements, the samples were saturated for 24 hours. Thermal and moisture content measurements were repeated on the saturated samples.

DATA PROCESSING

Data from the KD-2 Pro unit were exported as a spreadsheet. Measured laboratory soil core physical parameters (eg. moisture content, dry density, physical description) were manually entered into the spreadsheet. Thermal and physical parameter data were used to determine points on the thermal dryout curve per manufacturer recommendations. Data are presented as graphs of thermal resistivity and moisture content. All data are summarized on a comprehensive table.

RESULTS

In-situ and laboratory soil core thermal resistivity data are attached as Table 2. Thermal dryout curve points were established on laboratory soil core sample measurements at dry and saturated moisture content. Results are presented as thermal conductivity (K) in units of $W/(m \cdot K)$, as well as thermal resistivity (rho) in units of $^{o}C \cdot cm/W$, as requested by Hydrologue, Inc. Thermal dryout curves are attached as Figures 2 – 6.

All data files and field logs are archived.

SUMMARY

Soil thermal resistivity measurements were collected at three in-situ locations, as directed by Hydrologue, Inc., and from soil core samples acquired from five locations at the Pasadena Water & Power facility. Measurements were made in accordance with ASTM standard D5334. At least two measurements per in-situ location were acquired to ascertain consistency and repeatability. Soil core sample measurements were collected by Hydrologue, Inc. at depths of interest. Soil core sample measurements were made on dry and saturated samples to obtain two points on the dryout curve. In-situ thermal resistivity measurements made at BH-1, BH-3 and BH-5 are within the respective dryout curve (Figures 2, 3, and 4). Soil moisture content for in-situ locations was assumed to correspond with soil core sample moisture content from the nearest depth interval. Thermal resistivity measurements were also made on soil core samples from additional locations BH-4 and BH-8 and data were used to generate respective thermal dryout curves (Figures 5, and 6). Measurements were consistent and repeatable exhibiting low error values. Laboratory samples from BH-5 at 19.5 – 21ft exhibit a thermal range larger than adjacent BH-5 samples (Table 2). The soil composition (i.e., gravely sand) likely

caused the large moisture content range of 1.4% for dry and 10.2% for saturated (Table 2), consequently leading to the exhibited thermal variability.

All data are summarized on Table 2.

If you have any questions concerning this investigation, please call us at 951-549-1234.

Sincerely,

GEO*Vision* Geophysical Services





Submitted by:
Victor M. Gonzalez, PG
Senior Geophysicist

Reviewed and Approved by:
John G. Diehl, PE
President

Attachments:

Table 2: In-Situ and Laboratory Soil Core Sample Parameters
Figure 1: Site Map
Figure 2: BH-1 Thermal Dryout Curve
Figure 3: BH-3 Thermal Dryout Curve
Figure 4: BH-5 Thermal Dryout Curve
Figure 5: BH-4 Thermal Dryout Curve
Figure 6: BH-8 Thermal Dryout Curve

Table 2: In-Situ and Laboratory Soil Core Sample Parameters

Sample ID	Depth [ft]	MC [%]	Dry Density [pcf]	Dry Density [g/cm^3]	K [W/(m·K)]	Rho [°C·cm/W]	Err	Temp [°C]	Description
RT-1	0.75				1.358	73.6	0.0050	29.31	
(BH-1)					1.411	70.9	0.0056	29.08	
BH-1pt1	1 - 5	7.8	130.5	2.09	1.879	53.2	0.0039	24.42	silty sand
		7.8	130.5	2.09	1.857	53.8	0.0037	22.85	
		7.8	130.5	2.09	1.859	53.8	0.0035	22.18	
BH-1pt2	1 - 5	11.1	126.6	2.03	1.770	56.5	0.0018	22.78	
		11.1	126.6	2.03	1.783	56.1	0.0057	20.38	
BH-1	30 - 31.5	9.1	112.9	1.81	1.347	74.3	0.0033	23.77	slightly gravely fine silty sand
		9.1	112.9	1.81	1.341	74.6	0.0031	23.84	
BH-1	30 - 31.5	21	112.9	1.81	1.408	71.0	0.0025	22.17	
		21	112.9	1.81	1.426	70.1	0.0028	22.38	
BH-1	40 - 40.5	7.8	104.4	1.67	0.785	127.4	0.0244	24.11	slightly gravelly fine to coarse silty sand
		7.8	104.4	1.67	0.748	133.7	0.0280	24.30	
BH-1	40 - 40.5	21.7	104.4	1.67	1.581	63.2	0.0036	22.13	
		21.7	104.4	1.67	1.575	63.5	0.0032	22.35	
RT-2	1				1.612	62.0	0.0028	28.39	
(BH-3)					1.595	62.7	0.0033	28.21	
BH-3	5 - 6.5	7	109.3	1.75	1.550	64.5	0.0074	24.65	silty clayey sand with gravel
		7	109.3	1.75	1.531	65.3	0.0064	24.71	
BH-3	5 - 6.5	17.4	109.3	1.75	1.863	53.7	0.0088	21.97	
BH-3	20 - 21	3.2	106.8	1.71	0.860	116.3	0.0066	25.84	slightly gravelly fine to coarse silty sand
		3.2	106.8	1.71	0.871	114.9	0.0067	25.57	
BH-3	20 - 21	17.2	106.8	1.71	1.633	61.2	0.0037	21.64	
		17.2	106.8	1.71	1.589	62.9	0.0030	22.20	
BH-3	25 - 26	21.3	103.0	1.65	1.323	75.6	0.0023	21.85	slightly gravelly fine silty sand
		21.3	103.0	1.65	1.313	76.1	0.0017	22.05	
BH-3	25 - 26	23.5	103.0	1.65	1.394	71.7	0.0021	22.07	
RT-3	1				1.724	58.0	0.0040	27.60	
(BH-5)					1.698	58.9	0.0043	27.15	
BH-5	5	7.3	114.9	1.84	1.504	66.5	0.0026	23.09	fine to medium silty sand with gravel
		7.3	114.9	1.84	1.561	64.1	0.0032	23.22	
		7.3	114.9	1.84	1.551	64.5	0.0032	23.48	
BH-5	5	17.5	114.9	1.84	1.622	61.7	0.0029	22.26	
BH-5	19.5-21	1.4	110.2	1.76	0.113	883.6	0.0345	24.42	slightly gravelly slightly silty fine to coarse sand
		1.4	110.2	1.76	0.109	915.9	0.0341	24.87	
BH-5	19.5-21	10.2	110.2	1.76	2.186	45.8	0.0057	21.98	
		10.2	110.2	1.76	2.044	48.9	0.0054	22.56	
BH-5	35-36.5	6.5	102.7	1.64	0.802	124.8	0.0049	24.74	slightly gravelly fine silty sand
		6.5	102.7	1.64	0.828	120.8	0.0060	24.92	
BH-5	35-36.5	26.9	102.7	1.64	1.333	75.0	0.0023	22.22	
BH-4pt2	1-5	7.4	129.2	2.07	1.606	62.3	0.0096	24.63	clayey sand
		7.4	129.2	2.07	1.576	63.4	0.0158	24.31	
		20	129.2	2.07	1.680	59.5	0.0033	21.89	
		20	129.2	2.07	1.687	59.3	0.0043	21.98	

Sample ID	Depth [ft]	MC [%]	Dry Density [pcf]	Dry Density [g/cm^3]	K [W/(m·K)]	Rho [°C·cm/W]	Err	Temp [°C]	Description
BH-8pt3	1-5	8.4	131.5	2.10	1.441	69.4	0.0150	23.31	silty sand with gravel
		8.4	131.5	2.10	1.505	66.5	0.0125	23.10	
		14.3	131.5	2.10	1.668	59.9	0.0049	22.80	
		14.3	131.5	2.10	1.653	60.5	0.0052	22.81	
		14.3	131.5	2.10	1.646	60.8	0.0050	22.84	

Notes:

MC = Moisture Content
K = Thermal Conductivity
Rho = Thermal Resistivity
Err = Thermal Measurement Error
Temp = Temperature

MC, Dry Density and soil descriptions provided by Hydrologue, Inc.



Legend

- Approximate Test Location
- Approximate Borehole Location

0 40 80 120
Feet

N

NOTES:
1. California State Plane Coordinate System, NAD 83, Zone V (0405), US Feet
2. Base Image Source: ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP

GEOVision geophysical services

Date:	7/28/2011
GV Project:	11195
Developed by:	V Gonzalez
Drawn by:	T Rodriguez
Approved by:	W Dalrymple
File Name:	GV11195-1.MXD

FIGURE 1
SITE MAP

DWP BUILDING
GLENARM STREET AND FAIR OAKS
PASADENA, CA

PREPARED FOR
HYDROLOGUE, INC.

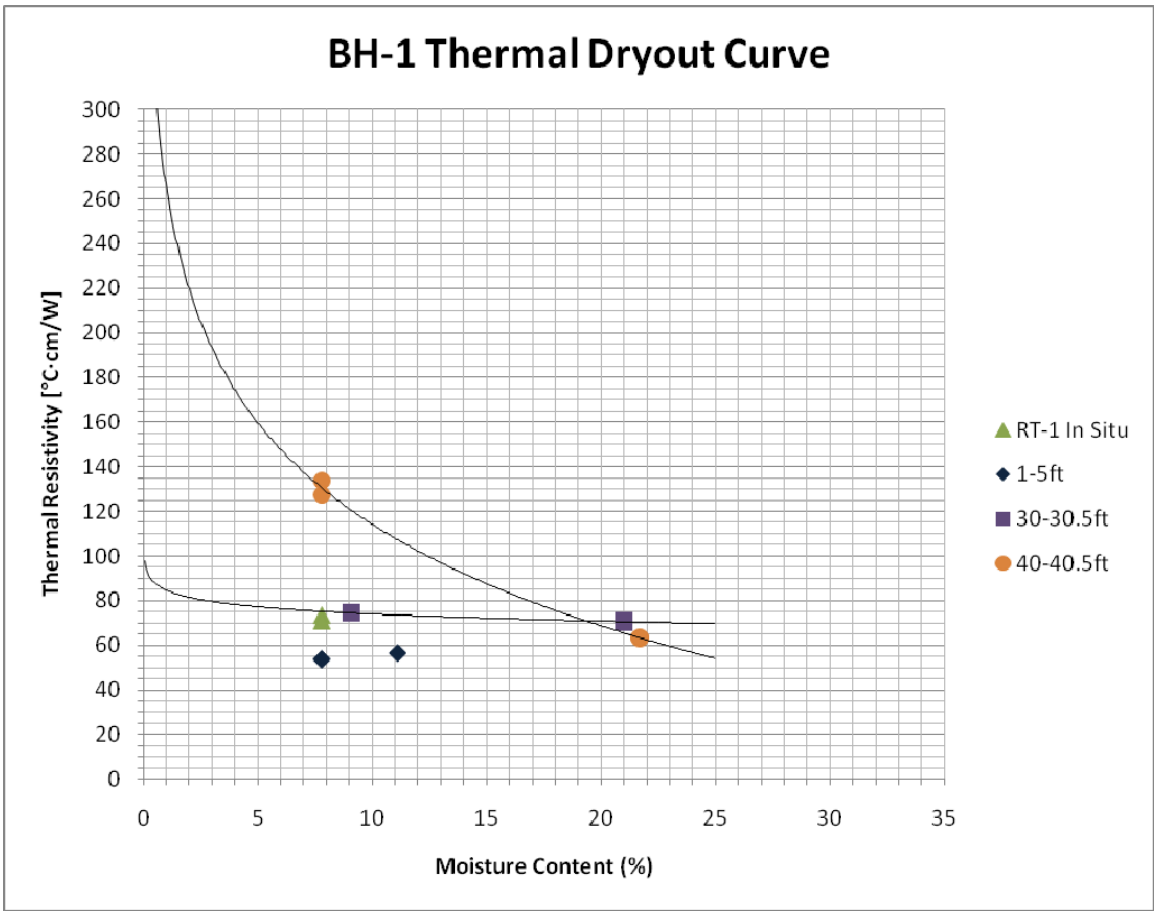


Figure 2: BH-1 Thermal Dryout Curve

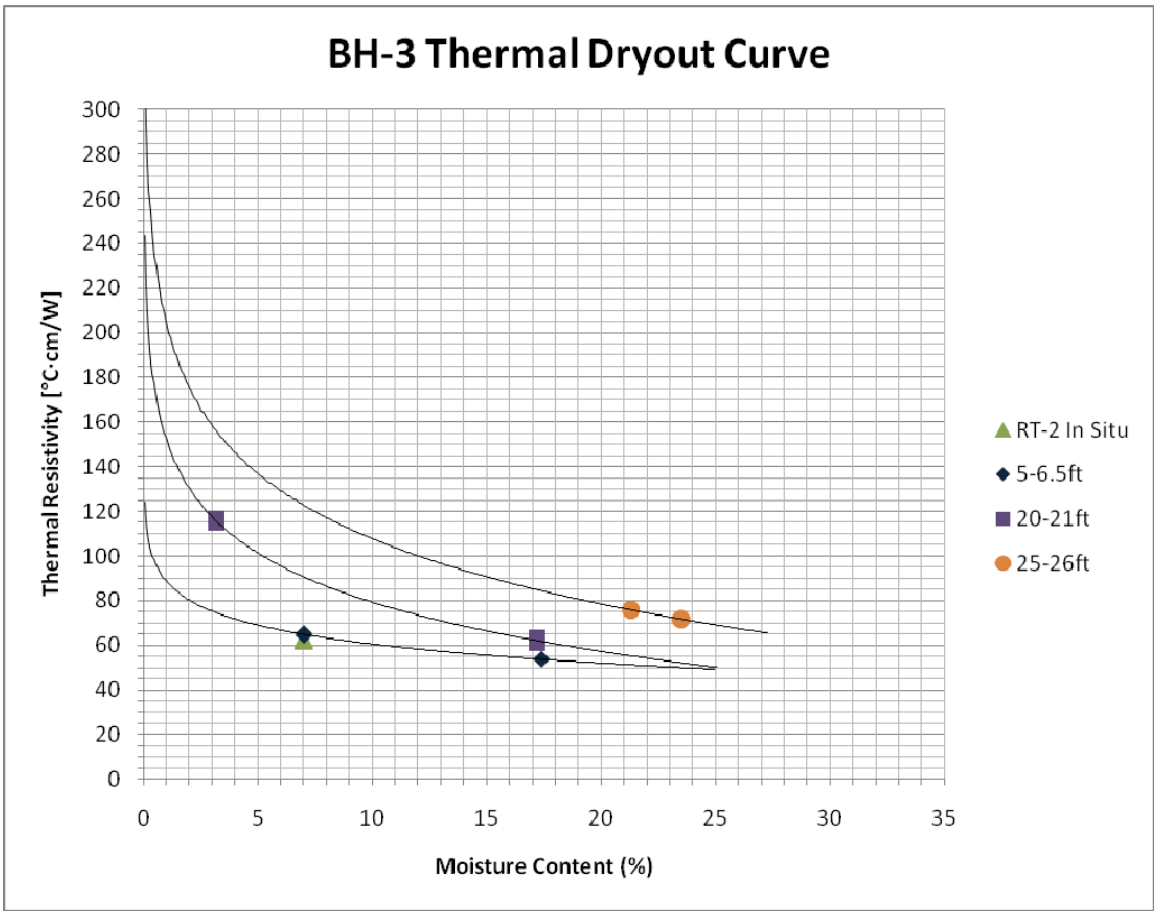


Figure 3: BH-3 Thermal Dryout Curve

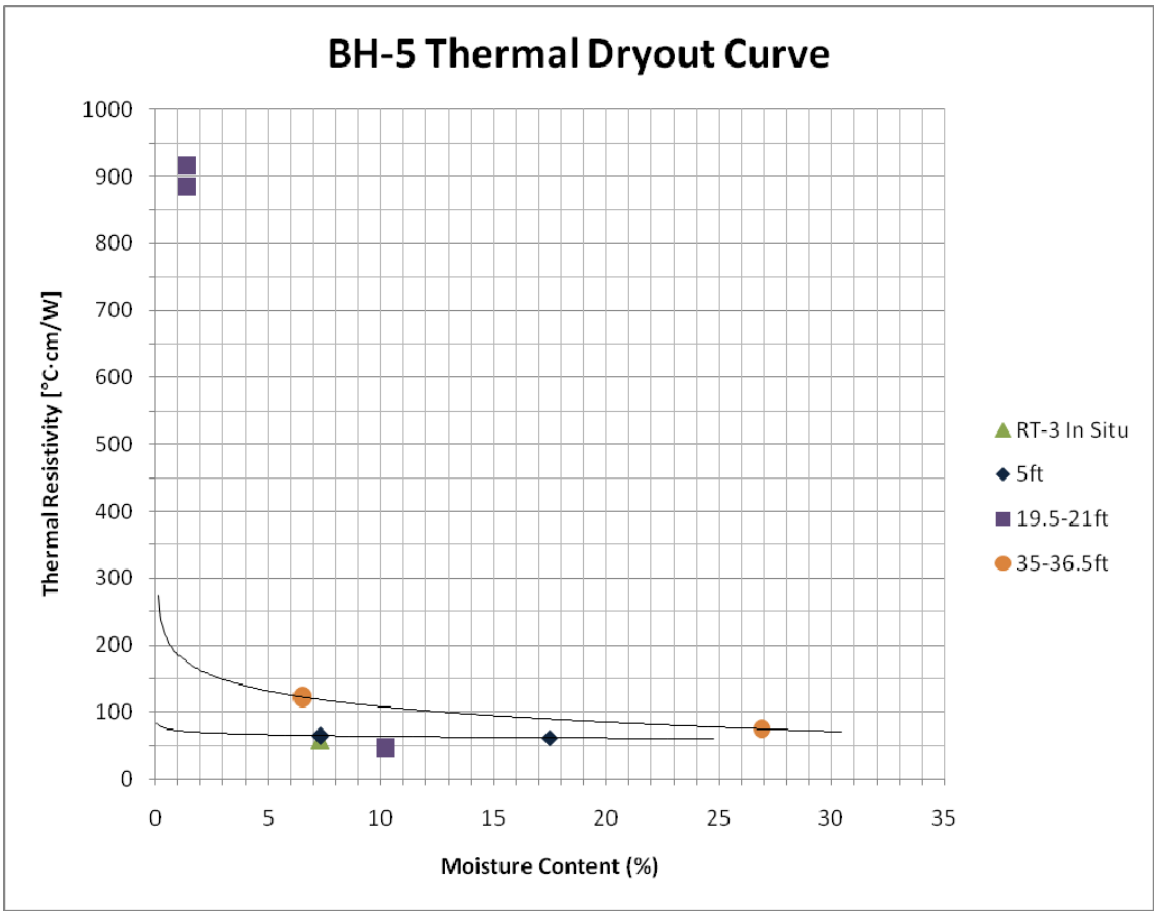


Figure 4: BH-5 Thermal Dryout Curve

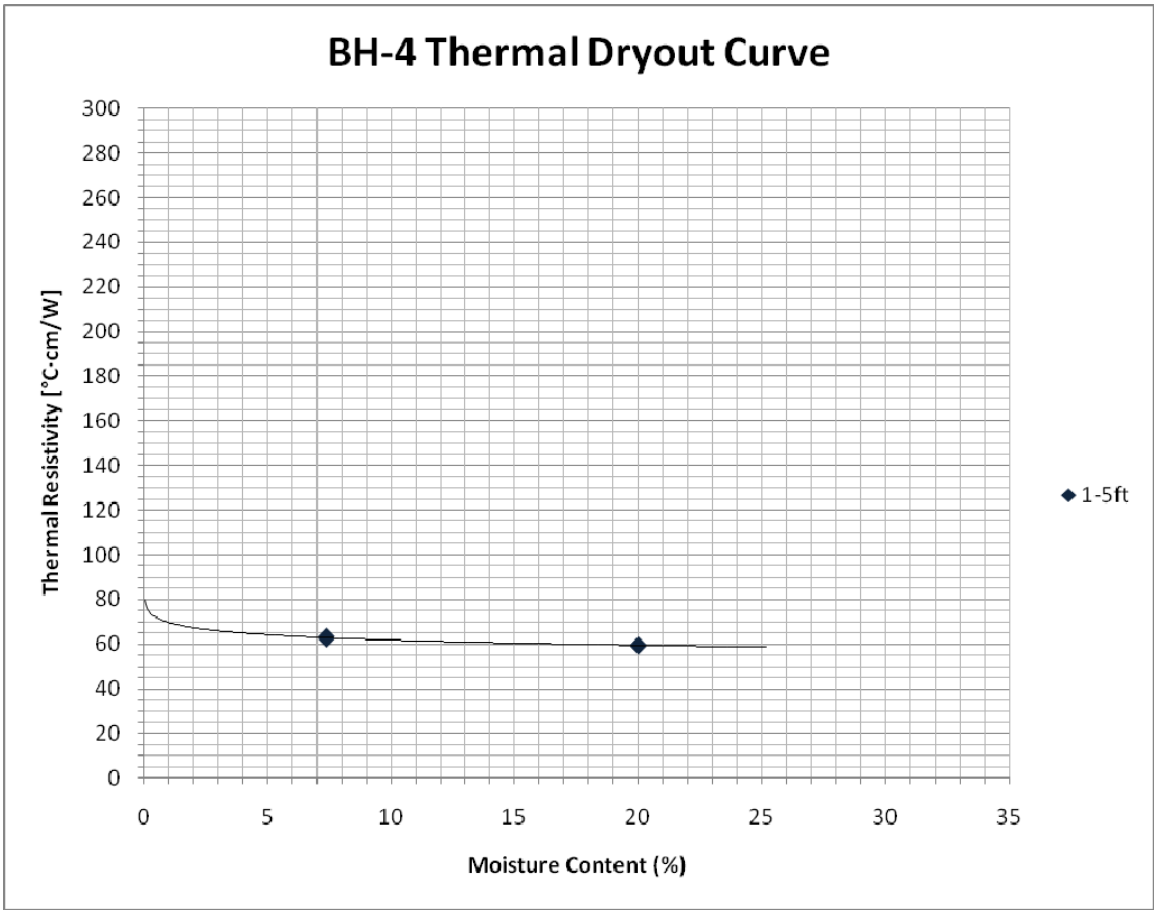


Figure 5: BH-4 Thermal Dryout Curve

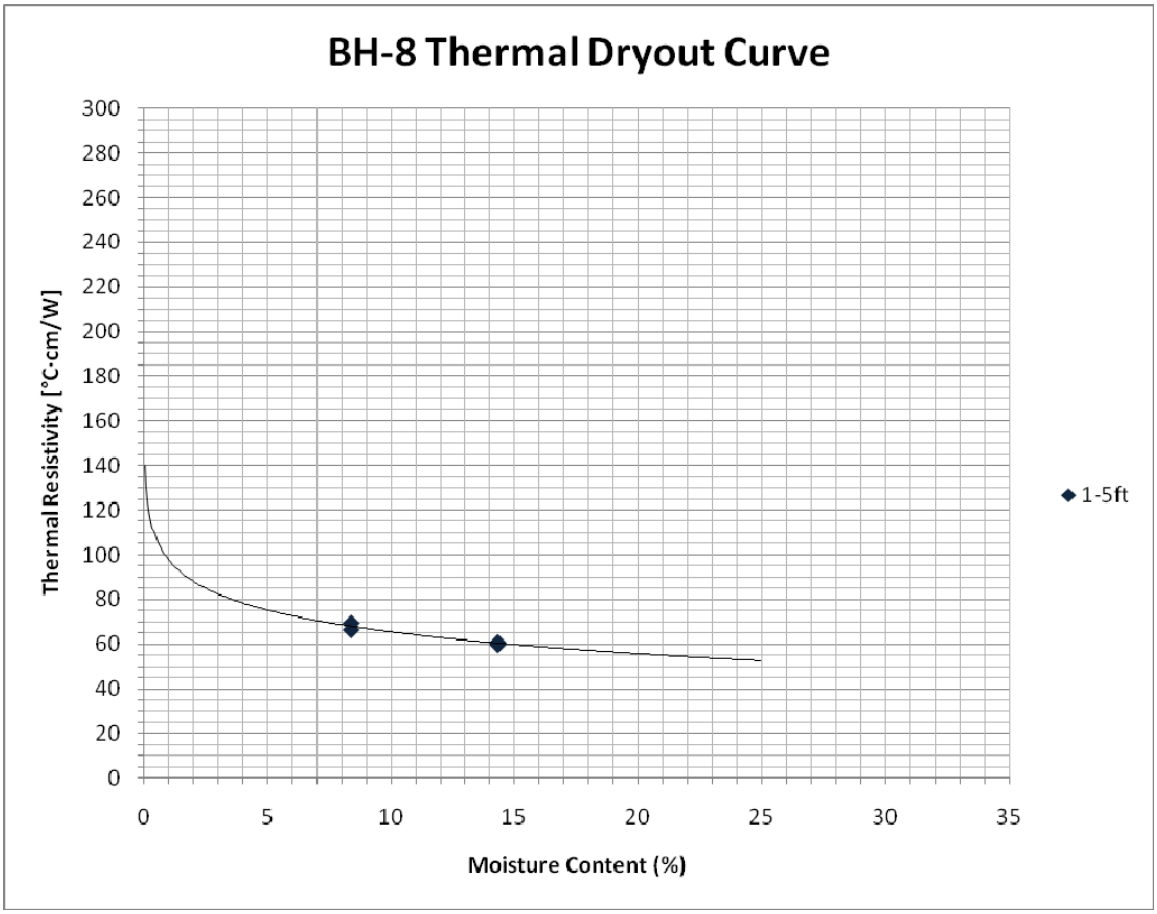
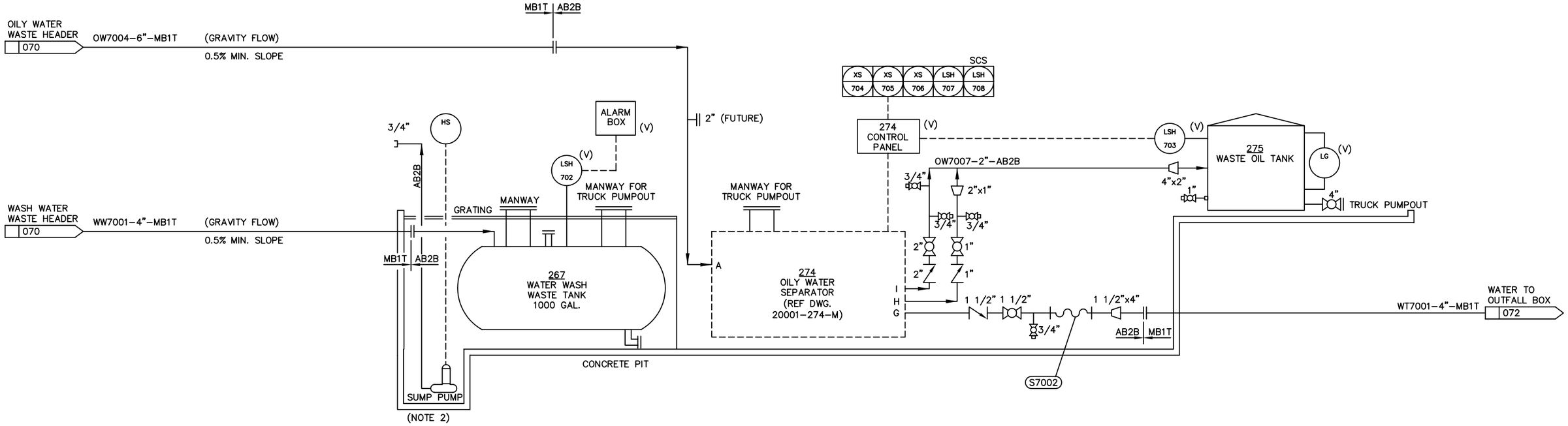


Figure 6: BH-8 Thermal Dryout Curve



FOR CONSTRUCTION

11/18/02

RESERVED

JOE D. TRISNA, P.E.
CA. LIC. 32239

NOTES

1. ITEMS DESIGNATED WITH (V) ARE SHIPPED LOOSE. CONTRACTOR TO INSTALL & CONNECT IN FIELD.
2. CONTRACTOR TO SPEC AND SUPPLY SUMP PUMP AND DISCHARGE LINE. MOTOR TO BE 120V OR 208V SINGLE PHASE OR 3 PHASE.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001–071R0.DWG
XREF DWG: N/A

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	KAG	11/18/02	JT	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

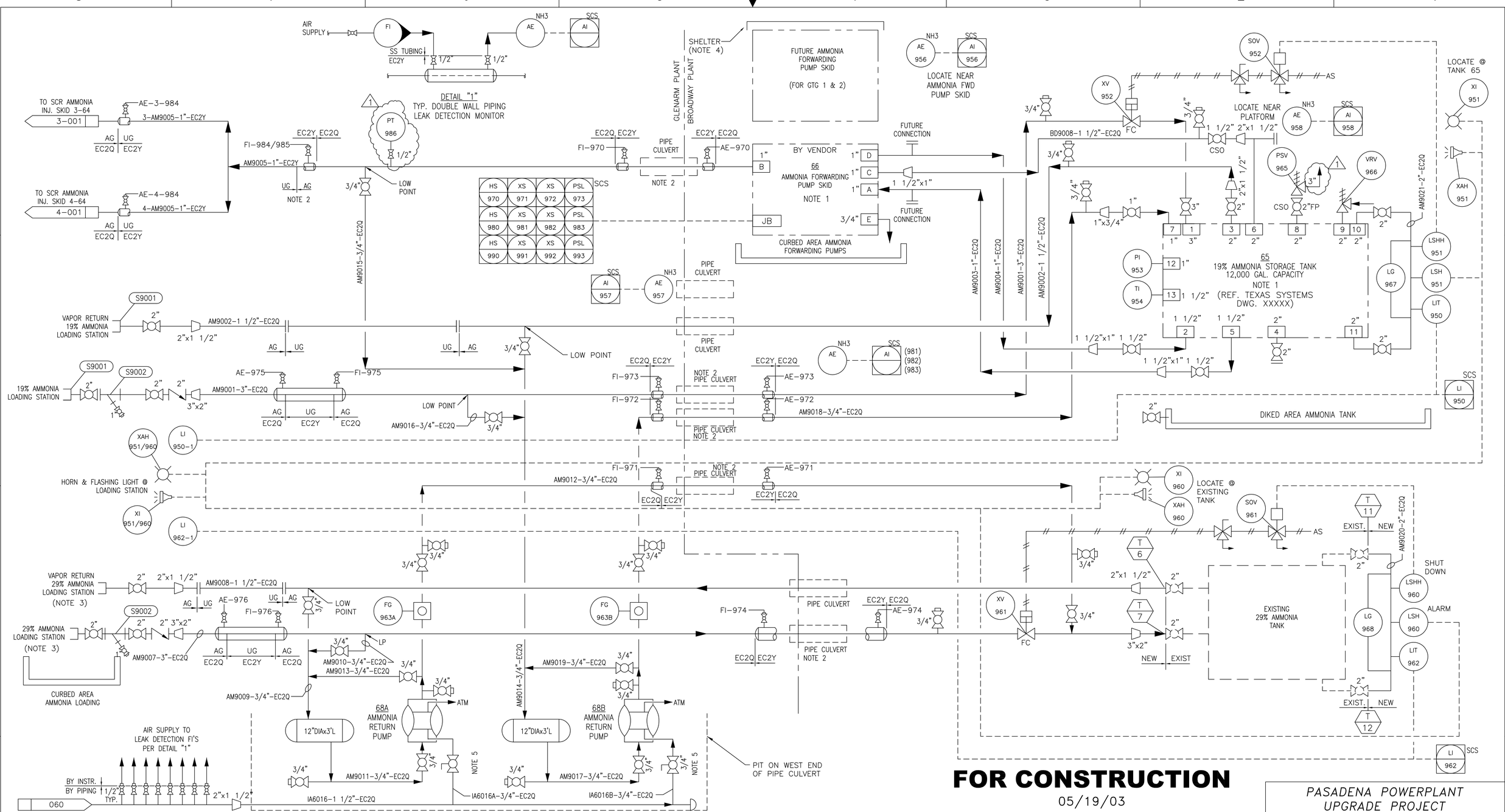
WORK ORDER NO. 20001

TITLE
FLOW & INSTRUMENT DIAGRAM
PLANT WASTE WATER SYSTEM

DWG NO.
20001–071

SCALE N/A

SHEET 1



FOR CONSTRUCTION

05/19/03

RESERVED

JOE D. TRISNA, P.E.
CA. LIC. 32239

NOTES

1. LOCATE AMMONIA TANK (65) IN DIKED AREA. LOCATE PUMP SKID (66) IN CURBED AREA.
2. LIQUID AMMONIA PIPING IN PIPE CULVERT AND UNDERGROUND (BURIED) TO BE DOUBLE WALL PER SPEC EC2Y. INSTALL AMMONIA LEAK DETECTION SENSORS PER DETAIL "1" THIS DWG.
3. RELOCATE EXISTING HOSE CONNECTIONS FOR 29% AMMONIA LOADING.
4. INSTALL SHELTER (NO WALLS) OVER FORWARDING PUMP AREA.
5. LOCATE AIR VALVES (TO DIAPHRAM PUMPS) ABOVE GRADE.
6. INSTALL AMMONIA VAPOR SENSORS IN TRENCHES ON THE BROADWAY SIDE OF THE PLANT. (3 REQ'D. @ 100' SPCG.)

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001-090R1.DWG
XREF DWG: N/A

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	ADDED PT-986, ADDED PSV-965 OUTLET SIZE	CJS	5/19/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	KAG	11/18/02	JT	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

FLOW & INSTRUMENT DIAGRAM
AMMONIA SYSTEM

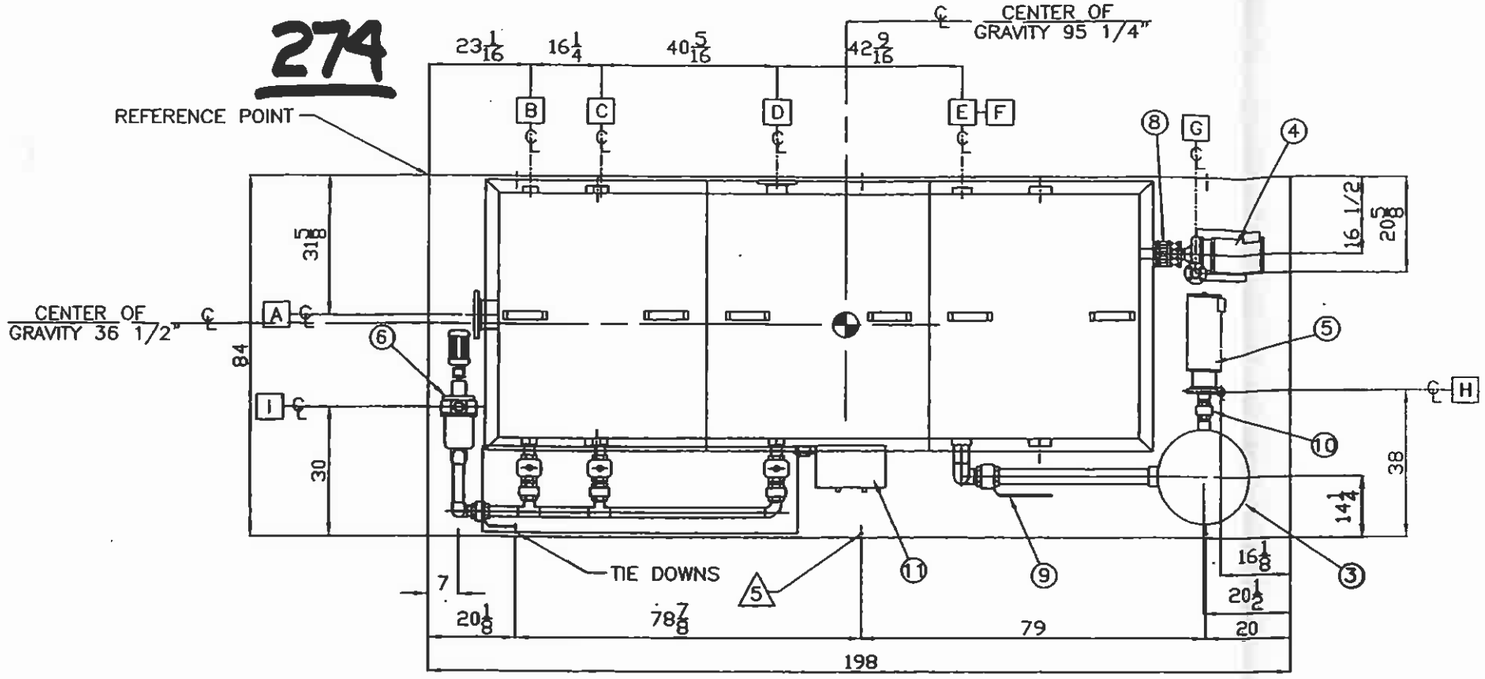
DWG NO.

20001-090

SCALE N/A

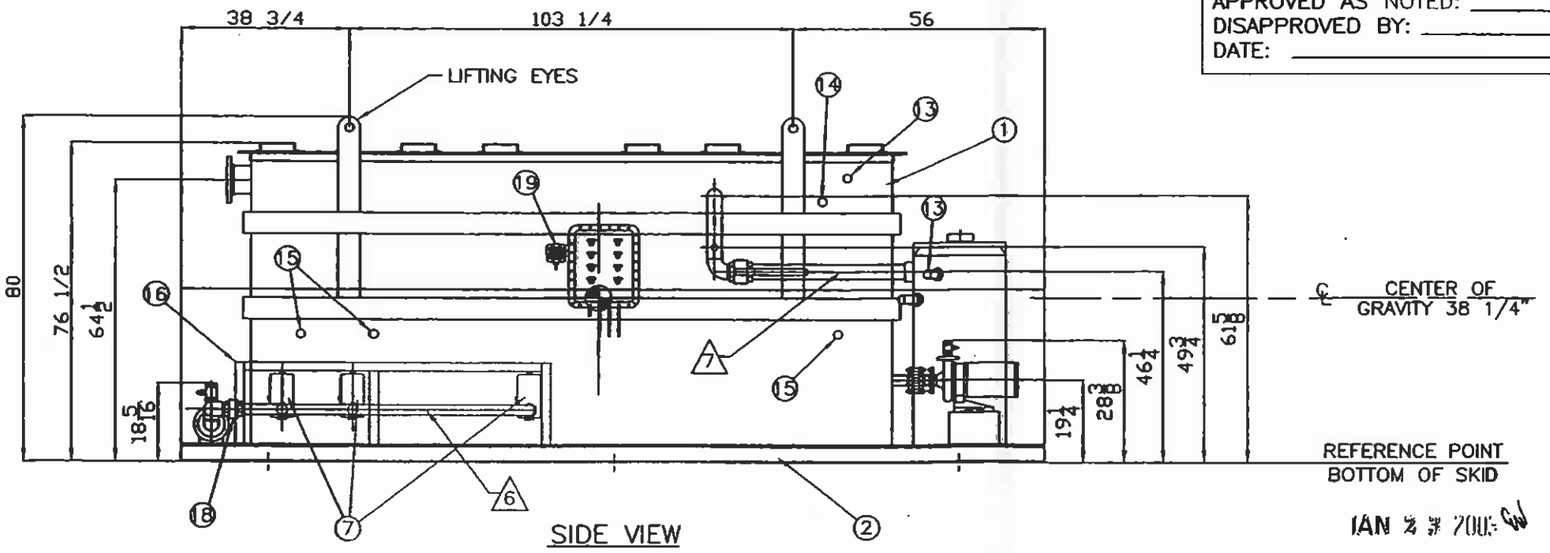
SHEET

274



PLAN VIEW

(APPROX) WEIGHT EMPTY 7222 LB
(APPROX) WEIGHT FULL 24355 LB



SIDE VIEW

TOLERANCES UNLESS SPECIFIED
+/-1/64 FOR FRACTIONS
+/-.01 FOR 2 PL. DECIMALS
+/-.005 FOR 3 PL. DECIMALS

EQUIPMENT LIST

ITM	QTY	DESCRIPTION	MODEL #
1	1	100 GPM OIL/WATER SEPARATOR	FTSOW150A
2	1	SKID	FTSOW150A-6
3	1	75 GAL. OIL ACCUMALATION TANK	FTSTN75
4	1	2 HP 2 X 1 1/2 WATER PUMP	FTS1570-5
5	1	1 HP 1 1/4 X 1 OIL PUMP	FTS1070-7
6	1	2 HP 2 X 2 SLUDGE PUMP	FTS36701
7	3	2" SOLENOID VALVE	FTSF36A47
8	1	2" BUTTERFLY VALVE	WV2N
9	1	3" BALL VALVE	3TUPOCH
10	1	1 1/4" BALL VALVE	1-1/4TUPOCH
11	1	NEMA ELEC. CONTROL PANEL	CE01-036
12			
13	2	HI/HI LEVEL SWITCHES	790SF1A
14	2	HI LEVEL SWITCH	790SF1A
15	4	LOW LEVEL SWITCH	790SF1A
16	1	STEP/VALVE COVER	FTS150A-7
17			
18	1	2" BALL VALVE	2TUPOCH
19	1	ALARM	EDWA8778EX
20			
21			
22			

APPROVED BY: _____
APPROVED AS NOTED: _____
DISAPPROVED BY: _____
DATE: _____

SCHEDULE OF OPENING

MARK	SIZE	RATING	FACING	SERVICE
A	6"	150#	RF	INLET
B	2"	--	FNPT	CLEANOUT
C	2"	--	FNPT	CLEANOUT
D	4"	150#	RF	CLEANOUT
E	3"	--	FNPT	CLEANOUT
F	1/2"	--	FNPT	CLEANOUT
G	1/2"	--	FNPT	WATER OUTLET
H	1"	--	FNPT	OIL OUTLET
I	2"	--	FNPT	SLDGE OUTLET

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△=NOTES:

1 ITEM 4: 100 GPM TDH 40'
2 ITEM 5: 20 GPM TDH 50'
3 ITEM 6: 36 GPM 25 PSI
4 FOR OTHER OPERATING PROCEDURES CONSULT OPERATING MANUAL
5 3/4 HOLES
6 2" SLUDGE DISPOSAL MANIFOLD
7 3" OIL DISCHARGE
8 AMERON SERIES PSX700FD (GR-3 PEARL GRAY)

GE PROJECT POWER INC.

PROJECT # : 20001

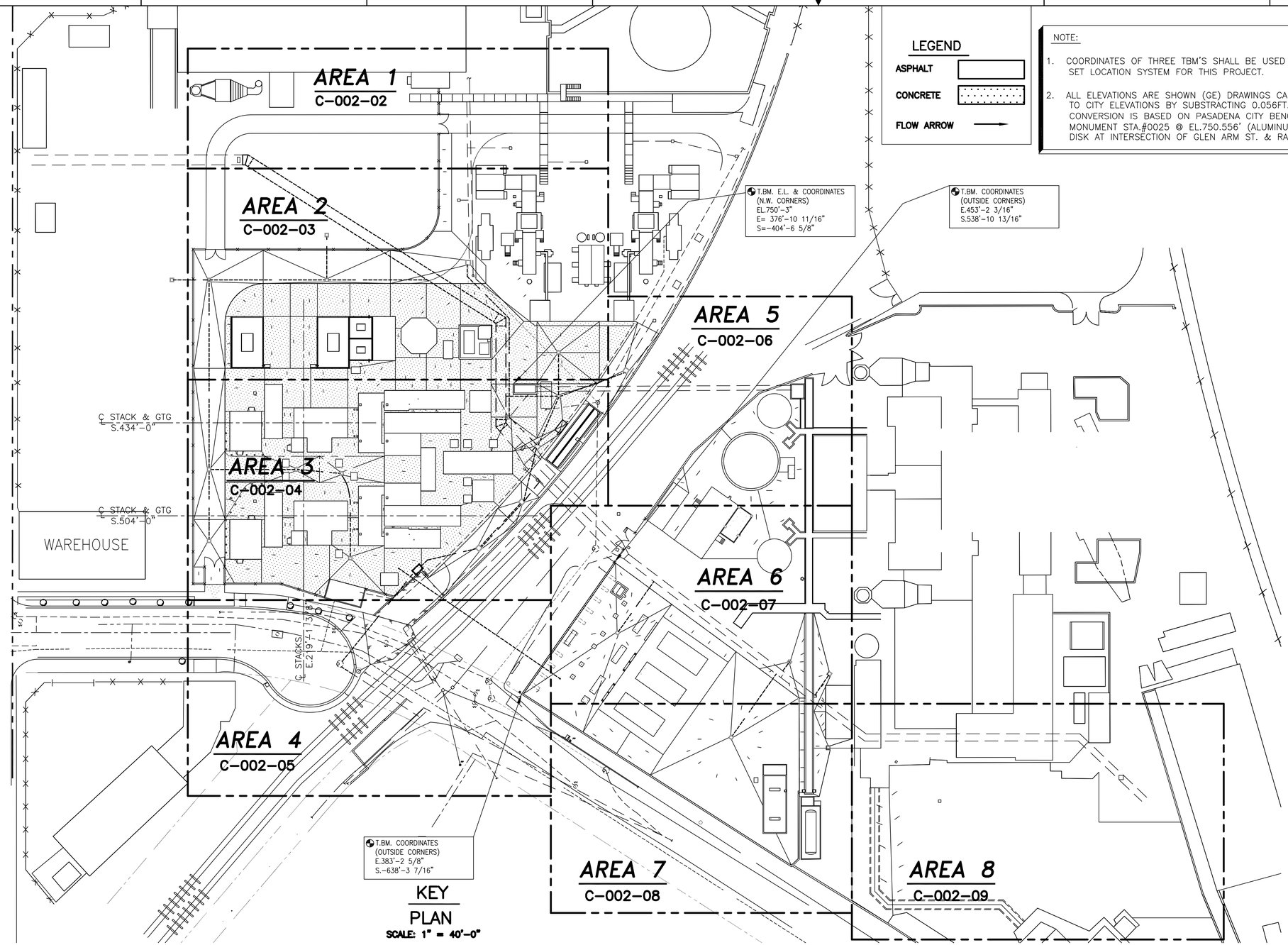
PROJECT NAME : CITY OF PASADENA

PROJECT LOCATION : PASADENA, CA

PLOT PLAN NUMBER : 274

FLO TREND SYSTEMS, INC.
707 LEHMAN HOUSTON, TEXAS 77018

SCALE:	APPROVED BY:	DRAWN BY:
NONE		JM
DATE:	DESCRIPTION	DATE REVISED / REV #
09-13-02	"AS BUILT"	01-16-03 / 0
TITLE: TPL150 OILY WATER SEPARATOR SKID		DRAWING NUMBER: 20001-274-M



KEY PLAN

SCALE: 1" = 40'-0"

LEGEND

ASPHALT

CONCRETE

FLOW ARROW

NOTE:

1. COORDINATES OF THREE TBM'S SHALL BE USED TO SET LOCATION SYSTEM FOR THIS PROJECT.
2. ALL ELEVATIONS ARE SHOWN (GE) DRAWINGS CAN BE CONVERTED TO CITY ELEVATIONS BY SUBSTRACTING 0.056FT. THIS CONVERSION IS BASED ON PASADENA CITY BENCH MARK MONUMENT STA.#0025 @ EL.750.556' (ALUMINUM SURVEY DISK AT INTERSECTION OF GLEN ARM ST. & RAYMOND AVE.)

UNDERGROUND PIPING GENERAL NOTES:

1. GENERAL CONTRACTOR SHALL SUBMIT CONSTRUCTION SCHEDULE AND PLAN TO THE OWNER FOR REVIEW. CONSTRUCTION SCHEDULE & PLAN SHALL BE BASED ON "NO SERVICE INTERUPTION" ON SANITARY SEWER AND STORMDRAIN. FOLLOWING ARE SOME SUGGESTED SEQUENCE BUT NOT LIMIT TO:
   -COORDINATE BETWEEN ALL TRADES.
   -WEATHER
   -PROVIDE ADEQUATE PUMPS TO DIVERT THE FLOWS
   -MAKE THE TIE-INS LAST.
   -INSTALL NEW MANHOLE AROUND EXISTING LINE, DO NOT BREAK THE LINE UNTIL THE NEW LINE IS READY FOR SERVICE THEN PLUG UP THE OLD OUTLET OF THE EXISTING LINE (M.H. #1 & 2 FOR EXAMPLE).
2. All WORK SHALL BE DONE IN ACCORDANCE WITH THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" AND "STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION", LATEST EDITION (GREEN BOOK), INCLUDING SUPPLEMENTS.
3. ALL PIPING & FITTINGS FOR SANITARY SEWERS SHALL BE VITRIFIED CLAY PIPIE (VCP AND IN ACCORDANCE WITH ASTM-C700 AND STANDARD SPEC. GREEN BOOK ITEM 207-8 AND 208-2.
4. ALL PIPING & FITTINGS FOR STORM DRAIN UNLESS NOTED OTHERWISE SHALL BE DRISCOPIPE 1000-SDR21 OR EQUAL AND IN ACCORDANCE WITH THE "GREEN BOOK" STANDARD SPEC. ITEM 207-19. PIPE BEDDING; BACKFILL AND FIELD INSPECTION SHALL CONFORM TO ITEM 306-1.2.12, 306-1.2.13, 306-1.3
5. REINFORCED CONCRETE PIPE (RCP) FOR STORM DRAIN SHALL BE PRECAST AND IN ACCORDANCE WITH ASTM-C497M AND STD. SPEC. GREEN BOOK ITEM 207-2.
6. PRECAST REINFORCED CONCRETE BOX (RCB) CULVERT (6' SPAN x 4' RISE) SHALL CONFORM TO CALTRANS STANDARD XS 4-27 FOR MAXIMUM EARTH COVER DEPTH OF 10 FEET PLUS HS20 LIVELOAD. FOR DETAILS OF PRECAST RCB OF STRAIGHT JOINTS AND ELBOW, SEE "HYDRO CONDUIT" VENDOR DRAWING #A, B, C AND B150-CE-1243, THE DRAWINGS TO BE STAMPED BY CALIFORNIA LICENSED PROFESSIONAL CIVIL ENGINEER.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TEST (EXFILTRATION TEST...) WHICH ARE REQUIRED BY THE CITY OF PASADENA FOR SANITARY SEWER AND STORM DRAIN PIPE. BEDDING; BACKFILL AND FIELD INSPECTION SHALL CONFORM TO ITEM 306-1.2.12, 306-1.2.13, 306-1.3
8. EXCAVATION OF 5 FEET OR MORE IN DEPTH SHALL REQUIRE SHORING AND BRACING. SHORING AND BRACING SHALL BE STANDARD SPEC. GREEN BOOK ITEM 7-10-4-1. AND CALIFORNIA OSHA STANDARDS
9. EXCAVATION SHALL BE DONE CAUTIOUSLY DUE TO EXISTING UNDERGROUND PIPING AND CONDUIT. PROBING AND HAND EXCAVATING MAY BE REQUIRED
10. FOR CONSTRUCTION ON STATE STREET, ALL TRAFFIC CONTROL OPERATIONS SHALL CONFORM TO THE PROVISION OF THE SECTION 7-10, "PUBLIC CONVENIENCE AND SAFETY", OF THE PASADENA SUPPLEMENTS. AND TO THE "WATCH" HANDBOOK
11. BEDDING MATERIAL SHALL BE SAND AND, GRAVEL CRUSHED AGGREGATED OR NATIVE FREE- DRAINING GRANULAR MATERIAL HAVING A SAND EQUIVALENT OF NOT LESS THAN 30. BEDDING MATERIAL SHALL BE COMPACTED TO 85% RELATIVE COMPACTION.
12. A PERMIT FROM THE CITY OF PASADENA DEPARTMENT OF PUBLIC WORK IS REQUIRED PRIOR TO ANY WORK IN THE PUBLIC RIGHT OF WAY. THE PERMIT MAY BE OBTAINED AT CITY HALL 100 N. GARFEILD AVE. ROOM 212, TELEPHONE 626-744-4195
13. ALL WORK TO BE INSPECTED PER CBC 2001, SECTION 1701 & 1702

PAVING & GRADING NOTES:

1. SEE DWG. #20001-C-001-01 FOR GENERAL NOTES OF CONCRETE AND ASPHALT PAVEMENT. SEE TYP. ASPHALT & CONC. PAVEMENT DETAIL, DWG.# C002-09
2. THE STRIPING ON BOTH SIDES OF FIRE LANE (ON PAVEMENT) ON THE CURB OR ON ONE SIDE OF WALL SHALL CONFORM TO THE CITY OF PASADENA STANDARDS.

RESERVED

P.B.SUMMERS P.E.
CA. LIC. S3725
C44211

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:

1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION.
2. SEE THIS DWG. FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c002-01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	JLG	12/8/03	P.LE	YH	
0	ISSUED FOR CONSTRUCTION	JLG	1/24/03	P.LE	Y.H.	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

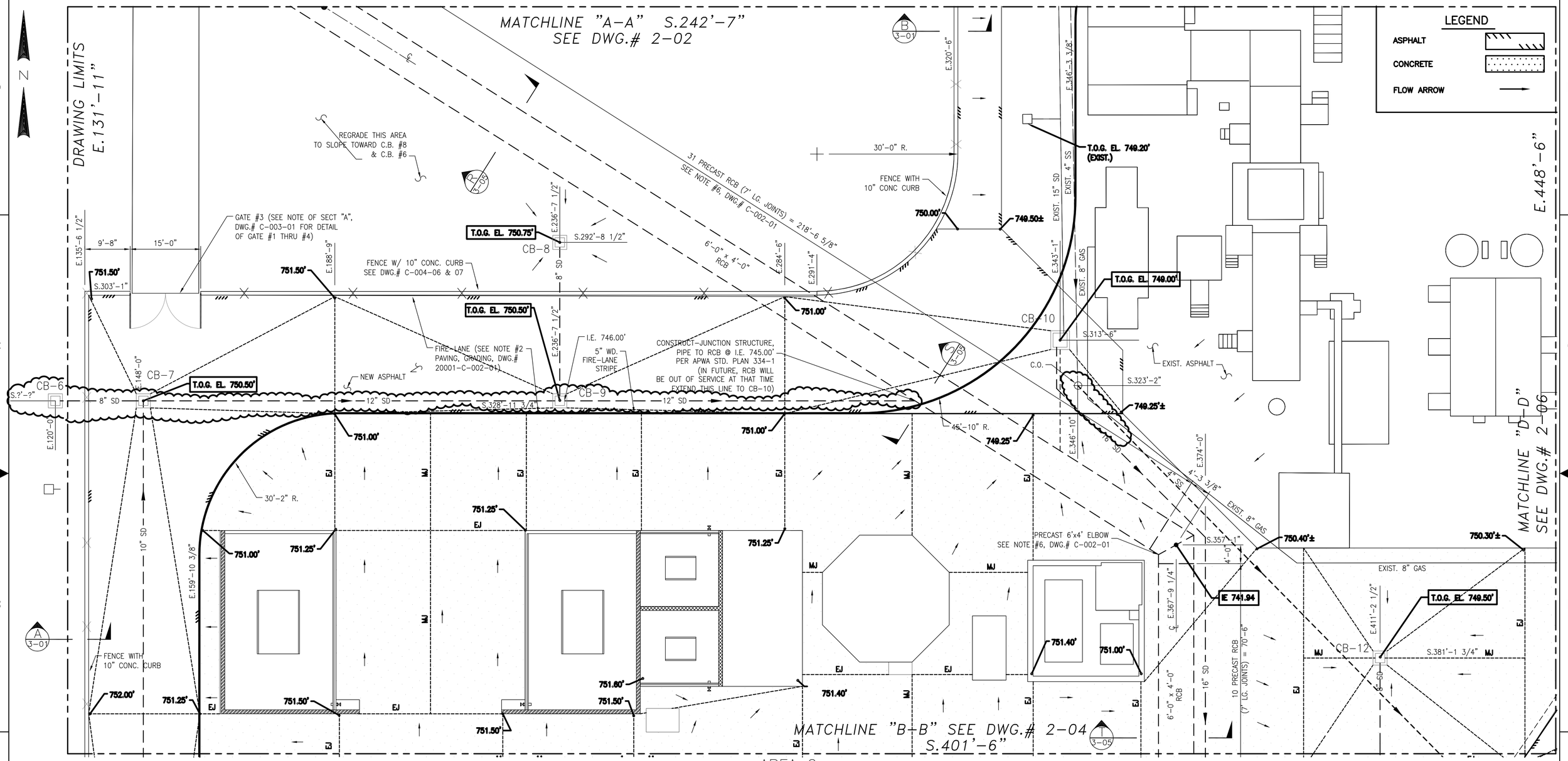
TITLE

CIVIL KEY PLAN
PAVING / GRADING
& U.G. SEWER

DWG NO.

20001-C-002-01

SCALE 1"=40'-0" SHEET OF



AREA 2

PLAN

SCALE: 1" = 10'-0"

RESERVED

P.B.SUMMERS P.E.
CA. LIC. S3725
C44211

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-01	CIVIL KEY PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-09	AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:

1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION.
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c002-03.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	JLG	12/8/03	P.LE	YH	
0	ISSUED FOR CONSTRUCTION	JLG	1/24/03	P.LE	Y.H.	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

AREA 2
CIVIL PLAN PAVING / GRADING & U.G. SEWER

DWG NO.

20001-C-002-03

SCALE 1"=10'-0" SHEET OF

MATCHLINE "B-B" S.401'-6"
SEE DWG.# 2-03

MATCHLINE "D-D" E.448'-6"
SEE DWG.# 2-06

MATCHLINE "C-C"
SEE DWG.# 2-05
S.567'-4"

DRAWING LIMITS

E.131'-11"

FENCE WITH 10" CONC. CURB

NEW ASPHALT

FIRE-LANE (SEE NOTE #2 PAVING, GRADING, DWG.# 20001-C-002-01)

SEE DWG.# C-003-01 FOR GUARD POST DETAIL (TYP.)

5" WD. FIRE LANE STRIPE

5" WD. TRAFFIC YELLOW STRIPE

PROVIDE CONC. RAMP @ LADDER OR DOOR LANDING (TYP.)

GAS METER SHELTER

GAS ENCLOSURE

STORM OUTFALL BOX DWG.# C003-01

PEDESTRAIN GATE

GATE #1

GATE #2 (SEE NOTES OF SECT. "A", DWG.# C-003-01 FOR DETAIL OF GATE #1 THRU #4)

EXIST. CONC. CURB W/ NEW FENCE

EXIST. (2) 48"

EXIST. CONC. CURB W/ NEW FENCE SEE DETAIL "1", DWG.# C-0003-02

RAISE EXIST. STORM DRAIN ACCESS COVER TO NEW ELEVATION.

10 PRECAST RCB (7 LG. JOINTS) = 70'-6"

NEW BOX EXIST. BOX

CB-1 CB-2 CB-3 CB-4 CB-5 CB-11 CB-13 CB-15 CB-16 CB-17

MA-1A

T.O.G. EL. 751.00'

T.O.G. EL. 749.50'

T.O.G. EL. 749.25'

T.O.G. EL. 749.00'

T.B.M. EL. USE T.O. EXIST. CONC. PIT EL. 750.25'

IE 741.67'

IE 738.17'

I.E. 738.74

I.E. 738.40

EXIST. 8" GAS

EXIST. 8" WATER

EXIST. 16" S.S.

R.O.W. & P.L.

DETAIL 4 3-05

DETAIL 1 3-02

AREA 3 / PLAN

SCALE: 1" = 10'-0"

LEGEND

ASPHALT

CONCRETE

FLOW ARROW

RESERVED

P.B.SUMMERS P.E.
CA. LIC. S3725
C44211

REFERENCE DRAWINGS:

20001-C-001	GENERAL NOTES
20001-C-002-01	CIVIL KEY PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-05	AREA 4-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-06	AREA 5-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-07	AREA 6-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-08	**AREA 7-CIVIL PLAN PAVING / GRADING & U.G. SEWER**
20001-C-002-09	**AREA 8-CIVIL PLAN PAVING / GRADING & U.G. SEWER**

NOTES:

1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION.
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c002-04.dwg
XREF DWG:

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1	AS BUILT PER CONTRACTOR MARKS	JLG	12/8/03	P.LE	YH	
0	ISSUED FOR CONSTRUCTION	JLG	1/24/03	P.LE	Y.H.	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

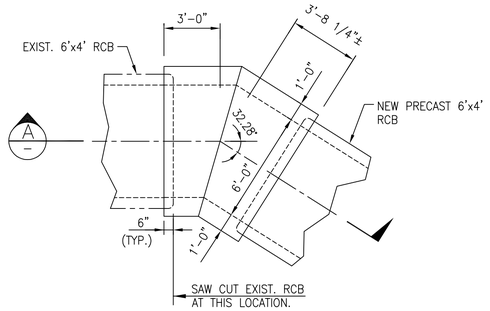
TITLE

AREA 3
CIVIL PLAN PAVING / GRADING & U.G. SEWER

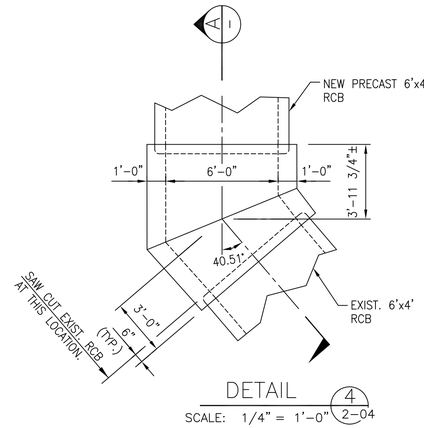
DWG NO.

20001-C-002-04

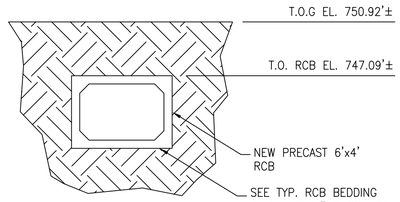
SCALE 1"=10'-0" SHEET OF



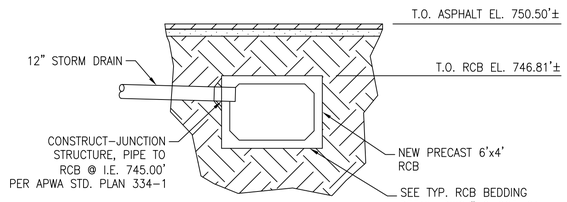
DETAIL 3 2-02
SCALE: 1/4" = 1'-0"



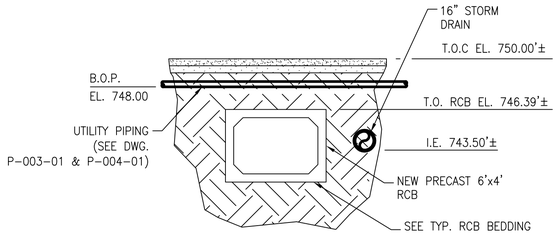
DETAIL 4 2-04
SCALE: 1/4" = 1'-0"



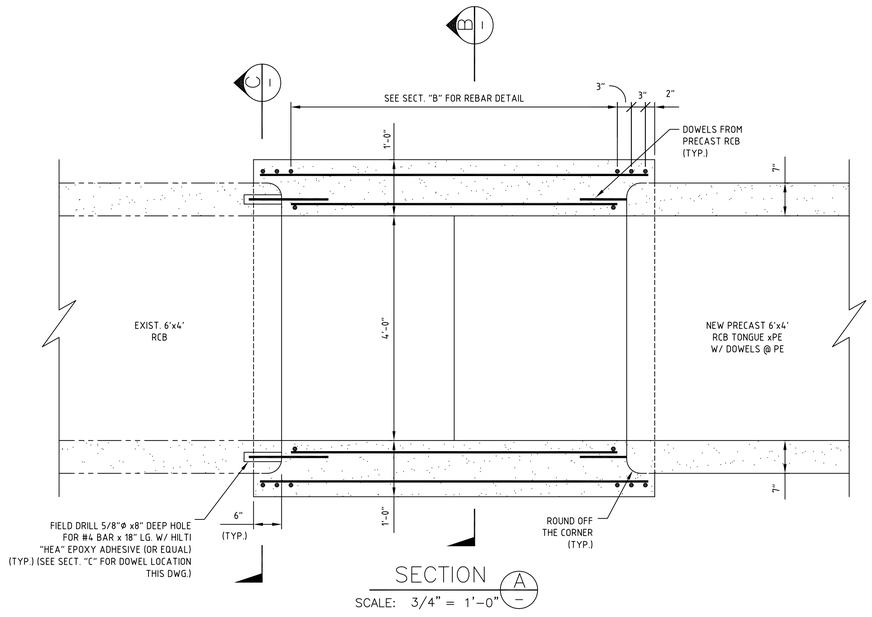
SECTION R 2-03
SCALE: 3/16"= 1'-0"



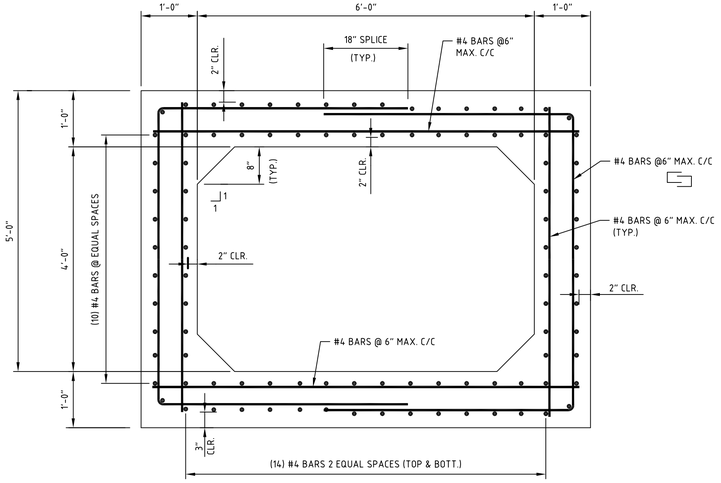
SECTION S 2-03
SCALE: 3/16"= 1'-0"



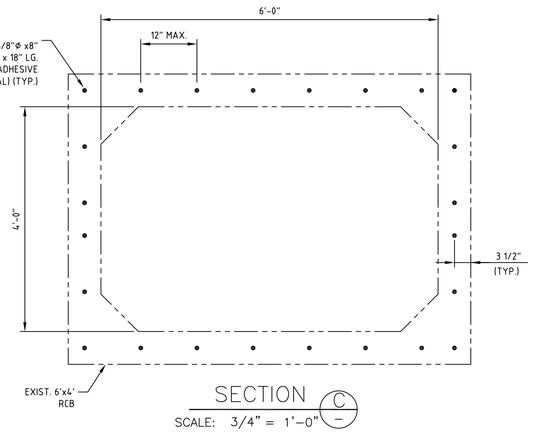
SECTION T 2-03
SCALE: 3/16"= 1'-0"



SECTION A –
SCALE: 3/4" = 1'-0"



SECTION B –
SCALE: 3/4" = 1'-0"



SECTION C –
SCALE: 3/4" = 1'-0"

FOR CONSTRUCTION

1-24-03

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C44211

REFERENCE DRAWINGS:

20001-C-002-02	AREA 1-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-03	AREA 2-CIVIL PLAN PAVING / GRADING & U.G. SEWER
20001-C-002-04	AREA 3-CIVIL PLAN PAVING / GRADING & U.G. SEWER

NOTES:

1. SEE DWG.# C-002-004 FOR TEMPORARY BENCHMARK (TBM) ELEVATION.
2. SEE DWG.# C-002-001 FOR U.G. PIPING GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c003-05.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	JLG	1/24/03	P.LE	Y.H.	

PASADENA POWERPLANT UPGRADE PROJECT

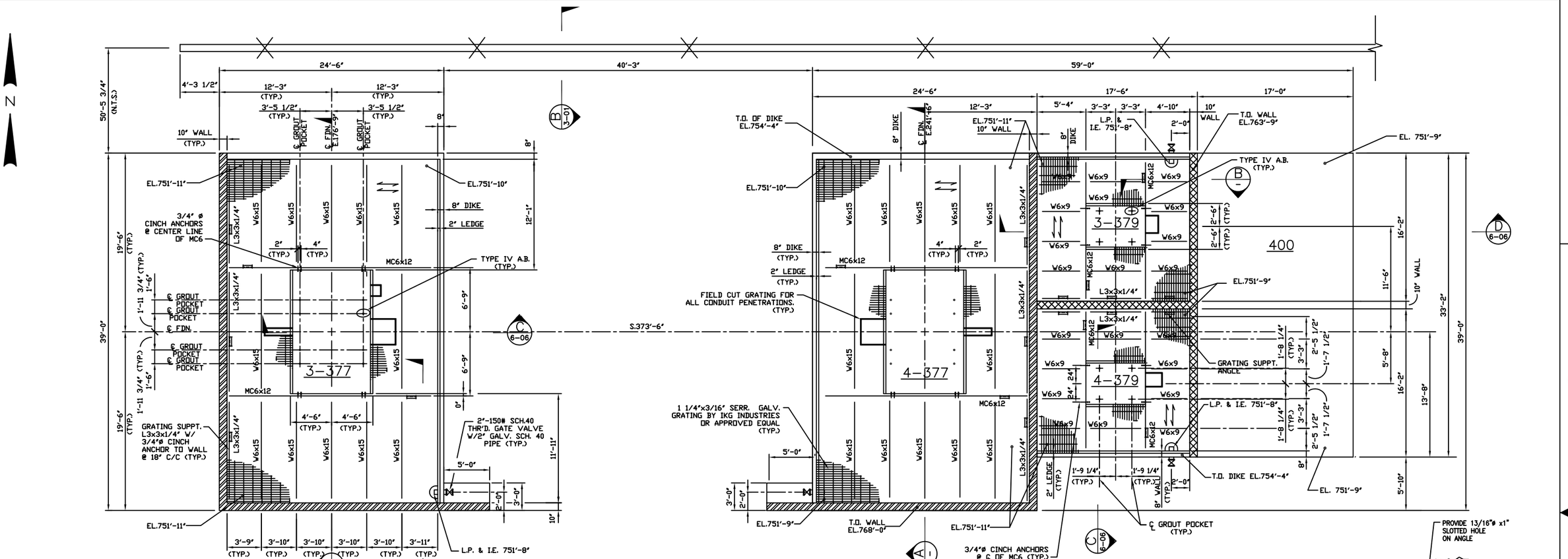
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
CIVIL
SECTIONS & DETAILS

DWG NO.
20001-C-003-05

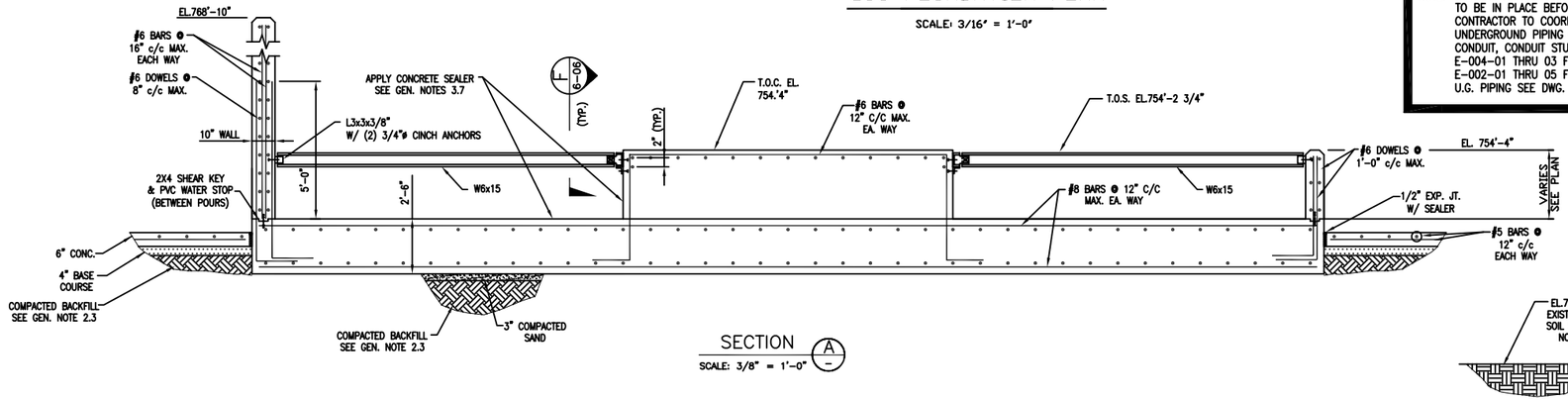
SCALE (AS NOTED) SHEET



GSU FOUNDATION PLAN

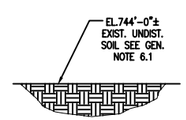
SCALE: 3/16" = 1'-0"

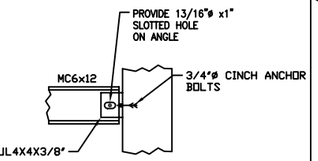
NOTE: ALL UNDERGROUND CONDUITS, ELECTRICAL GROUNDING AND PIPING TO BE IN PLACE BEFORE POURING ANY CONCRETE. CONCRETE CONTRACTOR TO COORDINATE WITH ELECTRICAL CONTRACTOR AND UNDERGROUND PIPING CONTRACTOR FOR LOCATION OF UNDERGROUND CONDUIT, CONDUIT STUB-UP, GROUNDING, AND PIPING. SEE DWG. E-004-01 THRU 03 FOR U.G. CONDUITS; SEE DWG. E-002-01 THRU 05 FOR U.G. GROUNDING; AND FOR U.G. PIPING SEE DWG. P-003 THRU 009



SECTION A

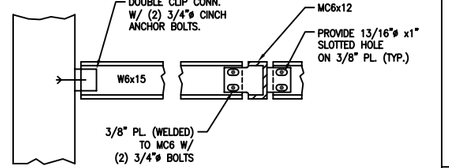
SCALE: 3/8" = 1'-0"





TYP. MC6 END CONN.

SCALE: 1" = 1'-0"



SECTION B

SCALE: 1" = 1'-0"

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C44211

REFERENCE DRAWINGS:

20001-C-001-01 GENERAL NOTES

NOTES:

1. FOR GENERAL NOTES SEE DWG C-001-01.
2. SEE DWG. C-007 FOR A.B. DETAIL.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c004-06.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
2	AS BUILT PER CONTRACTOR MARKS	JLG	12/8/03	P.LE	YH	
1	ADDED A.BOLTS	JLG	4/1/03	P.LE	YH	
0	ISSUED FOR CONSTRUCTION	JLG	3/6/03	P.LE	YH	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

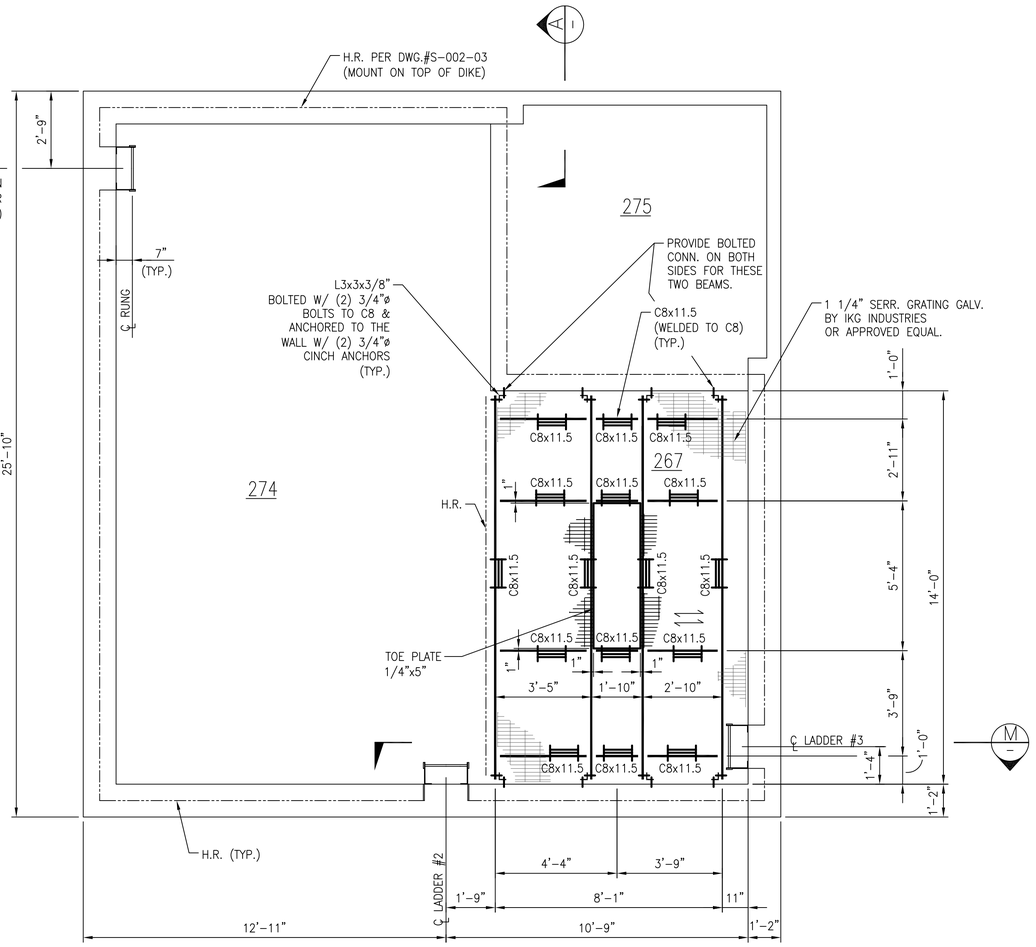
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE: GSU FOUNDATION PLAN

DWG NO. 20001-C-004-06

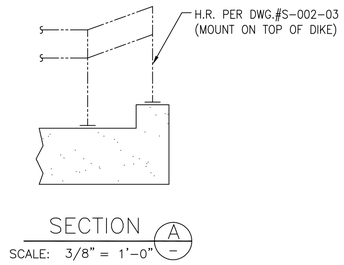
SCALE (AS NOTED) SHEET 1 OF 1



OILY WATER TANK FDN
STEEL PLAN

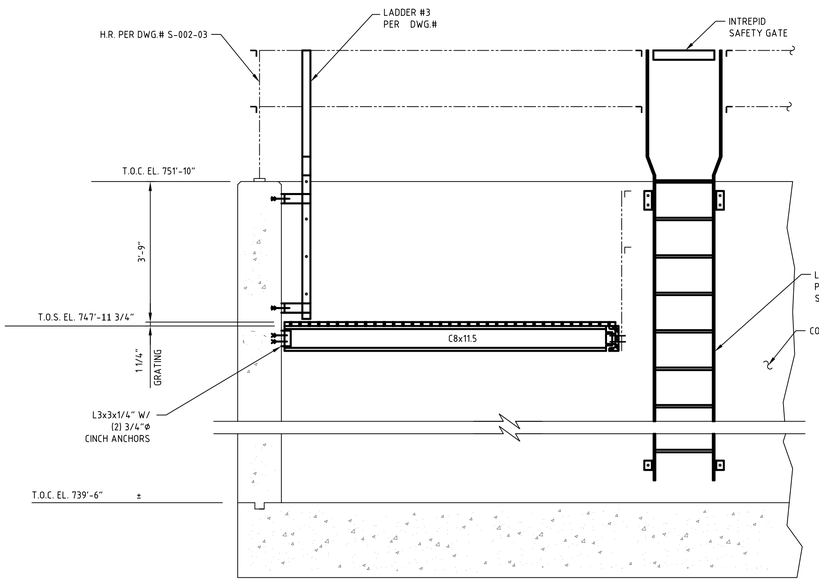
SCALE: 3/16"

(SEE DRAWING #C-004-07 FOR LOCATION PLAN)



SECTION A

SCALE: 3/8" = 1'-0"



SECTION M

SCALE: 1/2"-0"

FOR CONSTRUCTION

3-6-03

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CA. LIC. S3725
C44211

REFERENCE DRAWINGS:

20001-C-001-01 GENERAL NOTES

NOTES:

1. SEE GENERAL NOTES DWG. C-001-01

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001c006-04.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	JLG	3/6/03	P.LE	YH	

REVISIONS

PASADENA POWERPLANT
UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
FOUNDATION
SECTIONS & DETAILS

DWG NO.
20001-C-006-04

SCALE (AS NOTED) SHEET

DRAWING LIMITS S. −379'−4"

DRAWING LIMITS E. 133'−8"

MATCHLINE E. 389'5" C.O.D. 20001−E−004−03

MATCHLINE S. −468'−3" C.O.D. 20001−E−004−02

SEE DETAIL 1 (THIS DWG.)

NOTES:

1. ALL DUCTBANK CONDUITS TO BE RIGID PVC SCHEDULE 40.
2. TOP OF RED CONCRETE OF DUCT BANK SHALL BE A MINIMUM OF 6" BELOW ANY BOTTOM OF PIPE.
3. MINIMUM 6'−0" RADIUS SHALL BE USED FOR 35KV CONDUIT AT GSU TRANSFORMERS 3−377 AND 4−377.
4. ALL CONDUITS 4" & 6" CONDUIT SERIES #1500 WITH 15KV CABLES, THE MIN. RADIUS OF CONDUIT STUB−UP SHALL BE 36".
5. FOR ALL CONDUITS 2",3" THE MIN. RADIUS OF CONDUIT STUB−UP OR ELBOWS SHALL BE 18" AND FOR 4"C IT SHALL BE 24" MIN.
6. TOP OF DUCTBANK ELEVATIONS SHALL BE AS NOTED THIS DWG. OR DUCTBANK SECTIONS.
7. FOR STUB−UP LOCATIONS, SEE DWG. E008 SERIES.
8. ALL UNDERGROND PULL BOXES, PROVIDED BY CONTRACTOR, SHALL BE PRECAST CONCRETE, AS MANUFACTURED BY JENSEN PRECAST, PER APPROVED SPECIFICATIONS BY PWP. FOR PULL BOX INFORMATION REFER TO VENDOR DRAWING NUMBER 8−L−1322. FOR SIZE AND CONDUIT PENETRATIONS SEE DWG. E009 SERIES.
9. T.O.D. EL. SHALL BE "48'−0" FOR THE PORTION NOTED FOR THE 15KV BANK TO UGPB−3 AND THEN GRADUALLY REDUCED GOING EAST.
10. DUCTBANKS SOUTH OF 4−377 AND EAST OF 3−410 SHALL BE REINFORCED WITH REBARS. ALSO THE BACKFILL SOIL ALL AROUND UGPB−3 SHALL BE WELL COMPACTED TO PREVENT UGPB−3 FROM SHIFTING DUE TO BEING CLOSE TO 4−377 FOUNDATION SEE CIVIL DWG. C001−01 FOR STANDARD COMPACTION.
11. THE DUCTBANK BETWEEN UGPB−9 AND WEST PIPE PIT, CROSSING ABOVE THE STORM SEWER, SHALL BE REINFORCED WITH REBARS TO PREVENT POTENTIAL DAMAGE FROM HEAVY EQUIPMENT USAGE DURING GENERATOR 3−1 REMOVAL. SEE SECTIONS 23B AND 24 DWG. E004−10 FOR REBAR DETAILS.
12. ALL 35KV CONDUITS TERMINATING AT UGPB5 ARE SHOWN ON DWG. 2001−E004−13
13. THE RED CONCRETE MIX FOR FILLING IN ALL DUCTBANK SHALL BE 3000 PSI. STRENGTH AND BE A MAX. OF ½" SIZE OF AGGREGATE.

KEY PLAN

DETAIL−1 (NORTH OF PCM)

RESERVED

REFERENCE DRAWINGS:

20001−E−004−04 THRU 12	OVERALL CONDUIT BANK ROUTING PLAN & SECTION
20001−E−008−SERIES	UNDERGROUND CONDUIT STUB−UP PLAN

LEGEND:

- UNDERGROUND CONDUIT DUCT BANK,SIZE PER SECTION
- DUCTBANK SECTION NUMBER
- SUBSECTION NUMBER
- REFERENCE, SUFFIX NO. OF DWG. E−004
- T.O.D. TOP OF DUCTBANK
- B.O.D. BOTTOM OF DUCTBANK
- U/G PULL BOX TAG# UGPB−3

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E004−01.dwg
XREF DWG: _GAPLAN _PASABKGD E_STUB−UPS UGCONDUIT 20001c002−01 FDN PLAN(1)

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
4	REVISED AS NOTED	JC	4/10/03	SA	SA	
3	REVISED AS NOTED	JRD	2/24/03	SA	SA	
2	REVISED UNDERGROUND DUCTBANK ELEVATIONS	WTM	01/24/03	SA	SA	
1	ADDED NEW U/G DUCTBANK ROUTE TO GSU 3−377	WTM	12/16/02	SA	SA	
0	ISSUED FOR CONSTRUCTION	WTM	11/18/02	SA	SA	

REVISIONS

FOR CONSTRUCTION
4/23/03

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
ELECTRICAL
OVERALL CONDUIT BANK
ROUTING PLAN & SECTION

DWG NO.
20001−E−004−01

SCALE 1"=10' SHEET

MATCHLINE S. -468'-3" C.O.D. 20001-E-004-01

DRAWING LIMITS E. 133'-8"

N

T.O.D. EL.747'-0"

T.O.D EL. 748'-0"

SAME AS SECT. 13K

EL. 748'-0"

T.O.D. EL. 747'-6"

UGPB15 5'6" X 8'0"

SEE NOTES 1 & 2 BY PWP

T.O.D. EL. 746'-9"

BY PWP

4-172

4-177

4-173
4-175
(UNDER 4-172)

4"C, 4-502

35' R

BOTTOM OF LOWEST CONDUIT EL. 747'-8" IN 4-403 AREA TO CLEAR FDN.

4-415, 4-163, 4-172, 4-175

4-67A

4-63

4-354

2"C, 4-225

4-403

4-7

4-64

4"C, 4-411

4-67B

2"C, 187A

2"C, 4-352

2"C, 304

BY CONTRACTOR PWP

GAS METER SHELTER

4-397

4-380

2"C, 251

4"C, 4-1505

4-60

LH UNIT #4

4-410

T.O.D. EL. 746'-0"
9-6"C
4-151, 4-152
4-1504, 4-179
4-164, 4-664 SP, 4-663, 4-641

1 1/2" 4-166

SEE DETAIL-1 (THIS DWG.)

TEMPORARILY REMOVE EXIST FIRE HYDRANT IF NECESSARY

BEWARE OF EXISTING GAS & WATER LINES IN THIS AREA

4-162

4-160

4-150A

4-150B

B.O. CONDUIT EL. 747'-6"

4"C, 4-679
4"C, 4-634
2"C, 4-677
2"C, 4-635

2"C, 160

2"C,4-632
2"C, 160
2"C, 187D
2"C, 160A

2"C, 160
2"C, 4-170
2"C, 4-678

3-82
4-82

2"C, 187D

1 (8'x14')

NOTE 1

12-6" + 4-3" (EXIST. SPR.) NOTE 3

WV

EXISTING

EXISTING

4-5" + 3-4" (EXIST.)

EXISTING

DRAWING LIMITS S. -619'-5"

MATCHLINE S. -619'-5" C.O.D. 20001-E-004-03

MATCHLINE E. 389'-5" C.O.D. 20001-E-004-03

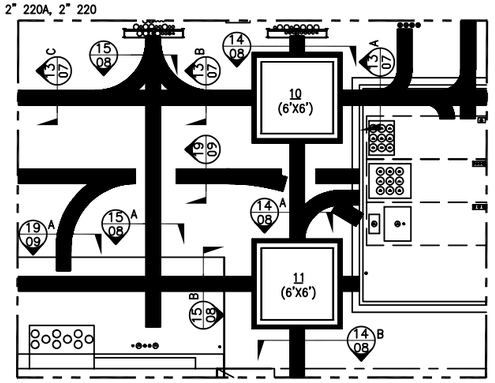
2"C 251, 4" 202A & B, 206, 3-354, 4-354, 4-170, 4-151, 4-152
3"C#307, 308, 309, & 310

228, 217, 229, 3-151

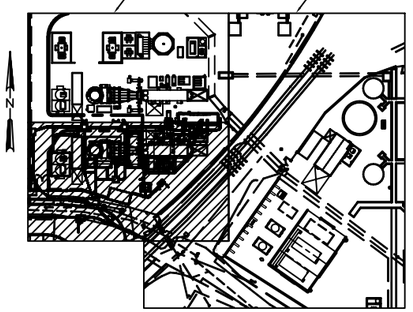
NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS REFER TO SHEET 01.

T.O.D. EL. 748'-0"
2" 220A, 2" 220



DETAIL 1
(SOUTH OF PCM)



KEY PLAN

RESERVED

REFERENCE DRAWINGS:

SEE DRAWING NO. E004-01

NOTES:

1. UGPB 1, 2, 5 & 15 SHALL BE INSTALLED BY PWP.
2. THE CONTRACTOR SHALL TERMINATE COMMUNICATION CONDUITS PER SECTION 13H ON THE EAST SIDE OF UGPB 15.
3. THE U/G BANK BETWEEN UGPB 1 & 2 IS EXISTING. PWP SHALL TERMINATE THE CONDUITS IN THIS BANK TO THESE PULL BOXES. ALSO ALL CONDUITS EXITING FROM SOUTH SIDE OF UGPB15 AND WEST OF UGPB1 SHALL BE BY PWP. THE CONTRACTOR SHALL TERMINATE ALL OTHER CONDUITS AS SHOWN.

LEGEND:

SEE DRAWING NO. E004-01

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E004-02.dwg
XREF DWG: _GAPLAN
_PASABKGD
E_STUB-UPS
UGCONDUIT
20001c002-01
FDN PLAN(1)

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
4	AS-BUILT PER CONTRACTOR MARK UPS	JC	12/8/03	SA		
3	REVISED AS NOTED	JC	4/10/03	SA	SA	
2	REVISED AS NOTED	JRD	2/24/03	SA	SA	
1	ADDED DUCTBANK SECTION	WTM	12/16/02	SA	SA	
0	ISSUED FOR CONSTRUCTION	WTM	11/18/02	SA	SA	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

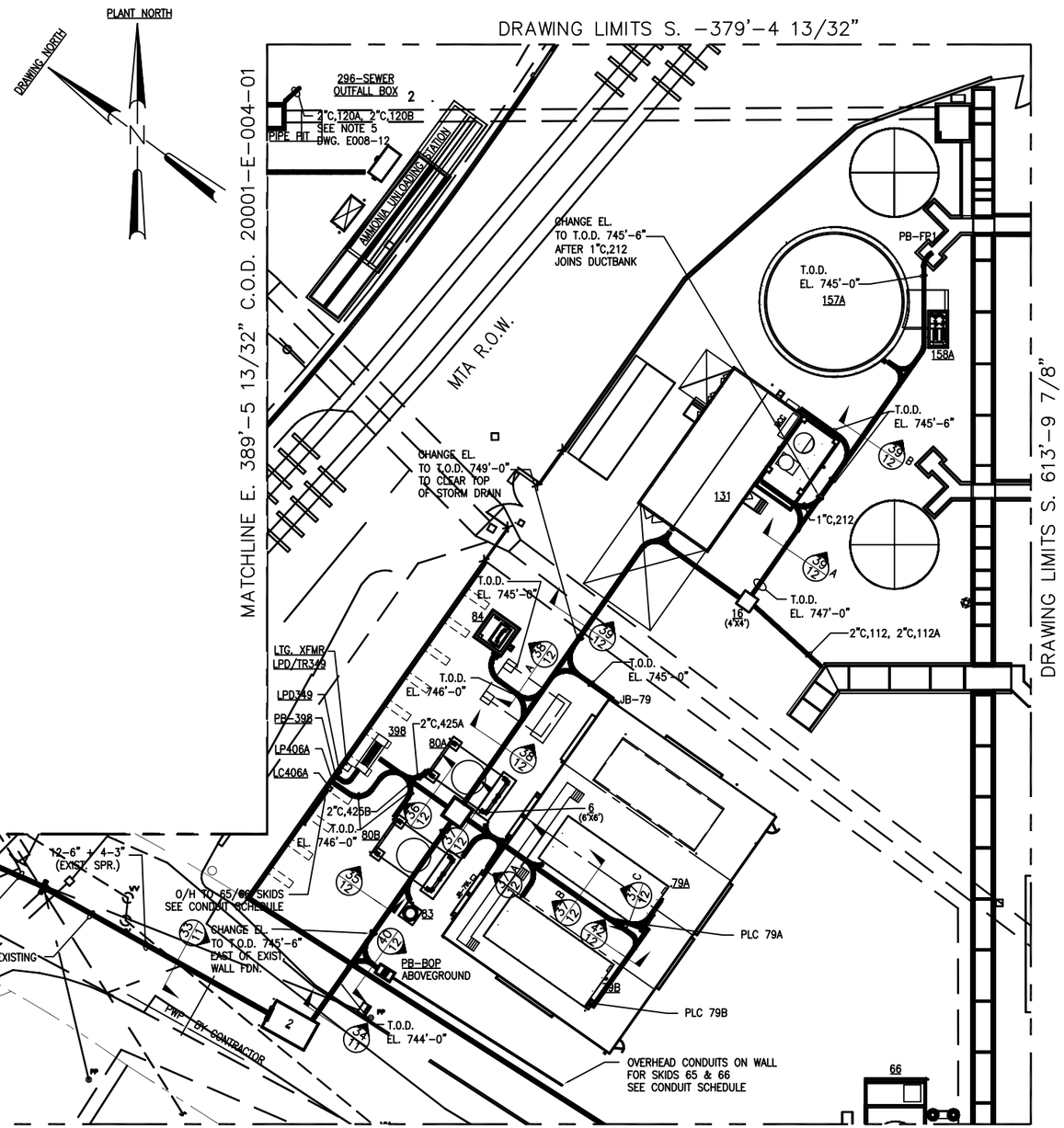
ELECTRICAL
OVERALL CONDUIT BANK
ROUTING PLAN & SECTION

DWG NO.

20001-E-004-02

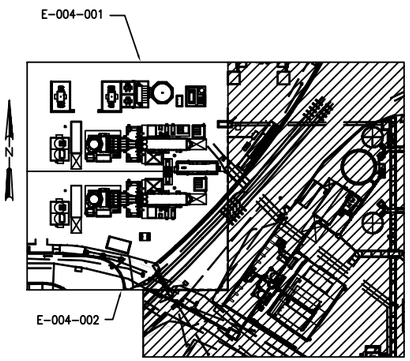
SCALE 1"=10'

SHEET



NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS, REFER TO SHEET 01.



KEY PLAN

RESERVED

SURRINDER AHLUWALIA, P.E.
CA. LIC. E 16826

LEGEND:
SEE DWG. E004-01

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E004-03.dwg
XREF DWG: _GAPLAN.DWG
_PASABKGD.DWG
E_STUB-UPS
UGCONDUIT

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
4	AS-BUILT PER CONTRACTOR MARK UPS	JC	12/8/03	SA		
3	REVISED AS NOTED	JC	4/10/03	SA	SA	
2	REVISED UNDERGROUND DUCTBANK ELEVATIONS	WTM	02/24/03	SA	SA	
1	REVISED AS NOTED	WTM	12/16/02	SA	SA	
0	ISSUED FOR CONSTRUCTION	WTM	11/18/02	SA	SA	

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

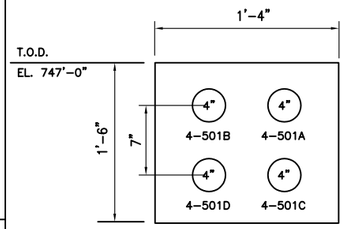
WORK ORDER NO. 20001

TITLE
ELECTRICAL
OVERALL CONDUIT BANK
ROUTING PLAN & SECTION

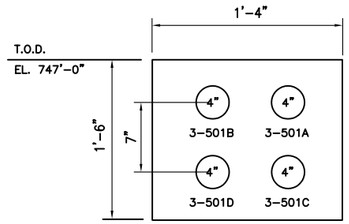
DWG NO.
20001-E-004-03

SCALE 1"=20'

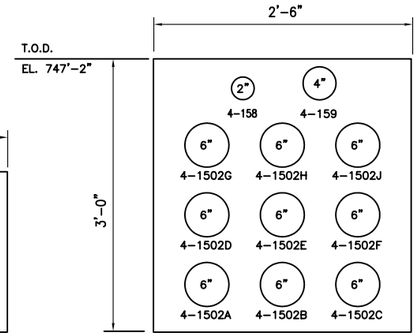
SHEET



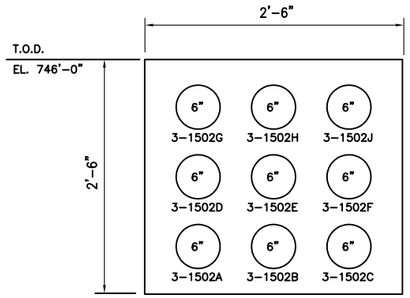
SECTION 4(01)
(EAST OF 4-379, LOOKING WEST)



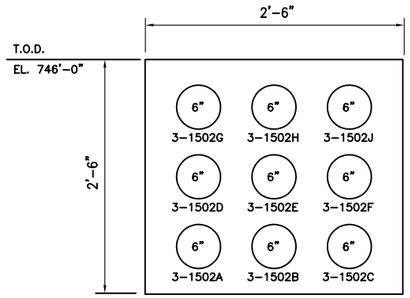
SECTION 5(01)
(EAST OF 3-379, LOOKING WEST)



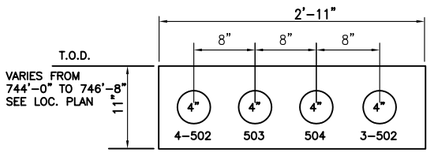
SECTION 6-(01)
(WEST OF 4-377, LOOKING NORTH)



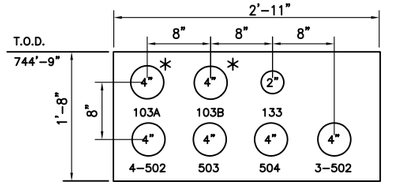
SECTION 7(01)
(EAST OF 3-377, LOOKING NORTH)



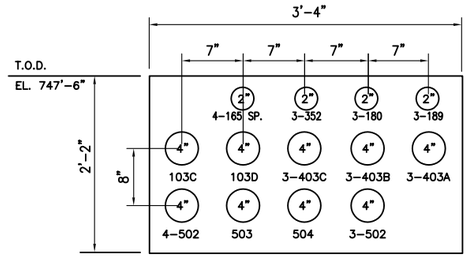
SECTION 7A(01)
(SOUTH OF 4-377, LOOKING WEST)



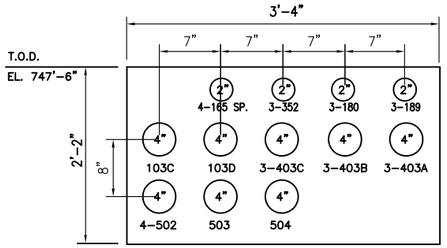
SECTION 7B(01)
(SOUTH OF 4-377, LOOKING WEST)



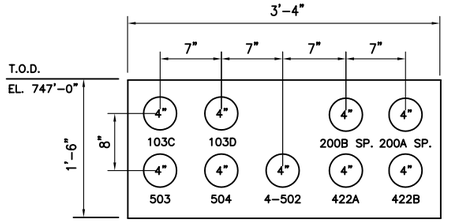
SECTION 8(01)
(SOUTH OF 5KV SWGR. 400, LOOKING SOUTH)
AFTER EXIST FROM 5KV SWITCHGEAR CONDUITS
103A & 103B WILL BE RAISED TO FALL IN PLACE
PER SECTION 3A(01 DWG. E004-04.



SECTION 9(01)
(EAST OF 3-177, LOOKING SOUTH)



SECTION 9A(01)
(SOUTH OF 3-177, LOOKING SOUTH)



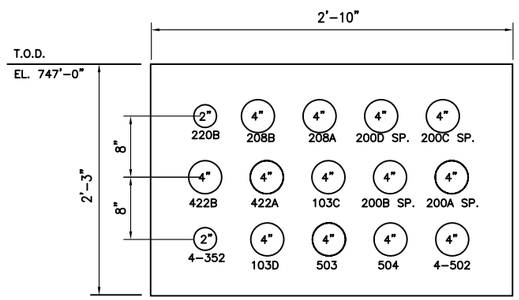
SECTION 9B(02)
(SOUTH OF 3-177, LOOKING SOUTH)

CENTER TO CENTER SPACING CHART FOR CONDUIT SECTIONS					
COND. SIZE	2"	3"	4"	6"	
2"	**4"**	**5"**	**5"**	**6"**	
3"	—	**5"**	**6"**	**7"**	
4"	—	—	**6"**	**7"**	
6"	—	—	—	**8 5/8"**	

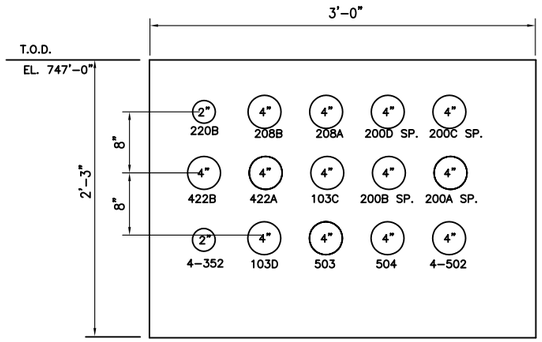
NOTES FOR CONDUIT CHART:

1. DIMENSION IN BOLD IS THE CENTER TO CENTER SPACING BETWEEN CONDUITS, EXCEPT WHERE NOTED.

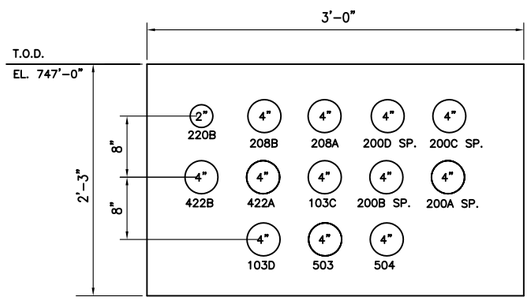
2. POUR A MINIMUM OF 3" CONCRETE COVER ON ALL OUTER CONDUITS WITHIN EACH CONDUIT DUCT BANK.



SECTION 9C(02)
(NORTH OF 4-177, LOOKING SOUTH)



SECTION 9D(02)
(EAST OF 4-177, LOOKING SOUTH)



SECTION 9E(02)
(SOUTH OF 4-177, LOOKING SOUTH)

LEGEND

SECTION 3C (**)
- DUCTBANK REF. DWG. E004 SERIES NO.
- SECTION NO.

T.O.D. TOP OF DUCT BANK
B.O.D. BOTTOM OF DUCT BANK

RESERVED

NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS, REFER TO DWG. E004-04

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E004-05
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
4	AS-BUILT PER CONTRACTOR MARK UPS	JC	12/8/03	SA		
3	REVISED AS NOTED	JC	4/10/03	SA	SA	
2	REVISED AS NOTED	JC	2/24/03	SA	SA	
1	REVISED AS NOTED	WTM	12/16/02	SA	SA	
0	ISSUED FOR CONSTRUCTION	WTM	11/18/02	SA	SA	

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

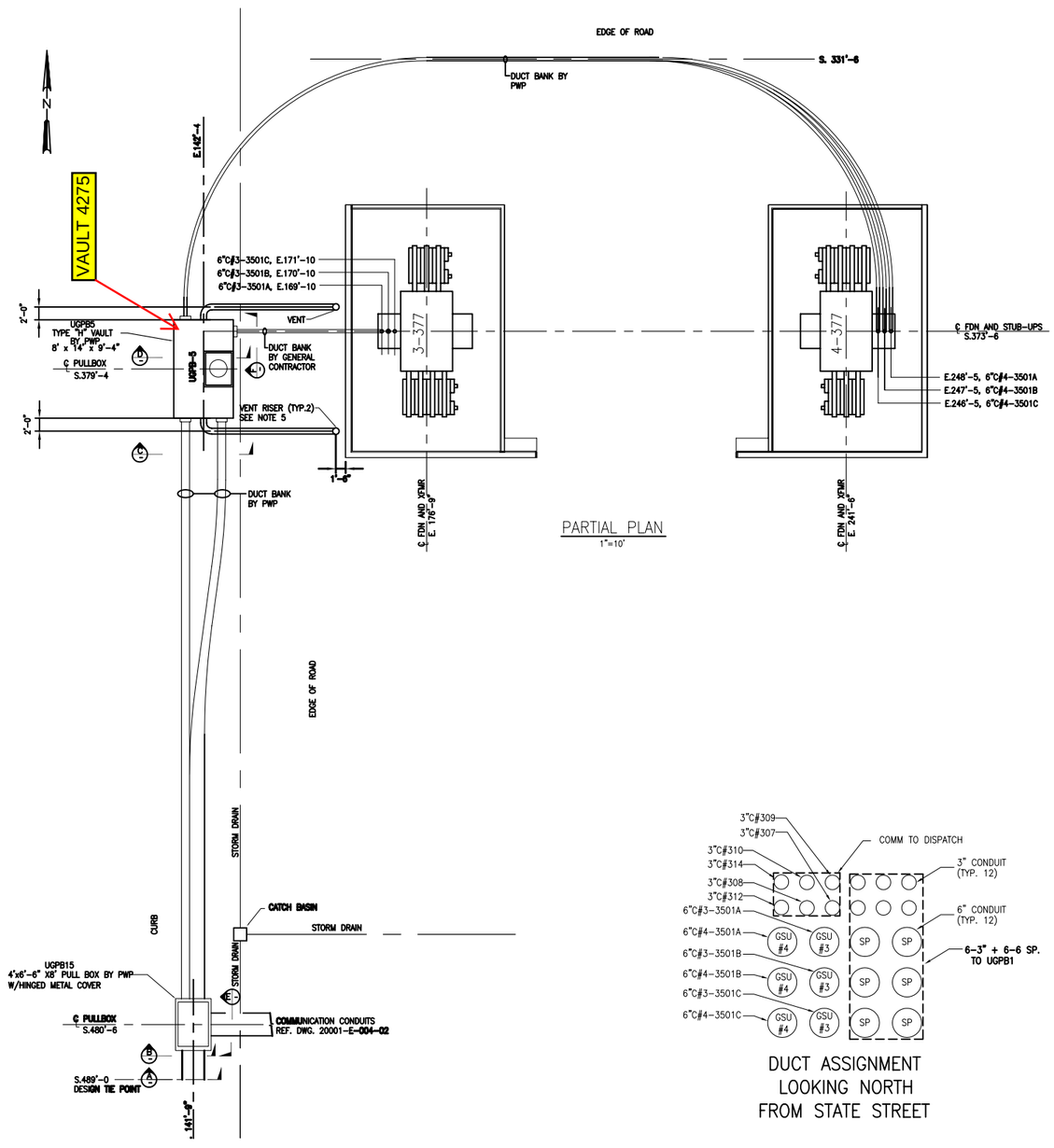
TITLE

ELECTRICAL
CONDUIT DUCTBANK SECTIONS
MISCELLANEOUS SECTIONS

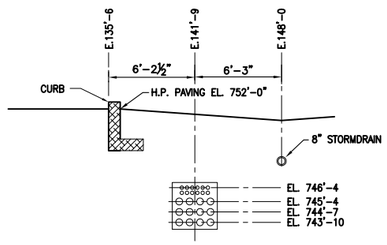
DWG NO.

20001-E-004-05

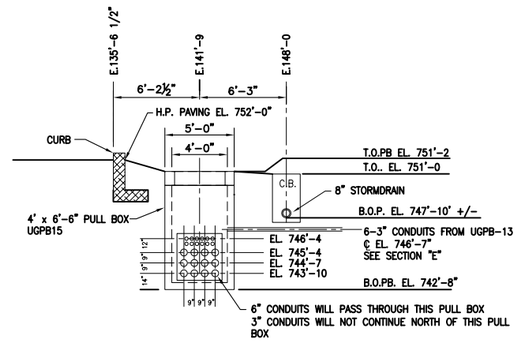
SCALE NONE SHEET



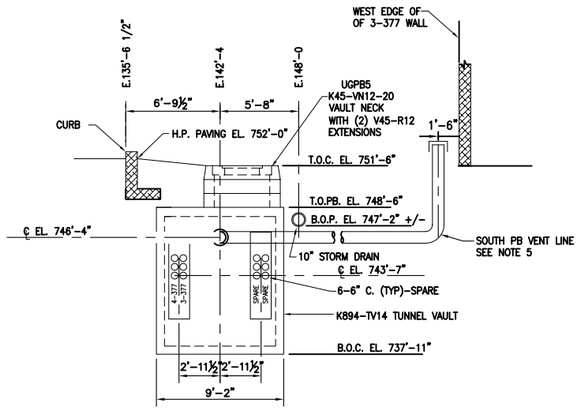
PARTIAL PLAN
1"=10'



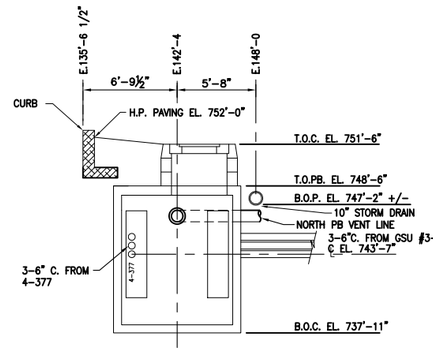
SECTION "A"
3/16"=1'-0"
FOR CONDUIT #'S SEE DUCT ASSIGNMENT BELOW



SECTION "B"
3/16"=1'-0"

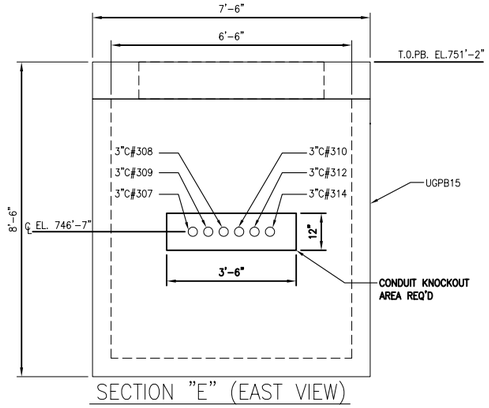


SECTION "C"
3/16"=1'-0"

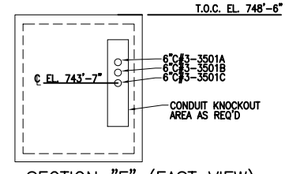


SECTION "D"
3/16"=1'-0"

DUCT ASSIGNMENT
LOOKING NORTH
FROM STATE STREET



SECTION "E" (EAST VIEW)
1/2"=1'-0"
REF. DWG. E004-07 SEC. 13H



SECTION "F" (EAST VIEW)
3/16"=1'-0"

RESERVED

NOTES:

1. SEE DWG. 20001-E-004-04 FOR GENERAL NOTES AND REF DWGS.
2. PULL BOXES AND VAULTS ARE FABRICATED BY JENSEN PRECAST PER CITY OF PASADENA SPEC.
3. BENCHMARK FOR COORDINATES ARE BASED ON THE N-W OUTSIDE CORNER OF THE EXISTING PIPE PIT LOCATED AT THE WEST END OF THE PIPE CULVERT: E.376'-10 11/16", S.404'-6 5/8", T.O.C. EL. 750'-3" (REF. 20001-C-002-01).
4. DUCT BANKS TO BE INSTALLED PER PWP SPECIFICATION FOR INSTALLATION BENEATH ROADWAYS.
5. TWO VENT LINES AND RISERS FROM UGPB5 SHALL BE INSTALLED AS SHOWN, PER PWP REQUIREMENTS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E004-13
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS-BUILT PER CONTRACTOR MARK UPS	JC	12/8/03	SA		
0	ISSUED FOR CONSTRUCTION	PF/ER	3/6/03	SA	PF	
A	ISSUED FOR APPROVAL	PF/ER	3/5/03	SA	PF	

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
ELECTRICAL
CONDUIT DUCTBANK DETAILS
GSU HV LINES

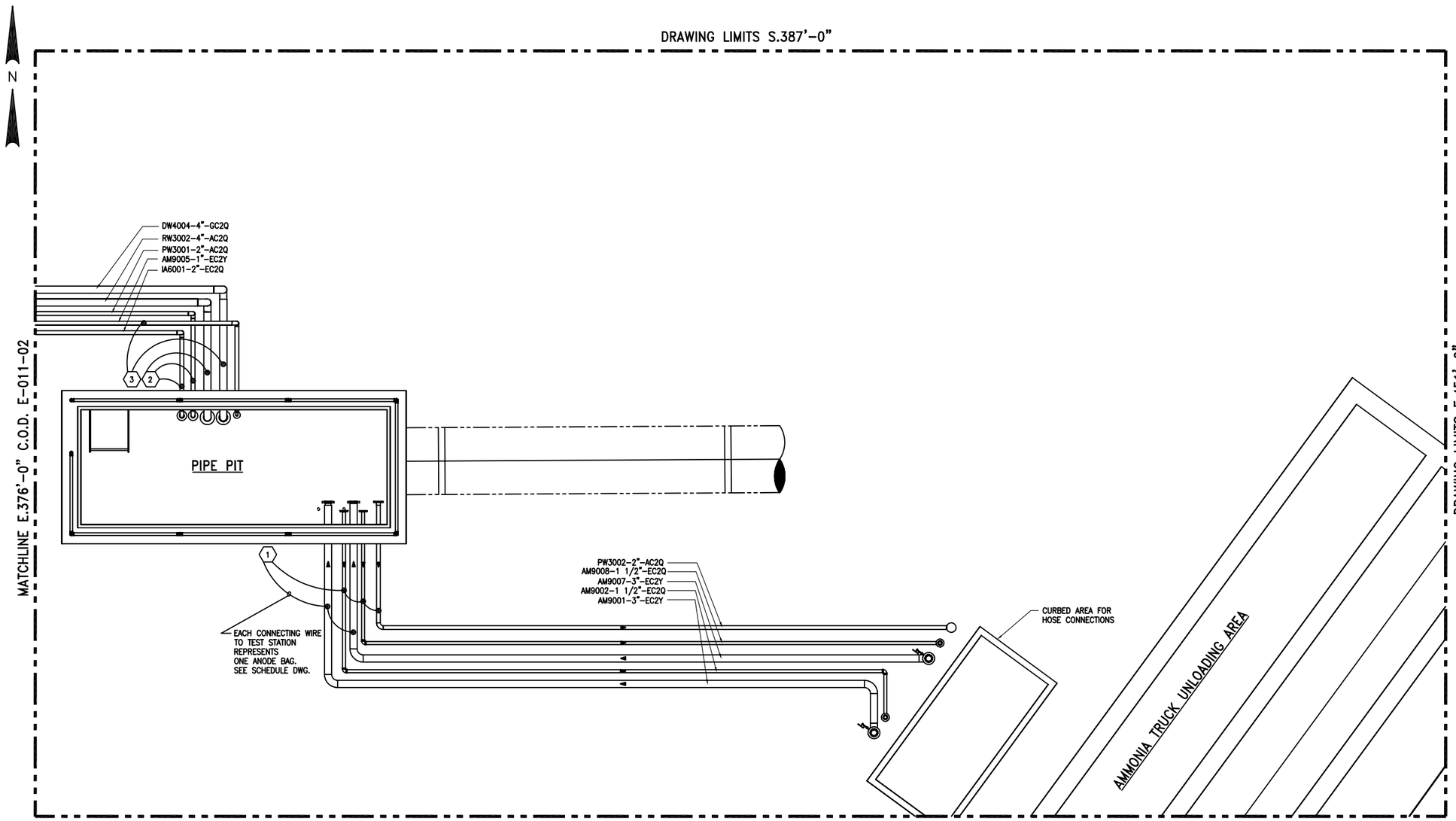
DWG NO.
20001-E-004-13

SCALE AS NOTED

SHEET

NOTES:

1. FOR NOTES AND LEGEND, SEE DWG. E-011-01.



FOR CONSTRUCTION
2/24/03

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001E011-04.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	JC	2/24/03	SA	WTM	

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

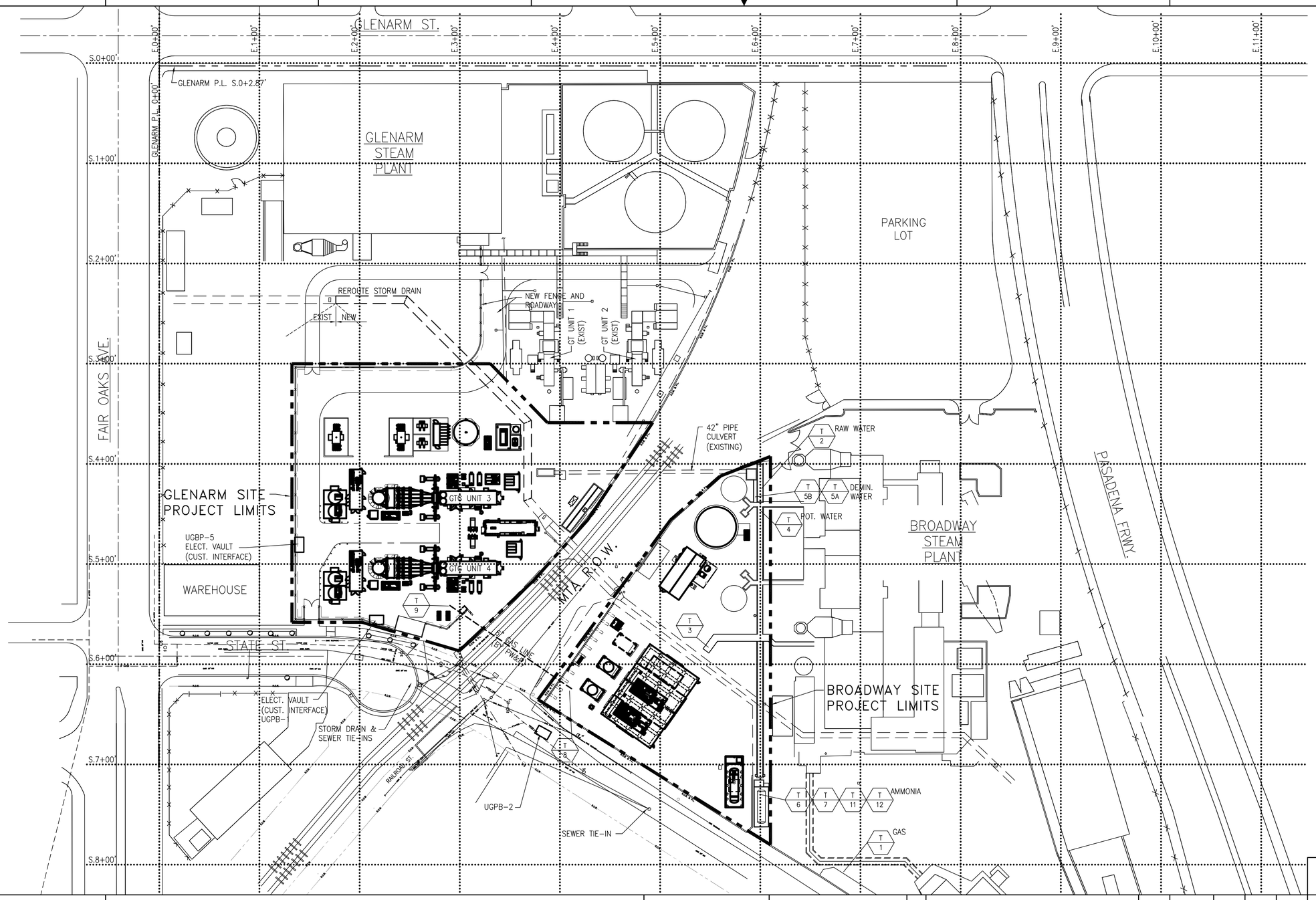
WORK ORDER NO. 20001

TITLE

ELECTRICAL CATHODIC PROTECTION PLAN PIPE PIT AREA

DWG NO. 20001-E-011-04

SCALE 3/8"=1'-0" SHEET



RESERVED

REFERENCE DWGS:

M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
C-002-01	CIVIL KEY PLAN – PAVING, GRADING, UG SEWER
C-004-01	FDN. LOCATION PLAN
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS
P-001-01	PIPING KEY PLAN – UNDERGROUND PIPING
P-001-02	PIPING KEY PLAN – PIPING ABOVE GRADE

NOTES

1. SEE DRAWING C-004-01 FOR PROJECT BENCHMARK.

T 8 INDICATES PIPING TIE-IN

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001M001.DWG
XREF DWG: _GAPLAN.DWG
_PASABKGD.DWG

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GAB	EAR	JT

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

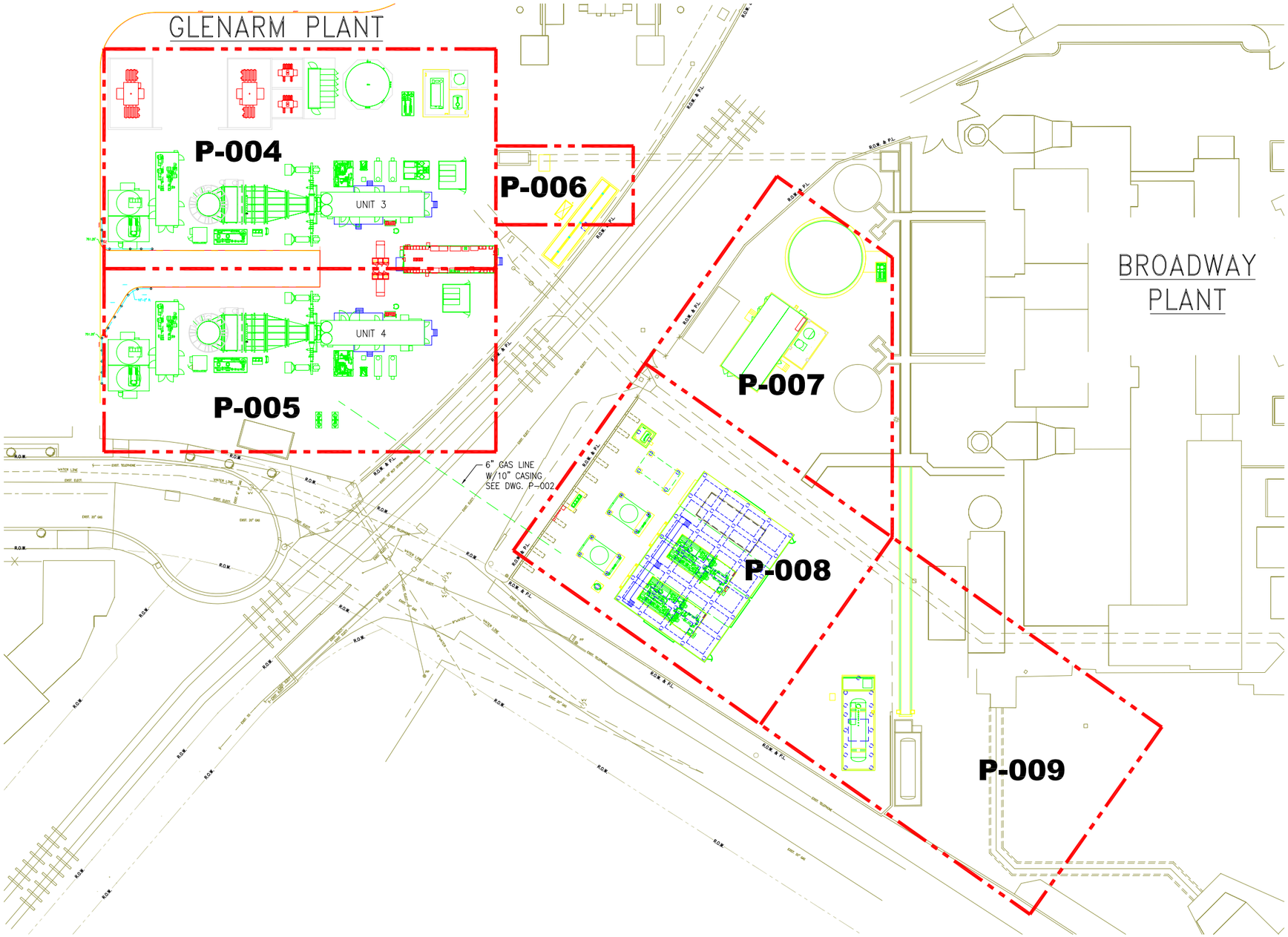
WORK ORDER NO. 20001

TITLE

OVERALL SITE PLAN GAS TURBINE GENERATOR UNITS 3 AND 4

DWG NO. 20001-M-001

SCALE 1"=50' SHEET



GENERAL NOTES – PIPING

1. SEE DRAWING C–004–01 FOR PROJECT BENCHMARK.
2. CONTRACTOR SHALL SUPPLY ALL MATERIALS UNLESS NOTED OTHERWISE.
3. ALL MATERIALS SHALL BE IN ACCORDANCE WITH THE PIPING DRAWINGS AND APPLICABLE SPECIFICATIONS. SUBSTITUTIONS ARE NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM PW&P.
4. PIPING BRANCH CONNECTIONS ARE TO BE MADE IN ACCORDANCE WITH THE BRANCH CONNECTION CHARTS INCLUDED WITH THE PIPING SPECIFICATIONS UNLESS NOTED OTHERWISE.
5. FABRICATE, INSPECT, AND TEST ALL METALLIC PIPING PER PROJECT SPECIFICATIONS AND ASME B31.1. ALL WELDS ON FUEL GAS LINES ARE TO BE 100% X–RAYED.
6. INSTALL ALL HDPE AND PVC PIPING IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.
7. PRESSURE TEST ALL PIPING AS DESIGNATED IN THE PIPING LINE LIST.
8. INSTALL EXPANSION JOINTS PER MANUFACTURER'S RECOMMENDATIONS. DO NOT PRESSURE TEST THROUGH EXPANSION JOINTS.
9. USE CAUTION DURING EXCAVATION. EXISTING UNDOCUMENTED ELECTRICAL AND PIPE LINES MAY EXIST.
10. ALL UNDERGROUND METALLIC LINES ARE TO BE COATED AND WRAPPED PER COATING SPECIFICATION PU1. COAT & WRAPPING TO EXTEND TO (BUT NOT INCLUDING) FIRST FLANGE ABOVE GRADE.
11. ALL UNDERGROUND METALLIC LINES ARE TO HAVE CATHODIC PROTECTION. INSTALL FLANGE INSULATION KITS AT FIRST FLANGE ABOVE GRADE. SEE ELECTRICAL DRAWINGS FOR CATHODIC PROTECTION DETAILS.
12. ALL UNDERGROUND GRAVITY DRAIN LINES (DESIGNATIONS OW & WW) ARE TO BE INSTALLED WITH A MINIMUM SLOPE OF 0.5% UNLESS NOTED OTHERWISE.
13. COMPLETE TESTING AND INSPECTION ON UNDERGROUND LINES BEFORE BACKFILL IS PLACED.
14. BACKFILL PIPE TRENCHES PER BEDDING DETAIL ON DWG. C–003–01.
15. DRAIN LINES FROM SKIDS TO DRAIN HUBS ARE TO BE FIELD ROUTED AS SHOWN ON THE F&IDS.

SCALE
0 30' 60' 90' 120' 150'

RESERVED

REFERENCE DWGS:

P–001–02	PIPING KEY PLAN – PIPING ABOVE GROUND AND IN TRENCHES
P–002	PIPING PLAN – GAS LINE UNDER MTA R.O.W.
P–003–01	PIPING PLAN – GTG EQUIPMENT DRAINS UNDERGROUND
C–002–01	KEY PLAN – PAVING, GRADING, & UG SEWER
C–004–01	FDN. LOCATION PLAN
M–001	OVERALL SITE PLAN
M–002	GENERAL ARRANGEMENT PLAN
M–003 THRU M–007	EQUIPMENT LOCATION PLANS
E–002	ELECTRICAL GROUNDING PLANS
E–004	ELECTRICAL DUCT BANK PLANS

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P001_01.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GAB	EAR	JT

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
KEY PLAN
UNDERGROUND PIPING PLANS

DWG NO.
20001–P–001–01

SCALE 1"=30' SHEET

DRAWING LIMITS S.349'-0"

N

3-377

4-377

3-379

4-379

400

157B

158B

3-410

240

3-63

3-177

3-173

3-172

3-175

3-1

SEE DWG. P-004-02 FOR DETAILS IN THIS AREA

DRAWING LIMITS E.162'-0"

MATCHLINE E.376'-0" C.O.D. P-006-01

MATCHLINE S.469'-0" C.O.D. P-005-01

℄ S.368'-6"

℄ E.306'-0"

E. 321'-0"

℄ SKID E.328'-0"

EDGE OF SKID S.372'-6"

EDGE OF GTG E.337'-0"

℄ GTG & SCR S. 434'-0"

℄ COOLING TOWER E. 175'-6"

℄ COOLING TOWER S.440'-3"

℄ STACK E. 219'-1 3/8"

E. 206'-0"

S. 416'-1 3/8"

S. 419'-6"

S. 421'-1 1/2"

S. 424'-6 1/2"

45° ELL (TYP)

E. 257'-4"

E. 259'-0"

B.O.P. EL. 748'-0"

B.O.P. EL. 746'-6"

B.O.P. EL. 749'-0"

B.O.P. EL. 748'-9"

4"x3" ECC RED (FSD)

SEE DETAIL #3 DWG. P-004-03

SEE DETAIL "1" DWG. P-004-03

SEE DETAIL "2" DWG. P-004-03

4"150# LJ FLG F/F EL. 752'-3" S. 370'-6" E. 326'-0"

4"150# LJ FLG F/F EL. 752'-3" S. 379'-4" E. 321'-9"

4"150# LJ FLG F/F EL. 752'-3" S. 380'-7" E. 320'-3"

B.O.P. EL. 749'-0"

3-IA6010-1"-EC2Q E. 298'-1"
3-DW4009-1"-GC2Q E. 296'-6"
3-NG1009-3"-FH2Q E. 298'-9"
3-IA6011-2"-EC2Q E. 301'-8"
3-DW4018-3"-GC2Q E. 307'-1"
3-DW4008-3"-GC2Q E. 307'-8"
IA6001-2"-EC2Q E. 334'-10"

DW4018-4"-GC2Q
DW4008-4"-GC2Q
DW4004-4"-GC2Q

DW4004-4"-GC2Q S. 399'-7"
RW3002-4"-AC2Q S. 400'-3"
PW3001-2"-AC2Q S. 400'-10"
AM9005-2"-EC2Y S. 401'-4"
IA6001-2"-EC2Q S. 401'-10"

3-CW5005-4"-AC2Q
3-CW5004-4"-AC2Q

12"-150# RFSO FLG. F/F EL. 752'-3"

3-CHW5002-12"-AC2Q
3-CHW5001-12"-AC2Q
B.O.P. EL. 748'-0"

3-IA6007-1"-EC2Q
1"-150# RFSW FLG. F/F EL. 752'-3"
S.434'-0"
E.268'-10"
SEE DETAIL #4 DWG. P-004-03

A P-004-03

1 1/2" 150# RFSW FLG F/F EL. 752'-3" S. 454'-7" E. 241'-0"

3"-150# RFSO FLG F/F EL. 752'-0" S. 448'-6" E. 257'-4"

1"-150# RFSW FLG F/F EL. 752'-3" S. 454'-7" E. 221'-4 3/8"

3-PW3003-1 1/2"-AC2Q B.O.P. EL. 749'-0"

3-RW3011-3"-AC2Q B.O.P. EL. 749'-0"

2"-150# LJ FLG F/F EL. 752'-3" S. 455'-1" E. 220'-7 3/8"

4-DW4018-3"-GC2Q
4-DW4008-3"-GC2Q
RW3002-4"-AC2Q
PW3001-2"-AC2Q
AM9005-1"-EC2Y
IA6001-2"-EC2Q
3-NG1009-3"-FH2Q
3-CW5004-4"-AC2Q
3-CW5005-4"-AC2Q

3-AM9005-1"-EC2Y
3-IA6002-2"-EC2Q
3-PW3004-1 1/2"-AC2Q
3-RW3011-3"-AC2Q
3-RW3003-3"-AC2Q
3-CW5005-4"-AC2Q
3-CW5004-4"-AC2Q

E. 265'-11"
E. 266'-7"
E. 267'-3"
E. 267'-10"
E. 268'-6"
E. 269'-1"
E. 270'-1"
E. 270'-9"

FOR CONSTRUCTION

2/17/03

SCALE 5' 10' 20' 30' 40'

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P004-01.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	CORRECTED 377 EQUIPMENT NUMBERS	EAR	2/17/03	EAR	EAR	J.T.
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GAB	EAR	J.T.

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

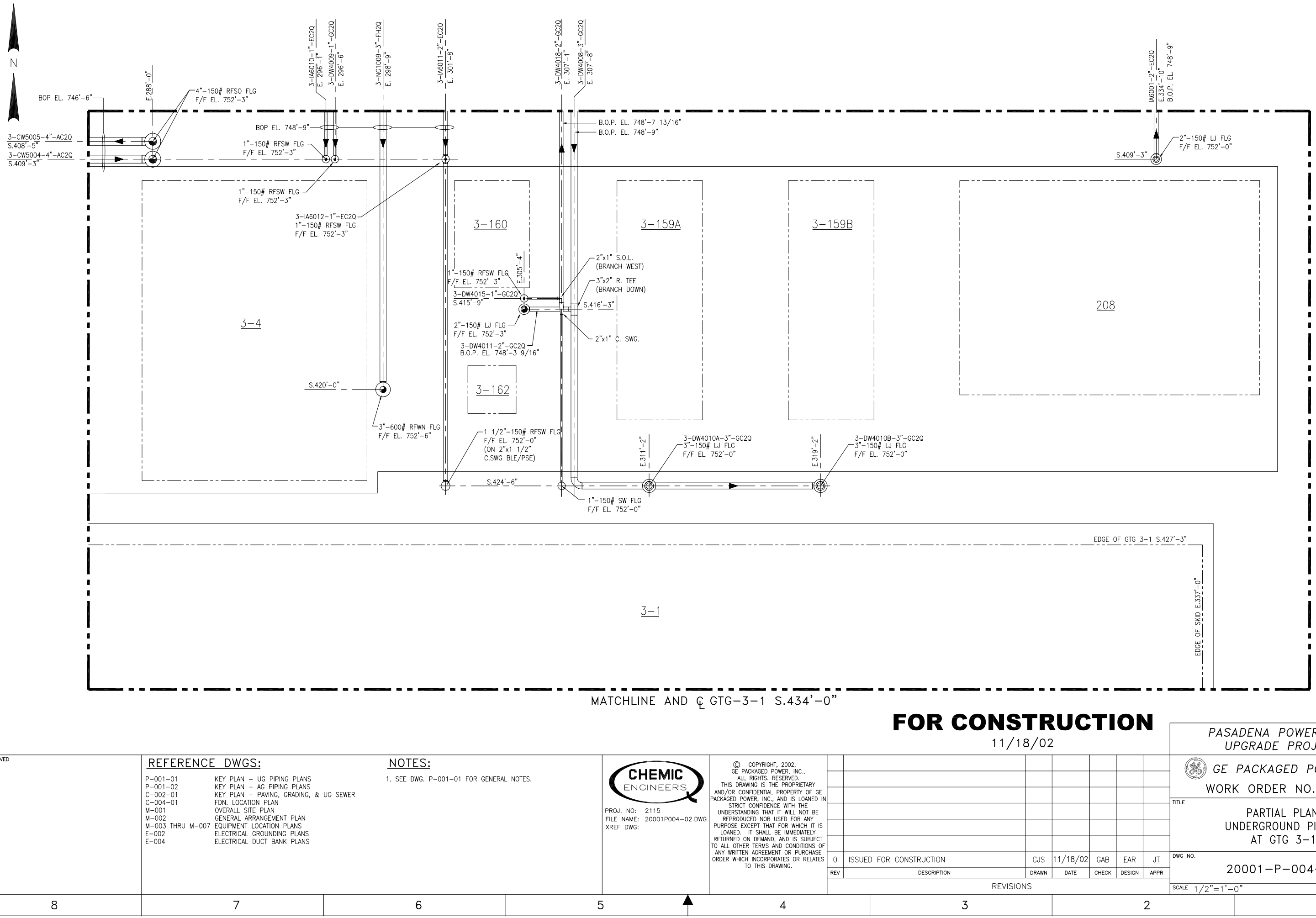
WORK ORDER NO. 20001

TITLE

UNDERGROUND PIPING PLAN GTG UNIT 3 AREA

DWG NO. 20001-P-004-01

SCALE 1/8"=1'-0" SHEET



FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P004-02.DWG
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	CJS	11/18/02	GAB	EAR	JT

PASADENA POWERPLANT
UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

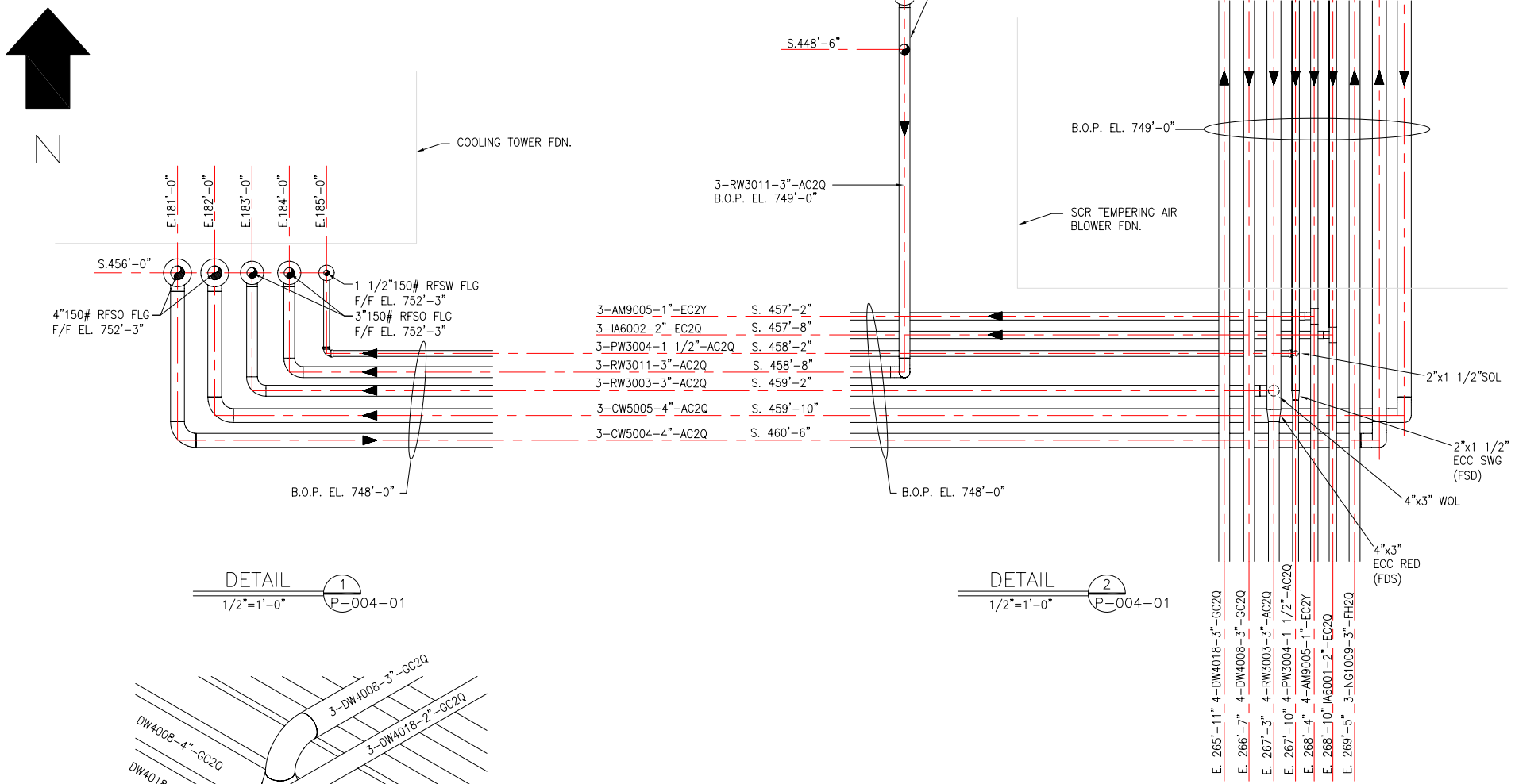
PARTIAL PLAN
UNDERGROUND PIPING
AT GTG 3-1

DWG NO.

20001-P-004-02

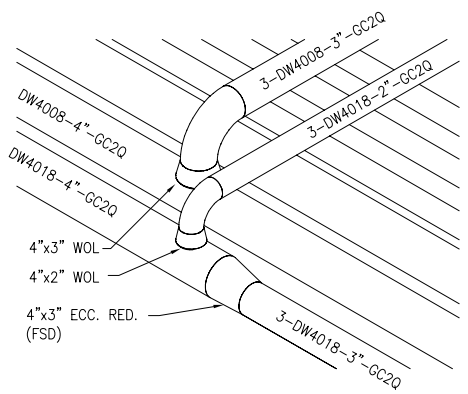
SCALE 1/2"=1'-0"

SHEET

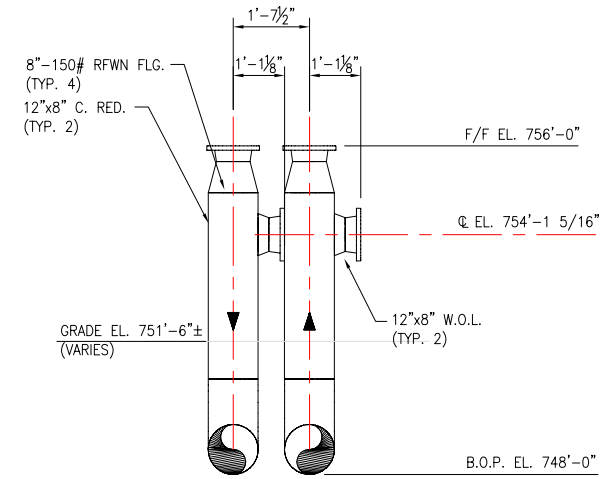


DETAIL 1 1/2"=1'-0" P-004-01

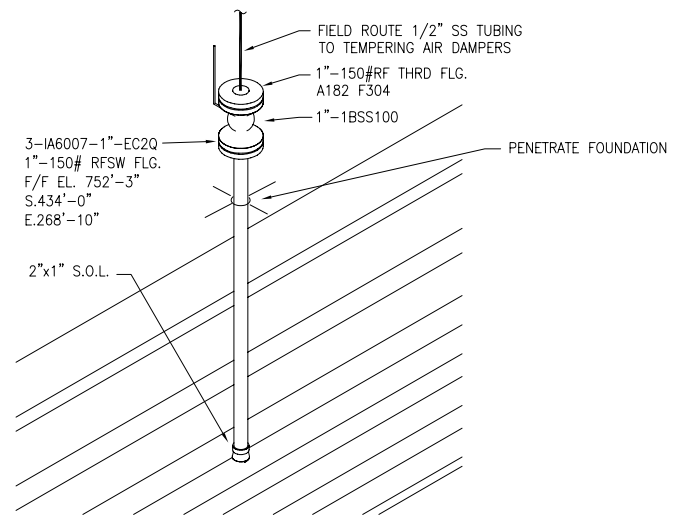
DETAIL 2 1/2"=1'-0" P-004-01



DETAIL 3 NTS P-004-01
VIEW LOOKING SOUTHEAST



SECTION A P-004-01 P-005-01
1/2"=1'-0"



DETAIL 4 NTS P-004-01
VIEW LOOKING SOUTHEAST

FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
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M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P004-03.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GAB	EAR	JT

PASADENA POWERPLANT UPGRADE PROJECT

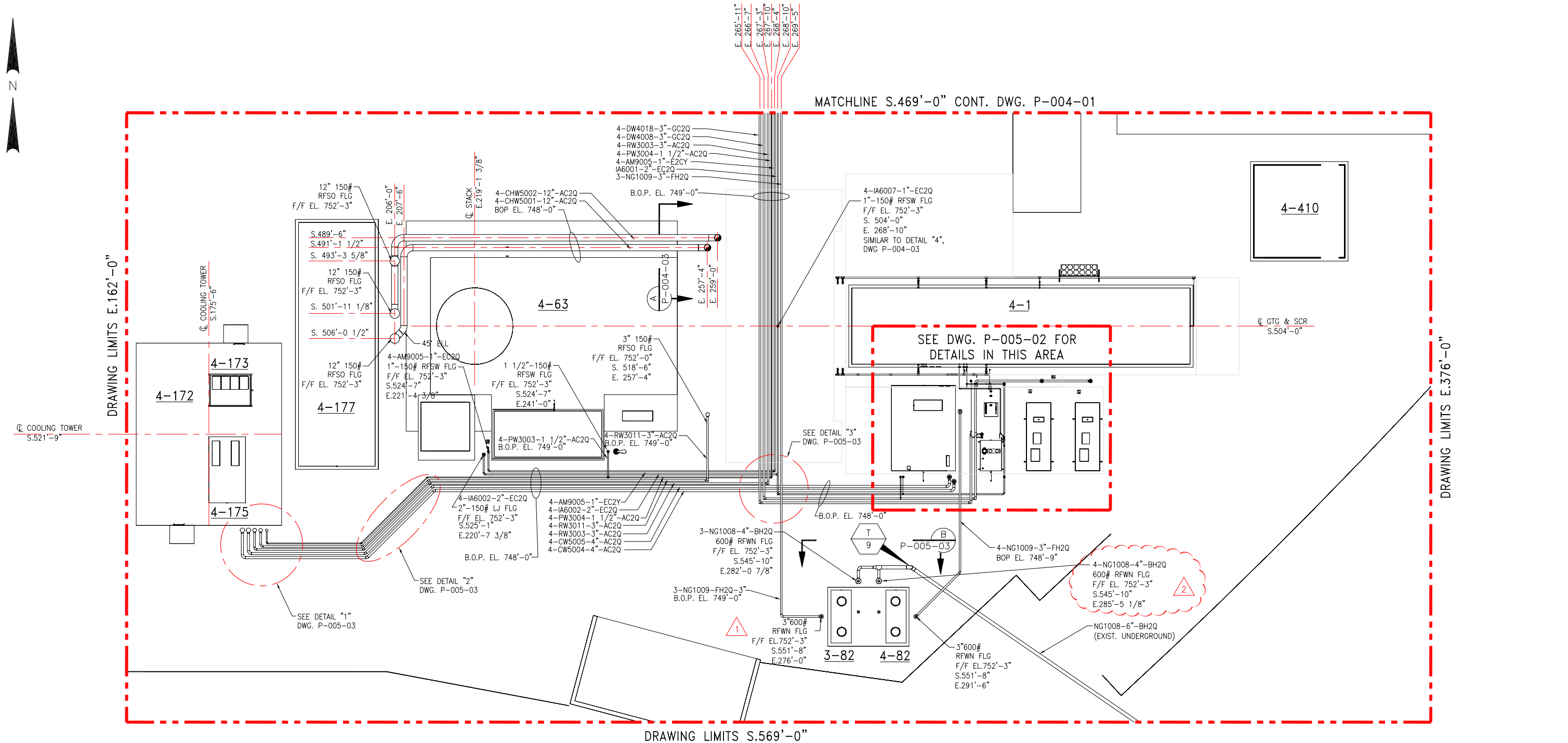
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING DETAILS
GTG UNIT 3 AREA

DWG NO.
20001-P-004-03

SCALE (AS NOTED) SHEET



FOR CONSTRUCTION
2/17/03

SCALE
0 5' 10' 20' 30' 40'

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-003-01 FOR UNDERGROUND DRAIN PIPING.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P005-01.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
2	REVISED ELEV OF GAS STUB UP	EAR	2/17/03	GAB	EAR	J.T.
1	REVISED AS NOTED	RCJ	12/16/02	EAR	EAR	J.T.
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GB	EAR	J.T.

PASADENA POWERPLANT UPGRADE PROJECT

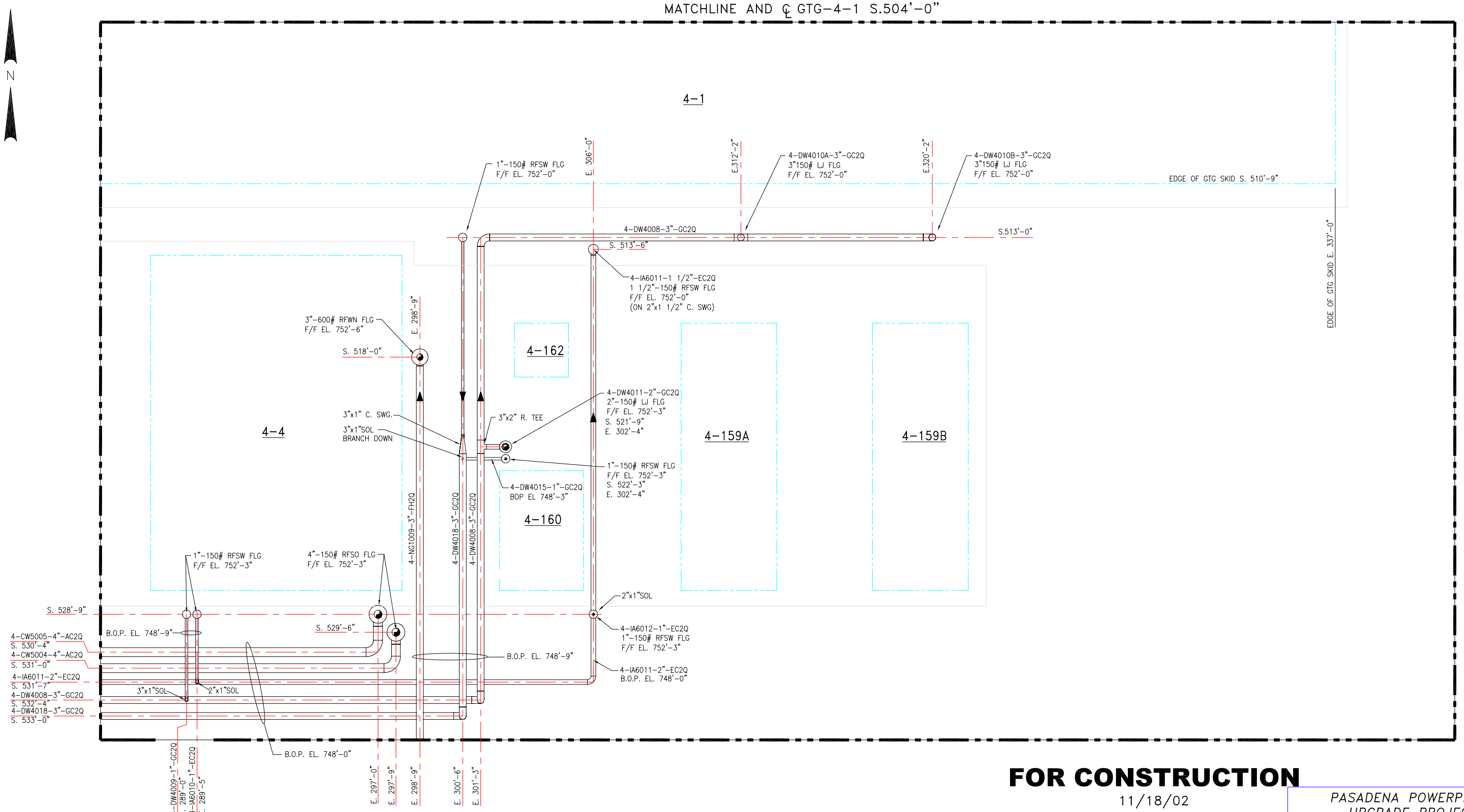
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
UNDERGROUND PIPING PLAN
GTG UNIT 4 AREA

DWG NO.
20001-P-005-01

SCALE 1/8"=1'-0" SHEET



FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
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E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-003-01 FOR UNDERGROUND DRAIN PIPING.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P005-02.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	CJS	11/18/02	GAB	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

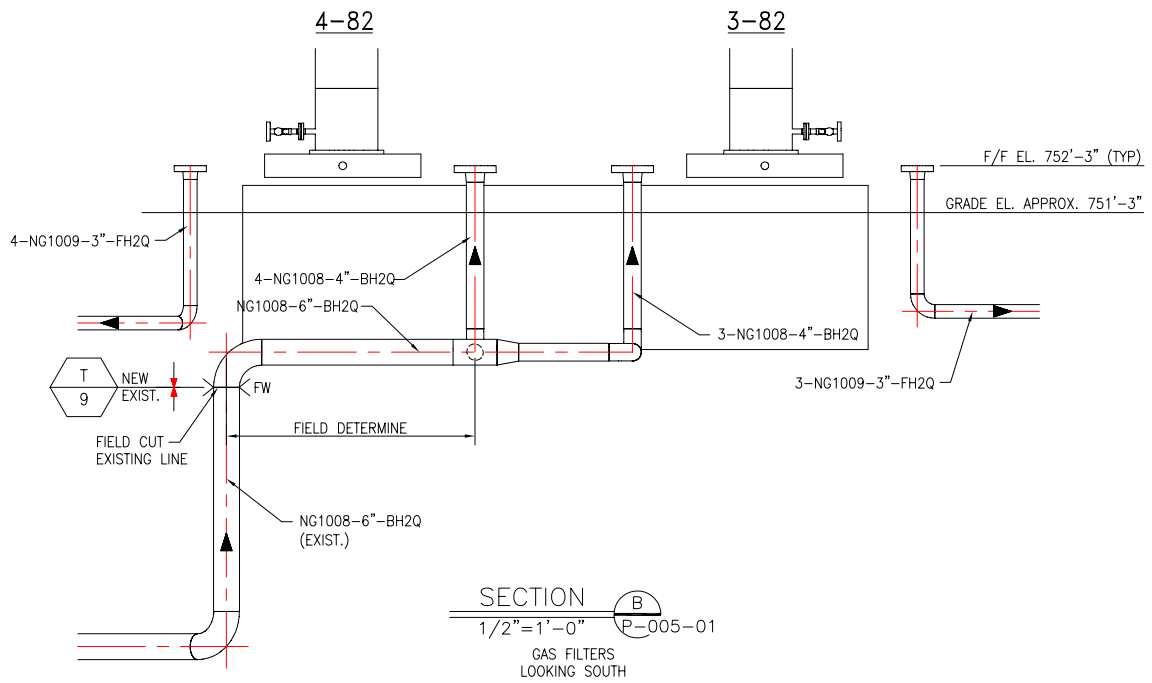
PARTIAL PLAN
UNDERGROUND PIPING
AT GTG 4-1

DWG NO.

20001-P-005-02

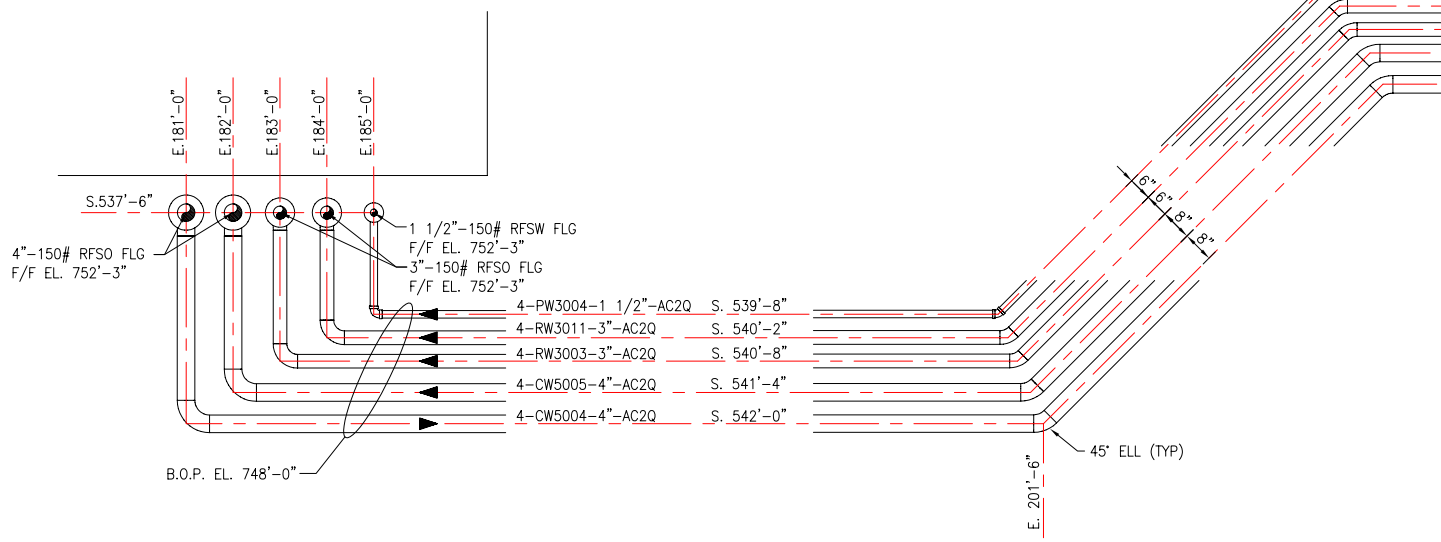
SCALE 1/2"=1'-0"

SHEET



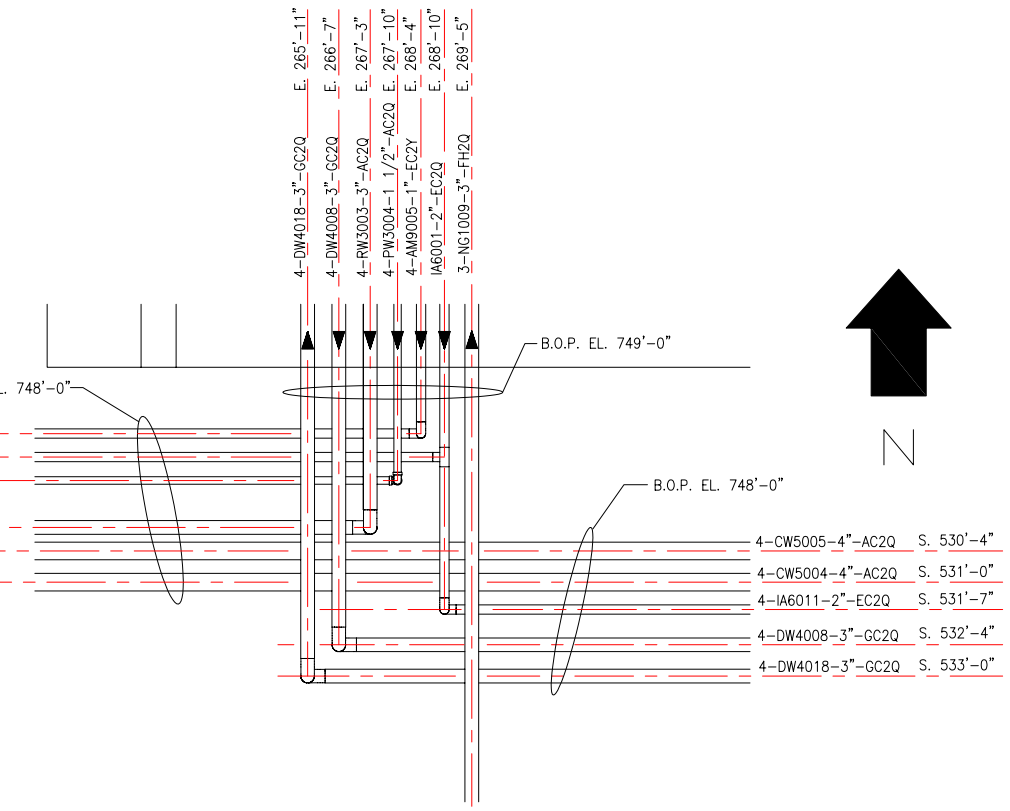
SECTION B
1/2"=1'-0" P-005-01

GAS FILTERS
LOOKING SOUTH



DETAIL 1
1/2"=1'-0" P005-01

DETAIL 2
1/2"=1'-0" P005-01



DETAIL 3
1/2"=1'-0" P005-01

FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P005-03.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	CJS	11/18/02	GAB	EAR	JT

REVISIONS

PASADENA POWERPLANT
UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

PIPING DETAILS
GTG UNIT 4 AREA

DWG NO.

20001-P-005-03

SCALE (AS NOTED) SHEET

DRAWING LIMITS S.399'-0"

DW4004-4"-GC2Q S. 399'-7"
RW3002-4"-AC2Q S. 400'-3"
PW3001-2"-AC2Q S. 400'-10"
AM9005-1"-EC2Y S. 401'-4"
IA6001-2"-EC2Q S. 401'-10"

B.O.P. EL. 748'-0"

B.O.P. EL. 747'-0"

INSTALL 1/2" TAP FOR AMMONIA LEAK DETECTION SYSTEM ON AM9005-1"-EC2Y PER DETAIL "1", THIS DWG.

PENETRATE EXISTING PIT WALL AND REPAIR W/EPOXY GROUT (TYP).

INSIDE EDGE OF PIT E 393'-10 11/16"

EXISTING CONCRETE PIT SEE DWG. 20001-P-006-03 & 04 FOR PIT PIPING.

EXISTING PIPE CULVERT (SEE NOTE #2) SEE DETAILS #2 & #3

BACK OF PIPES

6¼"

7" 9" 10" 8 1/2"

7'-10 3/16"

F/F EL. 746'-5 1/4" (TYP.)

10" 16" 16" 9 9/16" 5 7/16"

S 411'-6 5/8"

10⅛"

5/16"

SEWER OUTFALL BOX

INSTALL 1/2" TAP FOR AMMONIA LEAK DETECTION SYSTEM ON AM9001-3"-EC2Y & AM9007-3"-EC2Y PER DETAIL "1", THIS DWG.

B.O.P. EL. 747'-0"

MATCHLINE E.376'-0" C.O.D. P-004-01

1/2" TAP FOR PURGE AIR SEE EC2Y SPEC FOR DETAILS

CORE PIPE

1½"

4 1/2"

JACKET PIPE

CONCRETE WALL

DETAIL #1
LEAK DETECTION TAP (NTS)

1/2" TAP FOR PURGE AIR SEE EC2Y SPEC FOR DETAILS

192'-7½"±

CORE PIPE

JACKET PIPE

MIN. BY FIELD

EC2Q EC2Y

EC2Y EC2Q

PIPE CULVERT

EXISTING PIPE SUPPORTS ARE LOCATED ON 15'-0"± CENTERS THROUGHOUT THE CULVERT.

DETAIL #3
LEAK DETECTION TAP FOR ALL LINES REQUIRING DBL. CONTAINMENT IN PIPE CULVERT (NTS)

PW3002-2"-AC2Q
AM9008-1 1/2"-EC2Q
AM9007-3"-EC2Y
AM9002-1 1/2"-EC2Q
AM9001-3"-EC2Y

INSTALL 1/2" TAPS FOR AMMONIA LEAK DETECTION STYSTEM SIMILAR TO DETAIL "1" THIS DWG.

AE 976

AE 975

F/F EL. 751'-6" BOLT HOLES STRADDLE ANGLE SHOWN (TYP.)

CURBED AREA FOR HOSE CONNECTIONS

AMMONIA TRUCK UNLOADING AREA

9 1/16" 9 1/16" 8" 8"

1'-10" 1'-1" 3'-9⅞" 1'-1" 2'-10" 1'-0" (TYP.) 53.75°

S. 417'-2 7/8"
E. 423'-4 9/16"

S. 418'-0 9/16"
E. 422'-9 7/16"

S. 418'-10 1/4"
E. 422'-2 5/16"

S. 421'-11 3/16"
E. 419'-11 1/8"

S. 422'-8 13/16"
E. 419'-4 1/16"

INSTALL U-BOLTS AT ALL SUPPORTS PER STD RGN-3. DOUBLE NUT AND TIGHTEN U-BOLTS IN ORDER TO USE THEM AS GUIDES FOR INSTALLATION OF NEW PIPING.

DW4004
RW3002
PW3001
IA6001

30° 43° 24° 19° 19° 14° 14° 29° 19° 17° 13°

R20½"

AM9001 (DBL. CONTAINMENT)
AM9005 (DBL. CONTAINMENT)
AM9002
AM9018 (DBL. CONTAINMENT)
AM9007 (DBL. CONTAINMENT)
AM9008
AM9012 (DBL. CONTAINMENT)

DETAIL #2
LOOKIING EAST
SCALE 1"=1'-0"

42" PIPE CULVERT (EXISTING)

DRAWING LIMITS E.451'-0"

DRAWING LIMITS S.442'-0"

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. FIELD TO DETERMINE FINAL DIMENSIONS FOR ALL PIPING IN EXISTING PIPE CULVERT AND TIE-IN TO PIT PIPING.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P006-01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RJ	11/18/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

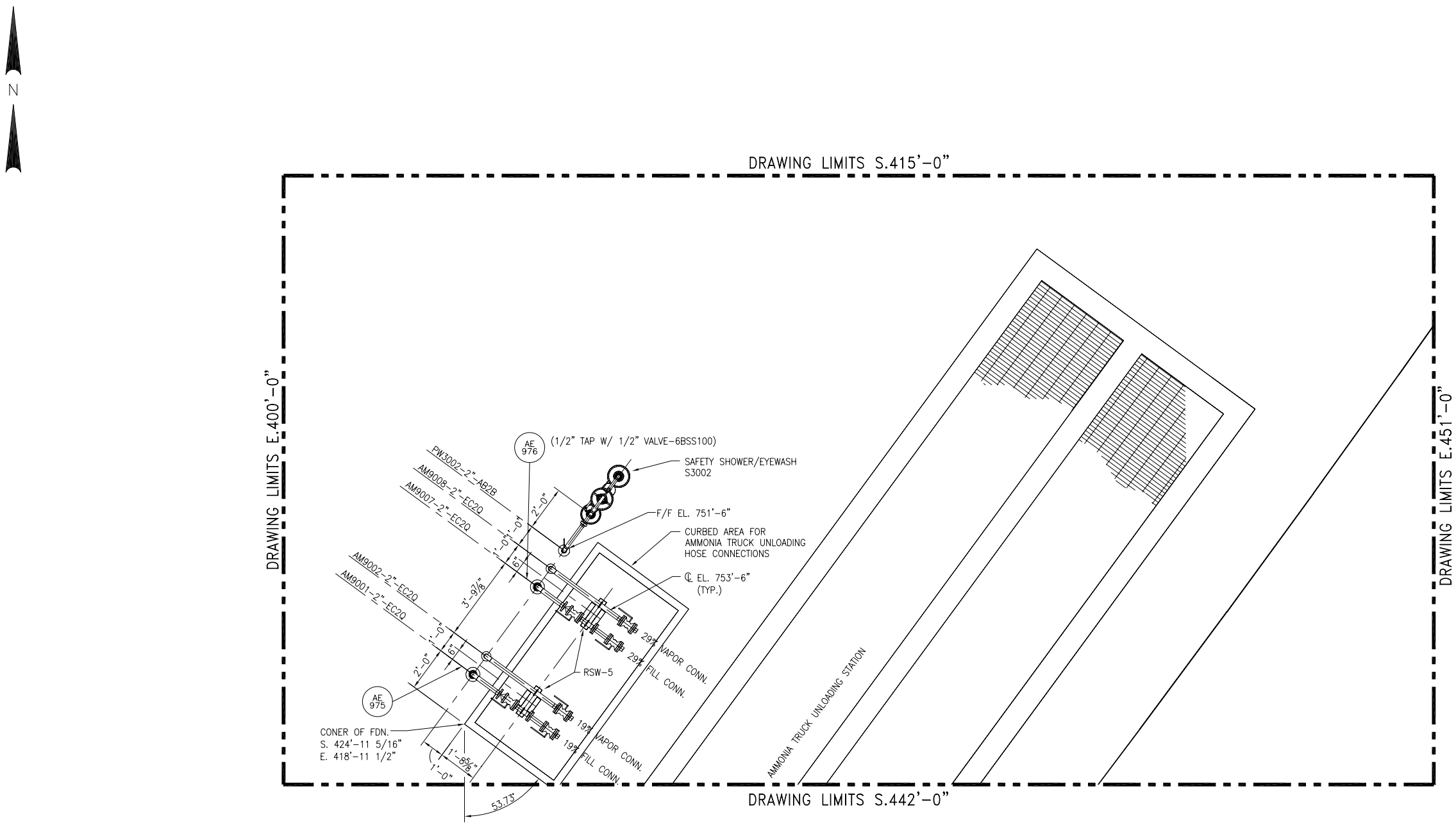
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING PLAN & DETAILS
AMMONIA TRUCK UNLOADING AREA
UNDERGROUND

DWG NO.
20001-P-006-01

SCALE 3/8"=1'-0" SHEET



RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

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REVISIONS

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1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	CJS	11/18/02	GAB	EAR	JT

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

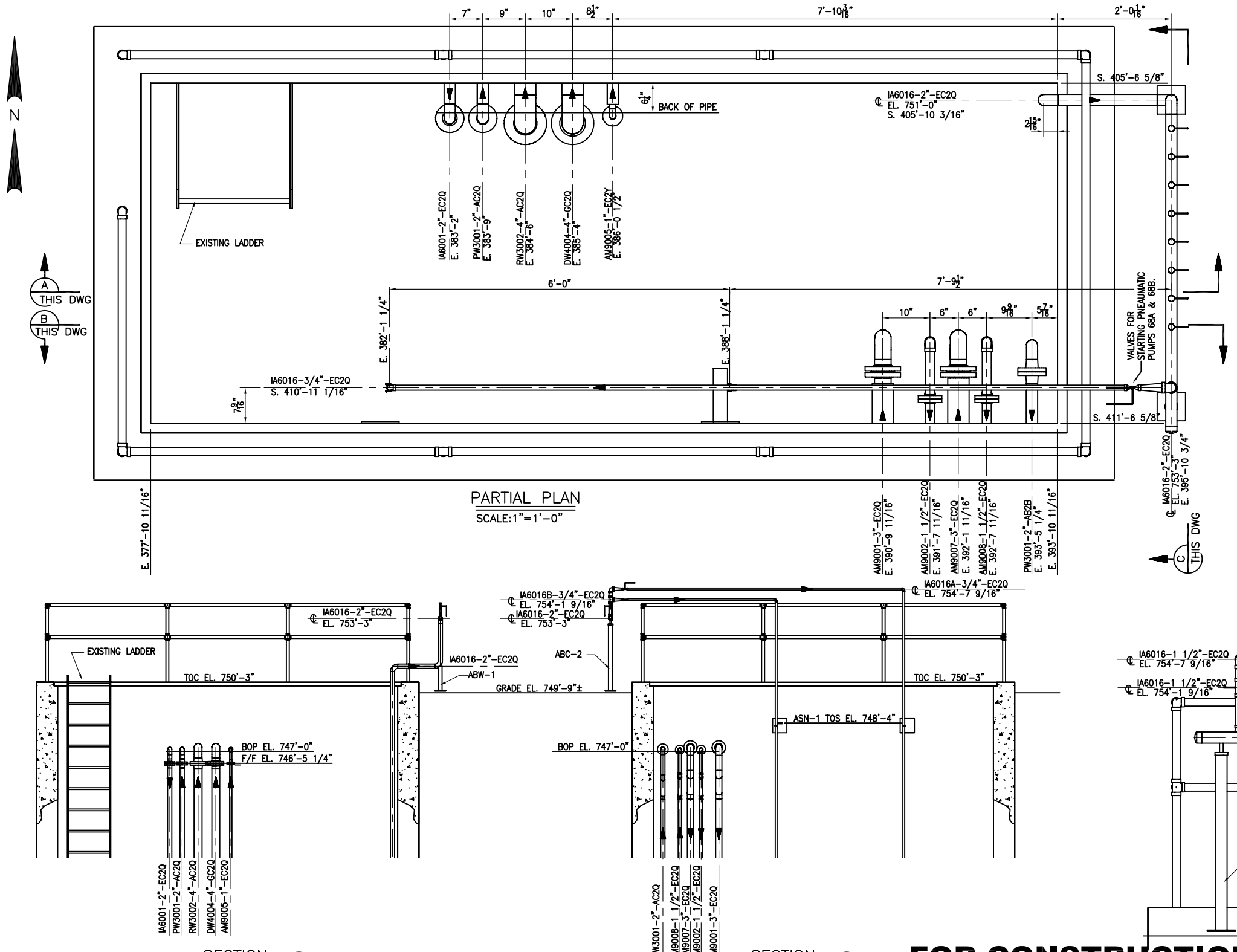
WORK ORDER NO. 20001

TITLE

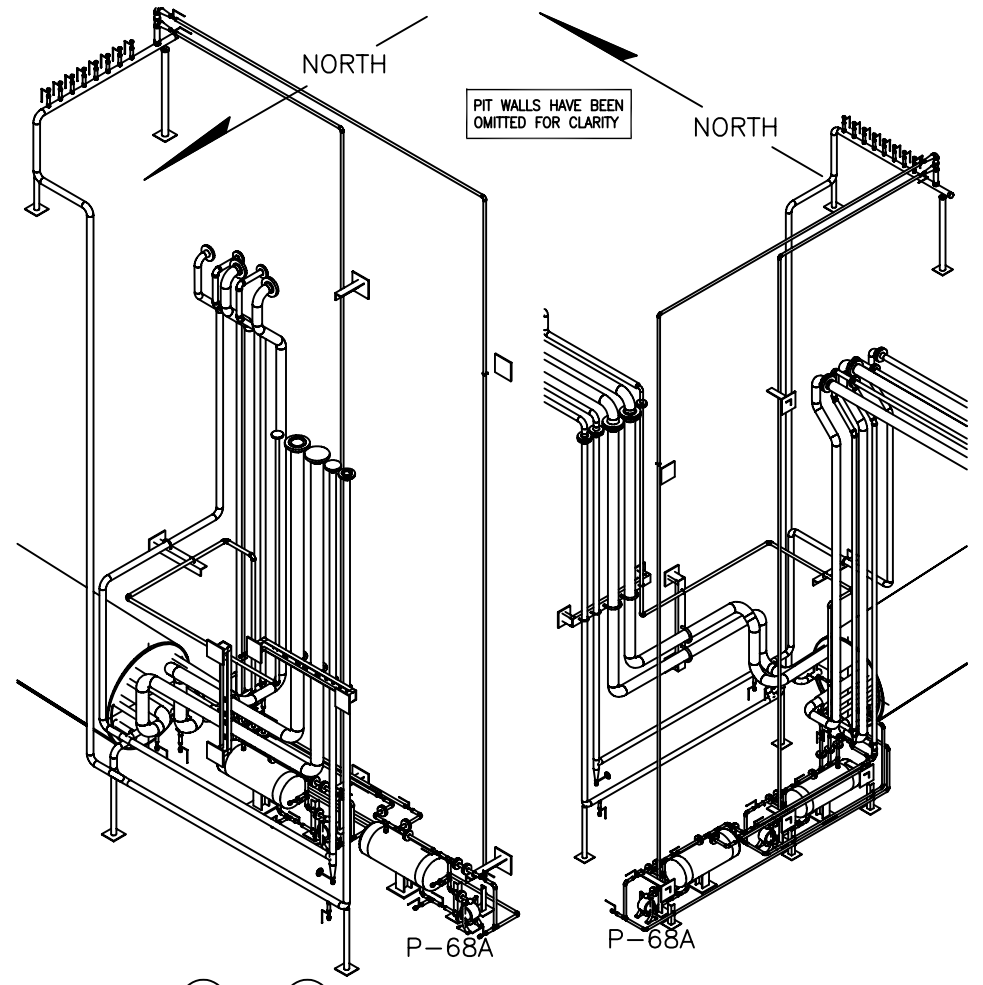
PIPING PLAN AMMONIA TRUCK UNLOADING AREA ABOVE GRADE

DWG NO. 20001-P-006-02

SCALE 3/8"=1'-0" SHEET

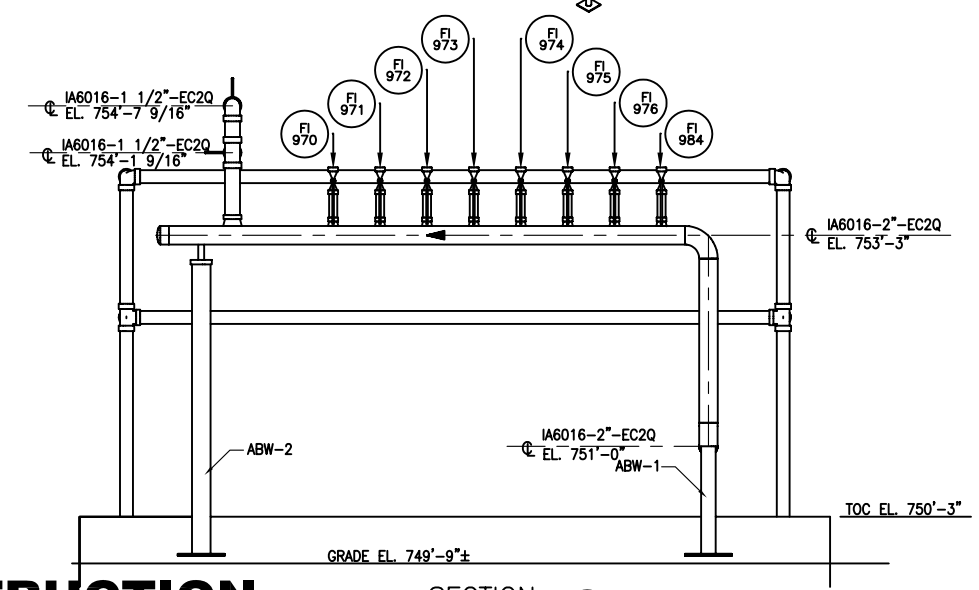


PARTIAL PLAN
SCALE:1"=1'-0"



SECTION A
3/8"=1'-0"

SECTION B
3/8"=1'-0"



SECTION C
1"=1'-0"
(INSTRUMENT AIR MANIFORLD)

FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-006-01 FOR LOCATION OF WEST END CULVERT.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

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FILE NAME: 20001P006-03.DWG
XREF DWG:

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0	ISSUED FOR CONSTRUCTION	RCJ	11/18/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT
UPGRADE PROJECT

GE PACKAGED POWER, INC.

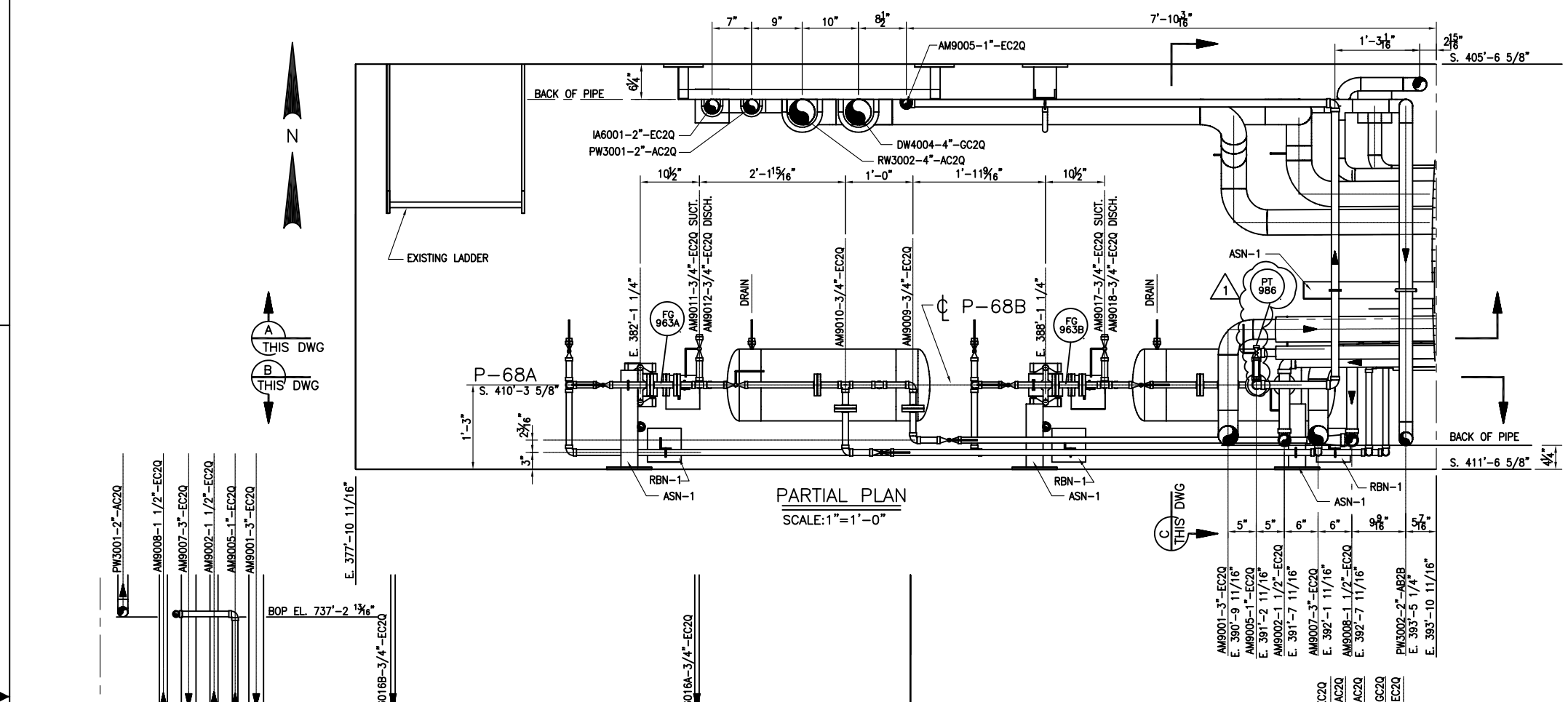
WORK ORDER NO. 20001

TITLE
PIPING PLAN & DETAILS
PIPE CULVERT WEST END
EL. 742'-0" AND ABOVE

DWG NO.
20001-P-006-03

SCALE AS NOTED

SHEET



FOR CONSTRUCTION
05/19/03

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN - UG PIPING PLANS
P-001-02	KEY PLAN - AG PIPING PLANS
C-002-01	KEY PLAN - PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-006-01 FOR LOCATION OF WEST END CULVERT.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P006-04.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	ADDED PT 986	CJS	5/19/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RCJ	10/13/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

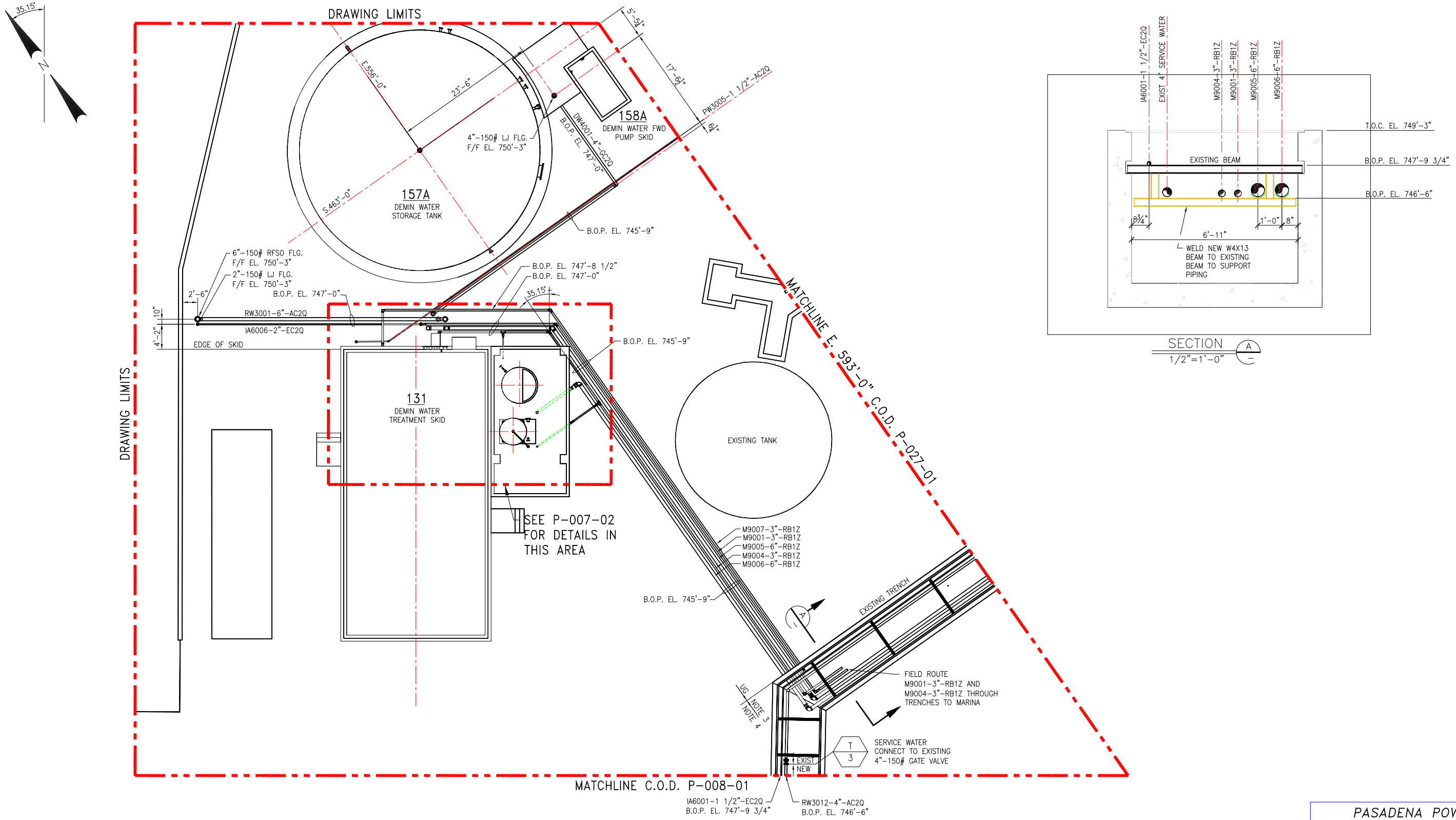
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE: PIPING PLAN & DETAILS PIPE CULVERT WEST END EL. 728'-3" TO EL. 742'-0"

DWG NO. 20001-P-006-04

SCALE AS NOTED | SHEET



SECTION A
1/2"=1'-0"

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMENSIONS.
3. CONTRACTOR TO FIELD ROUTE TRENCH PORTION OF M9001-3" AND M9004-3" TO MARINA.
4. REINFORCE FIBERGLASS PIPE AT ALL SUPPORT POINTS AND WALL PENETRATIONS WITH CRADLES PER MANUFACTURERS INSTRUCTIONS AND INSTALL VALVED DRAINS AT ALL LOW POINTS IN TRENCH.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P007-01.dwg
XREF DWG:

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REVISIONS

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2	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
1	REVISED AS NOTED	CJS	2/17/03	GAB	EAR	JT
0	ISSUED FOR CONSTRUCTION	EAR	12/16/02	GAB	EAR	JT

PASADENA POWERPLANT UPGRADE PROJECT

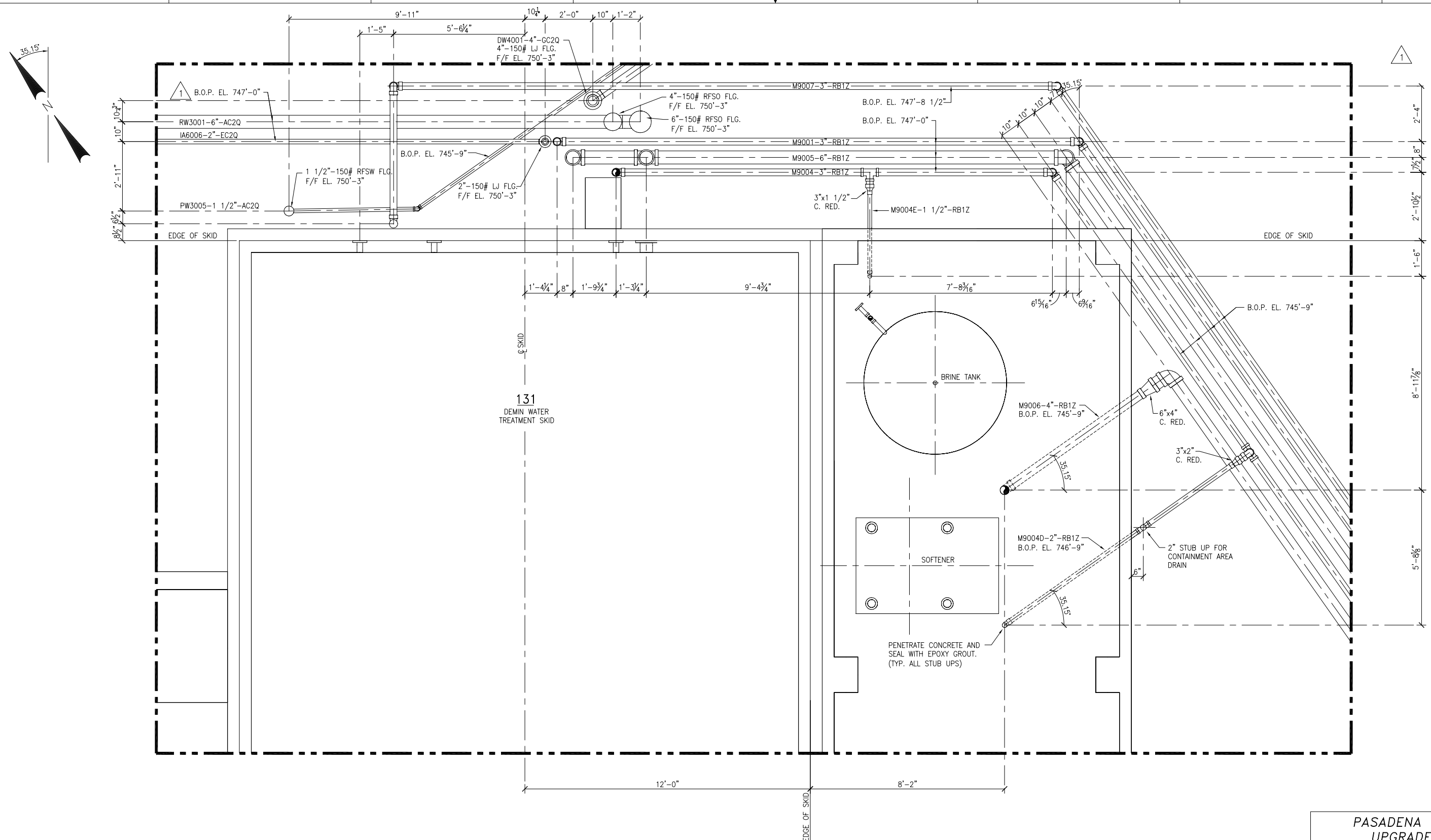
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING PLAN
DEMIN WATER TREATMENT AREA
UNDERGROUND

DWG NO.
20001-P-007-01

SCALE 1/8"=1'-0" SHEET



RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P007-02.dwg
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2	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
1	REVISED AS NOTED	CJS	2/17/03	EAR	CJS	JT
0	ISSUED FOR CONSTRUCTION	EAR	12/16/02	GAB	CJS	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

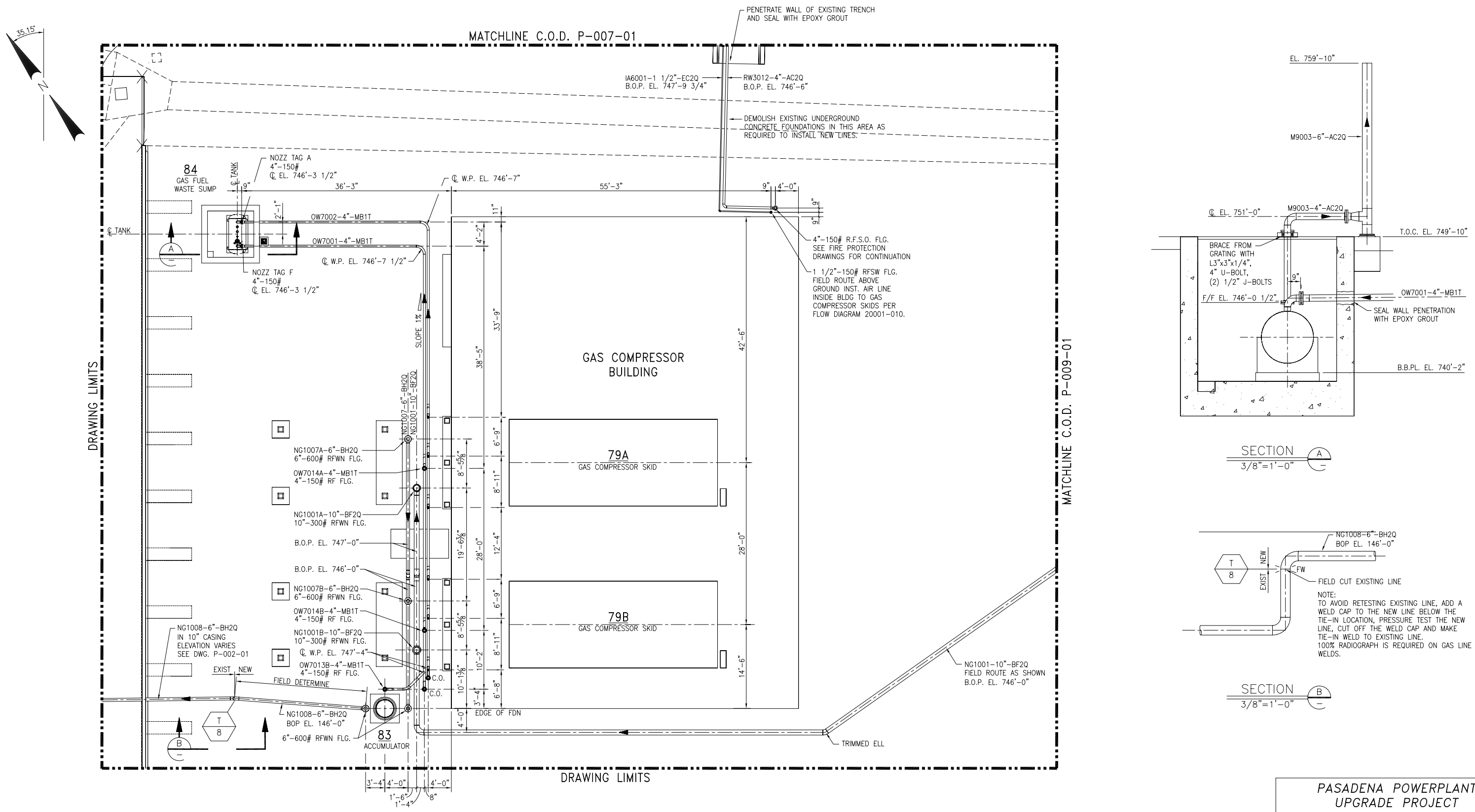
TITLE

PARTIAL PLAN DEMIN WATER TREATMENT AREA UNDERGROUND

DWG NO. 20001-P-007-02

SCALE 1/2"=1'-0"

SHEET



RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. DRAIN LINES TO BE SLOPED 1% MINIMUM.
3. ALL HDPE FITTINGS TO BE "FABRICATED" TYPE PER SPEC MB1T.
4. ALL DRAIN HUBS TO BE 4" OPEN ENDED HDPE PIPE. TOP OF HUB ELEVATION 749'-9".
5. ALL FLANGED STUB-UPS AND CLEAN-OUTS ARE TO BE INSTALLED AT F/F EL. 750'-0".

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P008-01.dwg
XREF DWG:

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1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	EAR	12/16/02	GAB	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

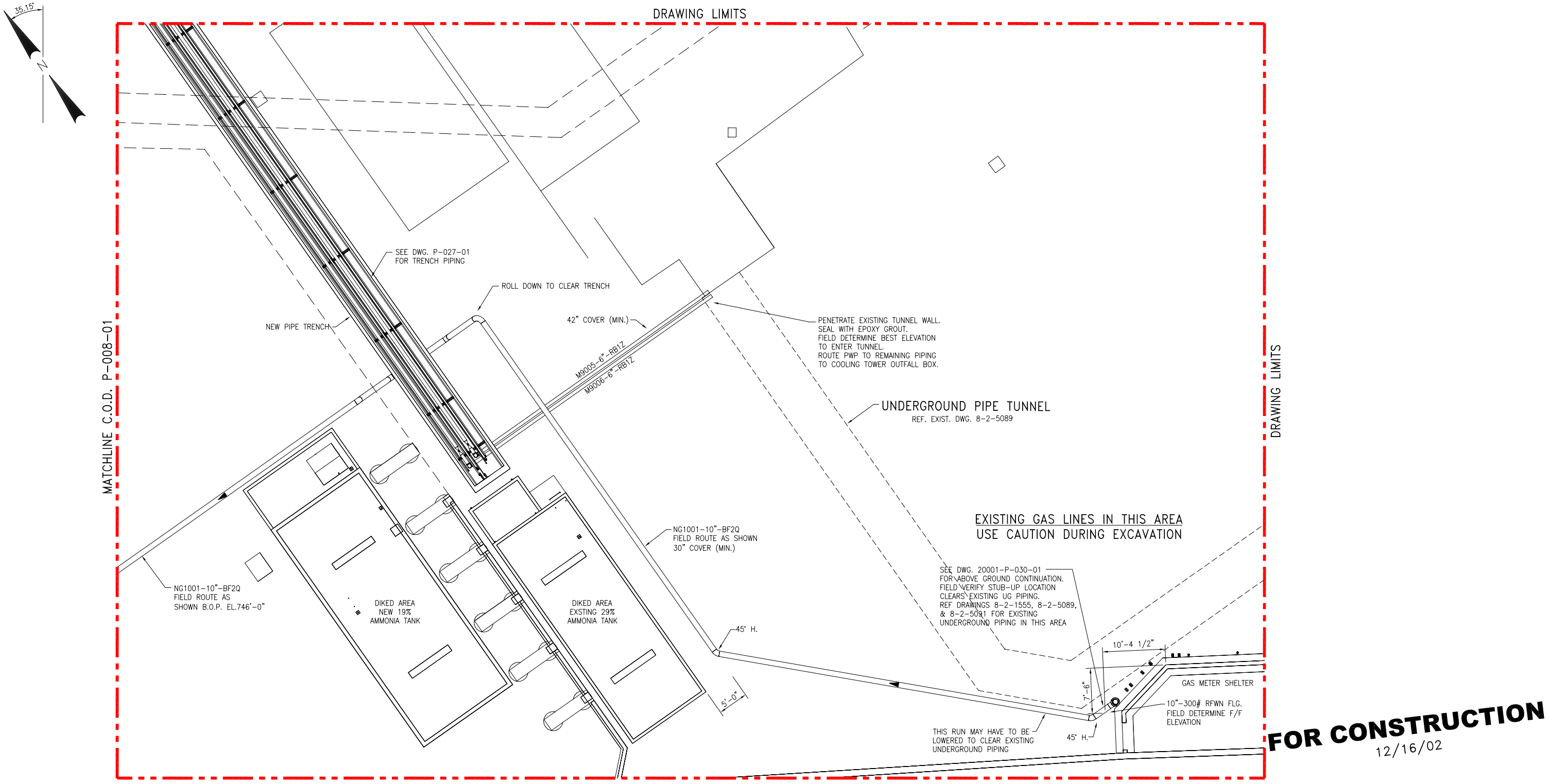
TITLE

PIPING PLAN
GAS COMPRESSOR AREA
UNDERGROUND

DWG NO.

20001-P-008-01

SCALE 1/8"=1'-0" SHEET



FOR CONSTRUCTION
12/16/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001-P-009-01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	EAR	12/16/02	GB	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

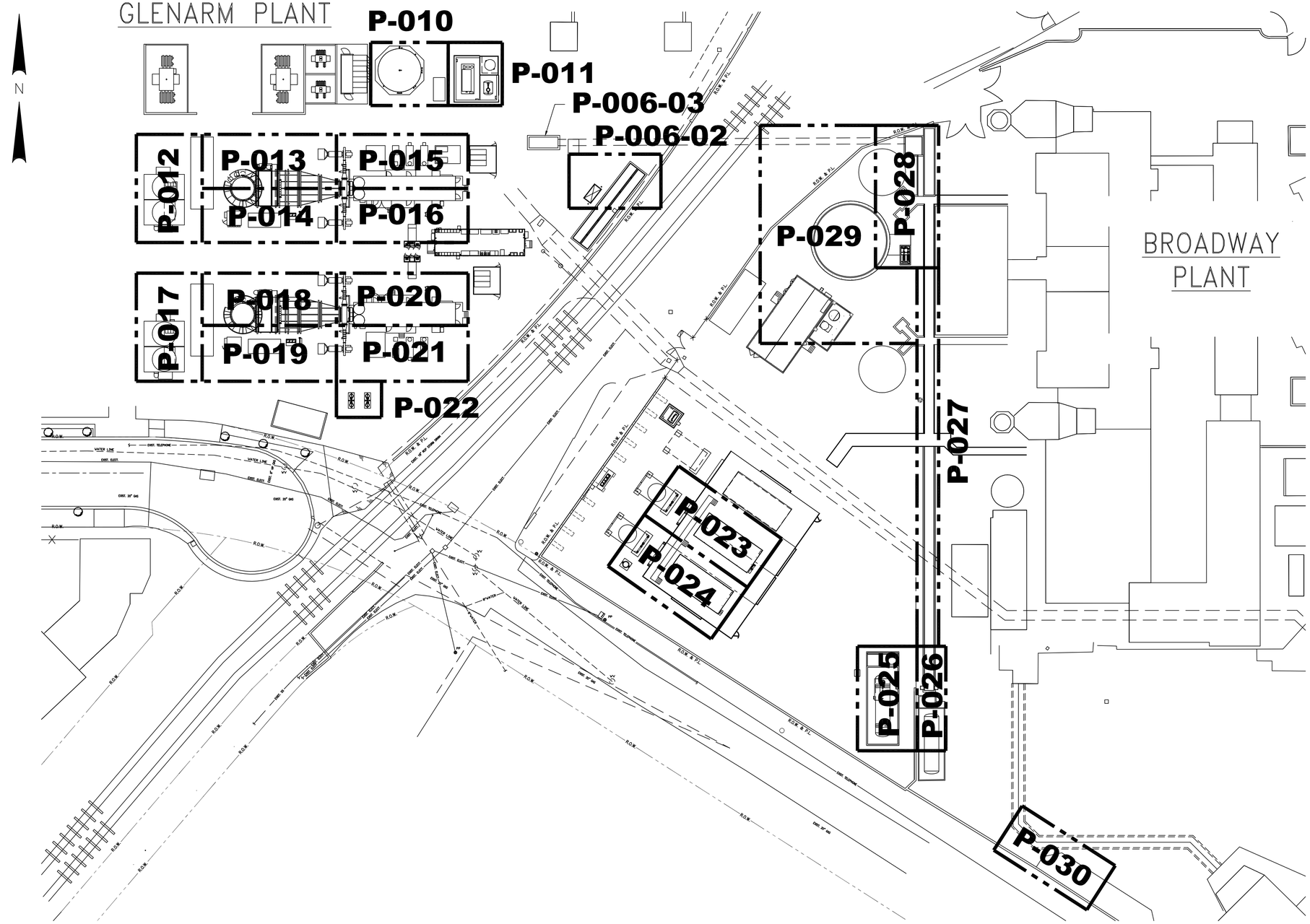
WORK ORDER NO. 20001

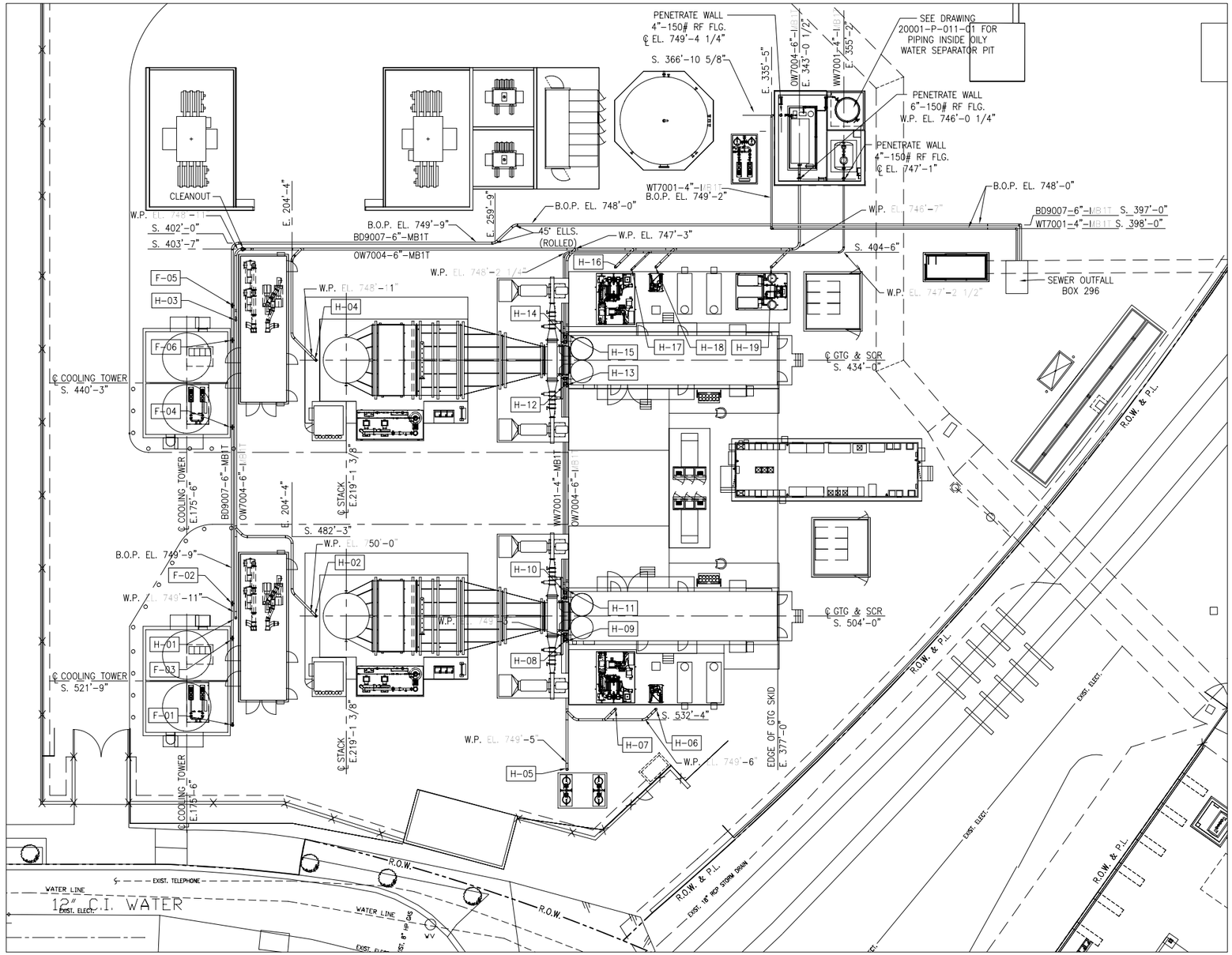
TITLE

PIPING PLAN AMMONIA TANK AREA UNDERGROUND

DWG NO. 20001-P-009-01

SCALE 1/8"=1'-0" SHEET


GLENARM PLANT
BROADWAY PLANT
N
P-010
P-011
P-006-03
P-006-02
P-012
P-013
P-014
P-015
P-016
P-017
P-018
P-019
P-020
P-021
P-022
P-023
P-024
P-025
P-026
P-027
P-028
P-029
P-030
R.O.W.
R.O.W. & P.L.
WATER LINE
CONC. TELEPHONE
CONC. ELECT.
CONC. 20" GAS
CONC. SLOPE
CONC. SLOPE DRN
CONC. 8" WATER
CONC. 12" WATER
CONC. 16" WATER
CONC. 24" WATER
CONC. 30" GAS
CONC. 36" GAS
CONC. 42" GAS
CONC. 48" GAS
CONC. 54" GAS
CONC. 60" GAS
CONC. 72" GAS
CONC. 84" GAS
CONC. 96" GAS
CONC. 108" GAS
CONC. 120" GAS
CONC. 132" GAS
CONC. 144" GAS
CONC. 156" GAS
CONC. 168" GAS
CONC. 180" GAS
CONC. 192" GAS
CONC. 204" GAS
CONC.



PIPING STUB-UP LOCATION CHART					
MK	SERVICE	SIZE & RATING	CENTERLINE LOCATION		F/F ELEV.
F-01	CLG WATER	4"-150#RF	S. 533'-9 5/8"	E. 188'-0"	752'-3"
F-02	CLG WATER	4"-150#RF	S. 500'-6 5/8"	E. 188'-0"	752'-3"
F-03	CLG WATER	4"-150#RF	S. 510'-0 3/4"	E. 188'-0"	752'-3"
F-04	CLG WATER	4"-150#RF	S. 452'-3 5/8"	E. 188'-0"	752'-3"
F-05	CLG WATER	4"-150#RF	S. 419'-0 5/8"	E. 188'-0"	752'-3"
F-06	CLG WATER	4"-150#RF	S. 428'-6 3/4"	E. 188'-0"	752'-3"

MK	SERVICE	HUB SIZE	CENTERLINE LOCATION		T.O. HUB ELEV
H-01	OILY WATER	6" PIPE	S. 504'-6"	E. 188'-11"	751'-10"
H-02	OILY WATER	6" PIPE	S. 504'-0"	E. 210'-10"	751'-10"
H-03	OILY WATER	6" PIPE	S. 423'-0"	E. 188'-11"	751'-10"
H-04	OILY WATER	6" PIPE	S. 434'-0"	E. 210'-10"	751'-10"
H-05	OILY WATER	6" PIPE	S. 546'-0"	E. 279'-6"	751'-6"
H-06	OILY WATER	6" PIPE	S. 529'-6"	E. 303'-10"	751'-10"
H-07	OILY WATER	6" PIPE	S. 529'-6"	E. 292'-9"	751'-10"
H-08	WATER WASH	4" PIPE	S. 511'-0"	E. 278'-8"	751'-7"
H-09	OILY WATER	6" PIPE	S. 511'-0"	E. 279'-6"	751'-7"
H-10	WATER WASH	4" PIPE	S. 497'-0"	E. 278'-8"	751'-7"
H-11	OILY WATER	6" PIPE	S. 497'-0"	E. 279'-6"	751'-7"
H-12	WATER WASH	4" PIPE	S. 441'-0"	E. 278'-8"	751'-7"
H-13	OILY WATER	6" PIPE	S. 441'-0"	E. 279'-6"	751'-7"
H-14	WATER WASH	4" PIPE	S. 427'-0"	E. 278'-8"	751'-7"
H-15	OILY WATER	6" PIPE	S. 427'-0"	E. 279'-6"	751'-7"
H-16	OILY WATER	6" PIPE	S. 408'-6"	E. 292'-9"	751'-10"
H-17	WATER WASH	4" PIPE	S. 409'-3"	E. 297'-2"	751'-10"
H-18	OILY WATER	6" PIPE	S. 408'-6"	E. 303'-10"	751'-10"
H-19	OILY WATER	6" PIPE	S. 408'-6"	E. 335'-6"	751'-10"

NOTE:
COORDINATE INSTALLATION OF THESE LINES WITH OTHER UNDERGROUND PIPING, SEWERS, AND ELECTRICAL DUCT BANKS. SEE REFERENCE DWG'S. LISTED AT LOWER LEFT.

SCALE
0 20' 40' 60' 80' 100'

RESERVED

JOE D. TRISNA, P.E.
CA. LIC. 32239

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
P-004-01	PIPING PLAN – GTG UNIT 3 AREA (UG)
P-005-01	PIPING PLAN – GTG UNIT 4 AREA (UG)
P-006-01	PIPING PLAN – AMMONIA T/T LOADING AREA UG)
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. LINES OW7004-6"-MB1T AND WW7001-4"-MB1T ARE DESIGNED WITH A MINIMUM SLOPE OF 0.5%. INSTALL THESE LINES IN ACCORDANCE WITH THE WORK POINT (W.P.) ELEVATIONS INDICATED TO AVOID INTERFERENCES WITH OTHER UNDERGROUND PIPING AND STORM SEWERS. WORK POINT ELEVATIONS SHOWN ARE TO CENTERLINE OF PIPE.
3. LINE BD9007-6"-MB1T IS NOT SLOPED. INSTALL AT BOP ELEVATIONS SHOWN.
4. SEE P-003-02, 03 & 04 FOR DRAIN LINE DETAILS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P003_01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RA	11/18/02	GB	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING PLAN
GTG 3 &4
EQUIPMENT DRAINS UNDERGROUND

DWG NO.
20001-P-003-01

SCALE 1/16"=1'-0" | SHEET

DRAWING LIMITS S.349'-0"

N

3-377

4-377

3-379

4-379

400

157B

158B

EDGE OF SKID S.372'-6"

4"150# LJ FLG F/F EL. 752'-3" S. 370'-6" E. 326'-0"

4"150# LJ FLG F/F EL. 752'-3" S. 379'-4" E. 321'-9"

4"150# LJ FLG F/F EL. 752'-3" S. 380'-7" E. 320'-3"

B.O.P. EL. 749'-0"

DW4018-4"-GC2Q
DW4008-4"-GC2Q
DW4004-4"-GC2Q

3-IA6010-1"-EC2Q E. 296'-1"
3-DW4009-1"-GC2Q E. 296'-6"
3-NG1009-3"-FH2Q E. 298'-9"
3-IA6011-2"-EC2Q E. 301'-8"
3-DW4018-3"-GC2Q E. 307'-1"
3-DW4008-3"-GC2Q E. 307'-8"
IA6001-2"-EC2Q E. 334'-10"

4"x3" ECC RED (FSD)

4"x3" ECC RED (FSD)

B.O.P. EL. 748'-0"

B.O.P. EL. 746'-6"

B.O.P. EL. 748'-0"

DW4004-4"-GC2Q S. 399'-7"
RW3002-4"-AC2Q S. 400'-3"
PW3001-2"-AC2Q S. 400'-10"
AM9005-2"-EC2Y S. 401'-4"
IA6001-2"-EC2Q S. 401'-10"

SEE DETAIL #3 DWG. P-004-03

B.O.P. EL. 748'-9"

3-CW5005-4"-AC2Q
3-CW5004-4"-AC2Q

B.O.P. EL. 749'-0"

DRAWING LIMITS E.162'-0"

℄ COOLING TOWER E. 175'-6"

3-173

3-172

3-175

3-177

E. 206'-0"

12"-150# RFSO FLG. F/F EL. 752'-3"

℄ STACK E. 219'-1 3/8"

S. 416'-1 3/8"

S. 419'-6"

S. 421'-1 1/2"

S. 424'-6 1/2"

45° ELL (TYP)

3-CHW5002-12"-AC2Q
3-CHW5001-12"-AC2Q
B.O.P. EL. 748'-0"

E. 257'-4"

E. 259'-0"

3-63

3-IA6007-1"-EC2Q
1"-150# RFSW FLG.
F/F EL. 752'-3"
S.434'-0"
E.268'-10"
SEE DETAIL #4
DWG. P-004-03

A P-004-03

12"-150# RFSO FLG. F/F EL. 752'-3"

1 1/2" 150# RFSW FLG F/F EL. 752'-3" S. 454'-7" E. 241'-0"

3"-150# RFSO FLG F/F EL. 752'-0" S. 448'-6" E. 257'-4"

1"-150# RFSW FLG F/F EL. 752'-3" S. 454'-7" E. 221'-4 3/8"

3-PW3003-1 1/2"-AC2Q B.O.P. EL. 749'-0"

3-RW3011-3"-AC2Q B.O.P. EL. 749'-0"

2"-150# LJ FLG F/F EL. 752'-3" S. 455'-1" E. 220'-7 3/8"

SEE DETAIL "1" DWG. P-004-03

SEE DETAIL "2" DWG. P-004-03

4-DW4018-3"-GC2Q
4-DW4008-3"-GC2Q
RW3002-4"-AC2Q
PW3001-2"-AC2Q
AM9005-1"-EC2Y
IA6001-2"-EC2Q
3-NG1009-3"-FH2Q
3-CW5004-4"-AC2Q
3-CW5005-4"-AC2Q

3-AM9005-1"-EC2Y
3-IA6002-2"-EC2Q
3-PW3004-1 1/2"-AC2Q
3-RW3011-3"-AC2Q
3-RW3003-3"-AC2Q
3-CW5005-4"-AC2Q
3-CW5004-4"-AC2Q

E. 265'-11"
E. 266'-7"
E. 267'-3"
E. 267'-10"
E. 268'-6"
E. 269'-1"
E. 269'-9"
E. 270'-4"
E. 270'-9"

EDGE OF GTG E.337'-0"

3-410

SEE DWG. P-004-02 FOR DETAILS IN THIS AREA

3-1

℄ GTG & SCR S. 434'-0"

240

MATCHLINE E.376'-0" C.O.D. P-006-01

MATCHLINE S.469'-0" C.O.D. P-005-01

SCALE 5' 10' 20' 30' 40'

FOR CONSTRUCTION

2/17/03

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P004-01.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	CORRECTED 377 EQUIPMENT NUMBERS	EAR	2/17/03	EAR	EAR	J.T.
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GAB	EAR	J.T.

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

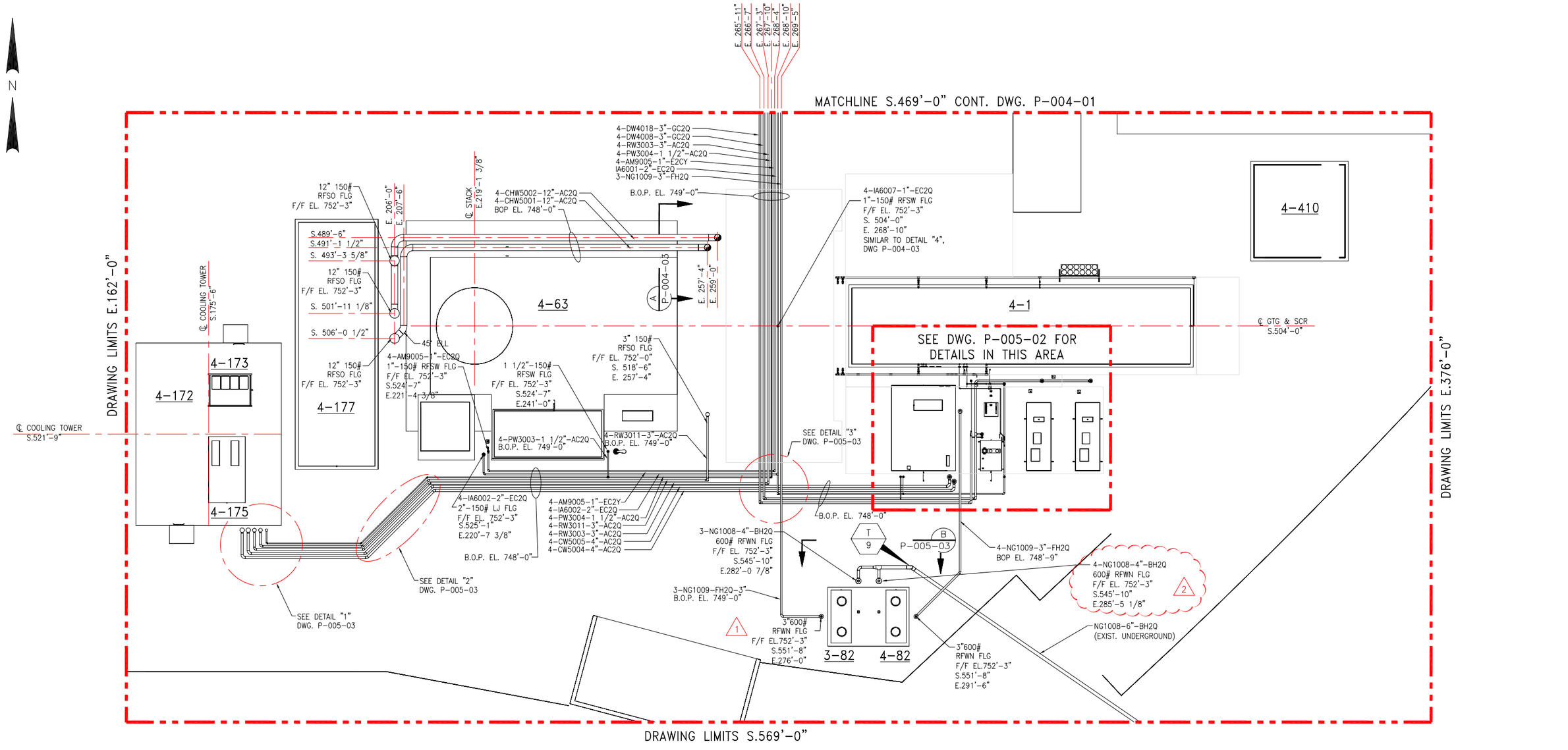
WORK ORDER NO. 20001

TITLE

UNDERGROUND PIPING PLAN GTG UNIT 3 AREA

DWG NO. 20001-P-004-01

SCALE 1/8"=1'-0" SHEET



FOR CONSTRUCTION
2/17/03

SCALE
0 5' 10' 20' 30' 40'

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-003-01 FOR UNDERGROUND DRAIN PIPING.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P005-01.dwg
XREF DWG:

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REVISIONS

REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
2	REVISED ELEV OF GAS STUB UP	EAR	2/17/03	GAB	EAR	J.T.
1	REVISED AS NOTED	RCJ	12/16/02	EAR	EAR	J.T.
0	ISSUED FOR CONSTRUCTION	RRC	11/18/02	GB	EAR	J.T.

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
UNDERGROUND PIPING PLAN
GTG UNIT 4 AREA

DWG NO.
20001-P-005-01

SCALE 1/8"=1'-0" SHEET

DRAWING LIMITS S.399'-0"

DW4004-4"-GC2Q S. 399'-7"
RW3002-4"-AC2Q S. 400'-3"
PW3001-2"-AC2Q S. 400'-10"
AM9005-1"-EC2Y S. 401'-4"
IA6001-2"-EC2Q S. 401'-10"

B.O.P. EL. 748'-0"

B.O.P. EL. 747'-0"

INSTALL 1/2" TAP FOR AMMONIA LEAK DETECTION SYSTEM ON AM9005-1"-EC2Y PER DETAIL "1", THIS DWG.

PENETRATE EXISTING PIT WALL AND REPAIR W/EPOXY GROUT (TYP).

INSIDE EDGE OF PIT E 393'-10 11/16"

EXISTING CONCRETE PIT SEE DWG. 20001-P-006-03 & 04 FOR PIT PIPING.

EXISTING PIPE CULVERT (SEE NOTE #2) SEE DETAILS #2 & #3

BACK OF PIPES

6¼"

7" 9" 10" 7'-10³⁄₁₆"

8 1/2"

F/F EL. 746'-5 1/4" (TYP.)

10" 6" 6" 9⁹⁄₁₆" 5⁵⁄₁₆"

S 411'-6 5/8"

10⅛"

5⅛"

SEWER OUTFALL BOX

INSTALL 1/2" TAP FOR AMMONIA LEAK DETECTION SYSTEM ON AM9001-3"-EC2Y & AM9007-3"-EC2Y PER DETAIL "1", THIS DWG.

B.O.P. EL. 747'-0"

MATCHLINE E.376'-0" C.O.D. P-004-01

1/2" TAP FOR PURGE AIR SEE EC2Y SPEC FOR DETAILS

CORE PIPE

JACKET PIPE

1½"

4 1/2"

CONCRETE WALL

DETAIL #1
LEAK DETECTION TAP
(NTS)

INSTALL U-BOLTS AT ALL SUPPORTS PER STD RGN-3. DOUBLE NUT AND TIGHTEN U-BOLTS IN ORDER TO USE THEM AS GUIDES FOR INSTALLATION OF NEW PIPING.

30° 43° 24° 19° 14° 4° 19° 13° 17° 19° 29° R20½"

DW4004
RW3002
PW3001
IA6001

AM9001 (DBL. CONTAINMENT)
AM9005 (DBL. CONTAINMENT)
AM9002
AM9018 (DBL. CONTAINMENT)
AM9007 (DBL. CONTAINMENT)
AM9008
AM9012 (DBL. CONTAINMENT)

DETAIL #2
LOOKIING EAST
SCALE 1"=1'-0"

42" PIPE CULVERT (EXISTING)

1/2" TAP FOR PURGE AIR SEE EC2Y SPEC FOR DETAILS

192'-7½"±

CORE PIPE

JACKET PIPE

1/2" TAP FOR PURGE AIR SEE EC2Y SPEC FOR DETAILS

MIN.

BY FIELD

EC2Q EC2Y EC2Y EC2Q

PIPE CULVERT

EXISTING PIPE SUPPORTS ARE LOCATED ON 15'-0"± CENTERS THROUGHOUT THE CULVERT.

DETAIL #3
LEAK DETECTION TAP FOR ALL LINES REQUIRING DBL. CONTAINMENT IN PIPE CULVERT
(NTS)

AMMONIA TRUCK UNLOADING AREA

PW3002-2"-AC2Q
AM9008-1 1/2"-EC2Q
AM9007-3"-EC2Y
AM9002-1 1/2"-EC2Q
AM9001-3"-EC2Y

INSTALL 1/2" TAPS FOR AMMONIA LEAK DETECTION SYSTEM SIMILAR TO DETAIL "1" THIS DWG.

F/F EL. 751'-6" BOLT HOLES STRADDLE ANGLE SHOWN (TYP.)

CURBED AREA FOR HOSE CONNECTIONS

9¼" 9¼" 8" 8"

1'-0" 1'-0" 3'-9⅞" 2'-0" 1'-0" (TYP.) 53.73°

S. 417'-2 7/8"
E. 423'-4 9/16"

S. 418'-0 9/16"
E. 422'-9 7/16"

S. 418'-10 1/4"
E. 422'-2 5/16"

S. 421'-11 3/16"
E. 419'-11 1/8"

S. 422'-8 13/16"
E. 419'-4 1/16"

DRAWING LIMITS E.451'-0"

DRAWING LIMITS S.442'-0"

N

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. FIELD TO DETERMINE FINAL DIMENSIONS FOR ALL PIPING IN EXISTING PIPE CULVERT AND TIE-IN TO PIT PIPING.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P006-01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RJ	11/18/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

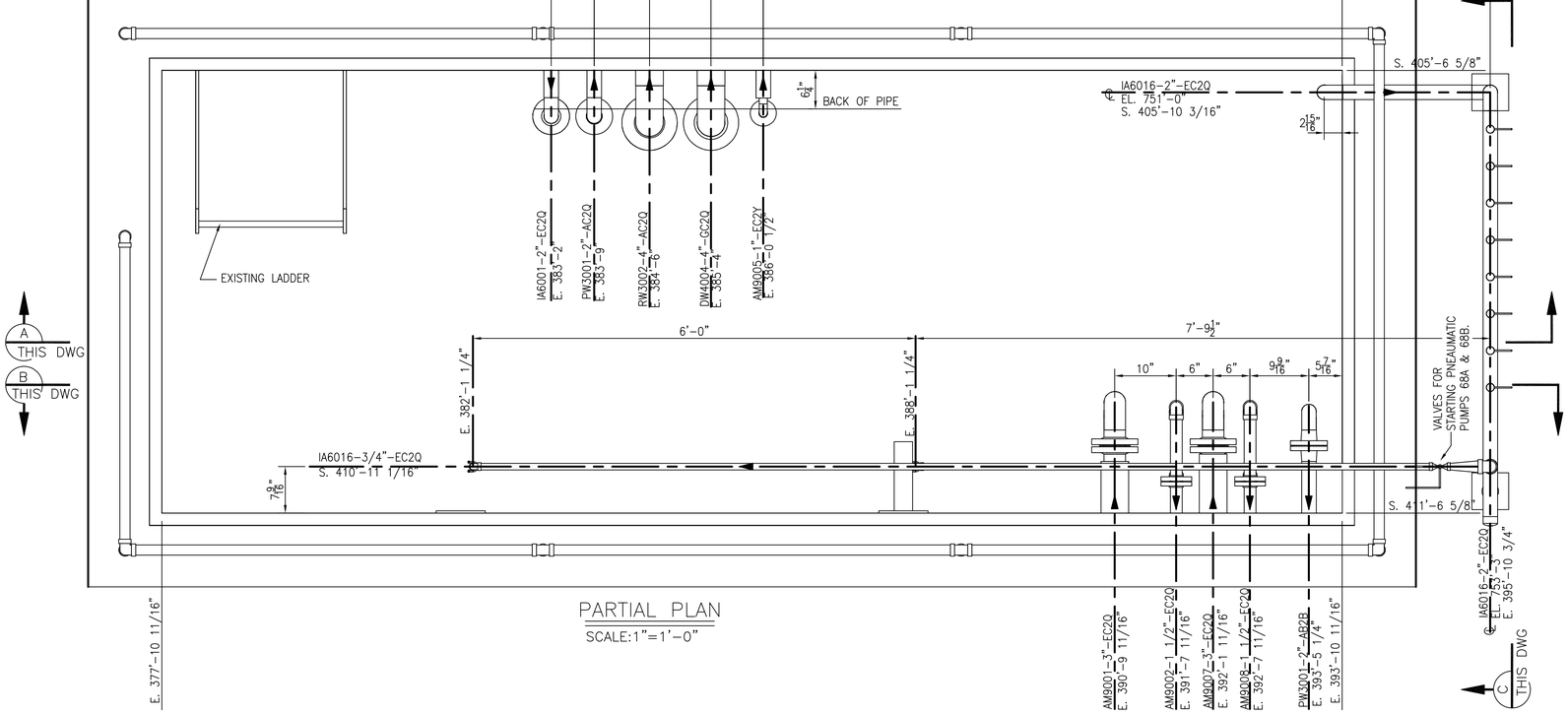
TITLE

PIPING PLAN & DETAILS
AMMONIA TRUCK UNLOADING AREA
UNDERGROUND

DWG NO.

20001-P-006-01

SCALE 3/8"=1'-0" SHEET



FOR CONSTRUCTION

11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-006-01 FOR LOCATION OF WEST END CULVERT.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P006-03.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
0	ISSUED FOR CONSTRUCTION	RCJ	11/18/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

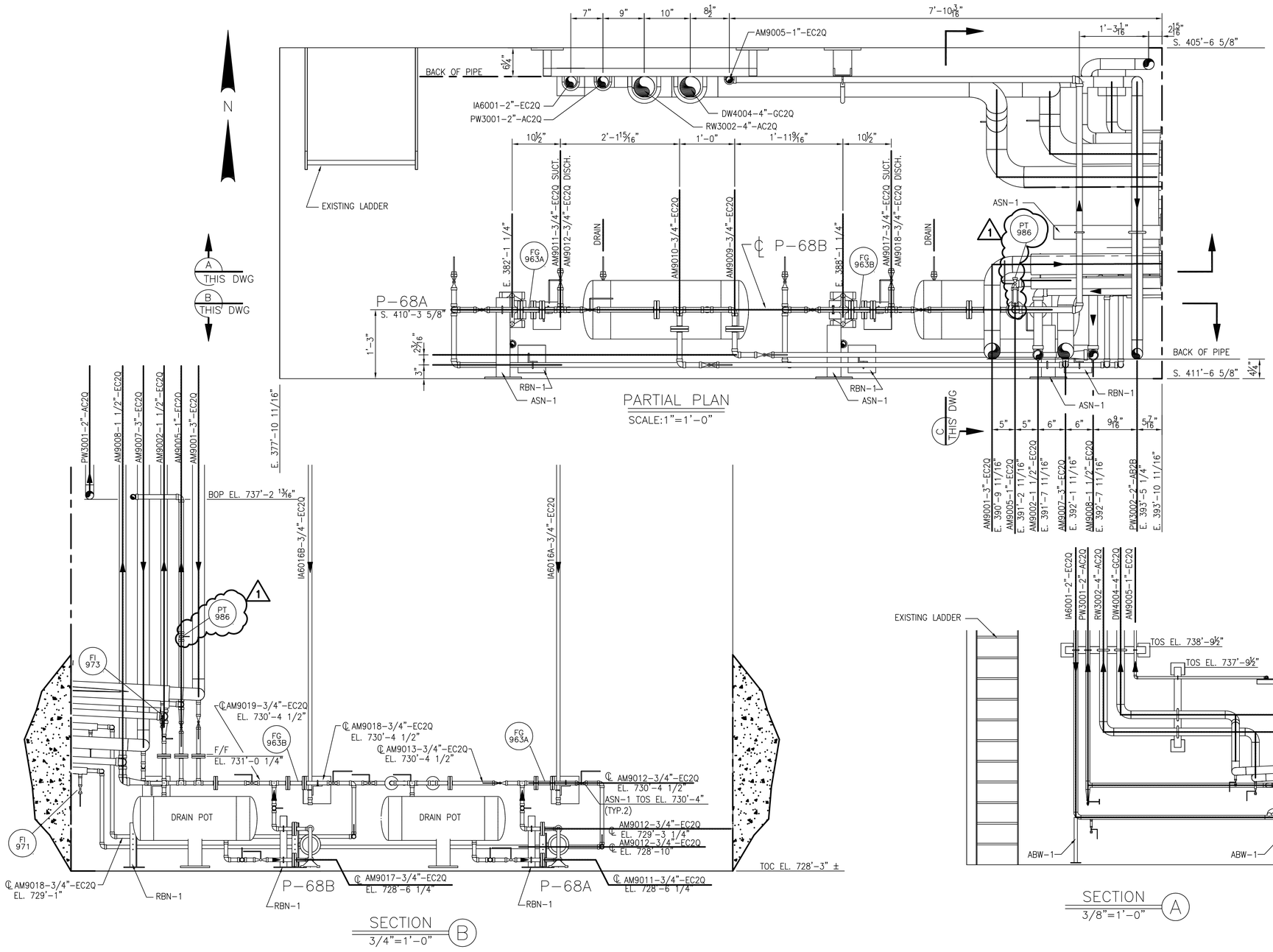
PIPING PLAN & DETAILS
PIPE CULVERT WEST END
EL. 742'-0" AND ABOVE

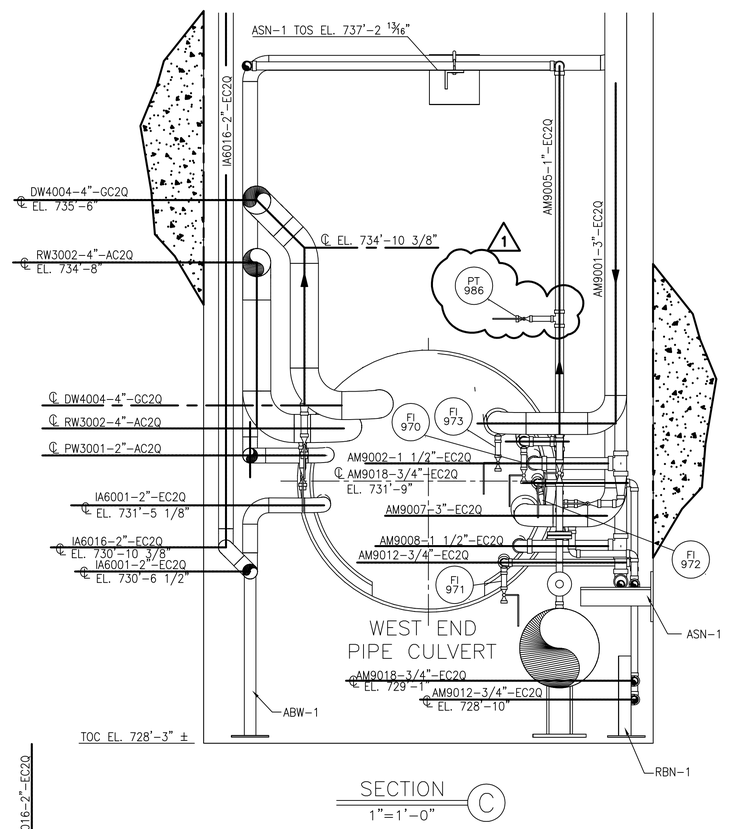
DWG NO.

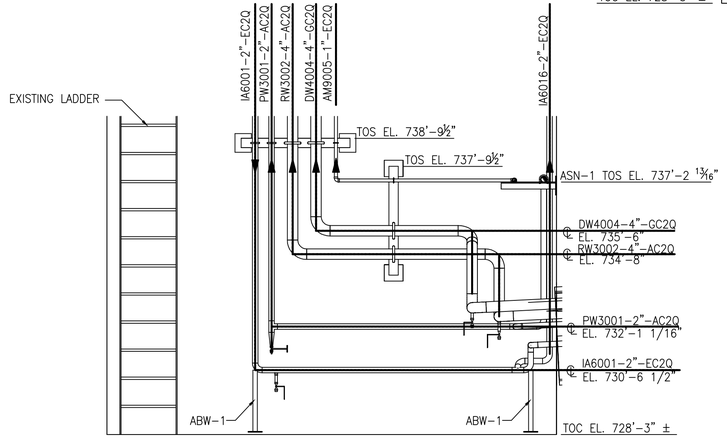
20001-P-006-03

SCALE AS NOTED

SHEET







FOR CONSTRUCTION
05/19/03

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-006-01 FOR LOCATION OF WEST END CULVERT.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P006-04.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	ADDED PT 986	CJS	5/19/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RCJ	10/13/02	GAB	RRC	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

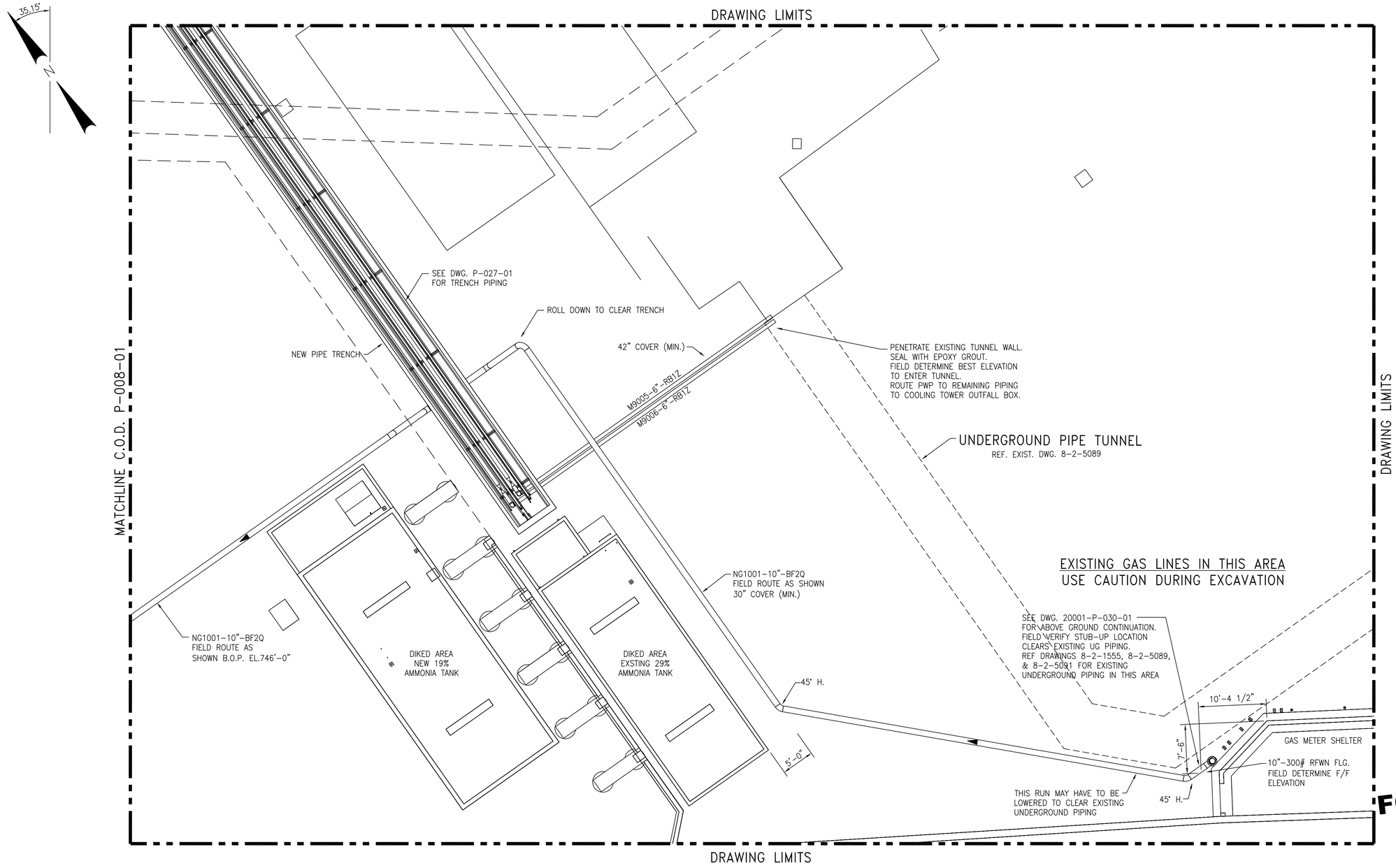
WORK ORDER NO. 20001

TITLE

PIPING PLAN & DETAILS PIPE CULVERT WEST END EL. 728'-3" TO EL. 742'-0"

DWG NO. 20001-P-006-04

SCALE AS NOTED | SHEET



FOR CONSTRUCTION
12/16/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001-P-009-01.dwg
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
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REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

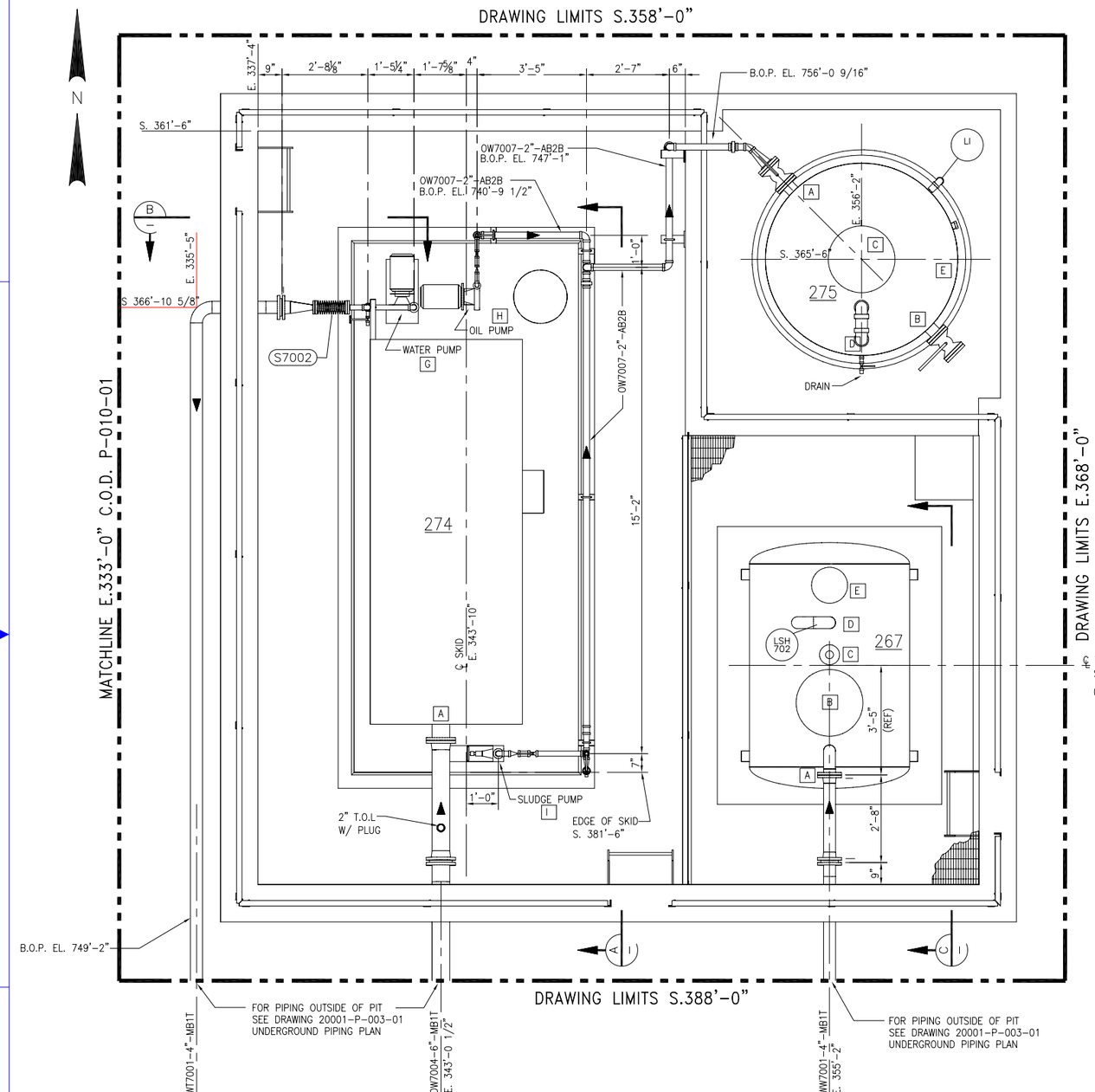
WORK ORDER NO. 20001

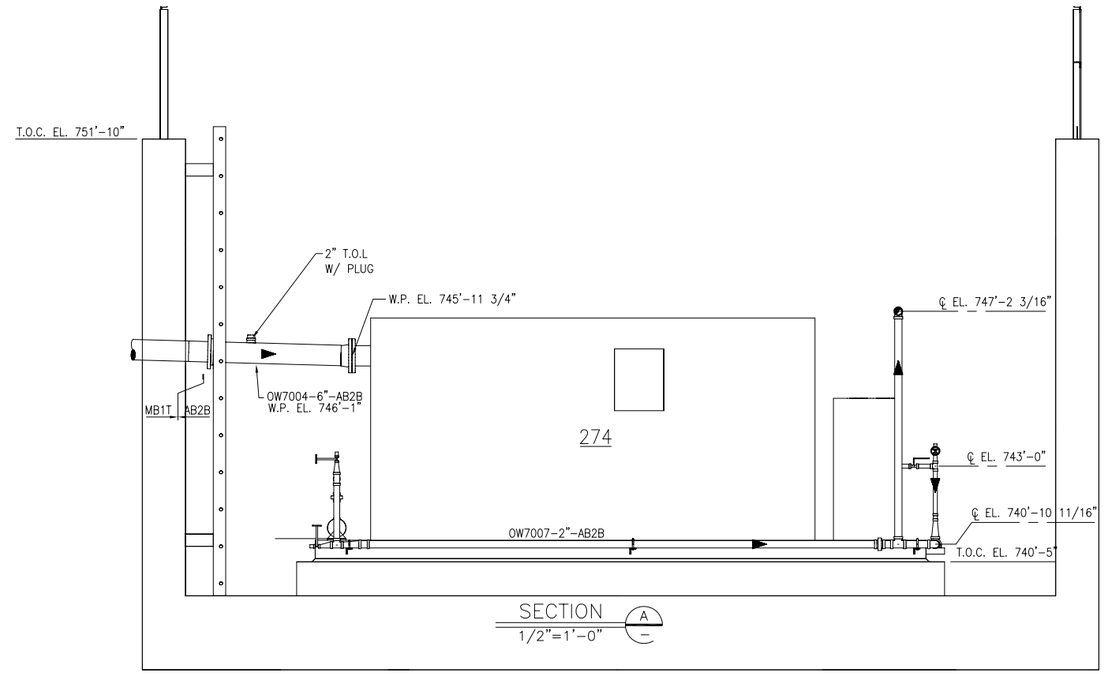
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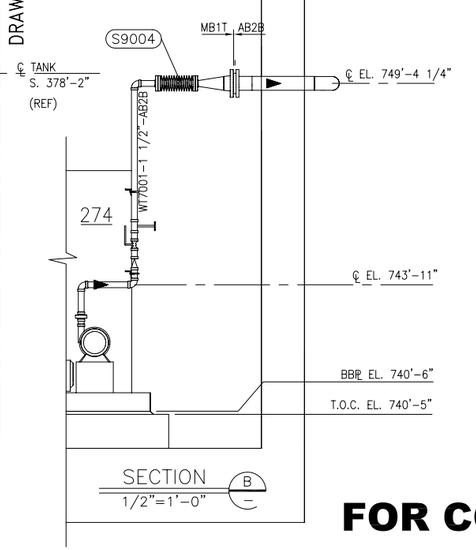
PIPING PLAN AMMONIA TANK AREA UNDERGROUND

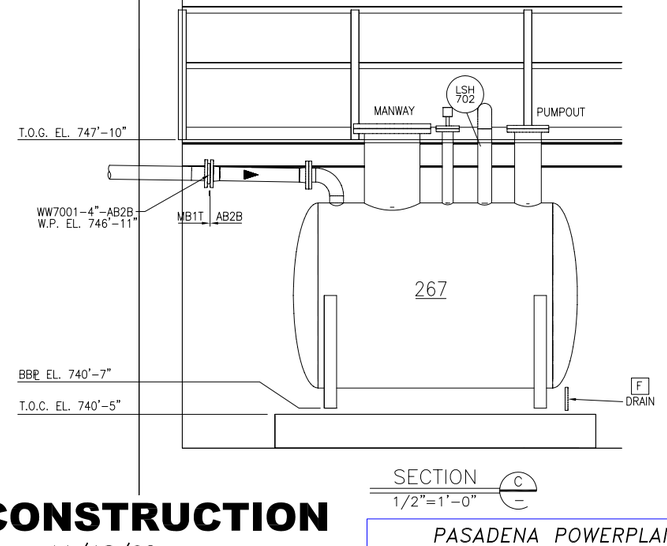
DWG NO. 20001-P-009-01

SCALE 1/8"=1'-0" SHEET









FOR CONSTRUCTION
11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMS.

CHEMIC ENGINEERS

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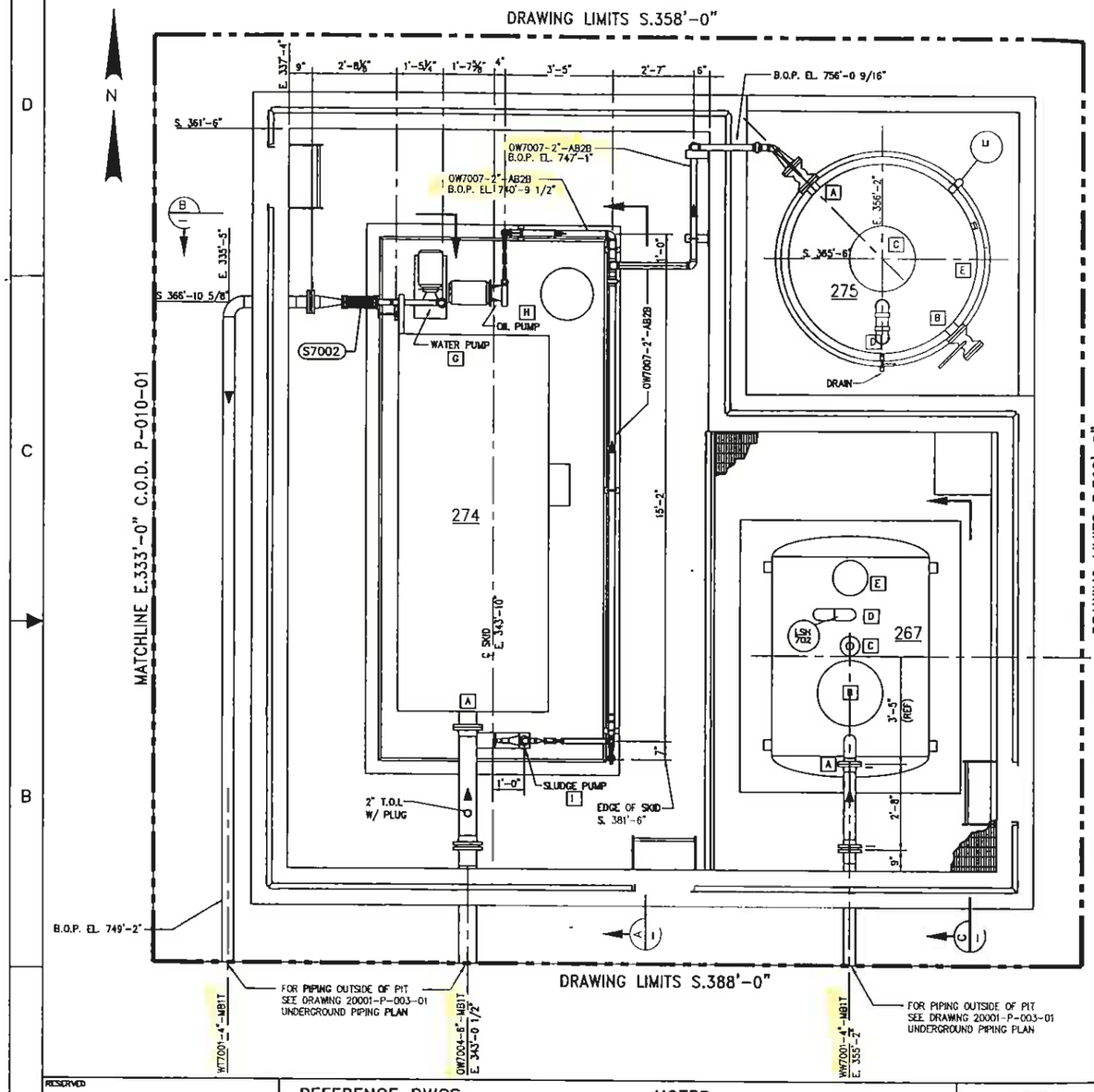
PASADENA POWERPLANT
UPGRADE PROJECT

GE PACKAGED POWER, INC.
WORK ORDER NO. 20001

TITLE
PIPING PLAN & DETAILS
OILY WATER SEPARATOR PIT

DWG NO.
20001-P-011-01

SCALE 1/2"=1'-0" SHEET



FOR CONSTRUCTION
11/18/02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMS.

CHEMIC ENGINEERS

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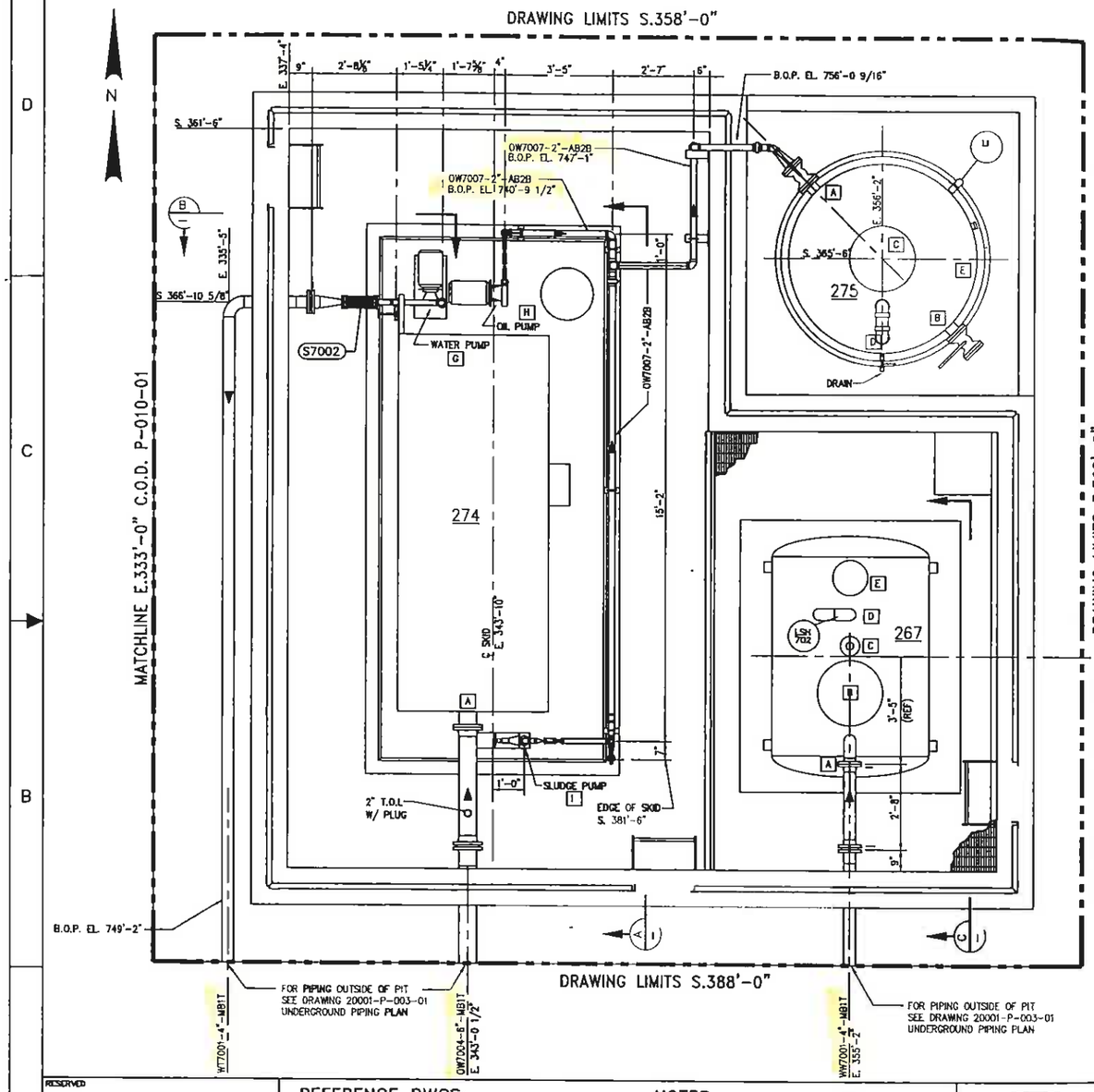
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING PLAN & DETAILS
OILY WATER SEPARATOR PIT

DWG NO.
20001-P-011-01

SCALE 1/2"=1'-0" SHEET



FOR CONSTRUCTION
11/18/02

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M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMS.

CHEMIC ENGINEERS

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PASADENA POWERPLANT UPGRADE PROJECT

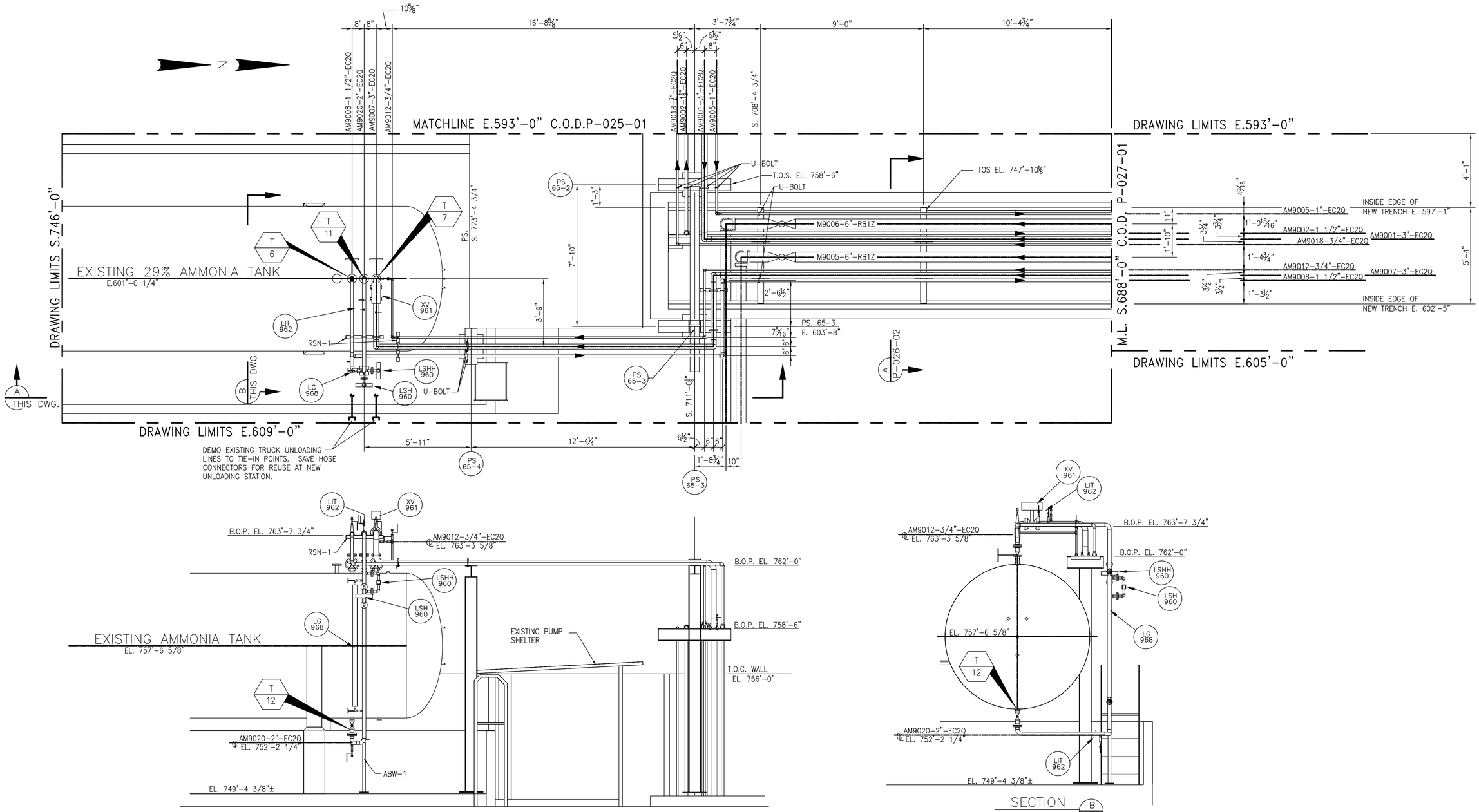
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING PLAN & DETAILS
OILY WATER SEPARATOR PIT

DWG NO.
20001-P-011-01

SCALE 1/2"=1'-0" SHEET



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M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMENSIONS.
3. ADD NOTE ABOUT EXTENT OF PIPING TO BE DEMO'D.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P026-01.DWG
XREF DWG:

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REV	DESCRIPTION	DRAWN	DATE	CHECK	DESIGN	APPR
1	AS BUILT PER CONTRACTOR MARKS	RRC	12/8/03	EAR	EAR	JT
0	ISSUED FOR CONSTRUCTION	RCJ	12/16/02	GAB	EAR	JT

REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

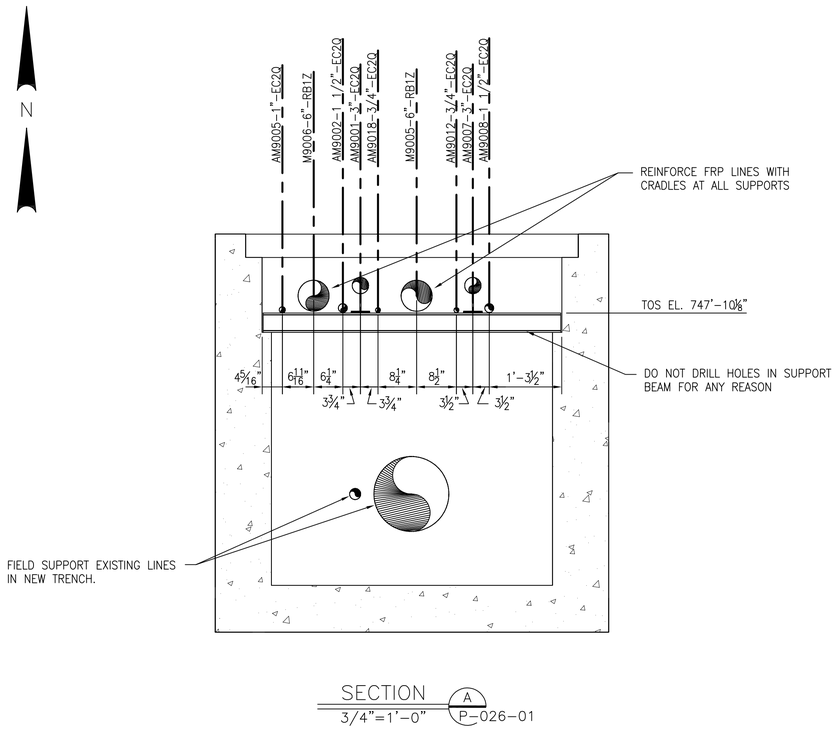
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

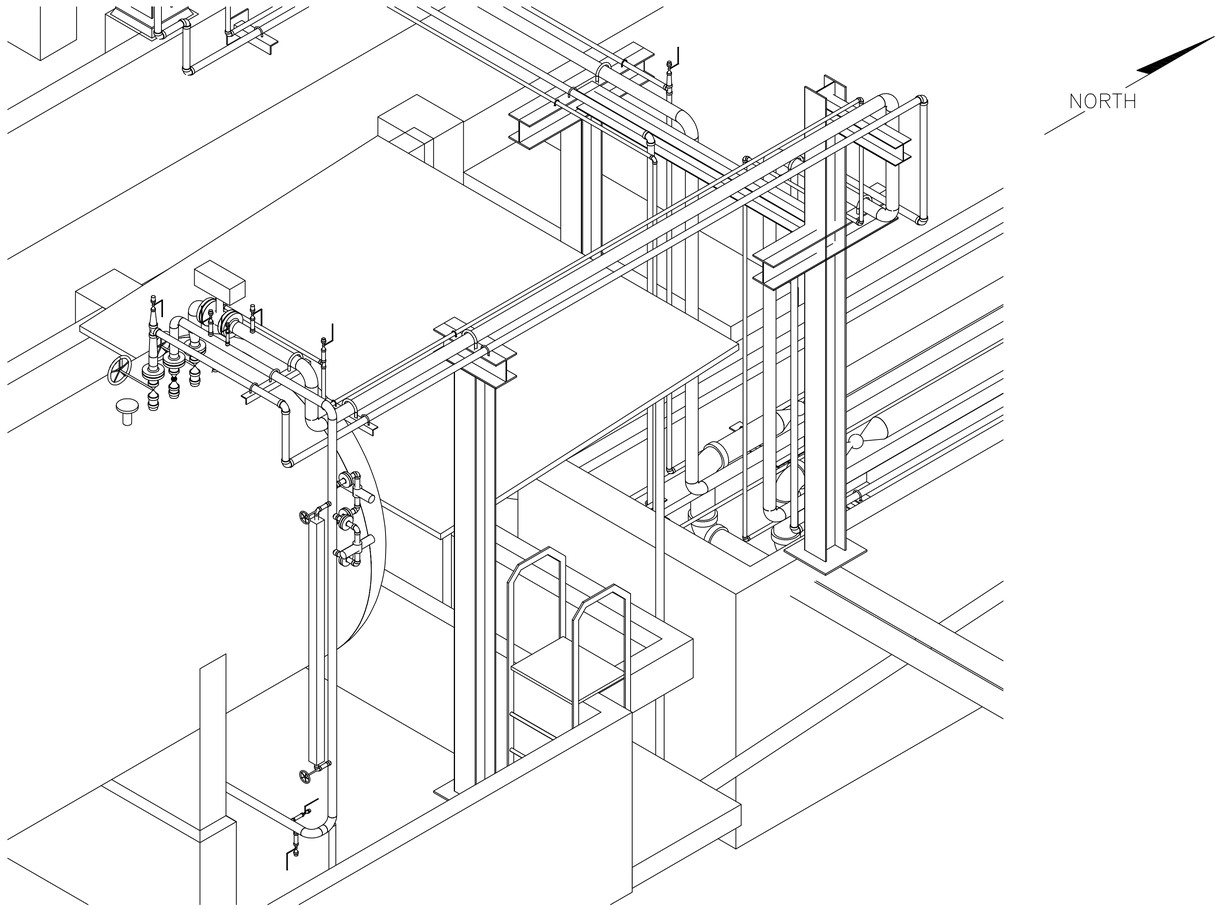
TITLE
PIPING PLAN
29% AMMONIA TANK AREA
ABOVE GRADE

DWG NO.
20001-P-026-01

SCALE 3/8"=1'-0" SHEET



SECTION A
3/4"=1'-0" P-026-01



ISOMETRIC VIEW
EXISTING 29% AMMONIA TANK
LOOKING NORTHWEST

RESERVED

CHEMIC ENGINEERS

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FILE NAME: 20001P026-02.DWG
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0	ISSUED FOR CONSTRUCTION	RCJ	12/16/02	GAB	EAR	JT

REVISIONS

PASADENA POWERPLANT
UPGRADE PROJECT

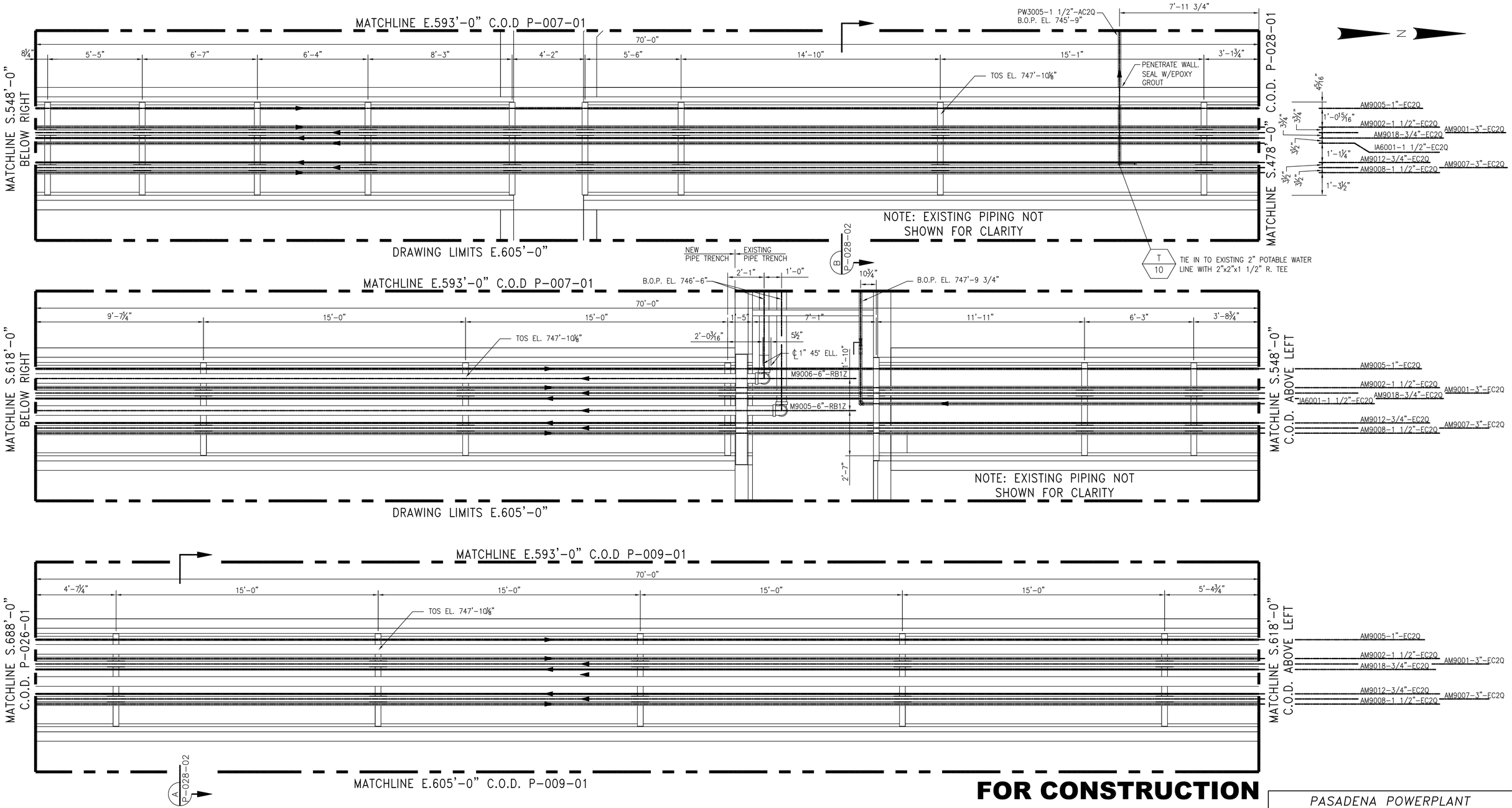
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE
PIPING DETAILS
29% AMMONIA TANK AREA
ABOVE GRADE

DWG NO.
20001-P-026-02

SCALE AS NOTED SHEET



FOR CONSTRUCTION

12-16-02

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
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E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

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FILE NAME: 20001P027-01.DWG
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PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

TITLE

PIPING PLAN
PIPE TRENCH BETWEEN CULVERT AND AMMONIA TANKS

DWG NO. 20001-P-027-01

SCALE 3/8"=1'-0" SHEET 1 OF 1

MATCHLINE E.570'-0" C.O.D. P-029-01

157A
DEMIN. WATER TANK

NOTE: FILL TANK W/DEMIN. WATER & ALLOW TO SETTLE FOR 3 DAYS BEFORE INSTALLING PIPING.

NOTE: EXISTING PIPING NOT SHOWN FOR CLARITY

EXISTING B1

EDGE OF PIPE

SEE PARTIAL PLAN P-028-02

158A
DEMIN. WATER FORWARD PUMP SKID

MATCHLINE S.478'-0" C.O.D. P-029-01

MATCHLINE S.478'-0" C.O.D. P-027-01

DRAWING LIMITS E.605'-0"

REROUTE EXISTING 6" WATER LINE PER ISO RW3013-6"-AC2Q

EXIST. PUMP FND.

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
M-001	OVERALL SITE PLAN
M-002	GENERAL ARRANGEMENT PLAN
M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-001-01 FOR NOTES CONCERNING DOUBLE CONTAINMENT PIPING.
3. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

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FILE NAME: 20001P028-01.DWG
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REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

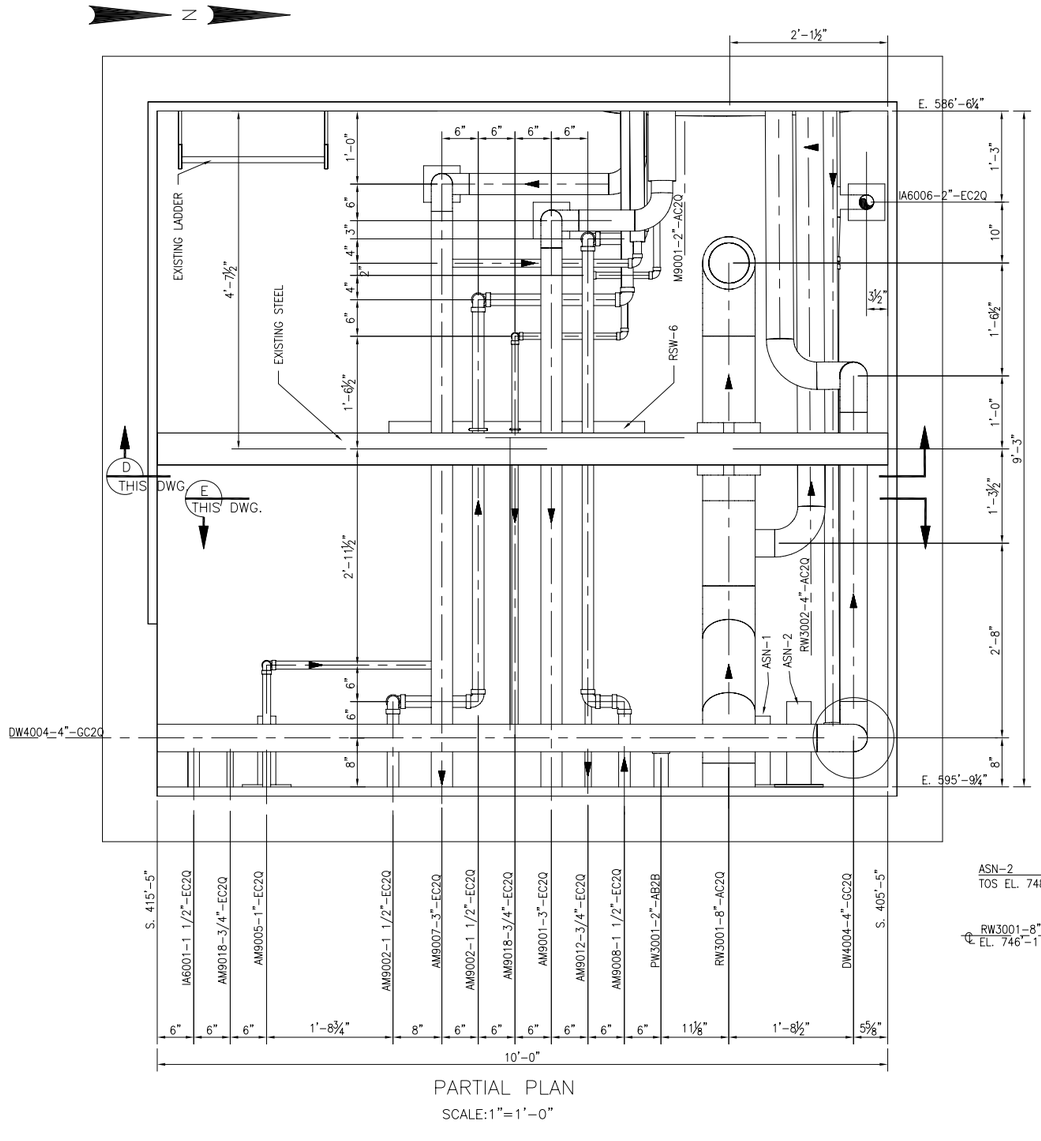
GE PACKAGED POWER, INC.

WORK ORDER NO. 20001

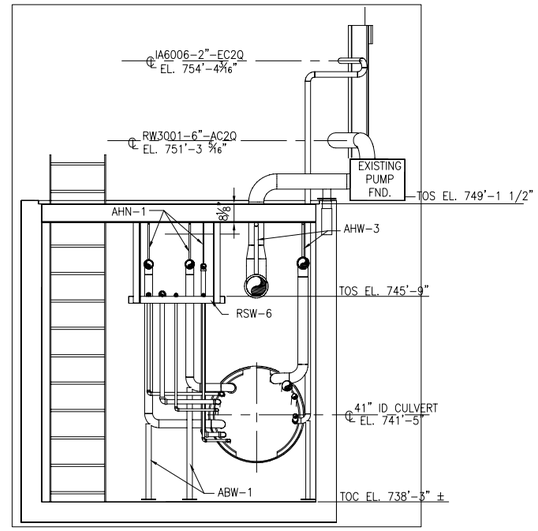
TITLE
PIPING PLAN
DEMIN WATER PUMP 158A
& PIPE TRENCH

DWG NO.
20001-P-028-01

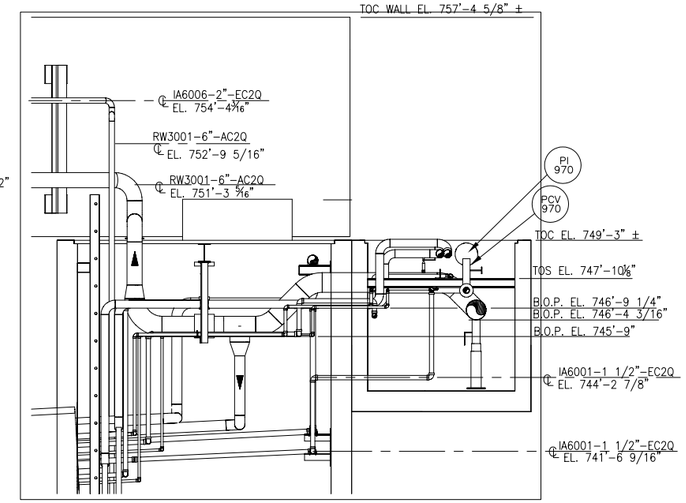
SCALE 3/8"=1'-0" | SHEET



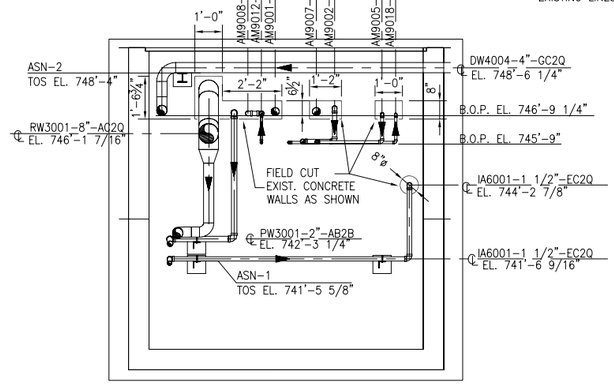
PARTIAL PLAN
SCALE:1"=1'-0"



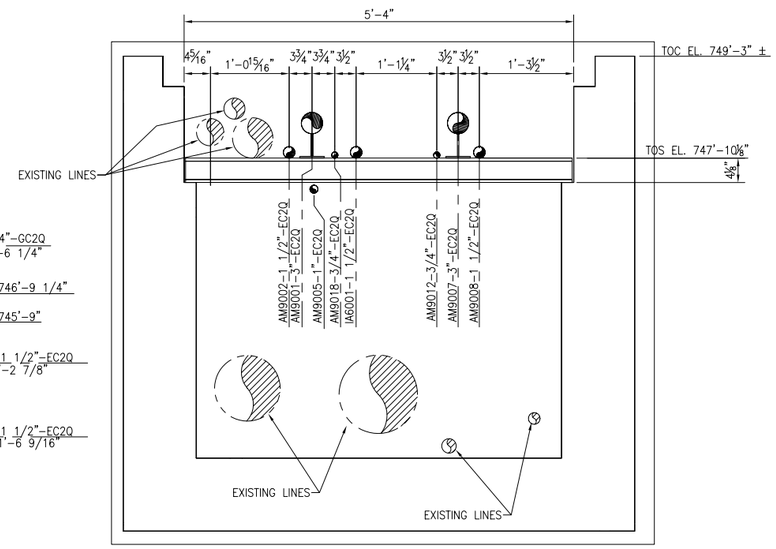
SECTION D
3/8"=1'-0"



SECTION C
3/8"=1'-0" P-028-01
EXISTING PIPING NOT SHOWN FOR CLARITY



SECTION E
3/8"=1'-0"



SECTION B
1"=1'-0" P-028-01

RESERVED

REFERENCE DWGS:

P-001-01	KEY PLAN – UG PIPING PLANS
P-001-02	KEY PLAN – AG PIPING PLANS
C-002-01	KEY PLAN – PAVING, GRADING, & UG SEWER
C-004-01	FDN. LOCATION PLAN
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M-003 THRU M-007	EQUIPMENT LOCATION PLANS
E-002	ELECTRICAL GROUNDING PLANS
E-004	ELECTRICAL DUCT BANK PLANS

NOTES:

1. SEE DWG. P-001-01 FOR GENERAL NOTES.
2. SEE DWG. P-006-01 FOR NOTES CONCERNING DOUBLE CONTAINMENT PIPING.
3. SEE DWG. P-028-01 FOR LOCATION OF EAST END CULVERT PIPING.
4. SEE ISOMETRICS FOR DETAILED DIMENSIONS.

CHEMIC ENGINEERS

PROJ. NO: 2115
FILE NAME: 20001P028-02.DWG
XREF DWG:

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REVISIONS

PASADENA POWERPLANT UPGRADE PROJECT

GE PACKAGED POWER, INC.

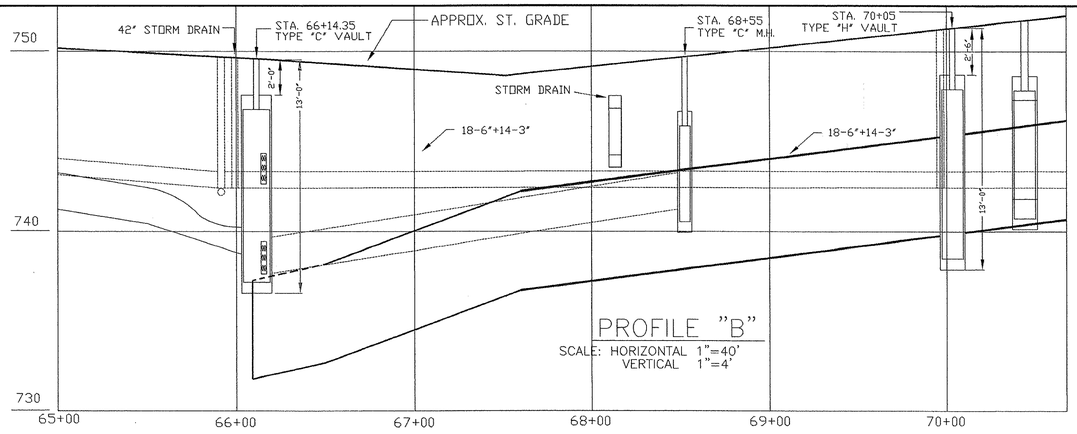
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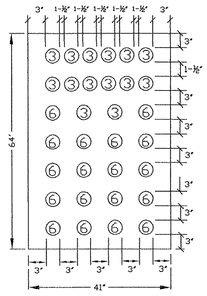
TITLE
PIPING DETAILS
EAST END OF CULVERT AND PIPE TRENCH

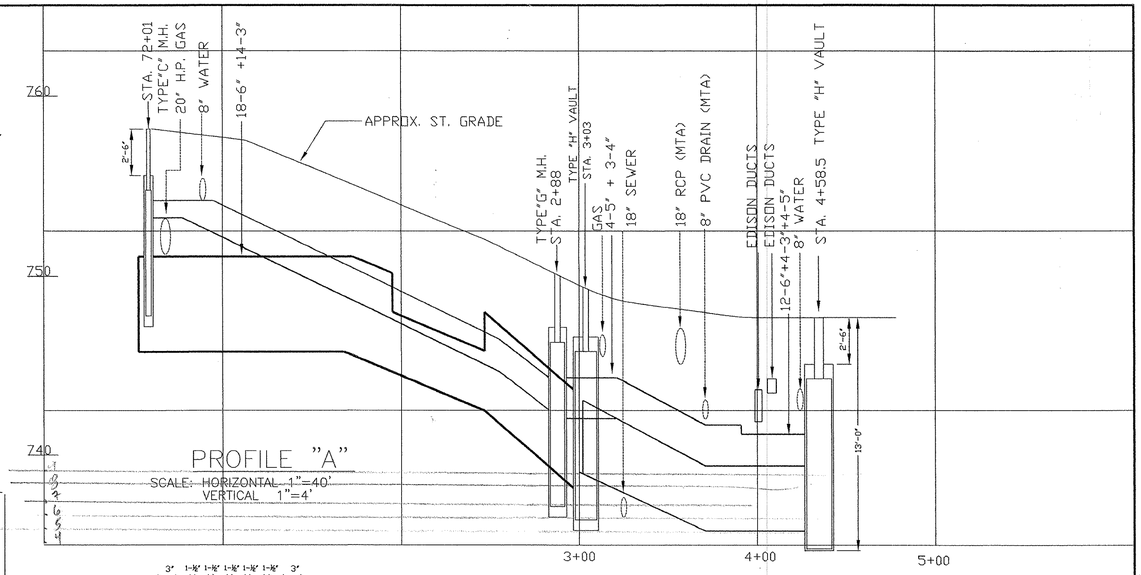
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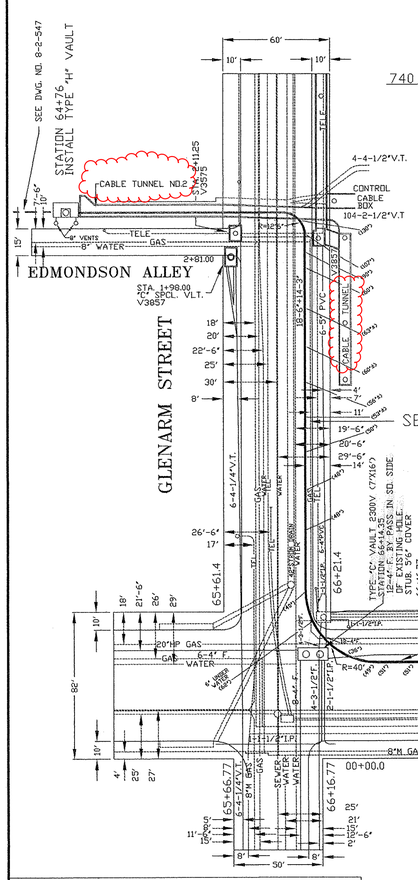
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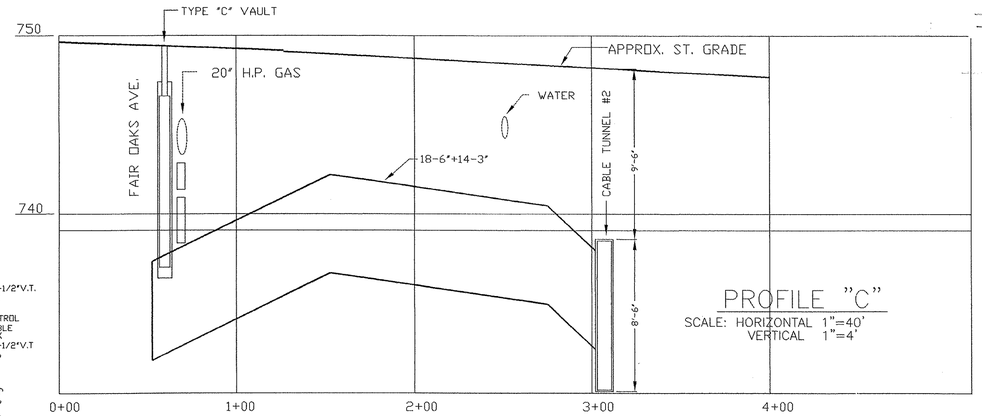
SHEET 1 OF 1

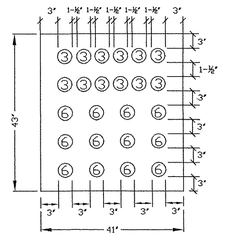


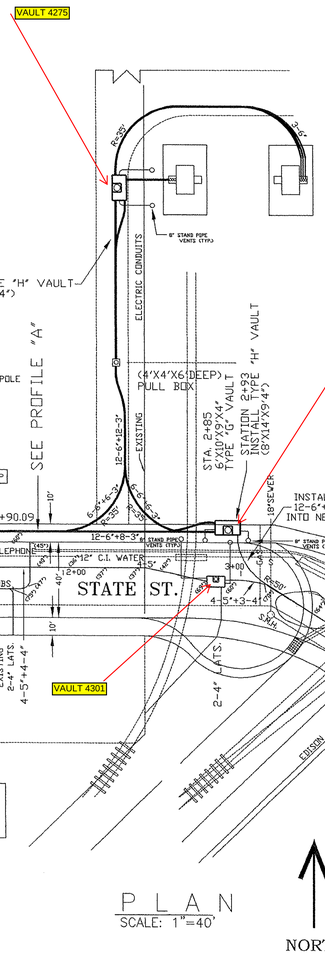












RECEIVED
MAY 0 1 2003

PUBLIC WORKS AND TRANPORTATION DEPARTMENT	
STREET LIGHT SECTION	PERMIT SECTION
DATE	DATE PERMIT NO.

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS	FILE NO.

DESIGN	M.C.	10-08-02	POWER DIVISION
DRAWN	M.C.	04-22-03	WATER AND POWER DEPARTMENT
CHECKED	T.M.		CITY OF PASADENA
CIVIL	T.M.		APPROVED / DATE
ELECT.	A.W.		APPROVED / DATE
MECH.		DATE	

UNDERGROUND

FAIR OAKS AVE.
GLENARM ST. TO STATE ST.

STATE ST.
FAIR OAKS AVE TO 110 FREEWAY

EJO NUMBER	FILE
SCALE 1"=40'	PAGE
DRAWING NUMBER 2-2-1562	

SHEET NUMBER

GLENARM ST.

12" C. I. EMERGENCY MAIN

172'

169

6"

4"

15'

4" CK.

50

50

4" METER

15'-6"±

128'±

105'±

- 7 -

89.5

228'-0"

STORM DRAIN NOT IN USE NORTH OF THIS POINT.

50

- 6 -

Nº 8 EXTENSION

WEST LINE OF OLD BLDG.

WATER LINE, ALONG EAST SIDE OF OLD BUILDING

FAIR OAKS AVE.

PROVISION MADE FOR 2-4" METERS ONE ONLY INSTALLED AT THIS TIME.

TO HYD. VALVES

2"

3"

4"

50

- 5 -

C. I.

2"

2"

6 CK.

SOUTH LINE OF BLDG.

SOFTENER.

4"

4" CIRC. LINE TRENCH.

50

- 4 -

6" MAIN

6" C.I. 7'-0" DEEP.

6" C.I. 4'-0" DEEP

FAIR OAKS SUPPLY

10

10

6"

4" METER.

DEDUCT METER FOR RE. SUPPLY.

- 3 -

EMERGENCY TO RESERVOIR.

FROM OHIO ST. WELL

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

LOCATION OF POWER PLANT WATER SERVICES

APPROVED	DRAWN	H H LEWIS	DATE 6-11-30
	TRACED	MF TAYLOR.	10-30-31
ELECT. ENGR.	CHECKED		
MECH. ENGR.	CORRECTED	To DATE	8-29-40
	CHANGES		
W D Lovley GEN. MGR.	11-17-31		

SCALE	DRWG. NO.	FILE NO.
1" = 30	33-W	TRACING 8-9-81 PRINT 6-9-81

hydrologue, Inc.
Consulting Engineers & Geologists *http://www.hydrologue.com*
Remediation Engineering *Hazardous Substances* *Geology and Hydrogeology* *Geotechnical Engineering*

April 15, 2010 Project No: 3626-03

Dan Angeles
City of Pasadena
Water and Power Department
45 East Glenarm Street
Pasadena, California 91105-3418

RE: GEOPHYSICAL INVESTIGATION REPORT
Geophysical Survey
Pasadena Power Plant
85 East State Street
Pasadena, California

Dear Dan:

Hydrologue retained GeoVision, geophysical services (GeoVision) to perform a geophysical investigation at the Pasadena Power Plant located at 85 East State Street in Pasadena, California. The purpose of the investigation was to screen an approximately 1.5 acre area of the Site for subsurface infrastructure that may interfere with future construction. Geophysical techniques used during the investigation included various electromagnetic (EM) methods and magnetic methods. These methods complement one another as each responds to different physical properties and has different strengths and limitations.

The geophysical survey is described in the attached GeoVision repot No. 10105 dated April 14, 2010. Please note that the north direction shown on the map is grid north.

Several buried metallic objects/debris were indentified in the EM data. These anomalies may be associated with former subsurface infrastructure or other debris.

There are two additional geophysical anomalies that are probably associated with larger buried metallic objects/debris. These anomalies are labeled as "BM" on the color contour maps attached to the GeoVision report and maybe related to subsurface infrastructure or unmapped reinforced concrete. However, because the exact source of these larger anomalies is unknown, consideration should be given to uncovering the anomalies to determine their source. Several pipes and other subsurface linear anomalies were identified in the EM data as well.

These anomalies are probably related to former building footprints and abandoned subsurface utilities. Additionally, two anomalies, labeled A-1 and A-2 may be caused by underground vault/access structures related to the metallic lids on the surface of the area. The full extent of these anomalies may have been masked by the presence of nearby reinforced concrete. The reinforced concrete may also mask further subsurface structures in the survey area.

The geophysical survey was designed to map metallic, subsurface infrastructure with 5 feet diameter or larger.

HI has prepared this report for the exclusive use of Pasadena Power Plant only. It is GeoVision opinion that the geophysical survey was appropriately designed to locate such objects less than about 8 feet deep; except in portions of the survey area where data was affected by surface structures, such as excavations, fences, other large surface metallic objects and areas with reinforced concrete. No other warranty, either expressed or implied, is made.

This opportunity to be of service is sincerely appreciated. If you have any questions concerning this report, please do not hesitate to contact this office.

Very Truly Yours,
HYDROLOGUE, INC.

Seyed Morteza Mortazavi, Ph.D
R.G.E. 2216



Attachments: GeoVision Repot No. 10105 dated April 14, 2010

\\JUPITER\projects\REPORTS\Phase2\3626-00 Pasadena Power Plant PPP\Geophysical Investigation.doc

REPORT
GEOPHYSICAL INVESTIGATION

Geophysical Survey
Pasadena Power Plant
85 East State Street
Pasadena, California

GEOV*ision* Project No. 10105

Prepared for:

Hydrologue, Inc.
2793 East Foothill Boulevard
Pasadena, CA 91107
(626) 585-9696

Prepared by:

GEO*Vision* Geophysical Services
1124 Olympic Drive
Corona, CA 92881
(951) 549-1234

Report 10105

April 14, 2010

TABLE OF CONTENTS

1 INTRODUCTION....1

2 GEOPHYSICAL TECHNIQUES....2

3 FIELD PROCEDURES....4

3.1 Site Preparation....4
3.2 Geonics EM-31 Survey....4
3.3 Geonics EM-61Mk2A Survey....4
3.4 Geometrics G858 Survey....5

4 DATA PROCESSING AND INTERPRETATION....6

4.1 Data Processing....6
4.2 Interpretation....7

5 CONCLUSIONS....9

6 CERTIFICATION....10

LIST OF FIGURES

FIGURE 1 SITE MAP WITH GEOPHYSICAL INTERPRETATION
FIGURE 2 COLOR CONTOUR MAP OF THE EM-61Mk2A CH3 RESPONSE
FIGURE 3 COLOR CONTOUR MAP OF THE EM-31 IN-PHASE RESPONSE

APPENDIX A GEOPHYSICAL TECHNIQUES FOR SHALLOW ENVIRONMENTAL INVESTIGATIONS

1 INTRODUCTION

A geophysical investigation was conducted on March 30th, 2010 at the Pasadena Power Plant located at 85 East State Street in Pasadena, California. The purpose of the investigation was to screen an approximate 1.5 acre area of the site for subsurface infrastructure that may interfere with future construction.

The site consisted of a rectangular lot, divided by a chain link fence in the southeast and the west and a building to the north. The site featured some scattered metallic debris and surface metallic objects related to power plant activities and areas with reinforced concrete (see Figure 1).

Geophysical techniques used during this investigation included various electromagnetic (EM) methods and the magnetic method. These methods complement one another as each responds to different physical properties and has different strengths and limitations.

Geophysical techniques used during the investigation are discussed in Section 2. Field procedures are described in Section 3. Data processing and interpretation are discussed in Section 4. The results of the geophysical survey are presented in Section 5 and our professional certification is presented in Section 6.

2 GEOPHYSICAL TECHNIQUES

This section presents background information on the EM and magnetic methods used during this investigation. A description of the geophysical methods used during this investigation, common applications of the methods, photographs of the instruments and example applications are included in Appendix A.

EM equipment used during this investigation consisted of a Geonics EM-31 Terrain Conductivity Meter (EM-31) and a Geonics EM-61 Mk2A high-resolution digital metal detector (EM-61). The EM-31 consists of a transmitter and receiver coil, one at each end of a 12-foot long boom. An alternating current is applied to the transmitter coil, causing the coil to radiate a primary EM field. This primary field generates eddy currents in subsurface materials, which give rise to a secondary EM field. The EM-31 measures the components of the secondary EM field both in-phase and 90-degrees out-of-phase with the primary EM field. The out-of-phase component is converted to apparent conductivity in millisiemens per meter (mS/m) and the in-phase component is measured as parts per thousand (ppt) of the primary EM field. A negative EM-31 response with positive shoulders is generally observed over shallow, buried metallic objects. When the instrument boom is orientated parallel to a long, linear conductor such as a pipe, a positive response centered over the conductor is typically observed. The EM-31 must pass directly over or immediately adjacent to a buried metallic object to detect it. Because of the 12-foot separation between the transmitter and receiver coils, the EM-31 cannot detect very small, buried metallic objects. Approximately 70% of the EM-31 conductivity response arises from material in the upper 18 feet; however, the instrument is most sensitive to materials in the upper 5 feet.

The EM-61 has a single transmitter and two receiver coils. The bottom coil is the transmitter during the current on-time and receiver during current off-time. The top-coil, mounted 40-cm above the bottom coil, is a receiver coil only. The transmitter and receiver electronics controls are mounted on a backpack or on the instrument handle and a hand-held data logger is used to store field measurements. During operation, a half-duty cycle waveform is applied to the transmitter coil. During the off-time, the receiver coils measure the decay of eddy currents, in millivolts (mV), produced in subsurface metallic objects by the pulsed primary EM field. The top coil is gained in such a manner that the instrument response to a metallic object lying on the surface will be approximately equal at both the top and bottom coils. The effects of surface debris can, therefore, be suppressed by calculating the differential response (subtraction of the bottom coil from top coil response). Positive EM-61 anomalies centered over the source are typically observed over buried metallic objects. Above ground metallic objects will often give rise to a negative differential response, as the top coil response is larger than the bottom coil response.

The magnetometer used during this investigation consisted of a Geometrics G858 optically pumped cesium-vapor magnetometer (G858). This instrument measures the intensity of the earth's magnetic field in nanoteslas (nT) and, optionally, the vertical gradient of the earth's magnetic field in nanoteslas per meter (nT/m). The vertical magnetic gradient is calculated by measuring the total magnetic field with two sensors at different heights, subtracting the top sensor reading from the bottom sensor reading, and dividing by the sensor separation.

Buried ferrous metallic objects give rise to anomalies in the earth's magnetic field. These anomalies are generally dipolar with a positive response south and a negative response north of the object. The dimensions and amplitude of a magnetic anomaly are a function of the size, mass, depth and magnetic properties of the source. Magnetometers are not able to detect nonferrous metals such as aluminum or brass. The magnetometer has the greatest depth of investigation of the instruments applied to this survey.

3 FIELD PROCEDURES

This section describes the field procedures used during the investigation, including site preparation, EM-31, EM-61 and magnetometer survey procedures.

3.1 Site Preparation

Before conducting the geophysical investigation, the extent of the survey area was established by Hydrologue representatives. Various points of a 240 ft by 300 ft grid were set up using a Nikon NPL-362 pulse laser station. Afterwards, a 10- by 10-foot grid was marked on the ground within the survey area with surveyors paint, a 300-ft survey rope and the established grid points. Obvious surface cultural features that could potentially affect the geophysical data (i.e. buildings, fences, etc.) were identified in the field and plotted onto a scaled, hand-drawn site map. Prior to geophysical data collection, a full site utility survey was performed by **GEO***Vision*. The results of the utility survey were marked on the ground and mapped using a Trimble Real-Time Kinematic (RTK) differential GPS system. Various points on the geophysical grid were also surveyed and used to combine the geophysical grid and the utility survey into a single map. A combined site map showing the location of the geophysical survey area, surficial features and results of the utility survey is attached as Figure 1.

3.2 Geonics EM-31 Survey

The EM-31 was assembled and battery levels were checked and found to be within acceptable levels. The EM-31 digital data logger was then programmed with the appropriate file name and sample interval. EM-31 measurements were made at 5 foot intervals along east to west (E-W) survey lines spaced 5 feet apart using the 10-foot grid points for spatial control. The EM-31 data were stored in a digital data logger along with line and station number. If an error was made on a survey line (missed station, etc.), the line was repeated. EM-31 data were downloaded to a laptop computer at the end of the survey using the computer program DAT31W by Geonics Limited.

3.3 Geonics EM-61Mk2A Survey

The EM-61 was assembled and battery levels were checked and found to be within acceptable levels. The EM-61 digital data logger was then programmed with the appropriate file name and sample interval. EM-61 measurements were made at 2.5 foot intervals along east to west (E-W) survey lines spaced 5 feet apart using the 10-foot grid points for spatial control. The EM-61 data were stored in a digital data logger along with line and station number. If a location error was made on a survey line (extra station, etc.), the line was repeated. EM-61 data were downloaded to a laptop computer at the end of the survey using the computer program DAT61MK2 by Geonics Limited.

3.4 Geometrics G858 Survey

Prior to data acquisition, the G858 was programmed with the appropriate sampling interval and grid settings. Measurements of the earth's total magnetic field intensity and vertical gradient data were made with the G-858 at 0.2-second intervals as the operator walked along parallel east to west (E-W) survey lines nominally spaced 5 feet apart. A marker was inserted in the data as the operator crossed a 5 ft grid mark. The 0.2-second sampling interval resulted in an average station spacing of about 0.5 feet. The magnetic data were stored in the internal memory of the magnetometer along with time of measurement. If an error was made on a survey line (wrong survey line, etc.), the line was repeated. Magnetic data were downloaded to a laptop computer at the end of the survey using the program MAGMAP 2000 by Geometrics, Inc.

4 DATA PROCESSING AND INTERPRETATION

This section presents the data processing procedures and interpretation of the geophysical data.

4.1 Data Processing

Color-enhanced contour maps of EM and magnetic data were generated using the Geosoft® Oasis montaj ™ geophysical mapping system. The maps were color-enhanced to aid in the interpretation of subtle anomalies. Prior to map generation, a number of preprocessing steps were completed and included:

- Backup of all original field data files.
- Correcting of all data acquisition errors (typically only deleting the first portion of a reacquired line, renaming lines incorrectly labeled, deleting additional readings outside the grid, etc.)
- Reformatting field data files to free format XYZ files containing line number, station, time (if applicable), and field measurements.
- Applying small adjustments to EM-61 and/or EM-31 station locations to compensate for data being recorded while the operator was walking.
- Merging of multiple data files into a single file and sorting, if necessary.

These data adjustments were made using a combination of commercial and in-house software. All adjustments made to data files and resulting file names were documented and are retained in project files.

The output of the data preprocessing was a data file containing line and station number and the geophysical measurements. These data files were imported into the Oasis montaj® mapping system and the following data processing steps applied:

- Reformatting of data files to Oasis montaj® format
- Generating final map scale
- Gridding data using a 1 to 2.5-foot cell size and down- and cross-line splines
- Masking grid in areas where data not acquired (i.e. around site perimeter, fence locations)
- Applying a Hanning filter to smooth the data, if necessary
- Generating color zone file describing color for different data ranges
- Contouring the data
- Generating map surrounds (title block, legend, scale, color bar, north arrow, etc.)
- Annotating anomalies
- Merging various plot files and plotting final map

The names of the files generated and the processing parameters used were documented and are retained in project files. All files generated during the processing sequence were archived on a backup drive.

4.2 Interpretation

Color-enhanced contour maps of the EM-61 Channel 3 (CH3) response and the EM-31 in-phase response are presented as Figures 2 and 3, respectively. Color-enhanced contour maps of the EM-31 conductivity response, EM-61 differential response and magnetic responses were also generated. These maps are not presented as they did not reveal additional information and were, therefore, considered redundant. The color bar indicates the amplitude of the measured quantity with the magenta and cyan colors representing high and low amplitudes, respectively. The light orange, yellow and light green colors indicate average "background" values of the measured quantity.

Areas covered by reinforced concrete had a severe impact on the EM-31 and EM-61 data responses. The reinforced concrete effectively masked any other responses in the EM-31 and EM-61 data.

Several surface anomalies imaged in the data were caused by surface metallic debris. These anomalies are labeled with “SM” on the respective contour maps.

There are several anomalies in the EM data that are interpreted as being caused by small buried metallic objects/debris. These anomalies are labeled with a “B” or a red dot on the color-enhanced contour maps (Figures 2 and 3) and the site map (Figure 1). Many of these anomalies are likely associated with former infrastructure debris or other discarded objects. No attempt was made to identify all of these anomalies on the color contour maps. Any unmarked anomalies are likely caused by very small sources and will have very little impact on future construction activities.

There are two anomalies in the EM data that are interpreted as being caused by large buried metallic objects/debris. The anomalies are identified with boxes and are labeled “BM” on the site map and the EM color-enhanced contour maps (Figures 1, 2 and 3). Both of these anomalies are located in close proximity to the buildings in the north. These anomalies are likely related to subsurface infrastructure or unmapped areas of reinforced concrete. Both anomalies give rise to large, positive EM-61 CH3 responses and strong, negative EM-31 responses. The EM-31 responses are not continuous throughout each zone. This may indicate that the sources of the anomalies are not from a single, large metallic object, but rather multiple objects/debris.

There are several anomalies in the EM data that are interpreted as being caused by underground pipes or other linear subsurface infrastructure. Many of these anomalies coincide with mapped utilities located during the utility location survey conducted prior to this investigation. In locations where the interpreted underground pipelines and the mapped utilities do not agree (line extensions, etc.), the interpreted pipelines are labeled “IP” on the site map (Figure1).

There are two additional anomalies interpreted in the EM data that warrant further discussion. These anomalies are located in the northeastern portion of the site and are labeled A-1 and A-2. Both of these anomalies are located south of an area containing reinforced concrete and south of the building. These anomalies give rise to strong, positive

EM-61 CH3 responses and strong, negative EM-31 in-phase responses. The negative EM-31 in-phase responses also have positive responses surrounding them. The lack of a single, coherent negative response with clear positive shoulders indicates that these anomalous zones may consist of multiple buried objects or a single object that changes orientation. Each anomalous zone is coincident with metallic access lids seen at the surface. A limited visual field inspection indicated that the lids lead to a large vault/junction access. Anomalies A-1 and A-2 may be associated with the extents of the vault/junction access locations. However, due to the presence of the nearby reinforced concrete, the extents of anomalies A-1 and A-2 may be obscured to the north and may further continue beneath the reinforced concrete slabs.

5 CONCLUSIONS

A geophysical investigation was conducted on March 30th, 2010 at the Pasadena Power Plant located on 85 East State Street in Pasadena, California. The purpose of the investigation was to screen an approximate 1.5 acre area for metallic subsurface infrastructure that may interfere with future construction. Interpretation of the geophysical data and the results of the utility survey conducted prior to this investigation are presented in Figure 1. Color-enhanced contour maps of the EM-61 CH3 response and EM-31 in-phase response are presented as Figures 2 and 3, respectively. Several buried metallic objects/debris were indentified in the EM data. These anomalies may be associated with former subsurface infrastructure or other debris. There are also several very small buried metallic objects that are unmarked on each of the color contour maps. These objects should not have any impact on construction activities at the site.

There are two additional geophysical anomalies identified in the EM-61 and EM-31 data that may be associated with larger buried metallic objects/debris. The anomalies are labeled as "BM" on the color contour maps and maybe related to subsurface infrastructure or unmapped reinforced concrete. However, because the exact source of these larger anomalies is unknown, consideration should be given to uncovering the anomalies to determine their source. Several pipes and other subsurface linear anomalies were identified in the EM data. These anomalies are likely related to former building footprints and abandoned subsurface utilities.

Additionally, two anomalies, labeled A-1 and A-2, are identified in the EM-61 and EM-31 data. These anomalies may be caused by underground vault/access structures related to the metallic lids on the surface of the area the area. The full extent of these anomalies may be masked by the presence of nearby reinforced concrete. The reinforced concrete may also mask further subsurface structures in the survey area.

The geophysical survey was designed to map metallic, subsurface infrastructure with dimensions of greater than 5 feet. It is our opinion that the geophysical survey was appropriately designed to locate such objects less than about 8 feet deep; except in portions of the survey area where data was affected by surface structures, such as excavations, fences, other large surface metallic objects and areas with reinforced concrete.

6 CERTIFICATION

All geophysical data, analysis, interpretations, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a **GEO*Vision*** California Professional Geophysicist.

Prepared by



04/14/10

William Dalrymple Date
Project Geophysicist
GEO*Vision* Geophysical Services

Reviewed and approved by

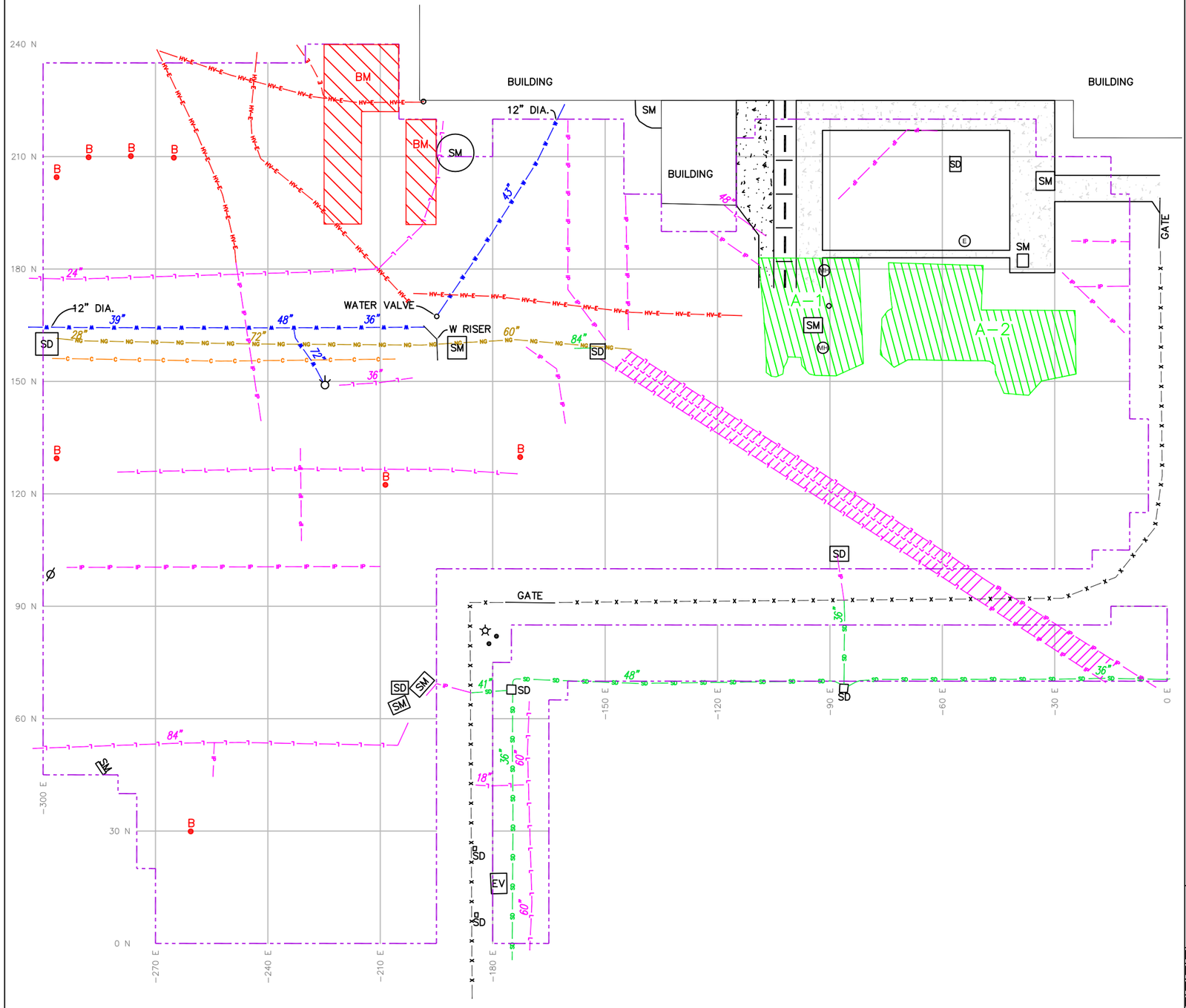


04/14/10

Mark Riches Date
California Professional Geophysicist, P. GP. 1025
GEO*Vision* Geophysical Services

* This geophysical investigation was conducted under the supervision of a California Professional Geophysicist using industry standard methods and equipment. A high degree of professionalism was maintained during all aspects of the project from the field investigation and data acquisition, through data processing interpretation and reporting. All original field data files, field notes and observations, and other pertinent information are maintained in the project files and are available for the client to review for a period of at least one year.

  A professional geophysicist's certification of interpreted geophysical conditions comprises a declaration of his/her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations or ordinances.



LEGEND

0 N, 0 E	RELATIVE COORDINATE SYSTEM OF GEOPHYSICAL SURVEY AREA
	BOUNDARY OF GEOPHYSICAL SURVEY AREA
	FENCE
	RAILROAD TRACKS
	REINFORCED CONCRETE
	METAL GUARD POST
	EXPOSED METAL PIPE
EV	ELECTRIC UTILITY VAULT
SD	STORM DRAIN GRATE
SM	SURFACE METALLIC OBJECT / DEBRIS
	POWER POLE
	LIGHT POLE
E	ELECTRIC MANHOLE
MH	UNKNOWN UTILITY MANHOLE
	FIRE HYDRANT
A-1	ANOMALY AS DISCUSSED IN REPORT
BM	LARGE BURIED METALLIC OBJECT / DEBRIS
B	SMALL BURIED METALLIC OBJECT / DEBRIS

UNDERGROUND CONDUIT AND TRENCH WITH DEPTHS TO TOP OF PIPE WHERE AVAILABLE (SD AND SS INVERT DEPTH).

E — E — E	E = ELECTRIC
HV-E — HV-E	HV-E = HIGH VOLTAGE ELECTRIC
C — C — C	C = COMMUNICATION
NG — NG — NG	NG = NATURAL GAS
W — W — W	W = WATER
SD — SD	SD = STORM DRAIN
L — L — L	L = UNKNOWN
IP — IP — IP	IP = INTERPRETED UNDERGROUND PIPE / UTILITY
	L = UNKNOWN TRENCH
	IP = INTERPRETED TRENCH

0 15 30 45
(feet)

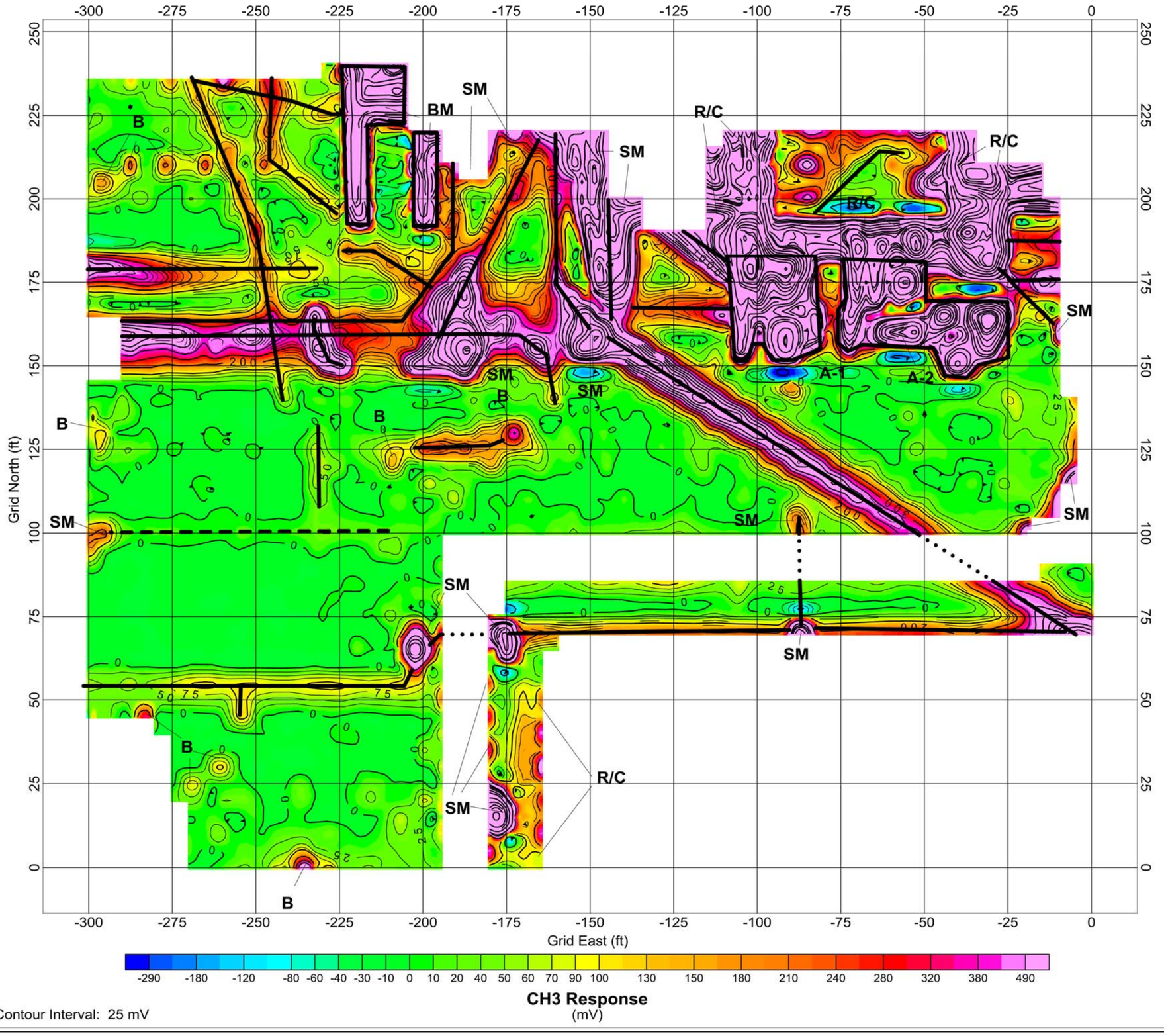
GEOVision geophysical services

Project #	10105
Date	Apr 15,2010
Developed by	M RICHES
Drawn by	T RODRIGUEZ
Approved by	
G:\10105\10105-1.dwg	

FIGURE 1
SITE MAP WITH GEOPHYSICAL INTERPRETATION

PASADENA POWER PLANT
85 EAST STATE AVENUE
PASADENA, CA

PREPARED FOR
HYDROLOGUE, INC.



Contour Interval: 25 mV

Grid North

Legend

A-1	Anomaly as Discussed in Report
———	Interpreted Underground Linear Object or Utility Dotted Where Interpolated
- - -	Possible Interpreted Underground Pipe/Utility
B	Small Buried Metallic Object
BM	Large Buried Metallic Object
R/C	Reinforced Concrete
SM	Surface Metallic Object

25 0 25 50
(feet)

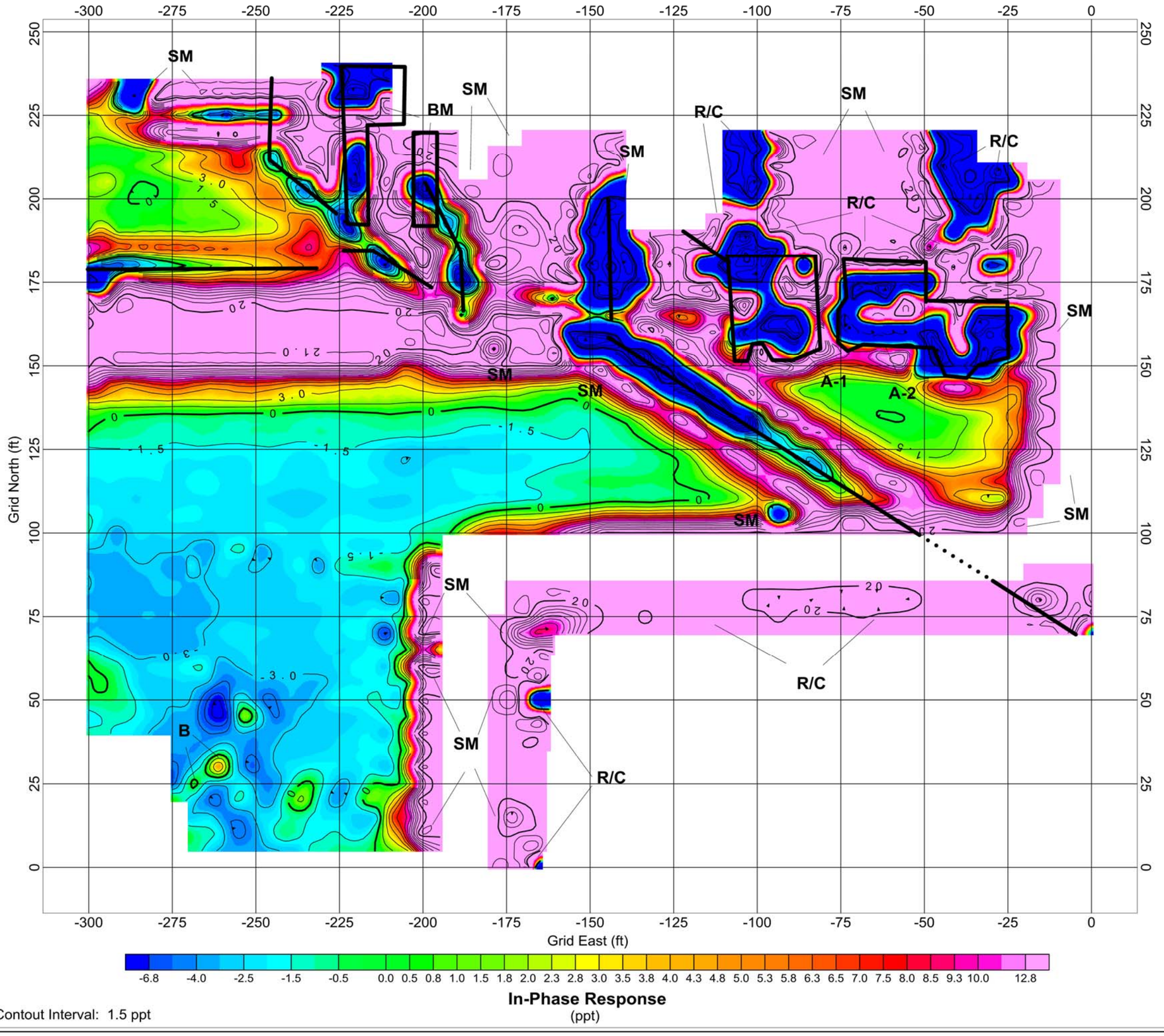
GEOVision geophysical services

Figure 2

EM-61Mk2A CH 3 Response
GV Project No. 10105

Pasadena Power Plant
85 East State Street
Pasadena, California

Prepared for Hydrologue, Inc.



Contout Interval: 1.5 ppt

Grid North

Legend

A-1	Anomaly as Discussed in Report
▬	Interpreted Underground Linear Object or Utility Dotted Where Interpolated
B	Small Buried Metallic Object
BM	Large Buried Metallic Object
R/C	Reinforced Concrete
SM	Surface Metallic Object

25 0 25 50
(feet)

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Figure 3

EM-31 In-Phase Response
GV Project No. 10105

Pasadena Power Plant
85 East State Street
Pasadena, California

Prepared for Hydrologue, Inc.

APPENDIX A

GEOPHYSICAL TECHNIQUES FOR SHALLOW ENVIRONMENTAL INVESTIGATIONS

GEOVision geophysical services

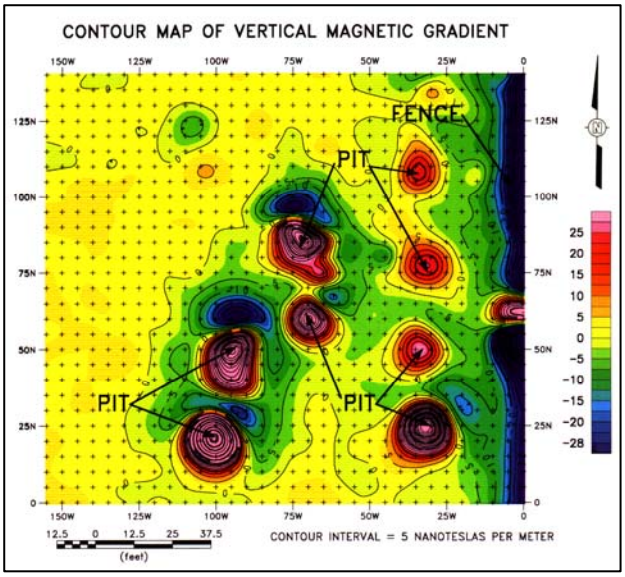
MAGNETIC METHOD

The magnetic method generally involves the measurement of the earth's magnetic field intensity or vertical gradient of the earth's magnetic field. Anomalies in the earth's magnetic field are caused by induced or remanent magnetism. Induced magnetic anomalies are the result of secondary magnetization induced in a ferrous body by the earth's magnetic field. The shape and amplitude of an induced magnetic anomaly is a function of the orientation, geometry, size, depth, and magnetic susceptibility of the body as well as the intensity and inclination of the earth's magnetic field in the survey area. The magnetic method is an effective way to search for small metallic objects, such as buried ordnance and drums, because magnetic anomalies have spatial dimensions much larger than those of the objects themselves. Typically, a single buried drum can be detected to a depth of about 10 feet. Larger metallic objects can often be located to greater depths. Induced magnetic anomalies over buried objects such as drums, pipes, tanks, and buried metallic debris generally exhibit an asymmetrical, south up/north down signature (positive response south of the object and negative response to the north).

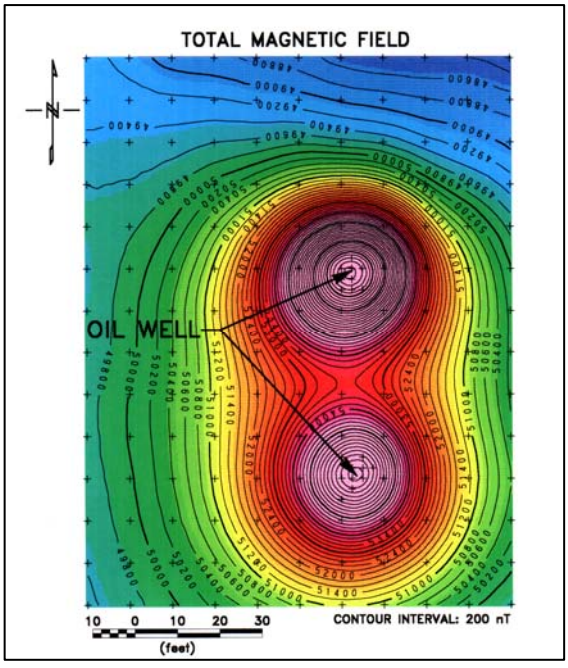


Geometrics G858 Cesium Magnetic Gradiometer

Magnetic data is typically acquired along a grid with results being presented as color-enhanced contour maps generated by the Geosoft™ Mapping System or OASIS montaj. The approximate location and depth of magnetic objects can be calculated using the Geosoft™ UXO System.



Magnetic Survey to Locate Pits Containing Buried Metallic Containers



Magnetic Survey to Locate Abandoned Oil Wells

Magnetic surveys are typically conducted to:

- Locate abandoned steel well casings
- Locate buried tanks and pipes
- Locate pits and trenches containing buried metallic debris
- Detect buried unexploded ordnance (UXO)
- Map old waste sites and landfill boundaries
- Clear drilling locations
- Map basement faults and geology
- Investigate archaeological sites

1124 Olympic Drive, Corona, California 92881, ph. 951-549-1234, fx. 951-549-123 www.geovision.com

ELECTROMAGNETIC METHODS

Electromagnetic (EM) methods typically applied to shallow environmental investigations include frequency domain EM methods, such as EM induction and EM utility location methods, time domain electromagnetic (TDEM) metal detection methods, and ground penetrating radar (GPR) methods.

EM Induction Method

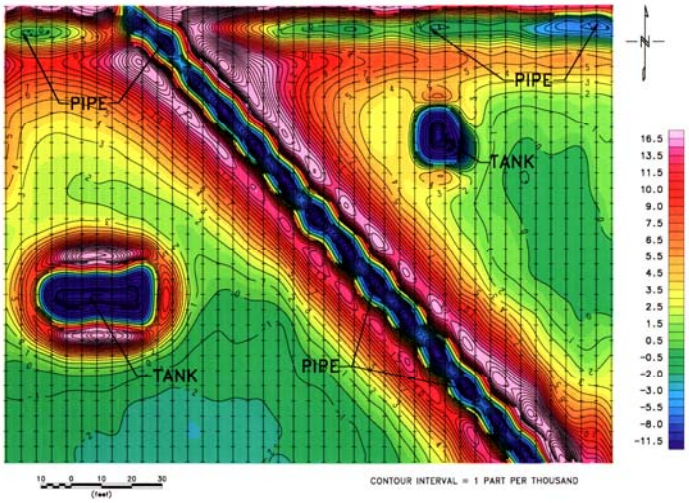
EM induction surveys are often conducted using the Geonics EM-31 terrain conductivity meter (EM-31). The EM-31 consists of a transmitter coil mounted at one end and a receiver coil mounted at the other end of a 3.7-meter long plastic boom. Electrical conductivity and in-phase component field strength are measured and stored along with line and station numbers in a digital data logger. In-phase component measurements generally only respond to buried metallic objects; whereas conductivity measurements also respond to conductivity variations caused by changes in soil type, moisture or salinity and the presence of nonmetallic bulk wastes. The EM-31 must pass over or immediately adjacent to a buried metallic object to detect it. Typical EM-31 anomalies over small, buried metallic objects consist of a negative response centered over the object and a lower amplitude positive response to the sides of the object. When the instrument boom is oriented parallel to long, linear conductors such as pipelines a strong positive response is observed. The EM-31 can explore to depths of about 6 meters, but is most sensitive to materials about 1 meter below ground surface. Single buried drums can typically be detected to depths of about 5 feet.



Geonics EM-31 Terrain Conductivity Meter

EM-31 surveys are typically conducted to:

- Locate buried tanks and pipes
- Locate pits and trenches containing metallic and/or nonmetallic debris
- Delineate landfill boundaries
- Delineate oil production sumps and mud pits
- Map conductive soil and groundwater contamination
- Map soil salinity in agricultural areas
- Characterize shallow subsurface hydrogeology
  - Map buried channel deposits
  - Locate sand and gravel deposits
  - Locate conductive fault and fracture zones



Geonics EM-31 Survey to Locate Underground Storage Tanks



EM Utility Location Methods

EM utility locators; such as the Metrotech 810, Metrotech 9890 and Radiodetection RD400, are designed to accurately trace metallic pipes and utility cables and clear drilling/excavation locations. These utility locators consist of a separate transmitter and a receiver. The transmitter emits a radio frequency EM field that induces secondary fields in nearby metallic pipes and cables. The receiver detects these fields and is used to accurately locate and trace the pipes, often to distances over 200 feet from the transmitter. Many of the utility locators have a passive 60Hz mode to locate live electrical lines. Modern utility locators are also capable of providing rough depth estimates of the pipes.

Metrotech EM Utility Locator

1124 Olympic Drive, Corona, California 92881, ph. 951-549-1234 fx. 951-549-123 www.geovision.com

TDEM Metal Detection Methods

A Geonics EM-61 (EM-61) is a high sensitivity, time-domain, digital metal detector which is often used to detect both ferrous and non-ferrous metallic objects. It is designed specifically to locate buried metallic objects such as drums, tanks, pipes, UXO, and metallic debris and to be relatively insensitive to above ground structures such as fences, buildings, and vehicles.

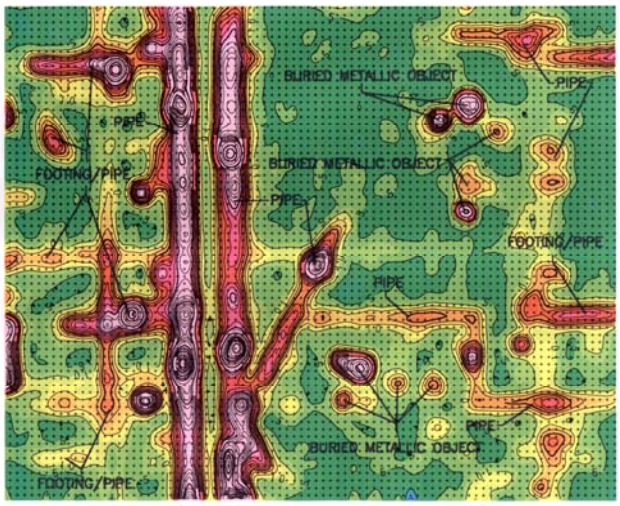


Geonics EM-61 Digital Metal Detector

The EM-61 consists of two square, 1-meter coils, one mounted over the other and arranged on a hand-towed cart. The bottom coil acts as both a transmitter and receiver while the top coil is a receiver only. While transmitting the bottom coil generates a pulsed primary magnetic field, which induces eddy currents into nearby metallic objects. When the transmitter is in its off cycle both coils measure the decay of these eddy currents in millivolts (mV) with the results being stored in a digital data logger along with position information. The decay of the eddy currents is proportional to the size and depth of the metallic target. A symmetrical positive anomaly is recorded over metallic objects with the peak centered over the object.

The signal from the top coil is amplified in such a way that both coils record effectively the same response for a metallic object on the surface and the top coil records a larger response for buried metallic objects. The response of near surface objects can, therefore, be suppressed by subtracting the lower coil response from the upper coil response (differential response).

In practice, the usable depth of investigation of the EM-61 depends on the size and shape of the object and the amount of above ground interference encountered at the site. A single buried drum can often be detected at a depth of about 10 feet.



Geonics EM-61 Survey to Map Subsurface Infrastructure

GPR Methods

Ground-penetrating radar (GPR) is a high-frequency electro-magnetic method commonly applied to a number of engineering and environmental problems.



GSSI SIR-10A GPR Unit

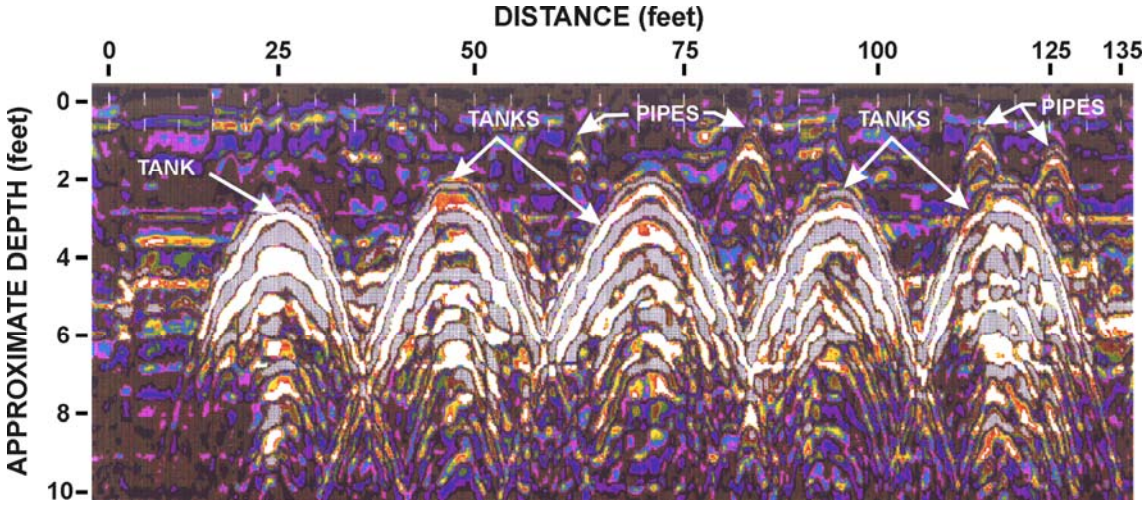
A GPR system radiates short pulses of high-frequency EM energy into the ground from a transmitting antenna. This EM wave propagates into the ground at a velocity that is primarily a function of the relative dielectric permittivity of subsurface materials. When this wave encounters the interface of two materials having different dielectric properties, a portion of the energy is reflected back to the surface, where it is detected by a receiver antenna and transmitted to a control unit for processing and display.

Depth penetration is a function of antenna frequency and the electrical conductivity of the soils in the survey area. Lower frequency antennas achieve greater depth penetration than higher frequency antennas, but have poorer spatial resolution. Conductive soils, such as clays, attenuate the radar waves much more rapidly than resistive dry sand and rock. In many environments in California, depth penetration of 500 and 300 MHz antennas is limited to 3 to 5 feet. Depth penetration may be greater if shallow soils consist of clean sands and less if shallow soils consist of clay.

GPR surveys are typically conducted to:

- Locate and delineate underground storage tanks (metallic and non-metallic)
- Locate metallic and nonmetallic pipes and utility cables
- Map rebar in concrete structures
- Map landfill boundaries
- Delineate pits and trenches containing metallic and nonmetallic debris
- Delineate leach fields and industrial cribs
- Delineate previously excavated and backfilled areas
- Map shallow groundwater tables
- Map shallow soil stratigraphy
- Map shallow bedrock topography
- Map shallow subsurface voids and cavities
- Characterize archaeological sites

Geophysical Survey Systems Inc. (GSSI) SIR-2 or SIR-10 GPR systems with antennas in the frequency range of 50 to 1,000 MHz are often used during GPR investigations. Mala Geoscience and Sensors and Software, Ltd also manufacture GPR systems. GPR data is processed using a variety of software including the RADAN™ or GRADIX software packages by GSSI and Interpex Ltd., respectively.



GPR Survey to Locate Underground Storage Tanks

hydrologue, Inc.
Consulting Engineers & Geologists *http://www.hydrologue.com*
Remediation Engineering *Hazardous Substances* *Geology and Hydrogeology* *Geotechnical Engineering*

August 1, 2011 Project No. 3626-04-01

Mr. Dan Angeles
City of Pasadena
Water and Power Department
85 East State Street
Pasadena, California 91105-3418

SUBJECT: Soils Engineering Investigation
Proposed Glenarm Repowering Project
(GT-5 Combined Cycle Installation)
City of Pasadena Power Plant
Southeast corner of Fair Oaks Avenue and East Glenarm Street
Pasadena, California

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Dear Mr. Angeles:

This report presents information gathered during our investigation and our opinions regarding the soils engineering factors affecting the construction of the proposed Glenarm Repowering Project (GT-5 Combined Cycle Installation) (Figures 3 & 4) at the southeast corner of the intersection of South Fair Oaks Avenue and Glenarm Street in the City of Pasadena, California (hereinafter referred to as "Site") (Figure 1). This investigation was performed from June 8, 2011 through August 2011 in conformance with the Pasadena Water & Power, Glenarm Repowering Project, GT-5 Combined Cycle Installation, Geotechnical Requirements, prepared by Power Engineers, dated May 3, 2011, and consisted of field exploration, laboratory testing, engineering analysis of the field and laboratory data, and preparation of this report.

DESCRIPTION OF SITE

The Site is located at the southeast corner of the intersection of South Fair Oaks Avenue and East Glenarm Street in Pasadena, California (Figure 1). The Site was first developed at the turn of the century with the existing warehouse building in its southwest comer. The Site now contains an inactive oil-and-natural-gas-fired electric generating station used by the Pasadena Water and Power Department from 1906 through 1977.

In 1906, Pasadena Water and Power Department constructed the original steam-plant building. The facility was demolished before construction of the tank farm in 1971. The existing non-operational steam plant occupies the Site's north side and currently consists of two attached buildings, including the eastern building, constructed in the early 1920s, and the western building, constructed in the early 1930s. Each of the existing buildings includes boiler and turbine generator areas. Both systems in the west building remain in place but Pasadena Water and Power Department removed the systems from the east building during the 1950s. Pasadena Water and Power Department later installed a few machine tools in the former boiler area of the east building. Some of those machine tools remain.

The topography of the Site is relatively flat. Mixed property uses surround the Site and include the Gold Line right of way (ROW) and the Water and Power Department Broadway Steam Plant to the east, a Southern California Edison substation and Water and Power Department Electrical and Maintenance shop to the south, and several commercial businesses to the west. Residential areas of Pasadena and South Pasadena are within 1,000 feet west and south of the Site, respectively. The Metropolitan Transit Authority presently owns the railroad Gold Line ROW along the east property boundary.

PROPOSED DEVELOPMENT

We understand that the proposed project consists of the construction of the Glenarm Repowering Project (GT-5 Combined Cycle Installation) (Figure 4). We also understand that the proposed stacks are approximately 12 feet in diameter and 125 feet high. Total approximate live and loads for Steam and Gas Turbine generators are 1,300 and 620 kips, respectively. The approximate total horizontal earthquake load for each turbine system and stack is about 205 kips. The approximate total wind loads for each turbine system and stack are 130 and 65 kips.

The project will consist of one Combustion Turbine Generator (CTG), one Steam Turbine Generator STG, once Through Steam Generator OTSG, OTSG Stack, Transformer, fuel gas compressor, Cooling Towers and associated equipment, driveways, and a parking lot. Some of the equipment will be subject to vibrations. Based on the available information, we understand that most of the structures and equipment will be constructed at or near the level of the existing ground surface. No basements or other underground structures are planned. We understand that major equipment and structures are planned to be supported on large concrete mats.

FIELD EXPLORATION

Subsurface conditions were explored by drilling 10 soil borings; 3 to a depth of 60 feet below ground surface (bgs), and seven to 50-feet bgs. Soil borings were placed in the vicinity of the requested boring locations by Power Engineers, Inc. Soil borings were drilled by R & C Drilling using a drilling rig equipped with hollow-stem augers to observe and sample the materials that will provide foundation support for the proposed equipment (Figure 4). Soil samples were collected at 5 foot intervals from each boring using six 2½-inch diameter by 1-inch long and two 2½-inch diameter by 3-inch long brass tubes mounted within a 2½-inch inside diameter Modified California split-spoon drive sampler. A Hydrologue geologist supervised drilling operations and logged all soil borings in accordance with the Unified Soil Classification System (Appendix A). Additionally, a Standard Penetration Test was performed at each sampling interval using a Standard Split Spoon Sampler. The blow count for each 6-inch penetration of the Standard Sampler was recorded in the boring logs. The number of blows required for the last 12-inch penetration of the Standard Split Spoon Sampler into the formation is the SPT blow counts.

The sampler was attached to sampling rods, lowered to the sampling depth, and then was driven 18-inches into the formation. Blow counts per last 12-inch of penetration of the sampler were recorded to evaluate the consistency of the formation. No groundwater was encountered during drilling. Undisturbed and bulk samples of the soils were collected from within the boreholes. The undisturbed soil samples were sealed immediately in water-tight containers for shipment to our laboratory for geotechnical testing.

SOIL CONDITION

Fill

Man-made fill was encountered to a depth of approximately 5 to 10 feet below ground surface (bgs) in the exploratory borings. The man-made fill consists of dark brown to brown clay, and silty sand in moist and moderately compact conditions. Deeper man-made fill may be present in unexplored areas of the Site.

Natural Ground

The Site is underlain by stream channel deposits of gravel, sand and silt (Qg) and alluvial fan outwash from major canyon grades northward into Q_a. The Site appears to be within the northern terminus of the Alhambra Wash. The Qg deposits underlying the Alhambra Wash intersect a concealed portion of the Eagle Rock Fault. According to Figure 16, the north side of the Site is covered with Holocene young Alluvial Fan Deposits, Qyf1, while the southeast of the Raymond Hills is covered with Pleistocene Alluvial Fan Deposits, Qof3gs. Raymond Hill and Grace Hill are mapped as pre-Quaternary bedrock. The Eagle Rock Fault is described in the following sections.

According to the Geologic Map of the Pasadena Quadrangle by Thomas W. Dibblee, Jr. dated 1989 (Figure 6), adjacent to the east and north sides of the Site is Q_a and west side of the Site is alluvium Q_{of} consisting of older dissected surfacial sediment alluvial fans from San Gabriel Mountains.

At the Site, beneath the man-made fill, brown to brown sandy silt, olive brown gravelly sand, and silty sand and in moist and moderately dense to dense conditions were encountered.

PHYSICAL SITE LOCATION

The coordinates of the Site are approximately 118.1494° west longitude, 34.1268° north latitudes. The Site is located at an elevation of approximately 752 feet above Mean Sea Level (MSL). The local surface drainage and topographic pattern is generally to the southeast and locally to the east, with a local topographic gradient of approximately 0.01 foot/foot, toward the east (Figure 1).

GEOLOGIC SETTING

The Pasadena Power Plant (Site) is located along the northeastern side of the Raymond Hills and eastern side of Grace Hill at the terminus of the Alhambra Wash in the southern portion of the City of Pasadena within Raymond Basin, a structurally elevated low relief surface lying to the northwest of the prominent San Gabriel Basin. The Raymond Basin is a triangular shaped alluvial plain that abuts the steep and high San Gabriel Mountains to the north and the moderate relief San Rafael Hills to the west. The active Raymond Fault forms its south-southeast boundary and separates the Raymond and San Gabriel Basins.

The Pasadena/Altadena/Sierra Madre areas are considered seismically active, where moderate sized earthquakes occur infrequently and active and potentially active faults abound. The east-west trending San Gabriel Mountains rises more than one mile above the basin floor with the steep southerly flank of the range, representing a recessed fault scarp of the Sierra Madre Fault zone. The north side of the San Gabriel Mountains is bounded by the active San Andreas Fault and represents the main boundary between the North American and Pacific tectonic plates. The Raymond Fault is trending east-northeast, a branch, and closely related to the Sierra Madre Fault that separates the Raymond and San Gabriel Basins. All of these faults have ruptured historically and have produced moderate to major earthquakes.

As a result of the continued movement between the plate boundaries, major north to south compressive forces are created across the region. These have resulted in uplift of mountains and chains of hills and depressed adjoining basins shaping a sequence of east-west trending uplands which collectively form the Transverse Ranges Physiographic Provence of Southern California. The adjacent basin floors are filled as a result of the uplands erosion and transport of sedimentary deposits. In the vicinity of the Site, alluvium of Pleistocene and Holocene age (Figure 16) was deposited by rivers and streams flowing south from the San Gabriel Mountain San Rafael Hills. The San Rafael Hills are characterized by small- and medium-sized rounded hills and intervening valleys. These drainages migrated back and forth, forming broad coalescing alluvial fans. Today the Raymond Basin is filled with several hundred feet of alluvial materials. Underlying the alluvium is a thick sequence of Tertiary age sedimentary rocks and below that is basement rock composed of granitic intrusive rocks of Mesozoic age and pre-Cambrian(?) metasediments (Figure 9). The depth to basement rock varies from a few feet near the mountain and hill front to nearly 2000 feet in the southerly portion of the basin.

A major geomorphic feature in the area is the Arroyo Seco, which extends through Pasadena down the west-central part of the area and veers southwesterly near the Pasadena/South Pasadena City boundary. The Arroyo Seco is a steep-walled, flat-floored ravine about 500 to 1,000 feet wide and 50 feet deep. The arroyo widens into a relatively flat plain in South Pasadena. This change in relief is related to the Raymond Fault scarp, which crosses the area on the southern side of Raymond Hill, on the south side of Pasadena Power Plant as a result of vertical displacement on the Raymond Fault. Relief across the scarp is about 40 or 50 feet, but has been highly modified by urban development.

The San Gabriel Valley, which encompasses the southeastern side of Raymond Basin, is essentially a flat, gently south-sloping surface consisting of ancient (Pleistocene age) alluvial fans, flood plain, and basin fill alluvium. Elevations in the northern part of the Valley are in the 800- to 900-foot range, whereas in the south, elevations are in the 400- to 500-foot range. The flatness of the San Gabriel Valley surface is interrupted by several small hills and knolls which are outliers of the Repetto and San Rafael Hills. The largest of these hills is Raymond Hill, which is about 90 feel high. A smaller knoll just northwest of Raymond Hill is called Grace Hill (Figure 7). The other knolls are not named and are relatively subtle features that go largely unnoticed by the general public. Because of the bedrock exposures, these small knolls are important for understanding the geology of the region.

STRATIGRAPHY

The majority of rocks in the area consist of Tertiary age (16 million years old) marine sedimentary rocks of Topanga Formation (Figures 8 and 9). It is important to recognize that the geologic profiles in Figure 9 and 10 are idealized and simplified to represent the entire area. The south of the area consists primarily of rock formations, whereas the east, west and north sides of the area have thick alluvial deposits over the rock formations at depth.

Quaternary-age alluvium occurs at the Site proximity to a depth of approximately 200 feet thick (190 feet at R-09Z3B3), and at the south side of the Site in the Raymond Hill area where it is much thinner and on the order of 0 to 50 feet (43 feet at R-09-Z3B6). Alluvium at the proximity of the Site consists of clay, silt, and sand with a major component of gravels and cobbles and some boulders, all composed of igneous and metamorphic rocks.

The principal formation in the southernmost portion of Figure 7 is the Fernando Formation, which consists of soft and weak, massive claystone and siltstone. The Fernando Formation overlies the Puente Formation in the southern part of Figure 7. The contact is sharp and possibly unconformable (Dibblee, 1992).

The sedimentary rock at the proximity of the Site is composed of the Topanga Formation and includes a wide variety of rock types ranging from coarse-grained rocks such as breccia, conglomerate, and sandstone to fine-grained sandstone and siltstone with minor claystone (mudstone). The part of the Topanga Formation north of the Raymond Fault is predominantly sandstone, conglomerate, and breccia. The Topanga Formation also has intrusive volcanic rocks. For example, a 10-foot-thick zone of hard volcanic rock was encountered in previous Caltrans study within boring EMI-2, drilled immediately south of the Raymond Fault.

The bedrock on the northern side of the Site, north of the San Rafael Fault, consists of the Cretaceous age (approximately 120 to 160 million years ago) basement complex that is generally mapped in exposures of the San Rafael Hills as Wilson Diorite or Quartz Diorite (Dibblee, 1989c; Lamar, 1970).

AREA GROUNDWATER CONDITIONS

The Raymond Basin and San Gabriel Basin have been extensively utilized for groundwater resources. Water wells drilled in both basins have produced good aquifer data necessary for the groundwater depth and flow direction determination. Groundwater is resupplied to the Raymond Basin from surface runoff in the San Gabriel Mountains. The Raymond Fault to the south forms a very effective groundwater barrier causing groundwater to cascade over the fault and fall about 200 feet.

The groundwater surface elevation ranges from about 1,400-feet near the mountain front in the north to 450-feet near the Raymond Fault. In the past, springs and small ponds have formed to the south of the Raymond Fault scarp. The groundwater in the basin is unconfined and has a southeast

gradient of 0.02- to 0.06- foot per foot. Perched groundwater was not encountered to the depth explored at the Site (60 feet bgs). Reported highest groundwater depth at the Site proximity was about 50 feet bgs. Reported groundwater depth by a Caltrans consultant on the south side of the Site (south of San Rafael Fault in boring R-09-Z3B6) was 51.2 and on the north side of the Site was 136 feet (north of San Rafael Fault in boring R-09Z3B3). Both borings were converted to piezometers after drilling.

SITE GROUNDWATER

Groundwater was not encountered at the Site to the depth explored (60 feet bgs). Based on the Los Angeles County Department of Public Works (LACDPW), the closest active well near the Site is Well # 4057H (personal communication with Miguel Osorio of LACDPW, December 17, 2009), located two blocks northeast of the Site at the intersection of Ohio Street and South Euclid Avenue. The depth to groundwater was measured at approximately 120.7 feet bgs on May 10, 2004. Ground surface elevation at this well is about 750 feet above mean sea level (MSL).

The closest inactive well near the Site is Well # 4056C, located near the railroad track at the intersection of Thomas Guide Grid Lines 6 and 7 (just south of Fillmore Street). The depth to water was last measured at approximately at 164.3 feet bgs on October 25, 1974. The ground surface elevation at this well is about 757.8 feet above MSL.

A groundwater well was discovered beneath a concrete block and slab during the demolition activities at the vicinity of then proposed gas turbine generators GT1 and GT2 at the Site. The demolition contractor excavated the perimeter of the well to approximately 15 feet below ground surface using a backhoe. A 12-inch steel conductor casing and a 2-inch diameter steel inner pipe was observed. The gap between the inner pipe and outer casing was filled with soil but the inner pipe was found open and the depth to water was measured by the contractor using a measuring tape and found to be about 85 feet below ground surface (bgs) with at least 5 feet of water. This is consistent with the depth to water reported by the LACDPW measured on May 16, 2002 from the nearby Well # 4057H.

TECTONIC SETTING

Tectonic processes (faulting and earthquakes) are very active in the Site region. Figures 6, 7, 12 and 13 show the Site location relative to the known active and potentially active faults. Obviously, the closer a site is to an active fault, the greater potential there is for surface rupture and high earthquake ground motions. The Site does not lie close to any known active fault capable of surface fault rupture. However, the queried and buried trace of the San Rafael Fault is shown to cross the northeastern corner of Jacob Parking Lot (Figure 14). It should be noted that, on Figure 6, the fault is shown to cross through the Pasadena Power Plant entering from the west and exiting from southeast corner along the Alhambra Wash.

The faults that trend mostly to the east-west are those associated with the Transverse Ranges. They produce mostly reverse (thrust) movement along north dipping planes which trend along southerly

facing upland flanks. The active thrusts in the region include the Sierra Madre, Cucamonga, Raymond, and Santa Monica-Hollywood Faults. Another type of thrust fault is a blind thrust, these faults also are associated with the same process that elevated the Transverse Ranges, but the fault has been remained buried and undetectable unless it produces an earthquake. The Raymond Fault, projecting along the south side of the Raymond Basin, at one time, may have been a blind thrust but because of continued activity it ruptured the ground surface.

The dominant fault system in the region is associated with the San Andreas Fault zone. The system moves in a right lateral northwest trending direction with locally some vertical movement. The San Jacinto, Whittier-Elsinore, Newport-Inglewood, Palos Verdes and Mojave Desert faults are coupled with the San Andreas (plate boundary) system. All of these faults have ruptured historically and produced moderate to major sized earthquakes.

STRUCTURAL GEOLOGY

As shown in Figures 9 and 10, the geologic strata are deformed into a series of folds and faults. Most of the folds and faults are continuations of geologic structures in the Santa Monica Mountains and the Elysian Hills to the southwest. These structures trend southeasterly through the Repetto Hills and continue below the flat-lying Quaternary alluvium of the San Gabriel Valley. The major folds are the Elysian Park Anticline and the South Pasadena Anticline.

The folding shown in Figures 9 and 10 is generalized and simplified. In reality, there are numerous small-scale folds within the larger fold trends. Frequent changes in bedding orientation due both to folding and faulting should be expected at depths.

Many of the faults are intra-formational features, meaning that the faults offset rocks of the same type. However, some of the faults could comprise highly fractured or clayey gouge zones.

One seismic reflection profiles, Z3-G1 was conducted by Caltrans at the proximity of the Site on the north side of San Rafael Fault Trace. Line Z3-G1 has a length of 1,912 ft.

LINE Z3-GL

The processed P-wave seismic section for Line Z3-G1 with interpretation is presented in Figure 11. Surface wave soundings were conducted in the northern and southern portions of seismic line Z3-G1. The S-wave velocity models for these soundings are very similar indicating that there may not be significant lateral velocity variation in the immediate vicinity of the seismic line. There is only about 15 feet (4.5 m) of elevation change along the seismic line and groundwater depth may not be highly variable. Therefore, the velocity assumptions and the groundwater depth estimate may represent actual Site conditions.

A sub-horizontal, continuous seismic reflector possibly associated with the top of bedrock or weathering contact within bedrock is interpreted between approximately 175 to 270 feet on the line

Z3-G1 seismic section (Figure 11). This reflector appears too deep for groundwater or the bedrock surface, which were encountered in the area at about 148 feet (45 m) and 185 feet (56 m), respectively. Assuming some lateral velocity variation in P-wave velocity across the Z3-G1, the reflector may be associated with the top of crystalline bedrock but could also be associated with an abrupt contact between highly weathered and slightly weathered bedrock.

There is no reflectivity below the interpreted bedrock reflector because bedrock consists of crystalline rock, with no bedding. The absence of significant reflectivity within the bedrock unit makes conclusive fault interpretation impossible. There are multiple discontinuities in the bedrock reflector, approximately located near 200, 550, 840, 1,100, 1,340 and 1,440 feet. Many of these bedrock discontinuities may be associated with topographic variation of the bedrock surface or bedrock weathering contacts. It is also possible that some of the discontinuities are related to bedrock offsets caused by faulting rather than erosion.

LOCAL AND REGIONAL FAULTING

The potentially active Sierra Madre Fault Zone is over 60-miles long and is located just about 5.6 (7.3 EQFAULT) miles to the north of the Site. The fault displays dominantly reverse (vertical) movement and forms a very irregular and deeply incised scarp which, in places, may be several hundred feet high. The fault zone strikes roughly east-west and locally dips northward at 18 to 70 degrees beneath the San Gabriel Mountains. Locally, at the foot of the range, the fault has been mapped most notably with basement rock thrust southward over older alluvium. A potentially active fault is one that has ruptured in the last two million years, but no evidence has been found to suggest rupture in the last 10,000-years. This infers that the fault has a relatively long recurrence interval.

The Sierra Madre Fault, in the Pasadena, Altadena and Sierra Madre areas, has not been placed into an active category or an Alquist-Priolo Earthquake Fault Zone as designated by the California Division of Mines and Geology. The potential for direct surface fault rupture through the subject Site is judged to be nil based on available geologic and fault related technical data. The upper bound (moment magnitude) earthquake assigned to the Sierra Madre Fault is M6.7 and the calculated slip rate is 3.0 mm per year. The fault is assigned to a Type B category. The entire Raymond Basin lies in Seismic Zone 4. Because of the proximity of this potentially active fault, it may produce significant ground motion effects should it rupture in the area closest to the Site and produce a major earthquake.

Our prior review of the City of Pasadena General Plan identified a possible fault approximately along Washington Boulevard, but the General Plan map did not show a City Fault Hazard Management Zone along the fault. We subsequently discovered a different General Plan map showing a Fault Hazard Management Zone for critical facilities along the fault.

The City General Plan indicates that the zoning is based upon a possible active strand of the Sierra Madre fault that was identified by Rubin in 1992. Rubin, along with Kerry Sieh, published an article in the

proceedings of the Association of Engineering Geologists 1992 Annual Meeting. The article, which is two pages long, discusses topographic steps in the stream profile of Arroyo Seco in Pasadena, and in Thompson Wash and its adjacent alluvial fan in La Verne. Their study utilized geomorphic analysis of 1928 Fairchild aerial photographs and a 1924 6-minute U.S. Geological Survey topographic map to supplement field mapping in the identification of possible fault traces. In the Arroyo Seco area, the authors report that modem stream channels and active fan surfaces show multiple topographic steps that indicate youthful deformation, and that topographic steps in Arroyo Seco are coincident with a dramatic change in channel width. The Thompson Wash study area is too distant to be relevant to this investigation.

It is worth noting that, although the Pasadena General Plan attributes the fault locations shown in the General Plan map to Rubin (1992), there is no corresponding map in the Rubin report. The report only contains two illustrations showing topographic profiles along Arroyo Seco and in the Thompson Creek area. Both profiles are quite small with a horizontal scale of one inch equals approximately 4,000 feet and vertical scale of one inch equals approximately 2,000 feet. During our research, we did not locate any other publications attributed to Rubin in 1992. A 1998 article prepared by Rubin and others was located. It discusses a geologic fault investigation at the Loma Alta Park site at the base of the San Gabriel Mountains more than 4 miles north of the Site.

The faults of most interest to the proposed Power Plant projects are the active faults that might result in ground rupture and displacement during an earthquake, and faults that might generate strong shaking of project facilities. The faults of most interest to the project are the Raymond Fault, the San Rafael Fault, and the Eagle Rock Fault.

The faults of greatest significance to the project are described in detail below. The locations of these faults are shown on Figures 6, 7, 8, 10, 12 and 13 and in the representative geologic profiles (Figures 9 and 10). These faults represent earthquake shaking hazards, but only the Raymond and Alhambra Wash faults located outside of the Site are identified as Alquist-Priolo Earthquake Fault Zones (APEQFZ), which implies a surface rupture potential. Such a designation indicates the fault is well known and its location is well defined. Other potentially active faults may not be identified as APEQFZ because their locations are not well defined and/or they have not generated earthquakes in historical time. The City of Pasadena Safety Element (City of Pasadena, 2003) has designated a "fault hazard management zone" for the Eagle Rock Fault, which means that geological studies are required for determining the potential for fault rupture before development occurs within the zone.

The active Raymond Fault Trace strikes east-northeast, 1.0 (1.9 EQFAULT) miles south of the Site, along the south boundary of the Raymond Basin. The length of the fault is 12 to 15.5 miles depending upon various interpretations, dips to the north beneath the basin at generally a high angle, and has produced lateral and vertical displacements. A well developed scarp to 100-feet high along with sag ponds, offset drainages, back tilted surfaces, springs, a groundwater barrier and pressure ridges suggest its surface rupture is relatively young. Carbon dating gave movement within the last 2,500-years. The fault has been assigned to a Type B Category with an upper bound (moment) magnitude earthquake of 6.5, and a slip rate of 0.1 to 0.4 mm per year.

The State of California (CGS) has established an APEQFZ along the Raymond Fault from the San Gabriel Mountains in the east to near the intersection of Avenue 50 and York Boulevard on the west. The Raymond Fault extends southwesterly from the Sierra Madre Fault Zone at the base of the San Gabriel Mountains through the communities of Monrovia, Arcadia, San Marino, and Pasadena to the Raymond Hill area of South Pasadena, where the Raymond Fault trends more westerly through the communities of South Pasadena, Highland Park, and possibly into Los Angeles. The fault forms a gentle arc, convex toward the south across the alluvial deposits of the San Gabriel Valley. The fault is best expressed in the San Marino and South Pasadena area, where it forms a prominent escarpment up to about 150 feet high.

A prominent linear gravity anomaly extending easterly from the southern margin of the Santa Monica Mountains, under the Los Angeles River plain, and into the Repetto Hills indicates that the Hollywood Fault may extend easterly into the Repetto Hills, and has led to the interpretation by some that the Hollywood and Raymond Faults may be interconnected. Others (Dolan, References 10 and 11) have postulated that the Raymond Fault is directly connected with the Hollywood Fault and other faults within the southern frontal fault system of the Transverse Ranges. The westerly continuation of the Raymond Fault into the Los Angeles River floodplain is uncertain. For the purposes of this study, it is assumed that the Raymond and Hollywood Faults are independent features.

The most recent major rupture on the Raymond Fault occurred in Holocene time, sometime about 1,000 to 2,000 years ago (Crook et al., 1987; Weaver and Dolan, 2000, Reference 10). The largest earthquake within the project area in historical times was the 1988 Pasadena Earthquake with a magnitude (ML) of 5.0; this shock was interpreted by Jones et al to have occurred on the Raymond Fault (1990).

Currently, most geoscientists consider the Raymond Fault to be a left-lateral reverse-oblique fault that dips steeply (approximately 80 degrees) to the north. Geological trenching across the fault scarp indicates average rates of fault slip between 0.1 and 0.4 millimeters per year (mm/yr) (SCEC, 2009; Dolan et al., 2000, Reference 10). More recently, the rate of slip has been estimated to be about 1.5 mm/yr and the recurrence interval at 3,300 years (Dolan et al., 2000; Cao et al., 2003; Weaver and Dolan, 2000, Reference 10). The maximum earthquake estimated by the CGS (2009, Reference 10) is in the range of M_w= 6.0 to 7.0. Merriam and Shantz (2007, Reference 10) estimate a maximum earthquake of 6.6.

The nature of potential surface displacements on the Raymond Fault is poorly known. Due to the lack of earthquake history on the Raymond Fault, seismic design for the fault must be based on empirical fault/earthquake relationships from worldwide data. Based on a length of 12 miles, a down-dip width of 10 miles, and average slip of 1.6 to 3.3 feet a maximum earthquake of Mw=6.7 was estimated. Such earthquakes could generate average displacements of 0.3 to 1.5 feet per event and maximum displacements of 0.8 to 3.4 feet per event.

Alhambra Wash Fault

The Alhambra Wash Fault is a short northwest-southeast-trending fault in the southern part of the San Gabriel Valley (Figure 6). The faults surficial expression is approximately 1.5 miles long and extends from I-60 on the southeast to San Gabriel Boulevard on the northwest. The fault is designated as an APEQFZ and, therefore, is considered to be active.

Extensive fault trench investigations revealed faults generally dipping to the northeast, with the northeast side down (normal separation). It was postulated that the fractures in the exploratory trenches were due to three or four fault rupture events in latest Quaternary time with the latest event occurring about 1,000 years ago. The fault appears to have right-lateral, normal oblique slip with a lateral slip rate of about 0.1 to 0.2 mm/yr and a vertical slip rate of about 0.8 mm/yr.

Although there is no compelling direct geological evidence, several investigators have considered the fault to project to the northwest approximately coincident with the Alhambra Wash, which originates in the Raymond Hill region of South Pasadena.

Dibblee considers the fault to be an extension of the Workman Hill Fault and infers the fault to continue northwesterly well beyond Valley Boulevard into the City of Alhambra. However, there is no oil well data to support such an interpretation and fault associated geomorphic feature extends no farther northwesterly than the I-10 freeway.

Contour of the historically highest groundwater in the southwest San Gabriel Valley changes direction quite abruptly at the northwesterly projection of the Alhambra Wash Fault (CDMG, 1998b) suggesting that the fault forms a groundwater barrier in Quaternary-age sediments. The edge of the groundwater barrier extends beyond I-10 approximately to Mission Road in central Alhambra.

The potential for surface displacement on the Alhambra Wash Fault is poorly known and, like the Raymond Fault, must be based on empirical fault length/earthquake magnitude relationships. According to these empirical relationships, the maximum magnitude of an event on the Alhambra Wash Fault could be about 6.25. Based on this, potential surface rupture displacement along the Alhambra Wash Fault would be expected to be much less than those that would be expected along the Raymond Fault discussed above.

Eagle Rock and San Rafael Faults

The Eagle Rock and San Rafael Faults, in the Pasadena, area, have not been placed into an active category or an APEQFZ as designated by the California Division of Mines and Geology. Existing geological maps (Figures 6, 7, 8, 12 and 13) show different locations for the Eagle Rock and San Rafael Faults. The principal difference is that Lamar's (Figure 7) map shows the San Rafael and Eagle Rock Faults as separate features. The San Rafael Fault extends southeasterly from within the San Rafael Hills to the north edge of the Grace Hill, Raymond Hill and the smaller associated knolls, essentially along the same trace as Dibblee's Eagle Rock Fault. At the eastern end Lamar

splits the fault into two splays or branches; one extends through the top of Raymond Hill and the other is a dotted line (that is, a subsurface fault) trending more easterly past Arroyo Parkway and into the hills north of the main trace of the Raymond Fault. Lamar maps the Eagle Rock Fault to the south of the San Rafael Fault within the knolls and projecting south of Raymond Hill (Figure 7). The differences between the fault mapping are not really significant from an earthquake hazard perspective, but the differences might be important for the Pasadena Power Plant projects, in that if there is only one fault (as indicated by Dibblee), the fault crosses the Power Plant, while in the case of two separate faults (as indicated by Lamar) it may be located within the northern portion of the Jacob Parking lot or outside of the present Site. Borehole R-09-Z3B3 excavated during Caltrans study (Figure 8, Appendix F, and Reference 10) encountered a significant zone of fault gouge believed to be the San Rafael Fault. The Eagle Rock and San Rafael Faults do not extend across the Raymond Fault.

Both the Eagle Rock and San Rafael Faults are considered potentially active faults, as defined in the above. According to the Caltrans Seismic Design Criteria (2009) fault database, the Eagle Rock Fault is estimated at having a maximum earthquake magnitude of 6.8.

Although the San Rafael Fault is not well documented, the approximate magnitude of the maximum earthquake can be estimated using worldwide empirical data on earthquake magnitude and fault length data. These estimates indicate a maximum magnitude of about 6.0.

Eagle Rock Fault

The Eagle Rock Fault and San Rafael Fault are considered in this study to be separate and discrete features following the mapping of Lamar (1970). The Eagle Rock Fault will not cross the Power Plant but the San Rafael Fault crosses the northeast corner of Jacob Parking Lot. The Eagle Rock Fault, which has been mapped as an eastward continuation of the Verdugo Fault in the City of Glendale is shown to trend along the southerly side of the San Rafael Hills across the Arroyo Seco then along the back (north) sides of Grace and Raymond Hills in the southwestern corner of Pasadena (Figures 6, 7, 8, 12 and 12). The Eagle Rock Fault in Raymond Basin is shown to be buried beneath older alluvial units. An exposure of the fault in the Arroyo Seco shows an 80-degree northeast dip with basement rock to the north juxtaposed to Tertiary age sedimentary rocks to the south (Figure 8). It is believed to be a northeast dipping thrust fault (movement would be up on the north side). No detail study of this fault has been available. It has been linked to the Verdugo Fault to the northwest and to the Raymond Fault to the south and southeast. The Eagle Rock Fault is believed to merge with the Raymond Fault near Lacy Park in San Marino. These linkages (discontinuous fault strands that seem to line up/merge with or connect to the aforementioned faults) are uncertain and have not been thoroughly investigated.

With regard to the earthquake potential, the Eagle Rock Fault is not in the State fault database (CGS, 2004; Peterson, et al, 1996), but is mentioned in the Southern California Earthquake Center (SCEC) database with a 0.1-millimeter per year slip rate and a potential to rupture with the Verdugo fault. It is not thought that the Eagle Rock Fault would be an independent earthquake generating fault, since known recency of surface faulting and earthquake activity on the Raymond

(Hill) fault should make it more likely to release strain energy (e.g., 1988 M=5 Pasadena earthquake) build up in the site area. Likewise the southern/central portions of the Verdugo fault have been determined to show Holocene offset, so it would seem to have a higher potential to generate an earthquake northwest of the Arroyo Seco. The similarity in style of faulting (reverse) and slip rates (neither slip rate is well constrained) between the Verdugo and Eagle Rock Faults make them more similar than do the same factors for the Raymond and Eagle Rock Faults. The Verdugo Fault (as represented in the State database) is, in our opinion, an appropriate fault analog for the maximum earthquake magnitude on the Eagle Rock Fault.

Fault rupture hazard potential appears low, however the Eagle Rock Fault is considered potentially active, but lacks specific studies to define the actual recency of fault movement. It has been placed within a fault hazard management zone of the City of Pasadena Safety Element (2003), which requires geologic study to determine rupture potential for developments within the zone, may be associated with the Verdugo fault to the northwest or the Raymond Fault to the south and southeast (both faults are considered active).

Eagle Rock Fault rupture investigation methods for La Loma bridge located in the proximity of the Arroyo Seco included literature review and analysis/summary, and surface geologic mapping. For bridge design the Caltrans fault rupture studies consider a number of additional data gathering methods, e.g., aerial photo interpretation/analysis, geophysical surveys, exploration trenching, and soil stratigraphy or age-dating. Caltrans additional field exploration to evaluate the Eagle Rock Fault was limited by access and logistics constraints to the Arroyo Seco channel and the right (east) bank south of the bridge where the fault has been mapped and is expected to be located (Reference 17). The geotechnical engineer applied deterministic and probabilistic methods for the bridge analysis.

The Eagle Rock Fault is about 2,000 feet south of the San Rafael Fault. The fault extends southeasterly into the Topanga Formation rocks in the knolls west and south of Raymond Fault. Seismic-reflection line Z3-G2 (Reference 10) extends across its trace and indicates folding and faulting. Although the relationships are not clear, the seismic-reflection data are compatible with a steeply north-dipping fault. In addition, surface wave soundings Z3-S6 and Z3-S7 (Reference 10) were conducted at the northern and southern ends of seismic line Z3-G2, respectively. S-wave velocity models for these soundings indicate that there is significant lateral velocity variation along the seismic line, possibly resulting from a fault bisecting seismic line Z3-G2. The Eagle Rock Fault is considered potentially active. According to the Caltrans Seismic Design Criteria (2009) fault database, the Eagle Rock Fault could produce an earthquake with a maximum magnitude of about 6.8.

San Rafael Fault

The San Rafael Fault, which appears to exist separately from the easternmost Eagle Rock Fault, is the easternmost segment of the Verdugo-Eagle Rock-San Rafael Fault system. On the northwest, the fault apparently dies out to the north of the Eagle Rock Fault as a series of disjointed strands in the basement complex of the San Rafael Hills. To the southeast of the hills, the fault may be

expressed by irregular terrain in a nearly flat surface overlying terrace deposits in the vicinity of San Rafael School (locality 60a, Figures 7 and 7-1). Farther southeast, the fault is well-exposed where it separates granitic rocks from conglomerate-breccia of the Topanga Formation on the west side of Arroyo Seco (locality 60b, Figure 7 and 7-1). The fault continues east-southeast, along the north side of Grace and Raymond Hills, generally expressed by linear topographic lows and other features on the surface of the terrace underlain by older alluvial deposits (localities 62 and 63, Figures 7 and 7-1). The dip of the fault, as it is expressed at localities 57, 59 and 60b, probably is very steep to vertical, similar to the dip of the easternmost part of the Eagle Rock Fault. The fact that the fault may be expressed along the surface of terrace deposits suggests that it has been active in late Quaternary time (700,000 to present). At locality 65, a deflected south-trending drainage suggests left slip along the fault. An additional fault of parallel trend (locality 61) and a photo lineament north of locality 63 occur along the general trend of the San Rafael Fault segment.

The San Rafael Fault occurs on the north side of Raymond Hill and separates basement complex rock from the Topanga Formation (Figures 6, 7, 8, 12 and 13). Published geologic maps (Lamar, 1970, Figure 7) show two surface traces. The aerial photograph lineament analysis and drilling performed for Caltrans project (Reference 10) suggests the more likely location is the northern branch. Borehole R-09-Z3B3 encountered a light-gray clay fault gouge about 85 feet thick. This material is primarily sheared and pulverized basement diorite rock. The large thickness of the gouge encountered in the boring is reportedly believed to represent the down-dip thickness (that is, the boring was drilled down a steeply dipping fault zone). If so, the width of the fault zone would be expected to be approximately 20 to 40 feet. The San Rafael Fault is considered potentially active and according to empirical relationships, could produce an earthquake with a maximum magnitude of about 6.0.

Historical aerial photographs were not analyzed for this study since the Site does not lie within or immediately near an APEQFZ. In addition, the regional geologic mapping by the United States Geological Survey did not indicate any anomalies suggestive of surface faulting within the subject Site. Boring data was used to develop cross sections across the subject Site regardless of the thick coarse-grained mixed nature of the alluvial units or crystalline basement rock.

According to the opinion of Geotechnical Professional Inc. (GPI) opinion (Reference 37 and 38), the Eagle Rock (San Rafael) Fault does not pose a significant potential for ground rupture at the Blair 1B Magnet School primarily because there has been no evidence of Holocene activity on this fault, and subsurface investigations for projects in the vicinity of the Blair 1B Magnet School site (across the Highway 110 from the Pasadena Power Plant) have disclosed a very consistent subsurface soil profile with no indication of layer offsets that would be indicative of faulting. GPI opinion was based on an updated review of existing geologic information on the Eagle Rock (San Rafael) fault as well as a more detailed analysis of subsurface information from geotechnical investigations performed at the Blair Magnet School site and nearby sites.

GPI re-evaluated subsurface data from their original investigation at the Blair Magnet School site as well as data from other nearby sites.

Subsurface investigations at the site for Blair Magnet School as well as Blair High School to the west, Allendale Elementary School to the northeast and a commercial project site Ms-mile to the northwest, disclosed a very consistent soil profile, which typically included a layer of sandy silt or fill at the surface, underlain by a dark gray-brown to black clay, an olive gray-brown sandy to clayey silt and dense granular deposits consisting of well graded mixtures of sand, silt, gravel and cobbles. At some locations, the clay layer was replaced with fill or mixed into fills. Of primary significance is the continuity of this soil profile between the site of Blair Magnet School and Blair High School, because essentially the same soil profile is observed on both sides of the inferred alignment of the fault. The referenced report contains a site plan with the locations of borings, cone penetration tests and subsurface sections, together with the inferred alignment of the fault. GPI also presented contact elevations for the top of the dense granular deposits below the surficial clay and silt layers. The subsurface data included boring and CPT logs from their geotechnical investigations, as well as boring logs from geotechnical investigations performed by Converse Foundation Engineers in 1964 for the original construction at Blair High School. GPI presented three subsurface cross sections across the inferred alignment of the fault. The subsurface cross sections show a consistent soil profile with no evidence of vertical offsets that would be indicative of fault rupture at their site. The only general trend GPI had observed was a gradual dip of about one percent from northwest to southeast, which is roughly parallel to the overall dip in the natural ground surface.

GPI performed additional investigation reported in References 37 and 38 and confirms that there are several continuous subsurface layers across their site area. However, several of these layers appear to change character or pinch out locally. According to GPI such pinch outs are characteristic of alluvial fan deposits, however they speculated that one of these local variations may be an anomaly representative of a fault offset. Their additional investigation at closer spacing and greater depth penetration, demonstrated that the "anomaly" was underlain by continuous strata and therefore, the "anomaly" was probably due to depositional variations rather than to tectonics (i.e. faulting). According to GPI such depositional variations are completely within the character of the alluvial-fan deposits at their site area which consist of stream-channel, flood-plain, and distal debris flow lenses. In fact, such variations were clearly seen in their trench excavated as part of their investigation.

According to GPI based on their addition CPT data, the premise of Holocene activity on the San Rafael fault is virtually negated. In spite of an intensive array of investigative methods aimed at identifying Holocene activity, no evidence of Holocene activity has been uncovered.

GPI stated that although it appeared quite certain that there was a fault at depth, there was not any credible evidence of surface faulting in Holocene time. The "lineament" postulated by Weber (1980) is, at most, only a local topographic feature within ancient Pleistocene alluvium (Qt); this feature is not present within younger Pleistocene alluvium (Qalo). For example, there is a terrace of Pleistocene Oalo alluvium bordering the east margin of Arroyo Seco (Crook et al. 1987; Lamar, 1970; Weber, 1980) that shows no evidence of a surface scarp where the location of the fault has been documented quite closely. In other words, Weber's lineament is an ancient earlier Pleistocene feature that formed before the late-Pleistocene Qalo was deposited and has since been undergoing slow degradation.

GPI stated that their site and the surrounding area have been saturated with an extensive suite of surface and subsurface investigations that demonstrate the San Rafael Fault has not experienced surface rupture in Holocene time and therefore, it is not an active fault.

In summary, the fault has not been demonstrated to break pre-Holocene alluvial sediments that are widespread in the Pasadena Power Plant area, and therefore, in our opinion, the fault has no potential for fault rupture hazard at the Pasadena Power Plant Site.

SEISMICITY

Commercially available computer programs EQFAULT and EQSEARCH by Thomas F. Blake Computer Services were used to perform a fault search, and a historical earthquake search within a radius of 100 miles. The program uses the California digitized active fault file that includes the thrust faults beneath Southern California.

Historical seismicity for the past 200 years was evaluated using the computer program EQSEARCH (Blake, 2002). Our computer analysis provides a compilation of documented earthquakes (including aftershocks) with magnitudes greater than 5.0, within a 100-mile radius from Pasadena Power Plant. The computer program also estimates peak ground accelerations that would result at the Site from each earthquake using a choice of attenuation relationships. For our evaluations, we used attenuation relationships proposed by Campbell and Bozorgnia (1999). Average estimates of ground motion were obtained by using the attenuation relationship for mean. The parameters used in the attenuation relationship distinguish between fault types producing the earthquake. However, EQSEARCH limits the source type to a choice of only one of three types (strike-slip, dip-slip, or blind-thrust). For our evaluations, we selected the dip-slip option which produces conservative estimates of ground motion.

Historic earthquakes with magnitudes of M5.0 and greater and within a 100-mile radius of Pasadena Power Plant are summarized in Appendix D. The table shows epicentral distance, depth, date, magnitude, and estimated peak horizontal acceleration and intensity for each earthquake found, and is sorted by ascending epicentral distance to the Site (from the closest to the farthest). In total the computer search found 156 earthquakes (including aftershocks) in the designated time period, distance and magnitude.

The largest historical earthquake has an estimated magnitude of 7.7 epicentered approximately 77.8 miles, (125.3 kilometers) from the Site, and Modified Mercalli intensity of VI. The closest earthquake to the Site has an estimated magnitude of 6.3 epicentered approximately 3.4 miles (5.5 kilometers) from the Site, and Modified Mercalli intensity of X.

Based on our EQSEARCH analyses, these earthquakes produced a maximum estimated Site peak ground acceleration of 0.519g. Considering that this event occurred many decades before earthquakes were instrumented, the data should be considered very approximate.

More recently, during the life of the existing Power Plant facility, the largest local historic earthquakes near the Raymond Basin were the October 1, 1987, M5.9 Whittier Narrows; the October 4, 1987, M5.3 aftershock; December 3, 1988, M4.9 Pasadena; and June 28, 1991, M5.4 Sierra Madre events and January 17, 1994, M6.7 Northridge Earthquake. These all occurred in a relatively short time period, all showed north dipping reverse movement and none produced surface fault rupture. The Pasadena event may have actually occurred on the Raymond Fault.

Damage from any of the earthquakes in vicinity of the Pasadena Power Plant was generally light though some older structures sustained moderate damage, but no collapse. Damage during the Whittier Narrows Earthquake (1987) was substantial in Whittier and the East Los Angeles area, however. Based on our EQSEARCH analyses, these earthquakes produced estimated peak ground acceleration of 0.287g at the Site vicinity. The central portion of the Sierra Madre Fault (the segment closest to the Pasadena Power Plant) has produced only a few historic minor earthquakes. In 1971 the western portion of the Sierra Madre Fault (the active San Fernando Fault) ruptured and resulted in a M6.4 event about 25-miles to the west. This event produced major damage and loss of life. The extreme eastern section (active Cucamonga Fault) has moved in the last several thousands of years, but today remains quiet.

LIQUEFACTION

The subject Site is not within a "Liquefaction Hazard Zone", as delineated by the State of California, in compliance with Chapter 7.8, Division 2 of the California Public Resources Code (Seismic Hazards Mapping Act). No groundwater was encountered at the Site to the maximum depth of 60 feet below ground surface explored.

LABORATORY TESTING

Classification

Soils were classified visually according to the Unified Soil Classification System. Unit weight and moisture content were determined for each undisturbed sample. Results of density and moisture content, together with soil classifications, are shown on the attached boring logs.

Direct Shear Tests

In order to determine the shear strength of the on-Site soils, direct shear tests were performed on representative undisturbed samples of the on-Site soils. To simulate possible adverse field conditions, the samples were saturated prior to shearing. Graphic summaries of the test results are attached.

Expansion Test

Expansion tests were performed on a representative samples of the on-Site soil in accordance with ASTM 4829/UBC Standard 18-2 to evaluate their volume change with increasing moisture conditions. The results are as follows:

Sample Location	Depth (ft)	Soil Description	Expansion Index	Potential Expansion
BH-1	1 - 5	Brown silty sand	1.6	Very Low
BH-2	1 - 5	Dark brown clayey sand	0	Very Low
BH-4	1 - 5	Dark brown clayey sand	3.2	Very Low
BH-8	1-5	Brown silty sand with gravel	2.6	Very Low

Consolidation Test

To investigate the settlement of the soils under the pressure of the proposed foundations, load consolidation tests were performed on undisturbed samples of the soil collected from boring BH-3 at depth of 10 feet bgs, boring BH-4 at a depth of 20 feet bgs, boring BH-6 at a depth of 5-6.5' feet bgs, boring BH-7 at depths of 30 and boring BH-9 at a depth of 4.5 feet bgs.

Axial loads were carried to a maximum of 11,500 lbs/sq.ft. To hasten consolidation and simulate possible adverse field conditions, water was added at an axial load of 1,400 lbs/sq.ft. Compressibility of the soils within the zone of significant stress was investigated and the results considered in our engineering analysis. Graphic plots of the load consolidation curves are attached.

Compaction Test

The maximum dry density and optimum moisture content of the on-Site soils were determined in the laboratory in accordance with the ASTM D-1557-07 test method. The results are as follows:

Sample Location	Soil Description	Maximum Dry Density (PCF)	Optimum Moisture Content (%)
BH-1 @ 1-5'	Brown silty sand with gravel	131.3	8.8
BH-4 @1-5'	Brown silty sand with gravel	129.5	7.5
BH-8 @1-5'	Brown silty sand with gravel	132.0	9.5

Particle Size Analysis

Particle size analyses were performed on bulk samples of the soils collected from boring BH-1 at a depth of 1-5 feet bgs, boring BH-4 at a depth of 1-5 feet bgs and boring BH-8 at a depth of 1-5 feet bgs, in accordance with the American Society for Testing and Materials Standard (ASTM D422).

Organic Content

Nine organic carbon content tests were performed on select samples where high PID reading was obtained using ASTM Standard D2974. The organic content of the tested samples vary from 0.1 to 1.9 percent.

Sample I.D.	Organic Content Percen	PID Reading ppm_v
BH2 @ 26'	0.6	362
BH3 @ 16.5'	1.9	2.7
BH6 @ 16'	1.7	10,000
BH-7 @ 35'	0.1	-
BH-8 @ 9'	0.6	227
BH8 @ 10.5'	1.1	227
BH-9 @ surface	1.9	204
BH-9 @ 6.5'	1.3	12.3
BH-9 @ 7.5	0.6	12.3

R-Value Test and Modulus of Subgrade Reaction

R-value tests were performed on bulk samples of the soils collected from borings BH-2 and BH-9 at a depth of 1 to 5.0 feet bgs. The results of these tests indicate R-values of 60 and 67, respectively.

Chemical Tests

To address the presence of chemicals deleterious to construction materials and utility lines, chemical tests (sulfate, chloride, pH and soil resistivity) for the on-Site soils have been performed.

Bulk samples of the soil collected from boring B-1, B-2, B-4, B-6, and B-8 at a depth of 0 to 5.0 feet below ground surface were tested to determine its chloride and sulfate concentrations, as well as its pH and soil resistivity. The test results indicate 18.8 mg/Kg to 22.7 mg/Kg concentrations of chloride and 20.6 mg/Kg to 30.5 mg/Kg concentrations of sulfate. The soil pH varies from 7.52 to 7.55. The following summarizes the results of the analytical testing, with appropriate recommendations.

Sample Location	PH	Sulfate (%)	Chloride (%)	Oxidation-Reduction Potential mv@25°	Soil Resistivity Ohm-cm
BH-1 @ 0-5'	7.87	0.003	0.00165	599	4,394
BH-2 @0-5'	8.19	0.002	0.002	566	-
BH-4 @ 0-5'	8.14	0.001	0.0014	550	5,847
BH-8 @ 0-5'	8.25	0.003	0.0014	515	4,293
BH-9 @ 0-5'	8.39	0.01	0.002	563	-

Soils with sulfate concentrations more than 1,000 ppm (0.1%) are generally reported to have a moderate corrosive effect on foundation concrete. Normal Portland cement may be used for concrete in contact with the Site soils. Soils with less than 200 ppm (0.02%) of chloride generally have been observed to induce low corrosion on mild grade steel exposed to subsoil.

Any type of cement may be used for concrete structures and pipes because the sulfate concentration is negligible, 0 to 0.1 percent, per 1997 Uniform Building Code (UBC) Table 19-A-4 and American Concrete Institute (ACI-318) Table 4.3.1.

Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils.

Redox Potential

The redox potential essentially is a measure of the degree of aeration in soil. A high redox potential indicates a high oxygen level. Low redox values may provide an indication that conditions are conductive to anaerobic microbiological activity. Sampling of soil will obviously lead to oxygen exposure and unstable redox potentials are thus likely to be measured in disturbed soils.

A major factor in determining soil corrosivity is its electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to its electrical resistance. Lower electrical resistance results from higher moisture and chemical salts concentrations and indicate corrosive soil condition.

The electrical resistivity of each sample was measured in a soil box per ASTM G57 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured.

A correlation between electrical resistivity and corrosivity for ferrous metals is:

Soil Resistivity In ohm-centimeters In ohm-centimeters			**Corrosivity Category**
Over		10,000	Mildly corrosive
2,000	to	10,000	Moderately corrosive
1,000	to	2,000	Corrosive
Below		1,000	Severely corrosive

Other soil characteristics that may influence corrosivity in metals are pH, chemical salt concentrations, soil types, aeration, anaerobic conditions, and site drainage.

Based on the soil resistivity, on-Site soils are in the moderately corrosive category in a saturated condition.

The soil pH varies from 7.87 to 8.39. This range is slightly basic and does not increase soil corrosivity.

The soil is classified as corrosive to ferrous metals and negligible for sulfate attack on concrete.

CORROSION CONTROL RECOMMENDATIONS

The life of buried materials depends on their thickness, strength, loads, construction detail, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. However corrosion control methods will increase the life of buried materials.

Steel Pipe

Abrasive blast underground steel piping and apply a dielectric coating such as polyurethane, extruded polyethylene, a tape coating system, hot applied coal tar enamel, or fusion bonded epoxy intended for underground use.

Bond underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

Electrically insulate each buried steel pipeline from dissimilar metals and metals with dissimilar coatings (cement-mortar vs. dielectric), and above ground steel pipe to prevent formation of dissimilar metal corrosion cells and to facilitate the application of cathodic protection.

Apply cathodic protection to steel piping as per NACE International Standard RPO169-2002. The amount of cathodic protection current needed can be minimized by coating the pipe.

As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating or encase in 3 inches thick concrete.

Some steel piping systems, such as for gas and oil, require special corrosion and cathodic protection that must be evaluated for each specific application.

Iron Pipe - Pressurized:

Encase pressurized cast and ductile iron underground piping per AWWA Standard CI05, coat with epoxy or polyurethane, or with wax tape per AWWA C217. The thin factory-applied asphaltic coating of ductile iron pipe for protection during transportation and aesthetic purposes does not constitute a corrosion control coating. Electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE International Standard RP0286-2002. Bond all non-conductive type joints for electrical continuity. Apply cathodic protection to cast and ductile iron piping as per NACE International Standard RPO 169-2002.

For protection of Non-Pressurized iron pipe one of the following alternatives can be selected:

- Polyethylene encase cast- and ductile-iron piping per AWWA Standard CI05. Electrically insulate underground pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE International Standard RP0286-2002. Protect all non-cast iron and non-ductile iron fittings and valves with wax tape per AWWA Standard C2I7-99 after assembly.
- Concrete encase all buried portions of metallic piping so that there is a minimum of 3-inches of concrete cover provided over and around surfaces of pipe, fittings, and valves.
- Apply cathodic protection to cast and ductile iron piping as per NACE International Standard RPO 169-2002. The amount of cathodic protection current can be minimized by coating the piping.

Copper Tubing

In the absence of tests for ammonium and nitrate in the soil, protect buried copper tubing by one of the following measures:

- Soil contact may be prevented by installing the tubing above ground.
- Use a factory coated copper pipe with a minimum of 100-mil thickness such as "Aqua Shield" or similar products. Polyethylene coating protects against elements that corrode copper and prevents contamination between copper and its sleeve. However, the coating must be continuous with no cuts or defects for underground piping.

- Wrapping of copper with 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE International Standard RPO169-2002. The amount of cathodic protection current can be minimized by coating the tubing.

Plastic and Vitrified Clay Pipe

No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint. Protect all fittings and valves with wax tape per AWWA Standard C217-99 or epoxy.

All pipes, appurtenances, and fittings not protected by cathodic protection

Coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA Standard C217-99 after assembly.

Where metallic pipelines penetrate concrete structures such as building slabs, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

CONCLUSIONS AND RECOMMENDATIONS

1. General

From a soils engineering standpoint, the construction of the proposed Glenarm Repowering Project (GT-5 Combined Cycle Installation) is feasible. The proposed generators and related appurtenances can be founded on rigid mat foundation or cast-in-place concrete frictional piles. The mat foundation should be founded entirely on the properly compacted fill or dense natural ground. The existing man-made fill and organic soil (organic content of the on-site organic soil vary from 0.1 to 1.9 percent (Appendix A)) are not appropriate for the support of the proposed generators and related appurtenances if mat and shallow spread and continuous footing are used. The existing man made fill should be removed and replaced as properly compacted fill.

The potential for active faulting at the proposed project Site is studied based on previous and recent boring data, as well as previous excavation data at the Site, publicly available data from an ongoing study of the region by Caltrans/Metropolitan Transportation Agency

feasibility study for the 710 freeway extension as a tunnel through the Alhambra-Pasadena area, and GPI geotechnical investigations at Blair High School and Allendale School.

The Caltrans/Metropolitan Transportation Agency feasibility study included:

- compilation and analysis of published data and literature,
- historical aerial photograph review,
- geological mapping,
- continuous coring of deep boreholes,
- down-hole geophysics (e.g. seismic velocity)
- down-hole acoustic teleview
- seismic-reflection profiling
- surface-wave geophysics.

The Eagle Rock-San/Rafael Faults have been a prime focus in the Caltrans Metropolitan Transportation Agency study because the proposed tunnel will probably pass through the fault. The so-called Eagle Rock/San Rafael Faults have been discussed by numerous geoscientists over the past few decades and are shown on several geological maps, notably Lamar (1970), Crook et al. (1987), and Dibblee (1989), as well as several others (e.g. Weber, 1980; California Division of Mines and Geology, 1978). All of these investigations except CDMG (1978) were regional studies and did not really focus on the Eagle Rock/San Rafael Faults. Consequently none of these maps show the faults in the same location. However, the CDMG (1978) categorically states that no evidence of Holocene activity has been found by any investigation. Based on the CDMG (1978), our own investigation, Caltrans/Metropolitan Transportation Agency findings, and GPI re-evaluated subsurface data from their original investigation at the Blair Magnet School, it is our opinion that the fault is not active.

In HI's study the Eagle Rock/San Rafael Faults are considered as two discrete faults as shown by Lamar (1970); the southern fault is the Eagle Rock Fault, extending from the Eagle Rock area, crossing Arroyo Seco, and into the small hills and knolls west of Raymond Hill (Figure 13). The northern fault is the San Rafael Fault; this fault is basically parallel to the Eagle Rock Fault and similarly passes through Arroyo Seco, but extends to the north side of the Raymond and Grace Hills.

Lamar shows the San Rafael Fault bifurcating near Raymond Hill with one branch cutting through the rocks at the top of Raymond Hill and the other branch under the alluvium north of the hill extending towards Blair and Allendale schools. Although in the Caltrans/Metropolitan Transportation Agency report the southern branch is shown on their geological maps, and included in the final 710 tunnel report, but they could not find any evidence of such a fault on aerial photographs or during field geological mapping, or drilling.

In addition to the CDMG (1978) fault evaluation report, the Caltrans/Metropolitan Transportation Agency investigation, Wilson Geosciences, (Diaz-Yourman and Associates,

2007), and GPI geotechnical investigations at the adjoining Blair High School investigation, treated the Eagle Rock/San Rafael Faults as their primary focus.

The only location in the area where the fault can be identified is in Arroyo Seco where the fault extends under the La Loma Bridge (Figure 14). During a recent investigation by Wilson Geosciences (WGI), they excavated a trench on the west side of Arroyo Seco and found faulting within the Tertiary-age Topanga Formation rocks (Reference 17). The fault was entirely within Tertiary-age rocks and did not displace the overlying Quaternary alluvium. Although the faults in their trench exposure may not represent the main branch of the fault, the location is consistent with the change in rock type contact from igneous rocks on the north to the Tertiary-age Topanga Formation on the south. The trench exposure, in conjunction with boreholes and seismic refraction data, locate the fault location quite closely to the eastern end of the bridge. This location is slightly north of the location on Lamar's map and has a slightly more easterly trend than the Lamar's or Dibblee's maps.

The Caltrans/Metropolitan Transportation Agency drilled several boreholes in the area, at the proximity to the Pasadena Power Plant. Three of the holes revealed important information relative to the San Rafael Fault (R-09-Z3B3, R09-Z3B6, and R-06EM3). The boring R09-Z3B6 is located on State Street just south of the railway and near the Pasadena Power Plant. Borings R-09-Z3B3 and R06EM3 are located about 5,000 feet west of the Pasadena Power Plant along Pasadena Avenue (Figure 8, and 9).

Boring R-06EM3 was drilled in the park along Pasadena Avenue north of Arlington Drive. This boring was drilled to a depth of 201 feet and encountered alluvium at 50 foot depth below the ground surface (bgs) and Topanga Formation from 50 feet to the bottom of the hole. There was no indication of faulting; therefore the San Rafael Fault must be north of the boring. In addition, there was no indication of a southern branch as shown by Lamar.

Boring R-09-Z3B3 was drilled about 800 feet to the north of R-06EM3 in the grassy median just south of Bellefontaine Street (Figures 8 and 9). This boring was drilled to a depth of 275 feet and encountered old alluvium (Pleistocene age) to 185.5 feet bgs and light-gray clay fault gouge from 185.5 to the bottom of the hole. The fault gauge was intensely sheared, altered, pulverized, highly plastic clay and sandy clay. Reportedly, petrographic thin-section analysis of fault gauge included pebbles indicative of an origin from dioritic igneous rock. These relationships were verified by downhole acoustic teleview. The apparent great thickness of gouge (i.e. 90 feet) is interpreted by Caltrans/Metropolitan Transportation Agency to be due to the borehole extending down a steeply dipping fault. Geometric calculations indicate about an 80 degree northerly dip; the true thickness of the zone is probably more on the order of 20 to 40 feet. In any event, this gouge places the surface projection of the fault quite close to the intersection of Hurlbut Street and Pasadena Avenue (Figures 8 and 9).

The third boring, R09-Z3B6, was on State Street just south of the railway tracks, northeast of Raymond Hill and west of the power plant (Figures 8 and 9). This boring extended to a

depth of 326 feet bgs and encountered about 15 feet of alluvium overlying Topanga sandstone and conglomerate. Data from this boring suggests that there is no north-dipping fault through the top of Raymond Hill as shown by Lamar and Dibblee. Furthermore, the Caltrans/Metropolitan Transportation Agency believes that the lack of any apparent faulting indicates that the northern splay of Lamar's fault must be north of the boring (within Pasadena Power Plant).

A seismic-reflection line was run along Raymond Avenue from Glenarm Street to the north (Figures 8 and 11). The seismic-reflection line did not reveal any major faults, indicating that any faulting is south of Glenarm Street. Projecting the San Rafael Fault to the southeast based on these 3 borings and the seismic-reflection line places the fault directly through the Jacob Parking Lot (Figures 8 & 14). Groundwater was reported at depths of 51.5 and 136 feet in borings R-09-Z3B6 and R-09Z3B3 located south and north of San Rafael Fault respectively. A drop of 32.8 feet in groundwater elevations in the above borings is interpreted to be related to the San Rafael Fault.

Although Hydrologue believes the San Rafael Fault may cross the Jacob Parking lot and recognizes that the location may be somewhat imprecise, the fault appears to be located outside of the present proposed project that consists of the construction of a GT-5 Combined Cycle. However, it is important to find out whether the fault is active and represents a fault-rupture hazard at the proposed project Site. Reportedly, the Caltrans/Metropolitan Transportation Agency aerial-photograph analysis and geological mapping did not find any evidence of Holocene activity on the San Rafael Fault. As mapped, the fault trend crosses within Pleistocene-age alluvial deposits (Figures 14 and 16). The Pleistocene-age is well established by numerous carbon 14 dates (Crook et al., 1987). In support of the Pleistocene age, Caltrans boreholes found weathered, oxidized alluvium with crumbly clasts and multiple pedogenic soil horizons.

Crook et al. (1987) indicate two ages of alluvium along the San Rafael Fault trend; these are less recent alluvium Qal_2 and older alluvium Qal_3 at the Site proximity (Figures 14 and 16). Reportedly, Caltrans/Metropolitan Transportation Agency analysis of vintage Fairchild aerial photographs (late 1920s to 1950s) did not reveal any evidence of topographic fault scarps along the trace of the San Rafael Fault in either less recent or the older Holocene alluvium indicating that the fault has not been active in latest Quaternary time. The only surficial indication of a fault is the crude alignment of the widely spaced knolls and hills (i.e. Grace Hill, Raymond Hill, etc). This type of geomorphology is typical of what geologists call a fault-line scarp. A fault-line scarp is a scarp that represents the eroded remnant of an ancient fault. Such a feature is consistent with a Pleistocene age of latest displacement on the San Rafael Fault.

Reportedly, according to the borehole data adjacent to Blair and Allendale schools, near-surface stratigraphic relationships, revealed in the shallow geotechnical borings, indicate lack of Holocene activity on the San Rafael Fault. These borings indicate a black, clayey soil similar to one we observed during grading operations related to the construction of

GT1 and GT2 within the Pasadena Power Plant, overlie the Pleistocene alluvium (this layer was not observed during our investigation of the Boilers 1 & 2 but was observed during present investigation). This black soil is widespread throughout the area and is characteristic of a well-developed organic soil horizon on the Pleistocene alluvium. Although there are no carbon dates available for this soil, the thickness alone indicates a substantial age, perhaps several thousand years. The presence of carbonate nodules in the material supports advanced age. However, these clayey horizons are typically "cumulative" soil horizons that are difficult to date precisely. The consistent thickness, and consistent depth of this unit across the area indicates tectonic stability, and that there has not been any Holocene fault displacement at the Site.

According to GPI and based on their recent additional CPT data, the premise of Holocene activity on the San Rafael fault is virtually negated. In spite of an intensive array of investigative methods aimed at identifying Holocene activity, no evidence of Holocene activity has been uncovered.

GPI stated that although it appeared quite certain that there was a fault at depth, there was not any credible evidence of surface faulting in Holocene time.

GPI stated that the Blair High School site and the surrounding area have been saturated with an extensive suite of surface and subsurface investigations that demonstrate the San Rafael fault has not experienced surface rupture in Holocene time and therefore, it is not an active fault.

In conclusion, based on the above, Hydrologue believes the present data indicate that the San Rafael Fault may cross through the Jacob Parking Lot, but also it has not been active in Holocene time and, therefore, the present Site is suitable for development of the proposed project.

The City of Pasadena Safety Plan has specific geologic investigation requirements for development within the Fault Hazard Management Zones for the Sierra Madre and Raymond Faults, but not for Eagle Rock (San Rafael) Fault. We attached a copy of pages 26 through 30 of the City of Pasadena Safety Element which describes the policies for mitigation of Seismic Hazards. We contacted Mr. Neville Pereira (626-744-7601) City of Pasadena, to enquire whether the City does require fault trench studies for the Eagle Rock or not (San Rafael Fault). He advised HI that this should be determined by the California Geologic Survey. Based on the distance of the trace of the San Rafael Fault, it is our opinion that the proposed development area adjacent and south of historic power plant will not be affected by the San Rafael Fault.

Based on the above, summary shallow trenching for fault study is not recommended. However, the existing man-made fill and organic soil are recommended to be removed and the existing man-made fill will be replaced with properly compacted fill. We recommend the excavation be inspected for the purpose of fault study prior to the placement of the backfill. We will prepare an addendum report to document our finding and revise our recommendation if the data shows a need for it.

Concentrations of total recoverable petroleum hydrocarbons were encountered in some of the shallow soil samples collected and analytically tested at the Site. The vertical and lateral extent of the impacted soils are not yet defined (as the date of this report), certain environmental regulations are relevant to the potential off-Site disposal of the soils.

The potential expansion of the on-Site surface soils is considered to be very low. The construction plans for the gas turbine generators should take into account the appropriate soils engineering features of the Site.

The on-Site soil is in moderately corrosive category in a saturated condition.

Recommendations for grading are presented in the following section. Personnel from our firm should observe and test the reworking of the upper soils and the compaction of all required fill.

2. Grading

In order to provide support for rigid mat foundation, floor slabs, and adjacent concrete walks, slabs and parking, all existing man-made fill, organic soils and all disturbed and loose natural soils should be excavated. The approximate depth of the excavation according to our exploratory borings is 5 to 10 feet. Where possible, the excavation of the fill should extend at least equal to the thickness of the fill beyond the foundation perimeter in plan, otherwise the footings should be deepened to be founded on firm natural ground encountered at a depth of 5 to 10 feet bgs. The non organic excavated soil should be replaced as properly compacted fill in the excavation. Any required additional fill should be properly compacted.

To provide good support for asphaltic paving, all of the existing fill and disturbed and loose natural soils should be excavated and replaced as properly compacted fill. The existing fill was found to be up to 5 to 10 feet thick in our exploratory boring locations. However, if the possibility of some settlement with associated cracking and greater than normal maintenance of the asphaltic paved areas is acceptable, then the overexcavation of only the upper 2 feet of existing fill soils will be required; the lower portion of the existing fill could be left in place. Beneath Portland cement concrete paving, all of the existing fill should be removed and replaced as properly compacted fill.

2.1 Site Preparation and Compaction

Asphalt pavements, slabs, foundations, demolition and organic debris, fuel petroleum hydrocarbon and lead impacted soil, organic soil, vegetation and other unsuitable materials should be stripped and removed from the Site. Water lines or other old utility lines or installations to be abandoned should be removed. Cavities resulting from removal of buried obstructions and trees extending below finished grades should be backfilled with properly

compacted fill. The recommended minimum thickness of the compacted fill below the bottom of the footings founded on compacted soil is 3 feet.

After clearing the Site and recommended 5- to 10-foot deep excavation, the exposed soils at the bottom of the excavation should be carefully observed for the removal of all unsuitable deposits. Next, the bottom of the excavation should be rolled with heavy compaction equipment. The upper 6 inches of exposed soils should be compacted to at least 90 percent of the maximum density obtainable by the ASTM Designation D1557 Standard. After compacting the exposed soils at the bottom of the excavation, any required fill should be placed in loose lifts not more than 8 inches thick and compacted to at least 95 percent of the maximum density obtainable by the ASTM Designation D1557 Standard. The moisture content of the on-Site soils at the time of compaction should vary no more than 2% below or above optimum moisture content.

2.2 Material for Fill

The on-Site soils cleaned from any organic soil, debris or organic matter (i.e., tree roots), fuel petroleum and lead impacted soil and oversized rocks may be used in required fills. Any required imported fill should consist of relatively non-expansive soils with an Expansion Index of less than 35. Any import material should contain sufficient fines (binder) so as to be relatively impermeable and provide a stable sub-grade when compacted.

2.3 Pipeline Sub-grade, Bedding and Trench Backfill

2.3.1 Sub-grade Preparation

Pipelines may be laid in trench excavations. Based on the subsurface information obtained from the borings, existing fill soils are anticipated to be present beneath pipelines. If fill soils are encountered beneath the pipeline invert, they should be excavated and re-compacted as properly compacted fill soils. Pipelines may be supported either on undisturbed natural soils or on properly compacted fill soils. The excavation for the pipeline and the placing of the bedding material should be carefully performed in order to prevent loose or disturbed soils from remaining in the bottom of the excavation.

2.3.2 Pipe Bedding and Pipe Zone Backfill

Typical pipe bedding and pipe zone backfill details are shown on Figure 20, for typical pipe backfill and pipeline trench conditions. Unshaped bedding is typically used for pipeline support. Material for pipe bedding and pipe-zone backfill could be either on-Site sand and sandy soils or imported sand and gravelly sand, free from organic matter, loam, contaminates, or other deleterious substances. The material should meet the gradation requirements shown below when tested in accordance with ASTM D422. Based on the information obtained during our field explorations, it is our opinion that in general, the

on-Site sandy soils may be suitable for the pipe-bedding or pipe zone backfill. This should be checked during the construction.

Sieve Size No.	Percentage Passing Sieve (by weight)
½"	100
4	70-100
16	50-90
50	10-40
200	0-10

To provide a uniform bearing condition, we recommend a minimum 6-inch layer of bedding material be placed beneath pipes. Pipe zone backfill will be required all around proposed pipes and to a height of 6 inches above the top of pipes. The pipe bedding and pipe zone backfill materials should be compacted to at least 95% of the maximum density obtainable by the ASTM Designation D1557 method of compaction. The pipe-zone backfill materials may be compacted in place by vibration or may be backfilled with 1- to l'/2-sack sand-cement slurry.

We recommend that the backfill along the sides of the pipe be placed simultaneously and brought up to at least the top of the pipe in equal lifts and level heights during the backfill operation.

2.3.3 Trench Backfill

The soils at the Site are suitable for use as trench backfill cleaned of any debris, vegetation, and cobbles larger than 6 inches. Although not anticipated, to avoid nesting of larger particles, the trench backfill should not contain more than 10% of particles greater than 3 inches. We recommend these soils be compacted by mechanical means.

Any required imported fill should consist of relatively non-expansive soils (Expansion Index less than 35 per ASTM D-4829). Imported fill material should contain sufficient fines (binder material) so the resulting compacted fill will not rut under the wheels of compaction equipment. The use of cobbles or rock fragments larger than 3 inches in size should be avoided. Nesting of these materials should be avoided. Trench backfill should be compacted to at least 90% of the maximum dry density obtainable by the ASTM D1557 method of compaction.

After placement of pipe zone backfill around the pipe, the final backfill above the pipe zone (as shown on Figure 20) should be placed in layers and mechanically compacted to at least 90% of the maximum dry density obtainable by the ASTM Designation D 1557 method of compaction with the exception of the upper 3 feet of backfill beneath pavements which should be compacted to at least 95% of the maximum dry density obtainable by the ASTM Designation D 1557 method of compaction. Any required fill should be placed in horizontal

lifts, not more than 12 inches in loose thickness. It is recommended that the soils be compacted at moisture contents ranging from optimum moisture content to 2% above optimum moisture content at the time of compaction.

2.4 Field Observation

The reworking of the upper soils and the compaction of all required fill should be observed and tested by a representative of our firm. The observation and testing should include:

1. Observe the clearing and grubbing operations for proper removal of all unsuitable materials.
2. Observe the exposed sub-grade (bottom of the excavation) in areas to receive fill and in areas where excavation has resulted in the desired finished sub-grade, observe proof-rolling, and delineate areas requiring over-excavation.
3. Perform visual observation to evaluate the suitability of on-Site and import soils for fill placement; collect and submit soil samples for required or recommended laboratory testing where necessary.
4. Perform field density and compaction testing to determine the percentage of compaction achieved during fill placement.
5. Observe and probe foundation materials to confirm that suitable bearing materials are present at the design foundation depths.

The governmental agencies having jurisdiction over the project should be notified prior to commencement of grading so that the necessary grading permits may be obtained and arrangements may be made for the required inspection(s).

2.5 Idealized Soil Profile

The following table presents an idealized soil profile of the existing conditions under proposed mat foundations for major equipment (i.e. gas turbines generator GTG).

Depth Below Existing Ground Surface	Soil Classification	Consistency	Density (pcf)	Average Shear Velocity (ft/s)
0 to x feet*	Properly Compacted Fill	Engineered	120	1,200
x to 10 feet**	Sandy silt and clayey sand (SP)	Mod. dense	100	700
10 to 40 feet	Silty Sand (SM)	Mod. Dense	110	900
40 to 60 feet	Poorly Graded Sand (SP)	Dense	110	1,000

*x represents the depth of properly compacted fill beneath the mat foundation, and needs to be corrected by the depth of embedment of the mat to correspond to depth below existing ground surface.

**This layer should be removed where excavation and re-compaction occurs to 10 feet below grade.

2.5.1 Dynamic Characteristics of on-Site Soil

Based on our tests results, the average shear wave velocity in the upper 30 feet is about 725 feet per second. We have assumed that average shear wave velocity in the upper 30 feet will be increased to at least 1,200 feet per second after ground improvement. Therefore, the dynamic shear modulus (small-strain shear modulus), G_{max}, may be taken as 5,000,000 pounds per square foot in areas of compacted soil and as 3,500,000 per square foot in natural ground. The poisson's ratio of the soil may be taken as 0.3. The material damping ratio of the soil (small strain) may be taken as 0.05.The spring constant can be calculated using adjusted shear modulus (for anticipated soil strain(Reference 36 and 39, Appendices J and K)) and poison's ratio using various formula from pages 26 through 29 of the reference 36 (Appendix J) . The depth to rigid layer at the Site may be taken as infinite (with respect to the size of the foundations). The total unit soil weight (for the purpose of dynamic computations) may be taken as 120 pounds per cubic foot in areas of ground improvement and 110 pounds per cubic foot in other areas. A vertical modulus of sub-grade reaction of 175 pounds per cubic inch may be used for design of shallow foundations on improved ground. This value is a unit value for use with a 1-foot-square area. The modulus should be reduced in accordance with the following equation when used with the larger foundations:

$$K_R = K\,[(B+1)/2B]$$

Where K_R = Reduced sub grade modulus
K = Unit sub grade modulus
B = Foundation width in feet

3. Foundation Design

Based on our evaluation of the Site conditions and findings of this investigation, it is concluded that rigid mat foundation resting entirely on the properly compacted fill (the recommended minimum thickness of compacted fill below the bottom of the footing is 3 feet) or embedded into dense natural ground or cast-in-place concrete frictional piles embedded into dense natural ground will provide adequate foundation support for the proposed project. Reinforcement of footings and piles should be determined by the structural engineer.

3.1 Rigid Mat Foundations

Bearing Value

Rigid mat foundation carried at least 3 feet into undisturbed properly compacted fill, at least 10 feet wide, and at least 3 feet below the lowest adjacent grade or floor level can be designed to impose a net dead plus live load pressure of 3,000 pounds per square foot.

Footings for minor structures including any auxiliary retaining walls, free standing walls and elevator shaft that are structurally separate from the main foundations may be continuous or spread designed to impose a net dead-plus-live load pressure of 1,800 pounds per square foot, at a depth of 2 feet below the lowest adjacent grade. Such footings should be at least 1 foot wide and may be established in either properly compacted fill or undisturbed moderately dense natural soils.

A one-third increase in the allowable bearing values can be used for wind or seismic loads. The recommended bearing values are net values, and the weight of concrete in the footings can be taken as 50 pounds per cubic foot; the weight of soil backfill can be neglected when determining the downward loads.

While the actual bearing value of the compacted fill will depend on the material used and the compaction methods employed, the recommended value will be applicable if acceptable soils are used and are compacted as recommended. The bearing value of the fill should be confirmed after completion of the grading.

Modulus of Sub-grade Reaction

For design of the mat-type foundation, a modulus of sub-grade reaction of 175 pounds per cubic inch may be used for compacted soil. This value is a unit value for use with a 1-foot-square mat. The modulus should be reduced in accordance with the following equation when used with a larger mat:

$$K_R = K\,[(B+1)/2B]$$

Where K_R = Reduced sub grade modulus
K = Unit sub grade modulus
B = Foundation width in feet

Settlement

The settlement of the proposed equipment, supported on rigid mat foundation in the manner recommended, will be about 1 inch. Differential settlement between adjacent elements (50 feet apart horizontally) is expected to be about 0.25 inch or less.

Lateral Loads

Lateral loads may be resisted by soil friction against the footings and the floor slab and by the passive resistance of the soils. A coefficient of friction of 0.35 may be used between the floor slab and the supporting soils, and between the rigid mat foundation and the supporting soils. The passive resistance of the undisturbed natural soils or properly compacted fill

against footings may be assumed to be 250 pounds per cubic foot to a maximum of 3,500 psf. One-third increase in the passive value may be used for wind or seismic loads.

The passive resistance of the soils and the frictional resistance between the floor slab and the supporting soils and between the rigid mat foundation and the supporting soils may be combined with 30 percent reduction in passive resistance in determining the total lateral resistance.

3.2 Drilled Cast-in-Place Concrete Frictional Piles

Vertical Capacities

The average downward and upward frictional capacities of 500 and 250 psf are recommended for cast-in-place concrete piles at least 24 inches wide and 50 feet deep. One-third increase may be used for wind or seismic loads. The recommended frictional capacity is based on the strength of the soils and may be used from a depth 15 feet below the ground surface to the bottom of the pile; the compressive and tensile strength of the pile sections should be checked to verify their structural capacity. A negative skin friction of 200 pounds per square foot should be used for that portion of the pile in contact with the existing man-made fill.

Piles in groups should be spaced at least 3.0 diameters on center. If the piles are so spaced, no reduction in the capacities of the piles need be considered due to group action.

Settlement

The settlement of the drilled cast-in-place piles in the manner recommended is expected to be less than 1/2-inch.

Differential settlement between adjacent elements (50 feet apart) is expected to be about 0.25 inch or less.

Lateral Loads

Lateral loads may be resisted by the piles through the passive resistance of the undisturbed natural soils or properly compacted fill adjacent to the piles. An allowable lateral resistance of 300 pounds per square foot per linear foot of depth up to a maximum of 4,000 pounds per square foot may be used to calculate lateral resistance of the piles drilled into dense natural ground starting at 15 feet bgs. One-third increase in the passive value may be used for wind or seismic loads.

The subsurface conditions can be modeled by assuming a continuous soil layer with a friction angle of 30 degrees and a density of 100 pounds per cubic foot in the top 10 feet and 110 pounds per cubic foot below 10 feet. The sub-grade modulus K_H can be assumed 90 pci except for the upper 10 feet of soil profile. Sub-grade modulus, cohesion and Soil strain of 60, 250 psf and 0.005 (ε_{50}) can be assumed for the upper 10 feet of clayey sand.

The passive resistance of properly compacted fill against pile caps and grade beams may be assumed to be equal to the pressure developed by a fluid with a density of 300 pounds per cubic foot. A one-third increase in the passive value may be used for wind or seismic loads. The resistance of the piles and the passive resistance of the soils against pile caps and grade beams may be combined without reduction in determining the total lateral resistance.

It will be necessary to provide some flexibility in the foundation system in order to accommodate the anticipated deflections. One possible solution to the high bending moments and shear forces experienced by the shafts is to drill holes with larger diameters than the shafts in the upper clayey and fill the resulting space with a low-strength bentonite slurry or similar "weak" material (i.e. A slurry mixture can be placed within the annulus space with a unit weight of approximately 85 pcf and an undrained shear strength of 150 psf). It is even feasible that this annulus space around the upper portion of the shaft be left open to provide no resistance to lateral deflections within the Stratum 1 sands. This would allow the shaft to deflect without the strong horizontal reaction of the upper dense sands. A schematic of one possible system incorporating this concept is shown in Figure 20.

Ultimate Design Factors

When considering an ultimate design approach, the recommended design values provided in the previous sections may be multiplied by the factors shown below:

Item	Ultimate Design Factor
Bearing Pressure	3.0
Passive Pressure	1.3
Coefficient of Friction	1.5

Installation

Piles spaced closer than five diameters on centers should be drilled and filled alternately, with the concrete permitted to set at least eight hours before drilling any adjacent holes. All drilled piles excavation should be observed by personnel of our firm. Piles excavations should be filled with concrete as soon after drilling and inspection as possible: the holes should not be left open overnight. The concrete should be placed with special equipment so

that the concrete is not allowed to fall freely more than 5 feet and to prevent concrete from striking the walls of the excavations. Cobbles and boulders will be encountered during drilling operations and casing may be needed where natural ground is prone to caving. Casing and other requirements of the California State Division of Industrial Safety and CALOSHA, should be followed during construction.

Water or water seepage may be encountered in the piles excavations. The water should be removed from the pile excavations by pumping prior to placing the concrete.

Because of the presence of granular soils beneath the Site, the installation of drilled cast-in-place concrete piles will require special provisions to prevent caving of shaft side walls during construction. Special drilling provisions for caving include, but are not limited to, wetting of the upper soils prior to drilling, and/or use of casing.

Among other precautions, the drilling speed should be reduced as necessary to minimize vibration and sloughing of the sand deposits. Pile excavations should be filled with concrete as soon after drilling and inspection is completed; the holes should not be left open overnight. A collar should be placed around the mouth of the shaft after drilling to prevent soils from entering the excavation, and the pile shafts should be covered until concrete is placed.

Concrete should be pumped from the bottom up through a rigid pipe extending to the bottom of the drilled excavation, with the pipe being slowly withdrawn as the concrete level rises. The discharge end of the pipe should be at least 5 feet below the surface of the concrete at all times during placement. The discharge pipe should be kept full of concrete during the entire placing operation and should not be removed from the concrete until all of the concrete is placed and fresh concrete appears at the top of the pile. The volume of concrete pumped into the hole should be recorded and compared to design volume.

Only competent drilling contractors with experience in the installation of drilled cast-in-place piles in similar soil conditions should be considered for the pile construction. We suggest requesting the contractor to submit a list of similar projects along with references for each project.

Observation

The drilling of the piles and the placing of the concrete should be observed continuously by personnel of our firm. Our personnel should verify that pile excavations have at least the design diameters and penetrations into dense natural ground.

4. Retaining Walls

Cantilevered and restrained retaining walls with level backfill may be designed for assumed earth pressure equivalent to 30 and 45 pounds per cubic foot assuming that they are backfilled at least with 2 feet of non-expansive soil (as measured from the interior face of

the wall). External loads on the walls should be added to the recommended pressures. In addition to the recommended earth pressure, the retaining wall should be designed to resist surcharges in accordance with the County of Los Angeles and City of Pasadena Building Codes. Also, adequate drainage should be provided behind the walls to prevent the build-up of hydrostatic pressure.

Prior to backfilling, the excavation between retaining walls and temporary cut banks should be cleared of all loose materials, debris, and construction materials, etc. Soil placed as backfill should be compacted by mechanical means to at least 90 percent of the maximum dry density as determined by the ASTM: D-1557 Laboratory Standard. Ideally, the top two feet of backfill exposed to water infiltration should consist of clayey materials so that a relatively impervious condition is developed. Some settlement of the backfill should be anticipated and any utilities supported therein should be designed to accept differential settlement.

To preclude the adverse effects of possible intercepted subsurface seepage, it is recommended that a sub-drain system consisting of a 4-inch perforated drain pipe encased in three cubic feet per lineal foot of coarse gravel or No. 4 crushed rock be placed above and adjacent to the heel of retaining wall footings. The drain shall be sloped to direct all intercepted waters to approved and designated areas.

The contractor should be informed that the use of heavy compaction equipment in close proximity to the retaining walls cause excessive wall movement and/or earth pressure in excess of design values.

5. Slabs-on-Grade

When sub-grade is prepared as recommended in the above grading section, the building floor slabs and other concrete slabs may be supported on grade. Construction activities and exposure to the environment may cause deterioration of the prepared sub-grade. Therefore, we recommend that our field representative observe the condition of the final sub-grade immediately prior to slabs-on-grade construction and, if necessary, perform further density and moisture content tests to determine the suitability of the final prepared sub-grade. Subgrade soils for all concrete flatwork should be moisture conditioned to 3 percent above optimum moisture content within twenty-four hours prior to placement of concrete. The moisture content of the slab sub-grade should be kept at about optimum moisture content with periodic sprinkling of the slab sub-grade. Measures should be taken to maintain optimum moisture until concrete is placed.

Slabs-on-grade should be calculated for the anticipated live and dead loads by the structural engineer. Slabs-on-grade not subject to vehicular and other equipment traffic, should be a minimum of 4 inches (full) thick underlain by four inches of gravel and reinforced with 6 x

6 W2.9 X W2.9 welded wire mesh or No. 4 bars spaced 16 inches center to center in both directions, placed slightly above the slab mid-height. In areas where vinyl or other moisture-sensitive floor covering is planned, a 6-mil Visqueen should be placed beneath the slab, on the top of the above mentioned gravel layer with two-inch layer of sand between the concrete slab and the Visqueen to aid in curing. Cracks that develop in concrete slab-on-grade should be filled and sealed prior to placing floor coverings. Frequent control joints should be incorporated into the slab construction, particularly in the areas of reentrant corners, to help control cracking. The vapor barrier should be evaluated for holes and/or punctures, and the edges overlapped and taped, prior to placement of concrete. Any holes or punctures observed should be properly repaired. The barrier should be covered with two inches of sand to help protect it during construction. The sand should be lightly moistened just prior to placing the concrete. Relatively impervious floor coverings (i.e. vinyl, linoleum, etc.) that cover concrete slab-on-grade may block the passage of moisture vapor through the concrete slab, which could result in damage to the floor covering. It is suggested that after the concrete slab has sufficiently cured, the concrete slab surface be sealed with a commercial sealant prior to placing the floor covering. The compatibility and recommendations for placing of the concrete sealer, mastic, and floor covering should be verified by the floor covering manufacturer prior to sealing the concrete or placing of the floor covering.

The suggested gradation for the gravel is as follows:

Sieve Size	Percent Passing
3/4"	90-100
No. 4	0-10
No. 100	0-3

If a membrane is used, a low-slump concrete should be used to minimize possible curling of the slabs. The 2-inch-thick layer of coarse sand to be placed over the membrane will reduce slabs curling. If this sand bedding is used, care should be taken during the placement of the concrete to prevent displacement of the sand. The concrete slabs should be allowed to cure properly before placing vinyl or other moisture-sensitive floor covering.

Joints for concrete slabs on grade must be carefully designed. Joint spacing is dependent upon slab thickness and concrete properties and should be selected by the structural engineer. Joint should be properly sealed. Unless local conditions and concrete properties indicate otherwise, the joint spacing (in feet) should not exceed approximately twice the slab thickness (in inches). Joint spacing may be increased if slabs are heavily reinforced.

During hot weather, the contractor should take appropriate curing precautions after placement of concrete to minimize cracking of the slabs. The potential for slab cracking may be lessened by the addition of fiber mesh to the concrete, and/or control of water/cement ratio. Concrete should be cured by protecting it against loss of moisture and rapid temperature change for at least seven (7) days after placement. Mist curing,

waterproof paper, white polyethylene sheeting, white liquid membrane compound, or a combination thereof, may be used after finishing operations have been completed. The edges of concrete slabs exposed after removal of forms should be immediately protected to provide continuous curing.

5.1 Tile Flooring

Tile flooring can crack, reflecting cracks in the concrete slab below the tile. Therefore, the slab designer should consider additional steel reinforcement of concrete flat work where tile will be placed. The tile installer should consider installation methods that reduce possible tile cracking. A vinyl crack isolation membrane (approved by the Tile Council of America/Ceramic Tile Institute) is recommended between tile and concrete flat work.

5.2 Concrete Walks, Driveways, Access Ramps, Curb and Gutter

Except as modified herein, concrete walks, driveways, access ramps, curb and gutters should be constructed in accordance with Section 303-5, Concrete Curbs, Walks, Gutters, Cross-Gutters, Alley Intersection, Access Ramps, and Driveways, of the Standard Specifications for Public Work.

At least the upper 12 inches of the sub grade soils under these structures should be scarified; moisture conditioned to slightly above optimum and compacted to at least 90 percent relative compaction.

The sub-grade soils under the driveways, if any, should be pre-soaked prior to pouring concrete in accordance with the recommendations provided for concrete slabs-on-grade of the specification, Slabs-on-Grade. The thickness of the driveways should be spaced not more than 10 feet apart. Driveways wider than 12 feet should be provided with a longitudinal control joints.

Concrete walks subjected to pedestrian and bicycle loading should be at least four (4) inches thick. Transverse joint should be spaced 15 feet or less and should be cut to a depth of one fourth the slab thickness.

It is recommended that the proposed exterior perimeter slabs (sidewalks, patios, walkways, etc.) be designed to be relatively independent of foundation stems (free-floating) to help mitigate cracking due to foundation settlement and/or expansion.

Positive drainage should be provided away from all driveways and sidewalks to prevent seepage of surface and/or subsurface water into the concrete base and/or subgrade.

6. Drainage

A positive surface gradient should be provided adjacent to all structures so as to direct surface water run-off away from the foundations, slabs, and landscaped areas towards suitable discharge facilities. Ponding of surface water should not be allowed on pavements or adjacent to the building even during the construction period. All roof and wall surface drainage should be collected and conducted by a non-erosive device to the street.

7. Construction Cuts

Construction cuts up to 5 feet in depth may be cut vertically provided they do not undermine existing equipment foundations, buildings, walls, public streets or alleys. Deeper construction cuts should be laid back at 1:1 (horizontal:vertical) gradient or be shored. No surcharge loads should be allowed within four feet from the top of cuts or inside a line drawn at 45 degrees from the toe of the excavation. Exposed slope surfaces should be kept moist (but not saturated) during construction to minimize local sloughing. Screening may be necessary on the slope surface to protect the workmen. Where there is insufficient space for sloped excavations, shoring should be used. If the construction cuts removes lateral support of the existing building or equipment foundations, the existing foundations should be underpinned or construction cut be shored. An equivalent fluid pressure of 24 PCF may be used for the design of temporary shoring with no surcharge. The surcharge from the existing foundations should be added to the recommended equivalent fluid pressure in accordance with the Los Angeles County and City of Pasadena Building Codes. If the construction cuts are to remain open for more than two weeks or if rain is expected while the construction cuts are open, they should be covered by a plastic membrane. All construction cuts should comply with the State of California Construction Safety Orders (Cal/OSHA).

8. Planters

Planters adjacent to the foundations should be avoided, and where planters are planned adjacent to the building, they should have the bottom and walls waterproofed and a drain system installed beneath the planter to carry water away from the building area.

9. Pavement

9.1 General

To provide support for paving, the sub-grade soils should be prepared as recommended in Section 2.0. Compaction of the sub-grade to at least 95%, including trench backfills, will be important for paving support. The preparation of the parking area sub-grade should be done

immediately prior to the placement of the base course. Proper drainage of the paved areas should be provided since this will reduce moisture infiltration into the sub-grade and increase the life of the paving.

9.2 Asphaltic Paving

The required asphaltic paving and base course thicknesses will depend on the anticipated wheel loads and volume of traffic (Traffic Index). Assuming that the paving sub-grade will consist of the on-Site soils or comparable import soils compacted to 95% as recommended, the recommended paving sections for various Traffic Indices is presented in the following table. The paving sections were determined using the Caltrans design method and an assumed R value of 35 based on the R-value tests.

Asphalt Concrete (A.C.) Paving Thickness

Traffic Use	Traffic Index	A.C. (inches)	Base Course (inches)
Automobile Parking	5	3.5	4
Driveway and Light Truck Drives	6	4.0	5
Roadways and Heavy Truck Drives	7	4.5	6

Careful inspection is recommended to verify that the recommended thicknesses or greater are achieved and that proper construction procedures are used. We can provide paving sections for other Traffic Index values if desired.

9.3 Portland Cement Concrete Paving

Portland cement concrete paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for a range of Traffic Indices are presented below. We have assumed that the Portland cement concrete will have a compressive strength of at least 3,000 pounds per square inch.

Portland Cement Concrete (P.C.C.) Paving Thickness

Traffic Use	Traffic Index	P.C.C. (inches)	Base Course (inches)
Automobile Parking	5	5	4
Driveways and Light Truck Drives	6	5	4
Roadways and Heavy Truck Drives	7	6	4

We recommend that the concrete paving be properly reinforced. In addition, dowels are recommended at joints in the paving to reduce any possible offsets.

9.4 Base Course

The base course for both asphaltic and concrete paving should meet the specifications for Class 2 Aggregate Base as defined in the latest edition of the State of California, Department of Transportation (Caltrans) Standard Specifications. Alternatively, the base course should meet the specifications for untreated base as defined in Section 200-2 of the latest edition of the Standard Specifications for Public Works Construction (Green Book). The base course should be compacted to at least 95%.

Careful inspection is recommended to verify that the recommended thickness or greater are achieved and that proper construction procedures are used.

10. Observation

Construction cuts, footing and cast in place concrete pile excavation should be examined by us prior to forming and placement of steel to confirm that the soil conditions meet the requirements set by this report. Footings and pile excavation should be kept moist (not saturated) and the concrete should be poured as soon as possible after excavations are complete, examined and approved by us and the City of Pasadena inspectors. Inspection of foundation and pile excavations may also be required by other appropriate reviewing governmental agencies. The contractor should be familiar with the inspection requirements of the reviewing agencies. Foundations should be deepened if necessary to reach satisfactory supporting soils. Water within the foundation and pile excavations should be removed and any softened soils excavated prior to pouring the foundations. Backfill around and over footings and utility trench backfill within the building areas should be mechanically compacted and tested, flooding should not be used.

11. Plan Review

Formal plans should be reviewed by Hydrologue, Inc. Should the plans differ substantially from preliminary information provided to us, additional geotechnical work may be required.

12. Waterproofing

Rooms or spaces located below grade have a history of moisture intrusion, seepage, and leakage. Conventional waterproofing materials, such as asphalt emulsion, have often proved ineffective. Certain precautions can be taken to reduce the possibility of future seepage problems. Superplasticized and water-retardant concrete may be utilized to make pouring easier and reduce cracking and shrinkage. Also important is the use of a sub-drain

which daylights to the atmosphere. The sub-drain should be covered with gravel to facilitate collection of water.

13. Ground Motion

3.1 General

Seismic design for the proposed industrial development is performed in accordance with the 2007 CBC, which is identical to the 2006 IBC. In the 2006 IBC, the methodology to develop input ground motion parameters for use in seismic design is based on ASCE-7, *Minimum Design Loads for Buildings and Other Structures.* The procedure outlined in ASCE-7 is based on the MCE, which is defined as an earthquake that results in ground motions that have a 2 percent chance of being exceeded in 50 years (a 2,475-year recurrence interval). This procedure is outlined in Table 1.

Table 1
Summary of ASCE-7 Procedure for Seismic Design

Step	Procedure	Reference
1	Compute Generalized Response Spectrum	ASCE 11.4.5
2	Compute MCE Response Spectrum	ASCE 11.4.6
3	Compute Probabilistic MCE Response Spectrum	ASCE 21.2.1
4	Compute Deterministic MCE Response Spectrum	ASCE 21.2.2
5	Compute Deterministic Lower Limit on MCE Response Spectrum	ASCE 21.2.2 (Figure 21.2-1)
6	Compute Site-Specific MCE Response Spectrum	ASCE 21.2.3
7	Compute Two-Thirds of Site Specific MCE Response Spectrum	ASCE 21.3
8	Compute 80 Percent of Generalized Design Response Spectrum	ASCE 21.3
9	Compute Final Design Response Spectrum	ASCE 21.3

The steps summarized in Table 1 are briefly discussed in the following sections.

13.2 Generalized Response Spectrum

The generalized response spectrum for a site is developed by identifying the spectral ordinates at periods of 0.2 and 1 second and identifying the appropriate site class in accordance with Table 1613.5.2 of the 2006 IBC. The spectral ordinates are computed using JAVA Ground Motion Calculator (USGS).

Based on the data obtained from the borings at the Site, the soils at the Site may be classified as Site Type D.

Section 11.4.5 of ASCE-7 summarizes the development of the generalized design response spectrum. The seismic design parameters associated with this Site are summarized in Table 2 computed by JAVA Ground Motion Calculator.

Table 2
Seismic Design Parameters

Parameter	Short Period (T = 0.2 second)	1-Second Period (T, = 1.0 second)
Mapped Spectral Acceleration	S_s =2.550g	S_1= 0.850g
Site Class	D	
Site Coefficient, F_a and Fv	1.0	1.5
Adjusted Spectral Acceleration, S_M	S_{MS}=2.550g	S_{M1} = 1.276 g
Design Spectral Response Acceleration Parameters, S_D	S_{DS}=1.700g	S_{D1}= 0.850g

The generalized response spectrum determined for the Site is presented in Table 3.

13.3 MCE Response Spectrum

The MCE response spectrum is simply defined as the generalized response spectrum multiplied by 1.5.

13.4 Probabilistic MCE Response Specturum

The probabilistic MCE response spectrum is developed by performing a PSHA that takes into account faults that are a potential source of strong ground shaking at the Site based on a given risk, defined as the recurrence Interval. For the MCE, the recurrence interval is 2,475 years, which corresponds to ground motions that have a 2 percent probability of being exceeded in 50 years, as stated in Section 21.2.1 of ASCE-7.

We performed the PSHA using the computer software program EZ Frisk, Version 7.31 using following attenuation relationships (collectively referred to as the NGA Relationships).

- Boore and Atkinson (2008)
- Campbell and Bozorgnia (2008)
- Chiou and Youngs (2008)

In our analysis and based on the data collected from our borings and the prior data, we assumed a shear wave velocity of 1,100 fps to represent the soils at the Site.

The resulting probabilistic MCE response spectrum is presented in Table 3.

13.5 Deterministic MCE Response Spectrum

The deterministic MCE response spectrum is also developed by using EZ Frisk in conjunction with the attenuation relationships and soil stiffness estimate discussed in the "Probabilistic MCE Response Spectrum" section of this report. The deterministic approach simply considers the maximum ground acceleration that may occur at the Site as a result of an earthquake. The deterministic analysis differs from the probabilistic analysis in that recurrence intervals are not considered.

In accordance with ASCE-7 Section 21.2.2, the ordinates of the deterministic response spectrum are multiplied by 1.5 to obtain the ordinates for the deterministic MCE response spectra. The resulting deterministic MCE is presented in Table 3.

13.6 Deterministic Lower Limit on MCE Response Spectrum

The deterministic lower limit MCE response spectrum is defined in ASCE-7 Section 21.2.2 as the response spectrum that results using prescribed spectral ordinates of 1.5 and 0.6 for 0.2 and 1 second periods, respectively. The resulting deterministic lower limit on MCE response spectrum is presented in Table 3.

13.7 Site-Specific MCE Response Spectrum

As outlined in ASCE-7 Section 21.2.3, the Site-specific MCE response spectrum shall be taken as the lesser of the probabilistic MCE and the deterministic MCE. The resulting Site-specific MCE response spectrum is presented in Table 3.

13.8 67 Percent of the Site-Specific MCE Response Spectrum

Section 21.3 of ASCE-7 allows the Site-specific MCE response spectrum to be factored by two-thirds for subsequent comparison to 80 percent of the generalized response spectrum computed in Step 1 ("Generalized Response Spectrum"). Sixty-seven percent of the Site-specific MCE is presented in Table 3.

13.9 80 Percent of the Generalized Design Response Spectrum

Section 21.3 of ASCE-7 establishes the lower bound for design ground motions as 80 percent of the generalized response spectrum computed in Step 1 ("Generalized Response Spectrum" section of this report). Eighty percent of the generalized response spectrum is presented in Table 3.

13.10 Final Design Response Spectrum

To develop the final design response spectrum, the lesser of the values obtained from the probabilistic MCE and the deterministic MCE were taken at each period. If the resulting value is less than 80 percent of the generalized response spectrum, the value from the 80 percent response spectrum is used. The resulting final design response spectrum is, therefore, a hybrid curve based on the generalized response spectrum, the probabilistic MCE response spectrum, and the deterministic MCE response spectrum. The final design response spectrum is presented in table 3.

Table 3
Spectral Ordinates Step (defined in Table 1)

Period	1	2	3	4	5	6	7	8	9
	Design Response Spectrum With Section 11.4.5 (g)	Generalized MCE Response Spectrum Section 11.4.6 (g)	Probabilistic MCE Bulletin 09-01 (g)	Deterministic MCE Bulletin 09-01 (g)	Deterministic Lower Limit MCE ASCE 21.2.2 (Figure 21.2-1) (g)	Site Specific MCE Response Spectrum ASCE 21.2.3 (g)	Site Specific Design Response spectrum (2/3 Site Specific MCE Response Spectrum (of 21.2.3) ASCE 21.3	80% of Design Response Spectrum (of 11.4.5) ASCE 21.3	final Design Response Spectrum ASCE 21.3
0.03	0.986	1.479	1.2976	1.1817	1.500	1.1817	0.788	0.789	0.789
0.1	1.700	2.550	2.3158	1.9218	1.500	1.9218	1.281	1.360	1.360
0.2	1.700	2.550	2.7443	2.4062	1.500	2.4062	1.604	1.360	1.604
0.3	1.700	2.550	2.9480	2.7255	1.500	2.7255	1.817	1.360	1.817
0.4	1.700	2.550	2.8576	2.7248	1.500	2.7248	1.817	1.360	1.817
0.5	1.700	2.550	2.7014	2.6336	1.500	2.6336	1.756	1.360	1.756
0.6	1.417	2.125	2.4426	2.4429	1.500	2.4426	1.628	1.133	1.628
0.7	1.214	1.821	2.2554	2.2921	1.286	2.2554	1.504	0.971	1.504
0.8	1.063	1.594	2.0749	2.1195	1.125	2.0749	1.383	0.850	1.383
0.9	0.944	1.417	1.8688	1.9343	1.000	1.8688	1.246	0.756	1.246
1	0.850	1.275	1.6873	1.7782	0.900	1.6873	1.125	0.680	1.125
1.5	0.567	0.850	1.1725	1.3868	0.600	1.1725	0.782	0.453	0.782
2	0.425	0.638	0.8623	1.0832	0.450	0.8623	0.575	0.340	0.575
2.5	0.340	0.510	0.6797	0.9222	0.360	0.6797	0.453	0.272	0.453
3	0.283	0.425	0.5619	0.8114	0.300	0.5619	0.375	0.227	0.375
4	0.213	0.319	0.4299	0.6889	0.225	0.4288	0.286	0.170	0.286

The results of our seismic analysis are summarized graphically on Figures 21 and 22.

From Table 3, it can be concluded: S_{DS}=1.604g, S_{D1}=1.125g, seismic design category is D.

This report has been prepared for the exclusive use of the City of Pasadena Power Plant, their design consultants and for the specific project discussed herein. Since the report has not been prepared for use by other parties, it may not contain sufficient information for other parties or other uses. Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical consultants practicing in this or similar localities.

The recommendations provided in this report are based upon our understanding of the described project information and on our interpretation of the data collected during the subsurface explorations and laboratory testing. The recommendations and opinions expressed in this report reflect our best estimate of project requirements based on information obtained at exploratory borings, and sampling locations on the date indicated. It must be recognized, however, that evaluation of subsurface deposits, such as those present at the Site, are subject to the influence of undisclosed and unforeseen variations in soil conditions that may occur at different times and intermediate, unexplored areas. This report has been prepared in accordance with generally accepted soils engineering practices. No other warranties, either expressed or implied, are made as to the professional advice provided under the terms of our contract and included in this report.

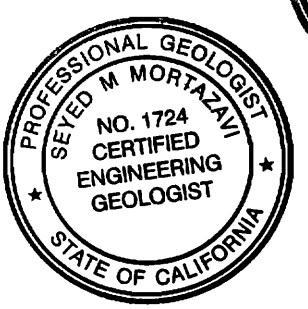
The recommendations provided in this report are also based upon the assumption that the necessary geotechnical observations and testing during construction will be performed by representatives of our firm. The field observation services are considered a continuation of the geotechnical investigation and essential to verify that the actual soil conditions are as anticipated. This also provides for the procedure whereby the client can be advised of unanticipated or changed conditions that would require modifications of our original recommendations. In addition, the presence of our representative at the Site provides the client with an independent professional opinion regarding the geotechnical-related construction procedures.

This opportunity to be of service is sincerely appreciated. If you have any questions concerning this report, please do not hesitate to contact this office.

Very Truly Yours,
HYDROLOGUE, INC.

Seyed Morteza Mortazavi, Ph.D.
R.G.E. 2216
G.E.G. 1724





Enclosures:

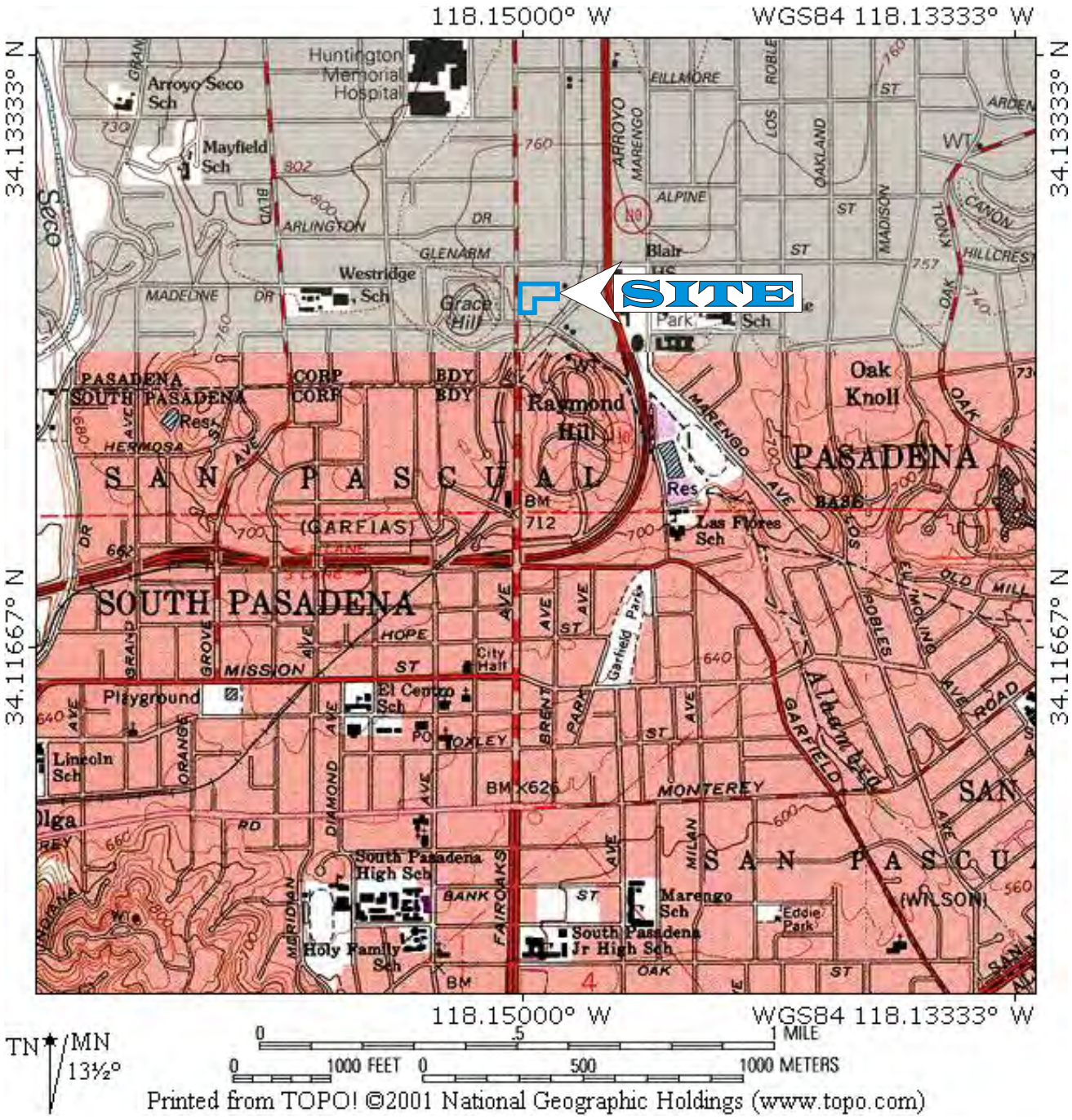
Figure 1	Site Location Map
Figure 2	PEG/IT Borings
Figure 3	Boring Locations, Proposed GT-5 Combined Cycle Installation
Figure 4	Boring Location Map
Figure 5	Boring Locations, Aerial Photograph Background
Figure 6	Geology Map
Figure 7	Fault Exposure Along Eagle Rock Fault
Figure 7-1	Fault Exposure Along Eagle Rock Fault
Figure 8	Geological Map
Figure 9	Representative Geological Profile for Zone 3
Figure 10	Geology Section A-A'
Figure 11	Line Z3-G1 Seismic Section
Figure 12	Geology Map
Figure 13	Geology Map
Figure 14	Map of San Rafael Fault and Features
Figure 15	Seismic Hazard Zones Map
Figure 16	Quaternary Geology Map
Figure 17	Historical Highest Groundwater Contour Map
Figure 18	Cross Section A-A' from Figure 5
Figure 19	Cross Section B-B' from Figure 5
Figure 20	Typical Pipeline Trench Condition
Figure 21	Probabilistic & Deterministic MCE and Lower Limit
Figure 22	Final Design Spectrum

Appendix A	HI Exploratory Boring Logs 2011
Appendix B	HI Exploratory Boring Logs 2009, and 2002
Appendix C	Test Data
Appendix D	Seismic Data
Appendix E	Guide Specifications for Drilled Pile Installation
Appendix F	R-09Z3B3 & R-09Z3B6 Boring Logs from Reference 10
Appendix G	Table B-1 from Reference 10
Appendix H	City of Pasadena Safety Element, Pages 26 through 30
Appendix I	PEG/IT Boring Logs from Reference 3
Appendix J	Pages 26-29 of reference 36
Appendix K	Dynamic Shear Modulus & Material Damping, Jonathan Bray

Distribution: (4) City of Pasadena

Z:\REPORTS\Phase2\3626-00 Pasadena Power Plant PPP\3626-04-01 GT-5 Investigation\3626-04-01 GT5 Geotechnical Investigation.doc

Figures

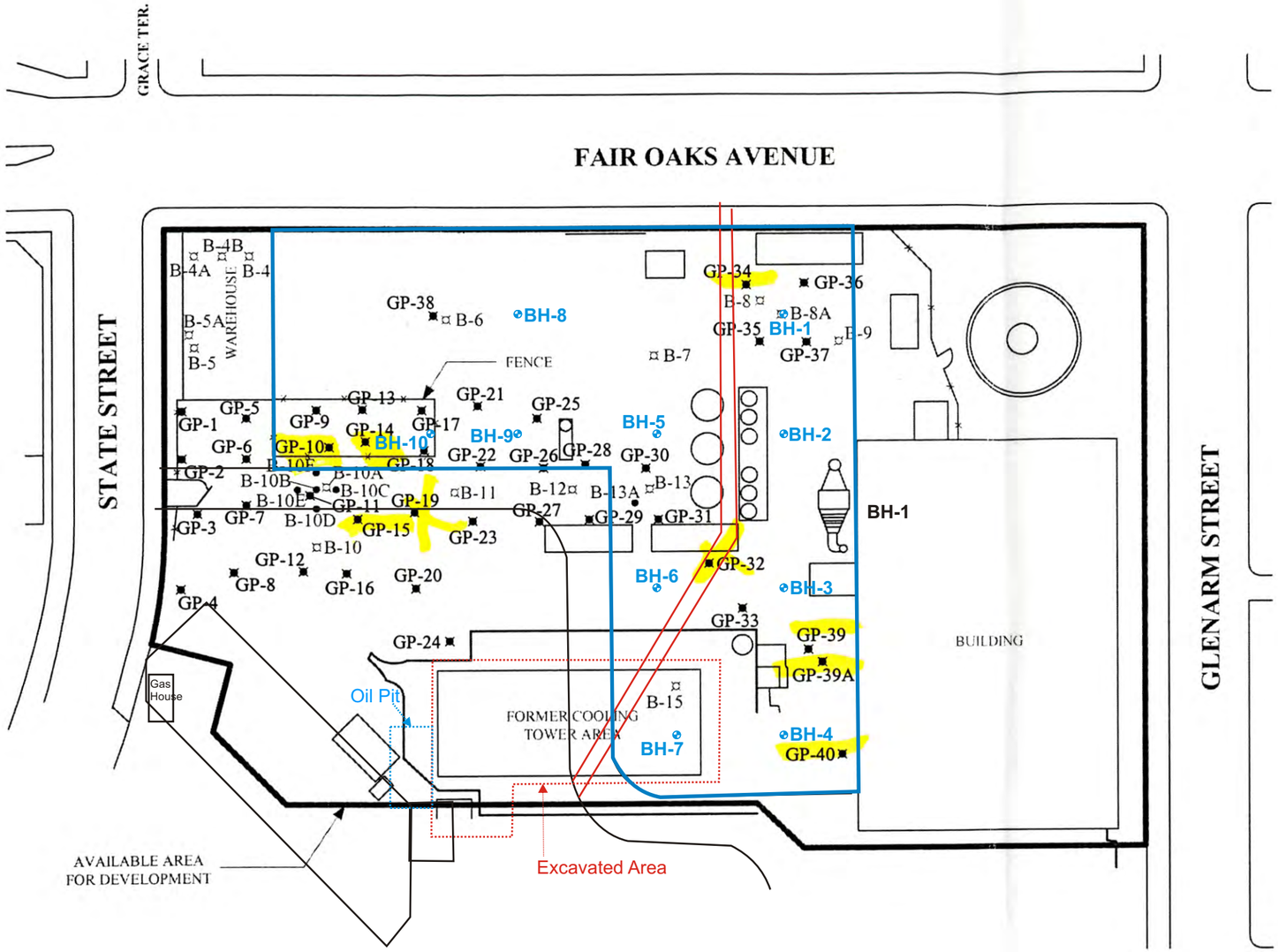


N

CLIENT	**PASADENA WATER AND POWER**
LOCATION	**SE Corner of Fair Oaks Ave & Glenarm St, CA**
TITLE	**SITE LOCATION MAP**
FIGURE NUMBER	**1**
PROJECT	3626-04-01

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LEGEND

GP-1 ✖	GEOPROBE BORING LOCATION AND DESIGNATION, 8/20/99
B-10D •	GEOPROBE BORING LOCATION AND DESIGNATION, 6/15/99
B-4 ¤	HAND AUGER BORING LOCATION AND DESIGNATION, 4/15/99
	MAIN STORM DRAIN
	EXCAVATED AREA
	PROPOSED DEVELOPMENT AREA
BH-1 ⊗	HI BORING 2011

N

SCALE

0 75 150 FEET

Source: 1. Summary of Additional Soil Assessment Activities(Phase III), Pacific Environmental Group, Inc., Project 640-001.1B, Sept. 3, 1999.
2. Report of Soil Investigation-Pasadena Water and Power Plant, Hunter-Kennedy and Associates, Inc., July 30, 2003.

CLIENT
PASADENA WATER AND POWER

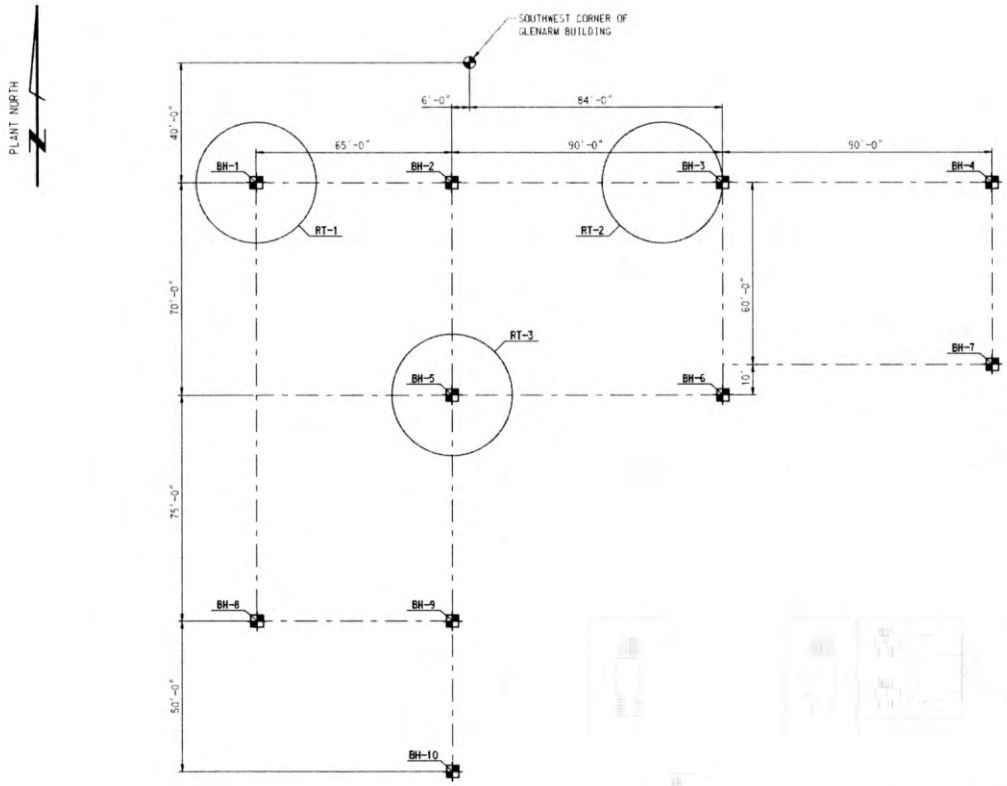
LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

TITLE	FIGURE NUMBER
PEG/IT BORINGS	2

PROJECT	DATE
3626-04-01	3/16/10

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Z:\Reports\phase2\Pasadena Power Plant \3626-04-01 figs\PEG-IT Borings Siteplan.cdr



LEGEND

- BH-1 BOREHOLE LOCATION
- REFERENCE POINT
- RT-1 RESISTIVITY TEST AREA

NOTES

1. CONTRACTOR SHALL COORDINATE WITH APPROPRIATE UNDERGROUND UTILITY LOCATE SERVICES TO ESTABLISH THE LOCATION OF EXISTING UTILITIES IN THE WORK AREA PRIOR TO COMMENCEMENT OF DRILLING OPERATIONS. ANY DAMAGE TO EXISTING FACILITIES, EITHER ABOVE OR BELOW GRADE, CAUSED BY CONTRACTOR DURING DRILLING OPERATIONS SHALL BE REPAIRED BY CONTRACTOR TO THE OWNERS SATISFACTION.
2. LOCATIONS DESIGNATED AS RESISTIVITY TEST AREAS ARE 40' DIAMETER AND LOCATED AS SHOWN. EARTH AND THERMAL RESISTIVIT TESTS CAN BE CONDUCTED ANYWHERE WITHIN THESE ZONES.

Source: Pasadena Power Plant

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

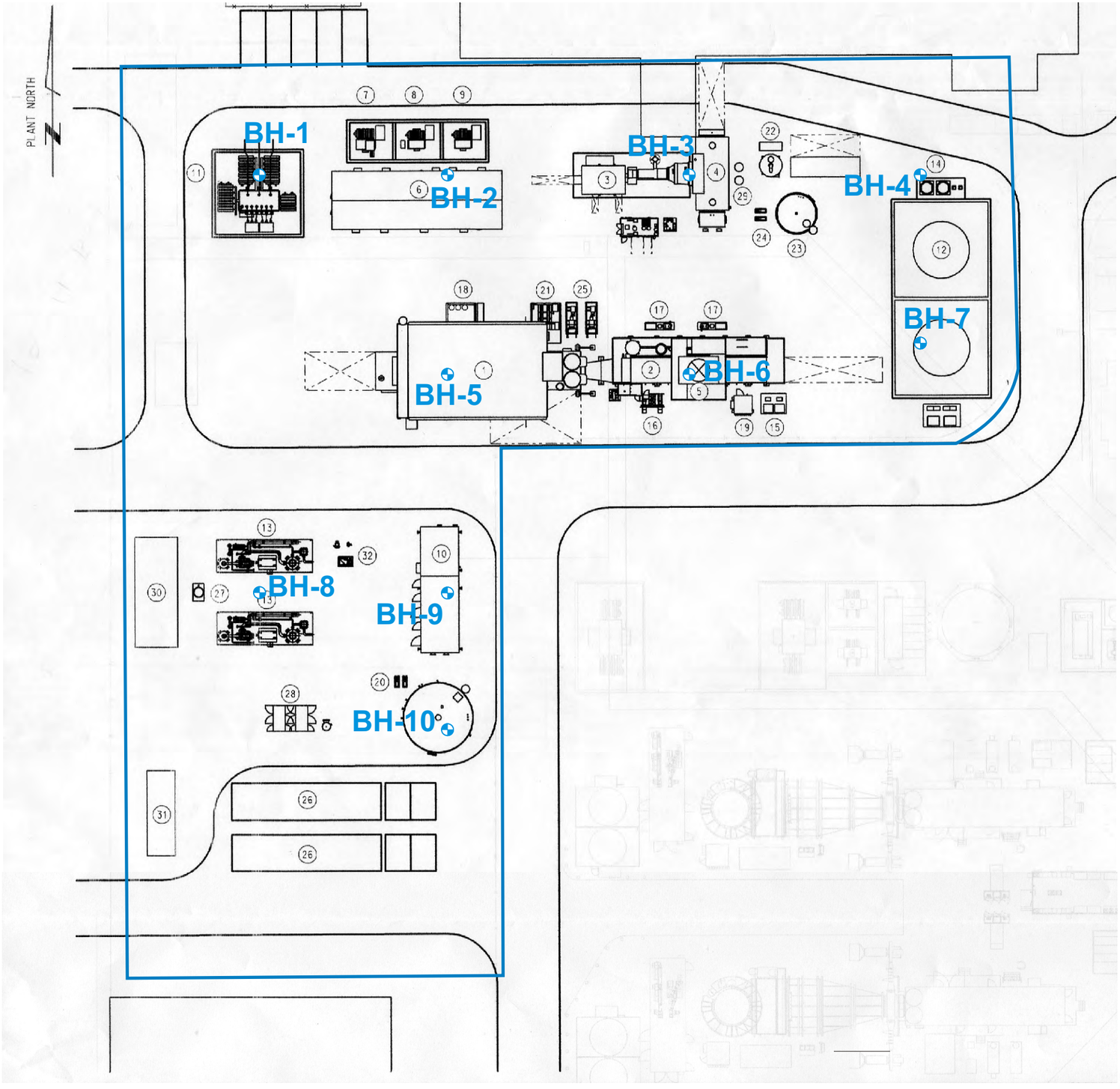
TITLE
BORING LOCATIONS
PROPOSED GT5 COMBINED CYCLE

FIGURE NUMBER
3

PROJECT
3626-04-01

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LEGEND

1. GAS TURBINE GENERATOR (GTG)
2. ONCE THROUGH STEAM GENERATOR (OTSG)
3. STEAM TURBINE GENERATOR (STG)
4. SURFACE CONDENSER
5. OTSG STACK
6. POWER DISTRIBUTION CENTER (PDC)
7. 4.16KV AUX. TRANSFORMER
8. 480V AUX. TRANSFORMER
9. 480V AUX. TRANSFORMER
10. INLET AIR CHILLER
11. GSU TRANSFORMER
12. COOLING TOWER
13. FUEL GAS COMPRESSOR SKID
14. CIRCULATING WATER PUMPS
15. OTSG CHEMICAL FEED SKID
16. AMMONIA FLOW CONTROL UNIT
17. BOILER FEEDWATER PUMPS
18. GTG CO2 BOTTLES
19. CEMS SKID
20. DEMINERALIZED WATER TANK AND PUMPS
21. GTG AUXILIARY SKID
22. CONDENSATE POLISHERS
23. CONDENSATE STORAGE TANK
24. CONDENSATE MAKE UP PUMPS
25. GTG NOX WATER INJECTION SKIDS
26. MOBILE DEMINERALIZED WATER TREATMENT
27. FUEL GAS COMPRESSOR DRAINS TANK
28. AIR COMPRESSOR AND RECEIVER
29. CONDENSATE PUMPS
30. FUEL GAS METERING
31. BLACK START GENERATOR
32. GTG FUEL GAS FINAL FILTER SKID

NOTES

1. CONCEPTUAL

0 10 20 40 60 FEET
1" = 20'

Source Map: Pasadena Water & Power, Glenarm Repowering Project (GT-5 Combined Cycle Installation)
General Arrangement Gas Turbine/Axial Exhaust drawing, Job Number 119977, Drawing No. M1-1-1, Rev A

CLIENT
PASADENA WATER AND POWER

LOCATION
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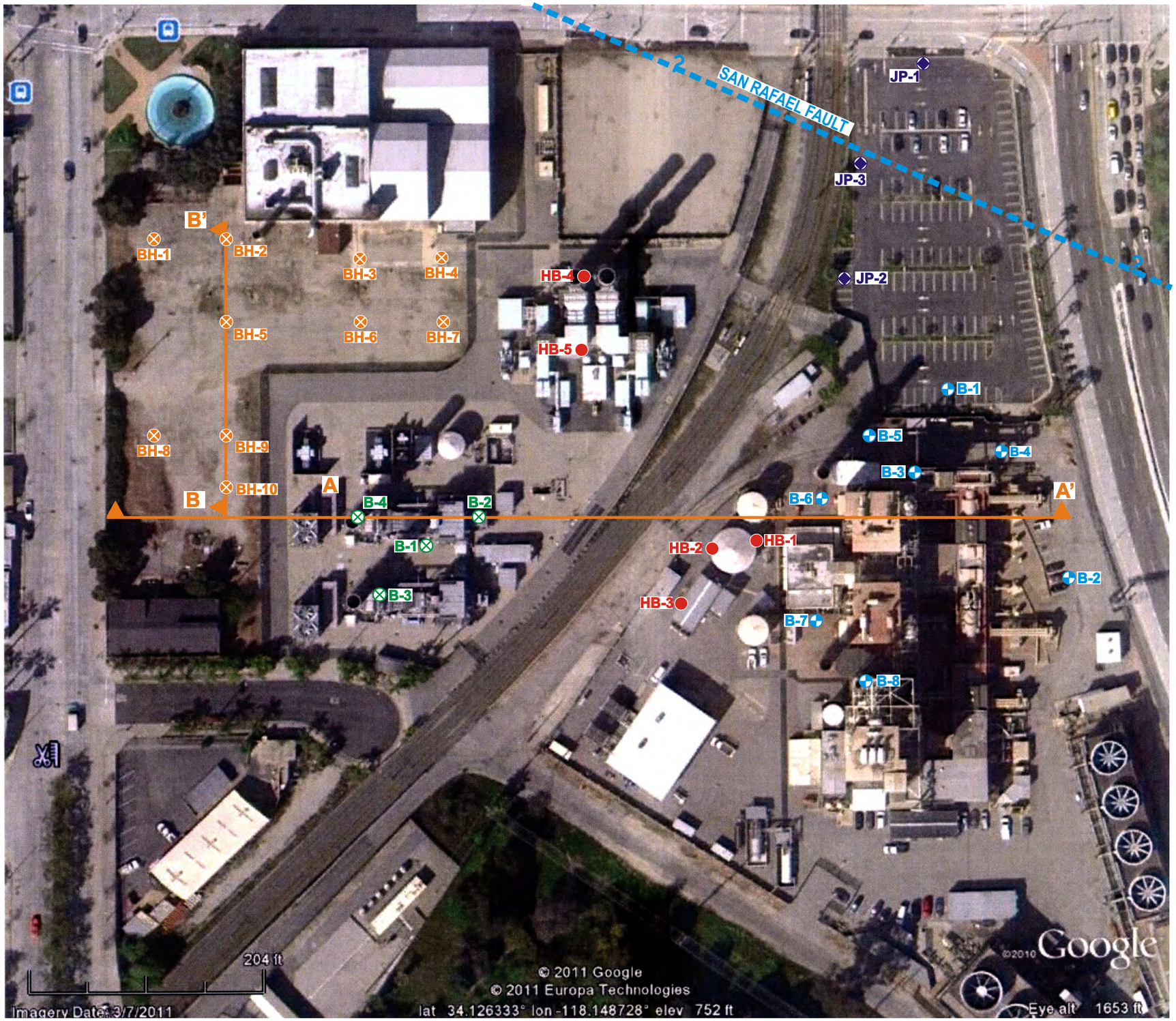
TITLE
BORING LOCATION MAP

FIGURE NUMBER
4

PROJECT
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3626-04-02 figs:3626-04-01 boring location mao.cdr



LEGEND

B-2	HI Borings - 2002
HB-1	HI Borings - 2002
B-4	HI Borings - 2009
JP-1	HI Borings - 2009
BH-1	HI Borings - 2011

N

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

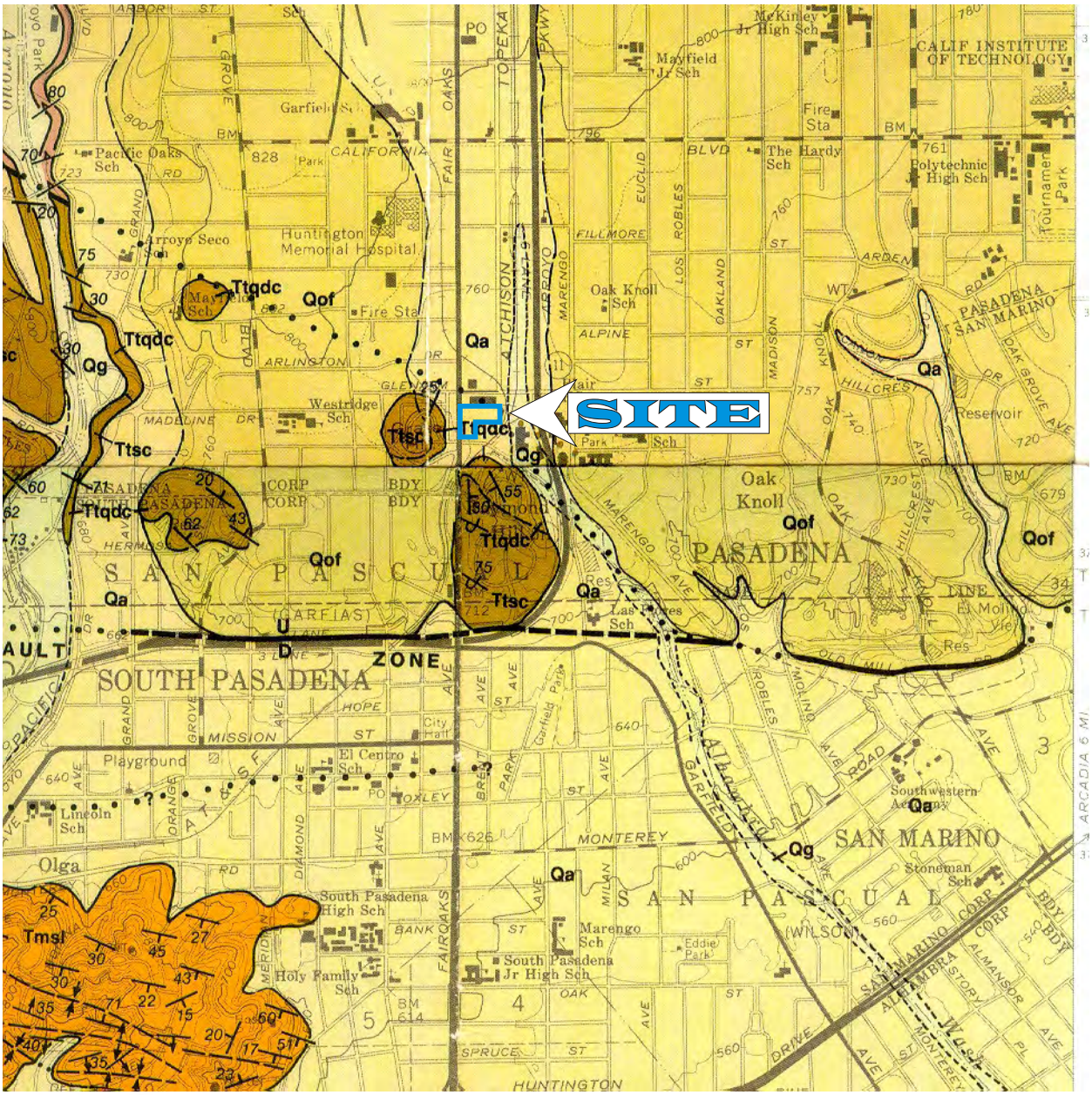
TITLE
AERIAL PHOTOGRAPH

FIGURE NUMBER
5

PROJECT
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Abbreviated
LEGEND
(complete legend on reverse side)

af / Qg / Qa

SURFICIAL SEDIMENTS
af *artificial fill*
Qg *gravel and sand of stream channels, and alluvial fan outwash from major canyons; grades southward into* **Qa**
Qa *alluvium of valley areas*

Qls

LANDSLIDE AND TALUS DEBRIS

Qof / Qoa / Qog

OLDER DISSECTED SURFICIAL SEDIMENTS
Qof *alluvial fan gravel and sand, from San Gabriel Mtns.*
Qoa *low terrace remnants of alluvial gravel and sand*
Qog *elevated remnants of fan gravel and sand; includes San Dimas Formation of Morton, 1973*
—UNCONFORMITY—

Holocene

?

e

N

SCALE
0 2000 feet

SOURCE: Geological Maps of the Pasadena and Los Angeles Quadrangles, Los Angeles County, Thomas Dibblee, Jr., 1989

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

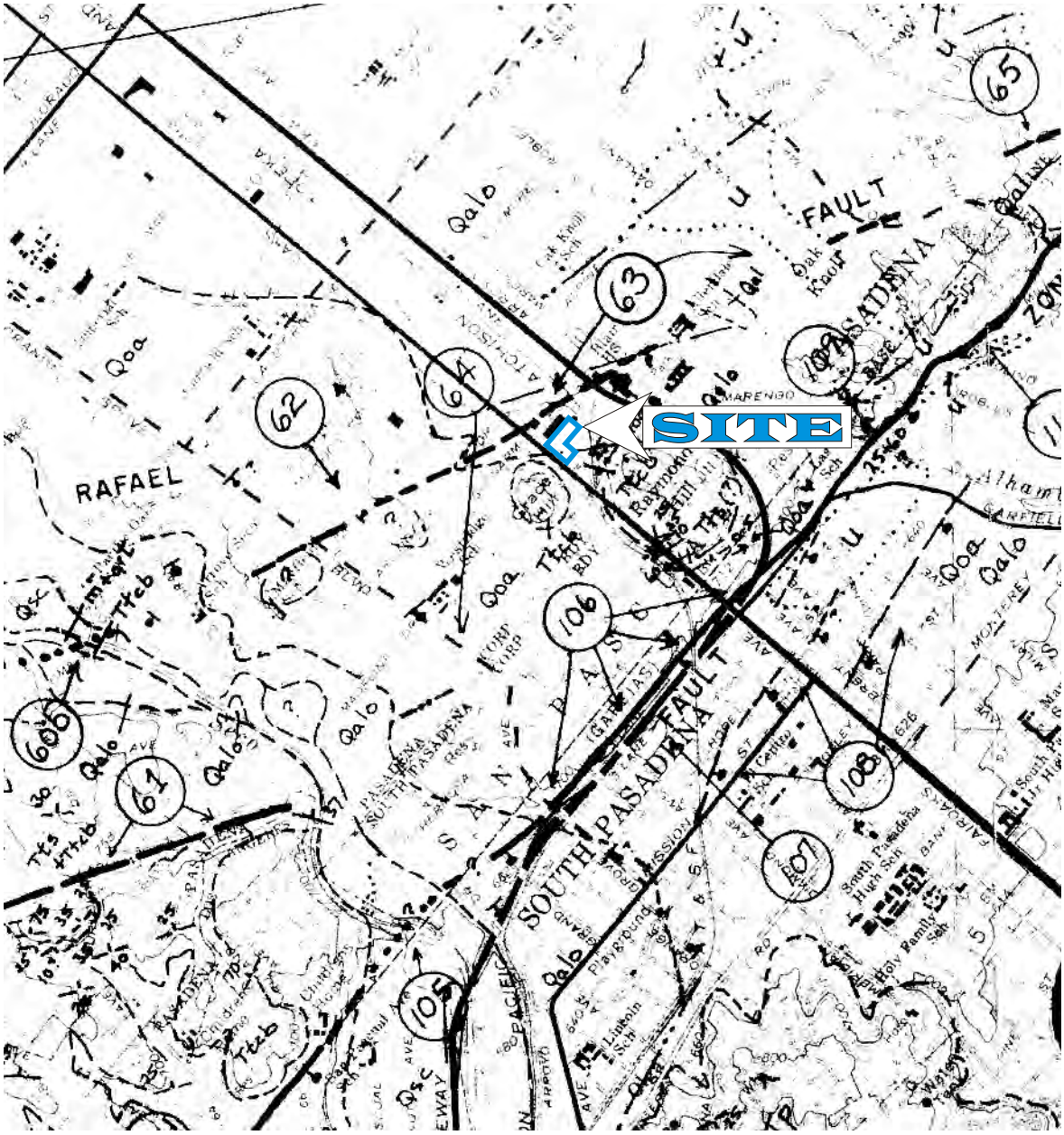
TITLE
GEOLOGY MAP

FIGURE NUMBER
6

PROJECT
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N

SCALE
0 0.75 Mile

SOURCE: PLATE 1, EARTHQUAKE HAZARDS ASSOCIATED WITH THE VERDUGO-EAGLE ROCK AND BENEDICT CANYON FAULT ZONES, LOS ANGELES COUNTY, CALIFORNIA, 1980, CALIFORNIA DEPT. OF CONSERVATION, DIVISION OF MINES AND GEOLOGY

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

TITLE
FAULT EXPOSURE ALONG EAGLE ROCK FAULT

FIGURE NUMBER
7

PROJECT
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62. A slight rise to the south in very gently sloping terrain underlain by older alluvium (Qoa) may have been caused by fairly recent movement along the San Rafael fault.

63. The trace of the San Rafael fault is represented by low breaks in slope and by irregular terrain on a nearly flat surface developed on the surface of older alluvium (Qoa).

64. Buwalda (1940) described essentially flat or even slightly north-dipping surface areas as being the product of upwarping along the fault.

SOURCE: EARTHQUAKE HAZARDS ASSOCIATED WITH THE VERDUGO-EAGLE ROCK AND BENEDICT CANYON FAULT ZONES, LOS ANGELES COUNTY, CALIFORNIA, 1980, CALIFORNIA DEPT. OF CONSERVATION, DIVISION OF MINES AND GEOLOGY

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

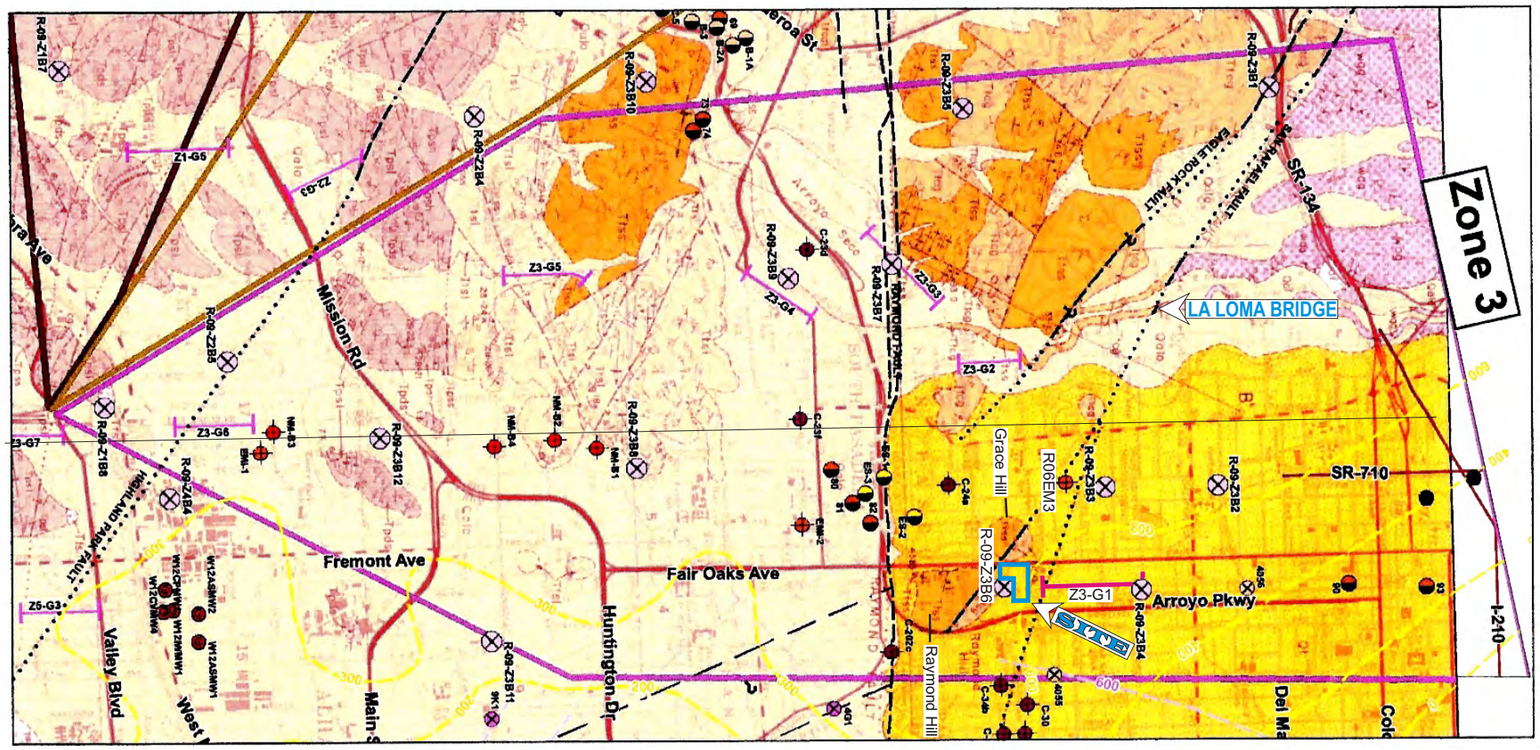
TITLE
FAULT EXPOSURE ALONG EAGLE ROCK FAULT

FIGURE NUMBER
7-1

PROJECT
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Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs 1.cdr



Legend

(All Locations are Approximate)

- R-09-Z1B8 — Continuous Core Boring (CH2M HILL, this study)
- W12ASMW2 — Facility Monitoring Well (CH2M HILL, 2009)
- Caltrans As-built LOTB's (Various Locations)
- 4077B — Water Production Well; Location for which only Groundwater Data is Available (LACDPW, 2009)
- EMI-1 — Continuous Core Boring (EMI, 2006)
- A-1 and B-3 — Geotechnical Boring (City of Los Angeles, 2000, 2006a, and 2006b)
- C-1 — Geotechnical Boring (URS, 2006)
- MW-17 — Groundwater Monitoring Well (CH2M HILL, 2006)
- CA-D3W — Water Production Well (Geosyntec, 2004)
- MW1-4 — Groundwater Monitoring Well (CH2M HILL, 2003)
- B-90 — Geotechnical Boring (City of Los Angeles, 2001)
- NM-B1 — Boring (Ninyo and Moore, 1999)
- 90 — Geotechnical Boring (Law/Crandall, 1993)
- PO-103-MW2 — Monitoring Well, (JMM, 1992 and CH2M HILL, 2007)
- 2760c — Boring (Yerkes, et al, 1977)
- C-65/C-23f — Boring (Caltrans, 1974a)
- ES-1 — Geotechnical Boring (Caltrans, 1974b)
- 502 — Water Production Well (CDWR, 1966)
- -200- — Depth to Bedrock in Feet Below Existing Ground Surface (Yerkes, et al, 1977)
- Structural Contour Line, Elevation at Top of Bedrock in Feet (MSL) (CDWR, 1966 and Geoscience, 2004)
- Groundwater Elevation in Feet (MSL) (San Gabriel Basin - MSGW, 2006 and Raymond Basin - RBMB, 2006 and 2007)
- Z3-G2 — Seismic Reflection Line (CH2M HILL, this study)
- Zone 1 Limits
- Zone 2 Limits
- Zone 3 Limits
- NEIS
- ECIS
- Metro Red Line
- Metro Gold Line Eastside Extension (Tunnel Portion)
- Existing Street, Road, or Highway

Source of Base Map: Lamar, 1970

N

HORIZONTAL GRAPHIC SCALE

2,000 0 1,000 2,000

Sourece: Draft Geotechnical Summary Report SR-710 Tunnel Technical Study
Los Angeles County, California (Report No. EA-07-187900), prepared By CH2M HILL,
6 Hutton Centre Drive, Suite 700Santa Ana, CA 92707, dated October 2009

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

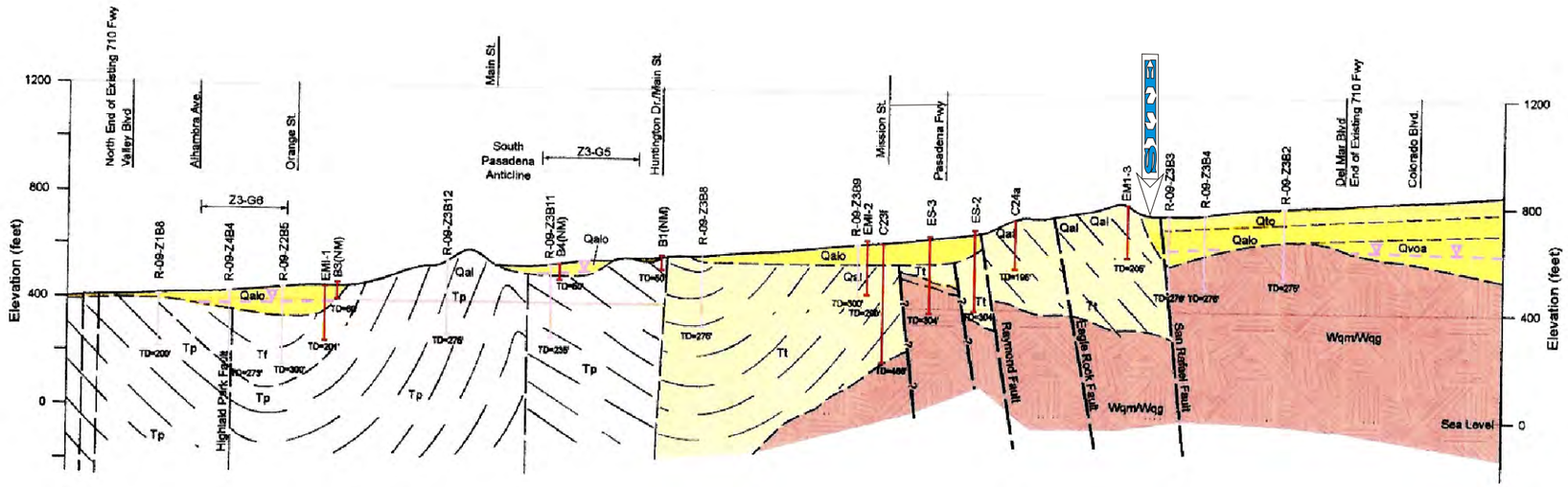
TITLE
GEOLOGICAL MAP

FIGURE NUMBER
8

PROJECT
3626-04-01

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Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs: 3626-04-01 geol map.cdr



EXPLANATION

Data Sources:

CDMG (1998d)
CDWR (1966)
CH2M HILL (2009)
EMI (2006)
Dibblee (1989b)
Dibblee (1999)
Geoscience (2004)
Lamar (1970)
MSGW (2006)
Morton and Miller (2003)
Tan (2000b)

UNITS (from Lamar, 1970)

Quaternary Deposits

- Qto — Old Terrace and fan alluvium: primarily sand and gavel
- Qalo — Old Alluvium, sand and gravel
- Qvoa — Very Old Alluvium: primarily cobbles and coarse gravel

Fernando Formation (Pliocene; Undifferentiated)

- Tf — Siltstone: massive

Puente Formation (Late Miocene)

- Tp — Interbedded Siltstone, claystone, mudstone, shale and sandstone, brown, gray, and black

Topanga Formation (Middle Miocene)

- Tt — Predominantly sandstone and conglomerate with abundant interbeds of siltstone and mudstone; brown, dark gray, and black.

Crystalline Basement Rocks (Mesozoic)

- Wqm / Wqg — Primarily Diorite and gneiss; generally highly fractured

SYMBOLS (All locations are approximate)

- Z4-B4 — Continuous Core Boring (CH2M HILL, this study)
- 14D1 — Water Production Well (CDWR, 1966)
- Z5-G2 — Seismic Reflection Line (CH2M HILL, this study)
- C23f — Caltrans Boring (1974a)
- B4(NM) — Ninyo and Moore (1999)
- EMI-2 — Continuous Core Boring (EMI, 2006)
- ES-2 — Caltrans Boring (1974b)

- Historically Highest Groundwater Level (CDMG, 1998f, 1998d)
- 2006 Groundwater Level (MSGW, 2006 and RBMB, 2006)
- Inactive Fault
- Active Fault
- Geologic Contact, dashed where inferred or indefinite

HORIZONTAL GRAPHIC SCALE
2,000 0 1,000 2,000

Sourece: Draft Geotechnical Summary Report SR-710 Tunnel Technical Study Los Angeles County, California (Report No. EA-07-187900), prepared By CH2M HILL, 6 Hutton Centre Drive, Suite 700Santa Ana, CA 92707, dated October 2009

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

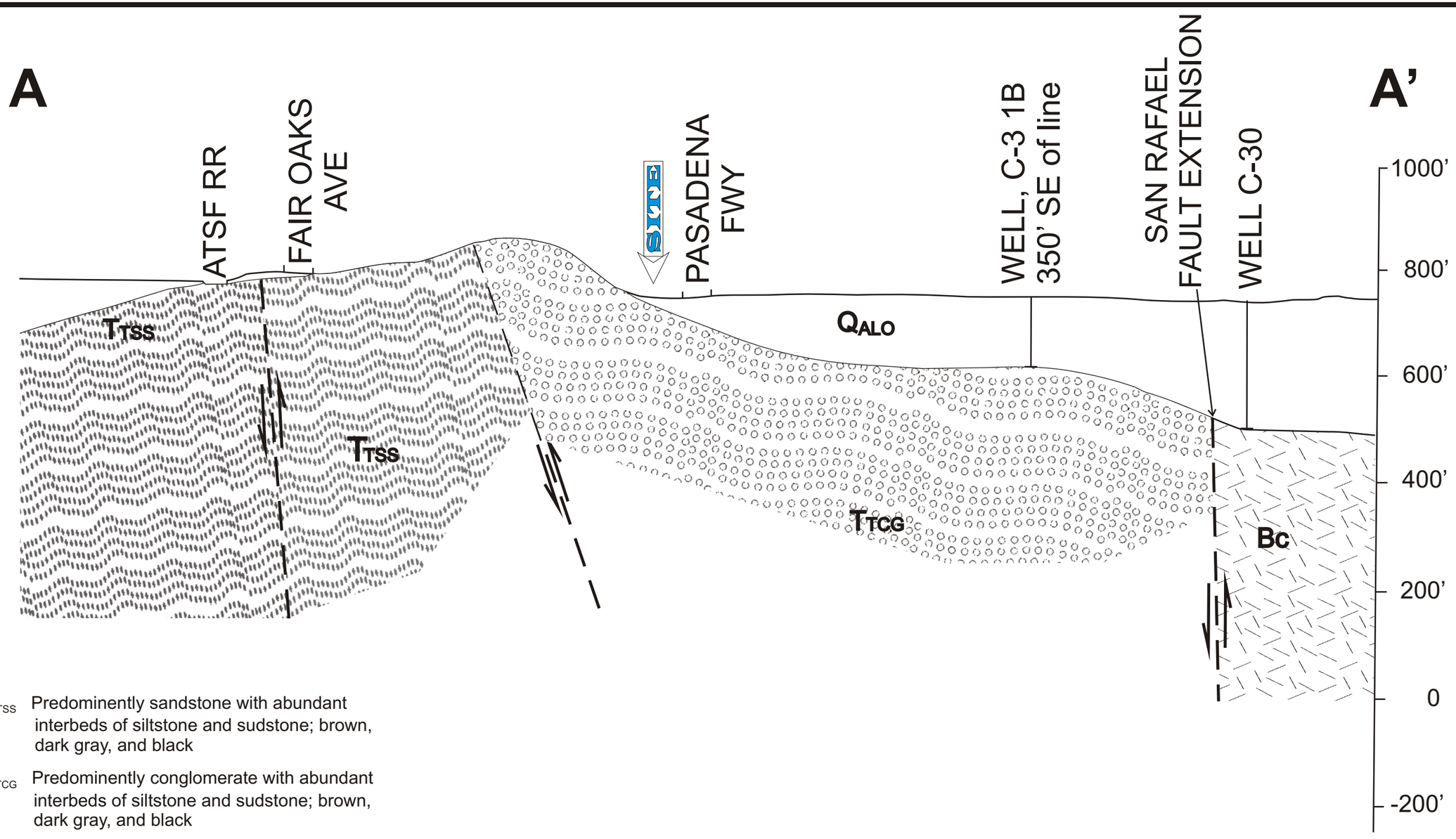
TITLE
REPRESENTATIVE GEOLOGICAL PROFILE FOR ZONE 3

FIGURE NUMBER
9

PROJECT
3626-04-01

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Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs: 3626-04-01 geol map.cdr



T_{TSS} Predominently sandstone with abundant interbeds of siltstone and sudstone; brown, dark gray, and black

T_{TCG} Predominently conglomerate with abundant interbeds of siltstone and sudstone; brown, dark gray, and black

Q_{ALO} Old Alluvium, sand and gravel

Sourece: Geotechnical Report for the Route 7 Freeway Corridors from Route 10 to Route 210 In and Near the Cities of Los Angeles, South Pasadena, Pasadena, and Alhambra, (Report No. 625.732) prepared by Materials and Environmental Investigations Section of the Engineering Services Branch, District 7, California Department of Transportation, dated January 1974.

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

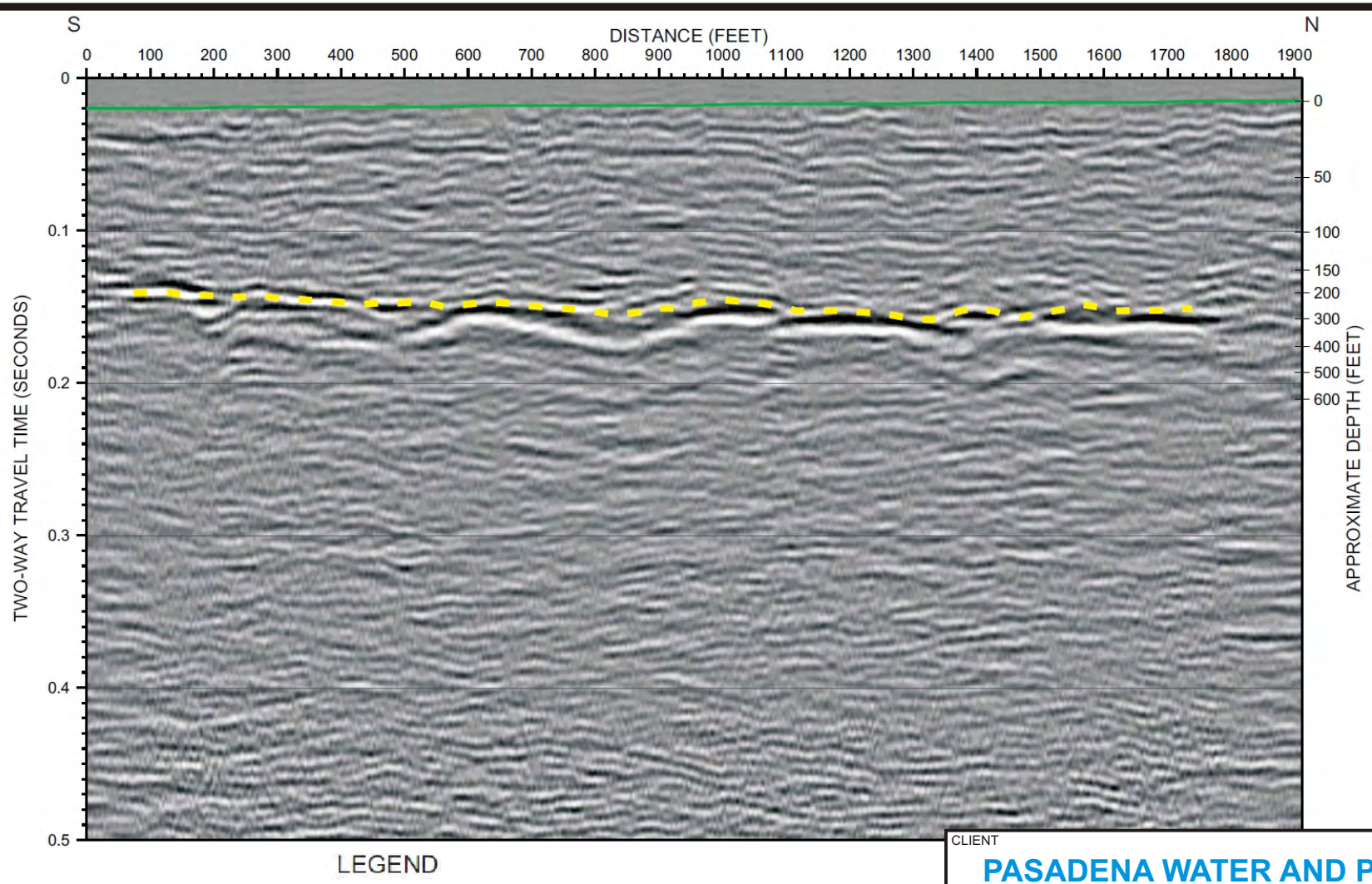
TITLE
GEOLOGY SECTION A-A'

FIGURE NUMBER
10

PROJECT
3626-04-01

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Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs: 3626-04-01 figs 2.cdr



LEGEND

- Ground Surface Reference
- Interpreted Water Table or Top of Bedrock
- Interpreted Top of Bedrock or Weathering Contact within Bedrock
- Example Seismic Reflector
- Possible Fault, dotted where uncertain

Sourece: Geo Vision section presented in Draft Geotechnical Summary Report SR-710 Tunnel Technical Study Los Angeles County, California (Report No. EA-07-187900), prepared By CH2M HILL, 6 Hutton Centre Drive, Suite 700 Santa Ana, CA 92707, dated October 2009

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

TITLE
LINE Z3-G1 SEISMIC SECTION

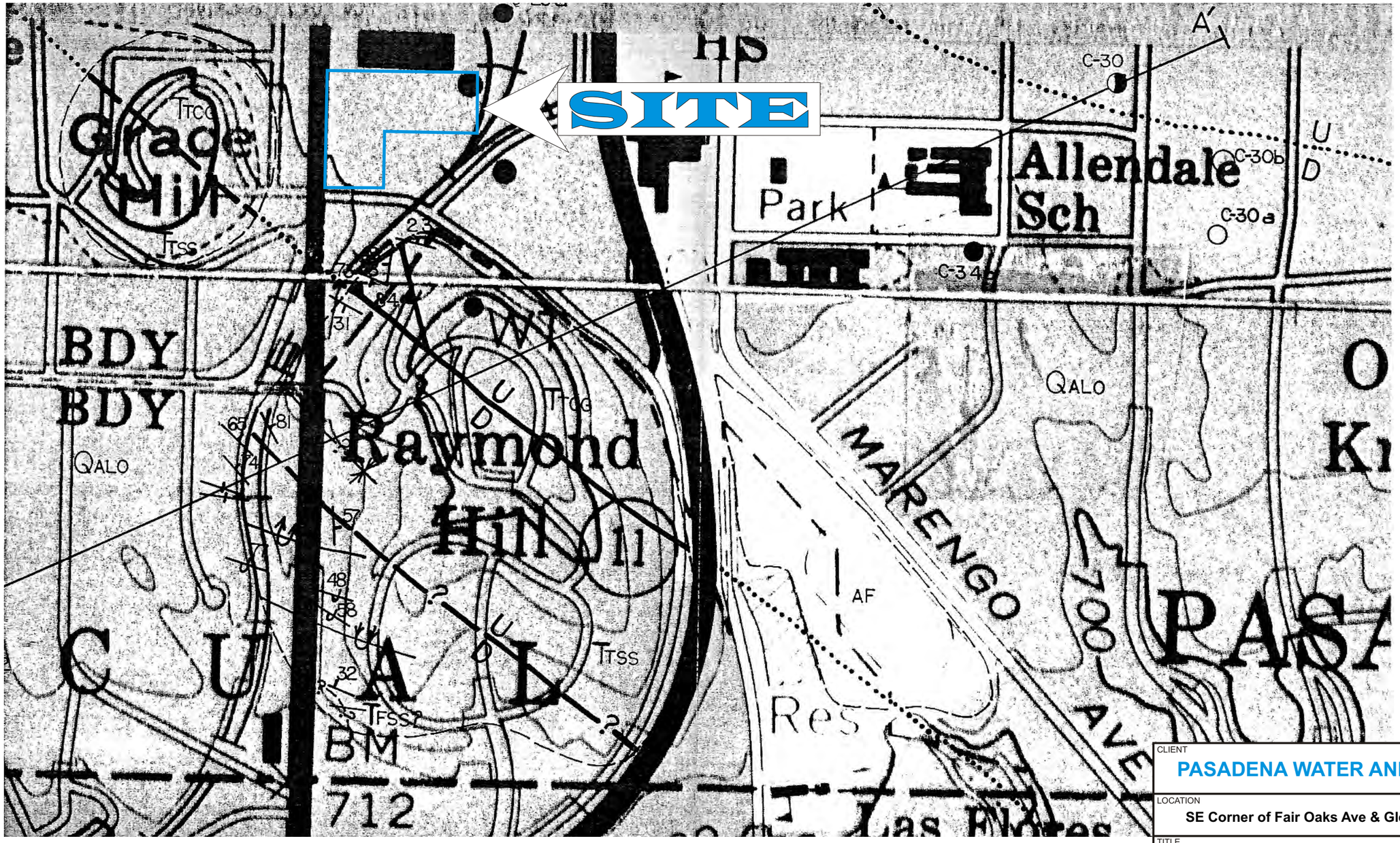
FIGURE NUMBER
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PROJECT
3626-04-01

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Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs 3.cdr


SITE
SCALE 1" = 2000'
N
SCALE
0
2000 feet
WESTERN CORRIDOR
MERIDIAN CORRIDOR
RAYMOND FAULT
SOUTH PASADENA FAULT
FAIR OAKS FAULT
HIGHLAND PARK
PASADENA
SOUTH PASADENA
ALHAMBRA
LOS ANGELES
Eagle Rock
Glassell Park
Mount Washington
Highland Park
Garvanza
Annandale Golf Club
Central Park
City Park
Arroyo
Lower Arroyo Park
Eagle Rock Recreation Center
Eagle Rock Reservoir
Annandale Country Club
Hunt Memorial Hospital
Huntington Memorial Hospital
Occidental College
Pasadena City College
Mayfield Sch
Marengo Jr High Sch
South Pasadena Jr High Sch
Garfield Sch
Lincoln Sch
Garvanza Sch
Franklin Sch
Jefferson Sch
Polytechnic Sch
Annandale Golf Course
Rose Hill Park
Hillcrest Park
Sunset Park
Orange Grove Park
Arroyo Park
Highland Park
Eagle Rock Park
Debs Park
Lower Arroyo Park
Linda Vista Park
Garfield Park
Memorial Park
Victory Park
Brookside Park
Rose Hill Park
Our Lady of Guadalupe Sch
Annandale Golf Club
Eagle Rock Reservoir
Eagle Rock Recreation Center
Lower Arroyo Park
Debs Park
Linda Vista Park
Garfield Park
Memorial Park
Victory Park
Brookside Park
Rose Hill Park
Hillcrest Park
Sunset Park
Orange Grove Park
Arroyo Park
Highland Park
Eagle Rock Park
Glassell Park
Mount Washington
Garvanza
Lincoln Sch
Garfield Sch
Franklin Sch
Jefferson Sch
Polytechnic Sch
Mayfield Sch
Marengo Jr High Sch
South Pasadena Jr High Sch
Occidental College
Pasadena City College
Hunt Memorial Hospital
Huntington Memorial Hospital
Annandale Golf Course
Annandale Golf Club
Central Park
City Park
Arroyo
Lower Arroyo Park
Eagle Rock Recreation Center
Eagle Rock Reservoir
Annandale Country Club
Hunt Memorial Hospital
Huntington Memorial Hospital
Occidental College
Pasadena City College
Mayfield Sch
Marengo Jr High Sch
South Pasadena Jr High Sch
Garfield Sch
Lincoln Sch
Garvanza Sch
Franklin Sch
Jefferson Sch
Polytechnic Sch



Sourece: Geotechnical Report for the Route 7 Freeway Corridors from Route 10 to Route 210 In and Near the Cities of Los Angeles, South Pasadena, Pasadena, and Alhambra, (Report No. 625.732) prepared by Materials and Environmental Investigations Section of the Engineering Services Branch, District 7, California Department of Transportation, dated January 1974.

SCALE
0 350 feet

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

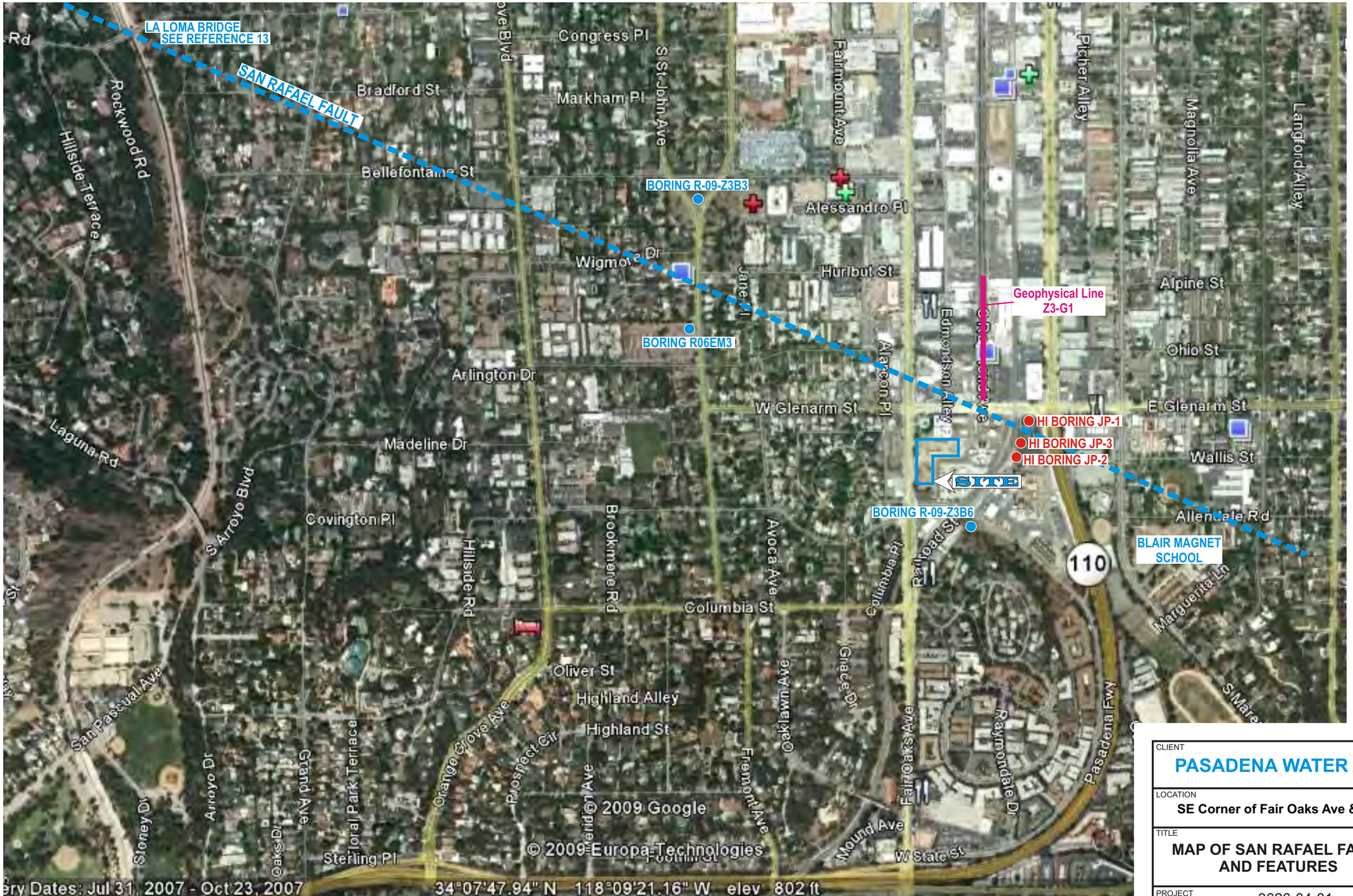
TITLE
GEOLOGY MAP

FIGURE NUMBER
13

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs: 3626-04-01 figs 2.cdr



BORING R-09-Z3B6,
BORING R-063M3,
BORING R-09-Z3B3,
from Reference 7

N

Modified from: Eagle Rock-San Rafael Fault, report prepared by Schell Geological Consulting CO. dated November 19, 2009.

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

TITLE
MAP OF SAN RAFAEL FAULT AND FEATURES

FIGURE NUMBER
14

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-02 figs: 3626-04-01 Map of Fault.cdr



MAP EXPLANATION

Zones of Required Investigation:

Liquefaction
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

SCALE
0 1000 feet

N

CLIENT	**PASADENA WATER AND POWER**
LOCATION	**SE Corner of Fair Oaks Ave & Glenarm St, CA**
TITLE	**SEISMIC HAZARD ZONES MAP**
FIGURE NUMBER	**15**
PROJECT	3626-04-01

Source: Seismic Hazard Zones Map for Pasadena & Los Angeles Quadrangle, dated March 25, 1999

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Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs 1.cdr



Qyf1: Quaternary, Young Alluvial
Fan deposits, sand to gravelly sand.

Qof: Quaternary, Pleistocene Alluvial
Fan deposits, sand, silt and gravelly.

SCALE
0 1 Mile

N

Source: Seismic Hazard Zone Map for Pasadena & Los Angeles Quadrangle, dated 1998

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

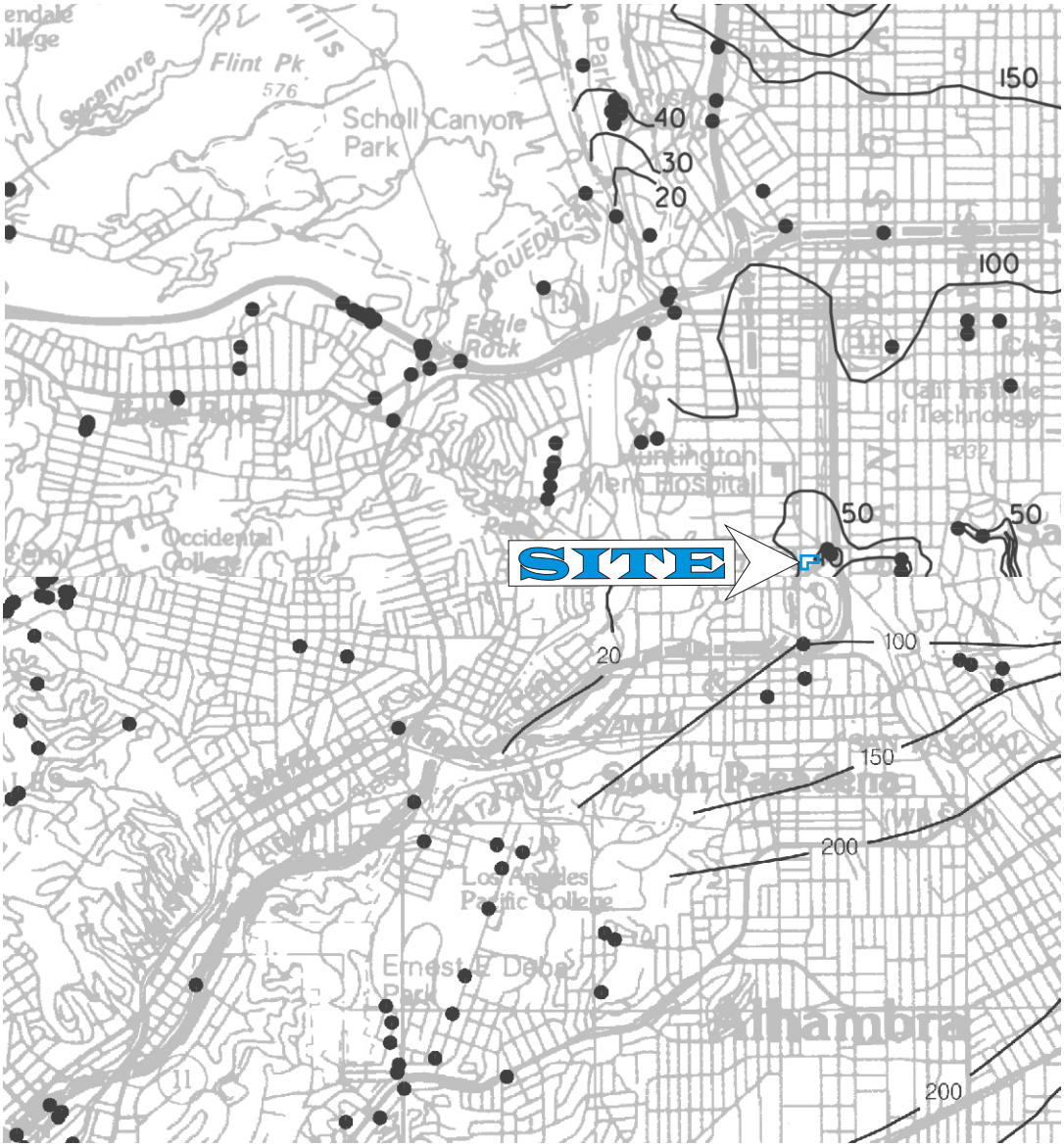
TITLE
QUATERNARY GEOLOGY MAP

FIGURE NUMBER
16

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs.cdr



30 Depth to ground water in feet

● Borehole Site

Source: Seismic Hazard Zone Map for Pasadena & Los Angeles Quadrangle, dated 1998

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm St, CA

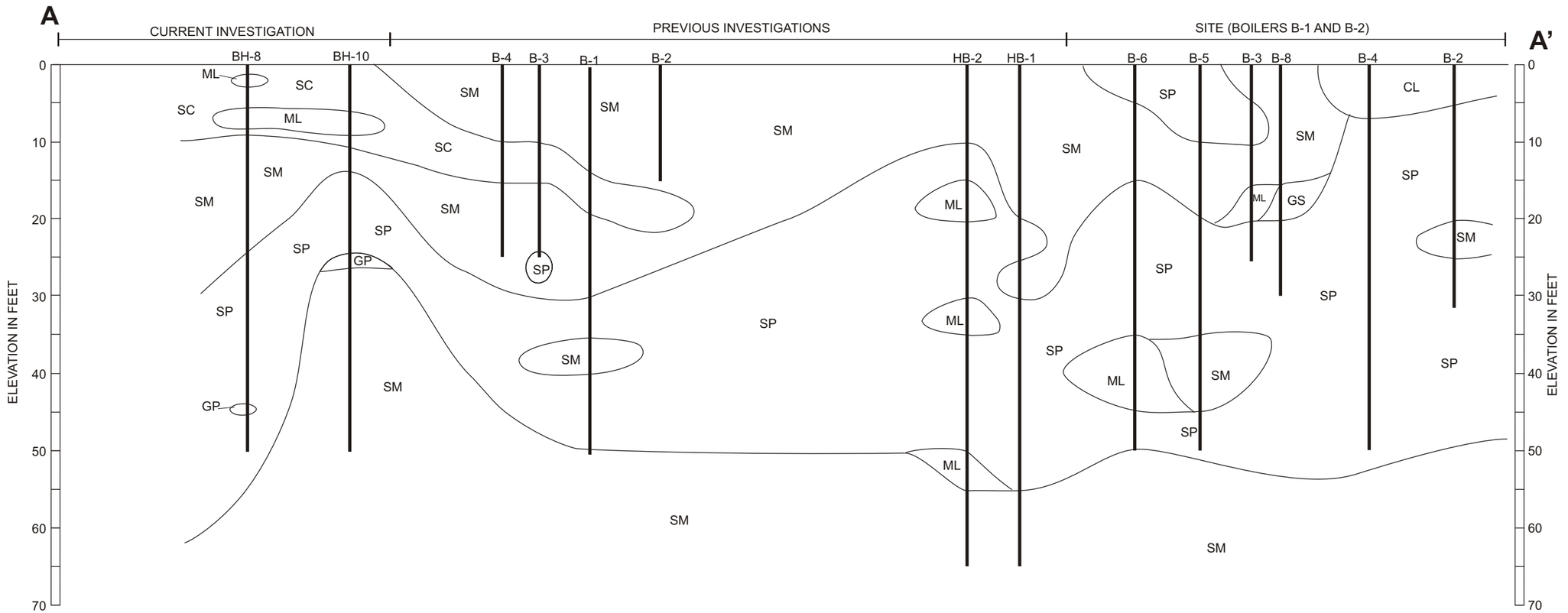
TITLE
HISTORICAL HIGHEST GROUNDWATER CONTOUR MAP

FIGURE NUMBER
17

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs.cdr



LEGEND

CL	Clay
ML	Silt
SC	Clayey Sand
SM	Silty Sand
SP	Poorly Graded Sand
GP/GS	Sandy Gravel

Approximate
Horizontal Scale
0 75 Feet

CLIENT
PASADENA WATER AND POWER

LOCATION
72 EAST GLENARM STREET, PASADENA, CA

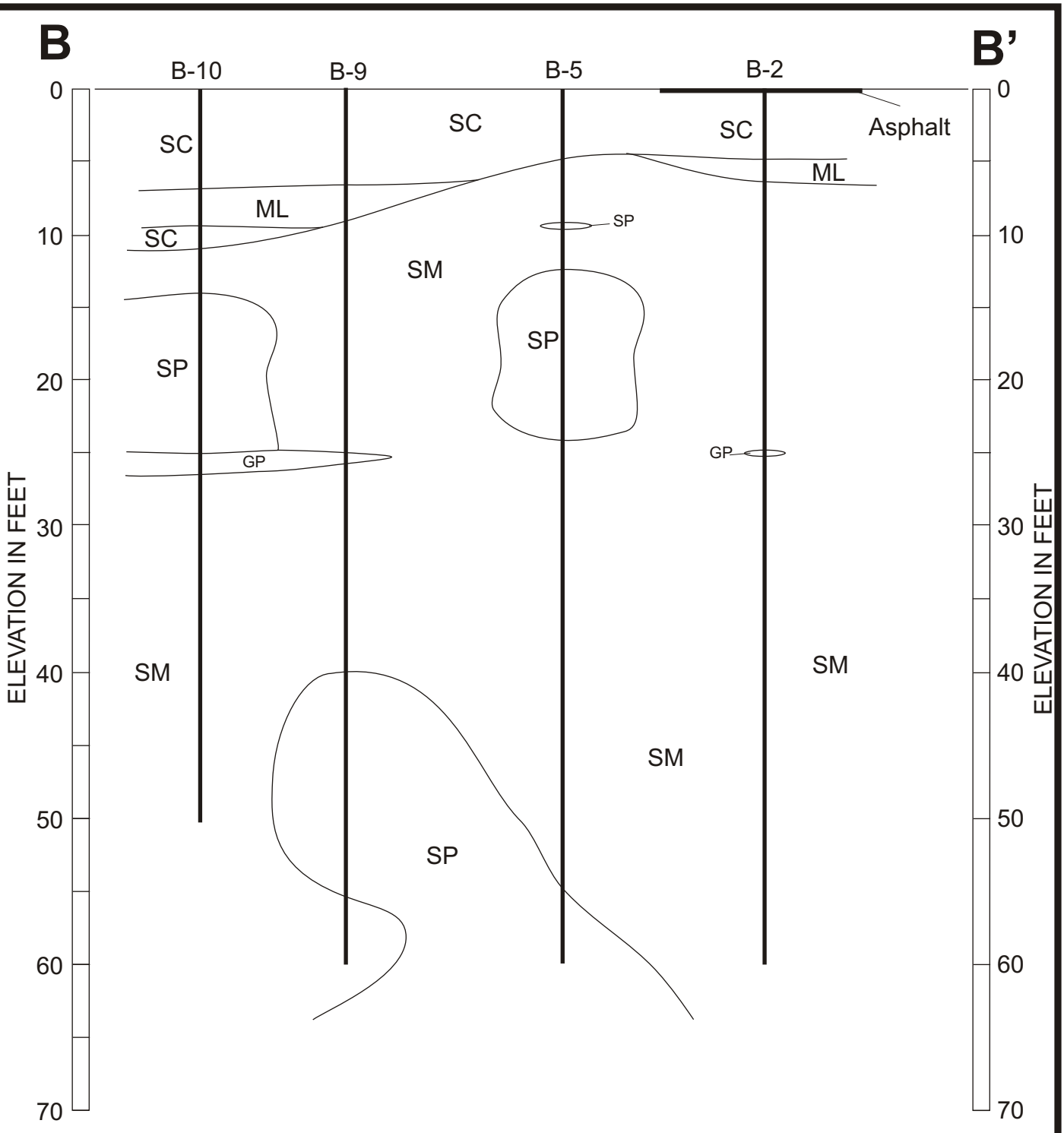
TITLE
CROSS SECTION A-A'
FROM FIGURE 5

FIGURE NUMBER
18

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:
3626-04-01 cross sec AA'.cdr



LEGEND

CL	Clay
ML	Silt
SC	Clayey Sand
SM	Silty Sand
SP	Poorly Graded Sand
GP	Gravel / Sandy Gravel

Approximate Horizontal Scale

0 50 Feet

CLIENT
PASADENA WATER AND POWER

LOCATION
72 EAST GLENARM STREET, PASADENA, CA

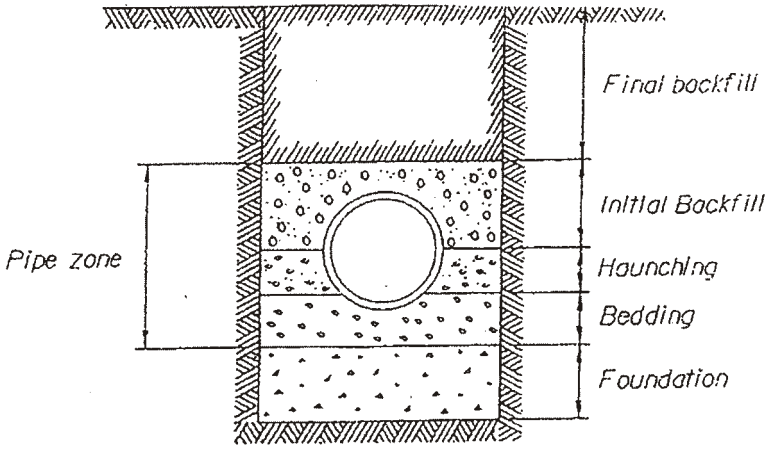
TITLE
CROSS SECTION B-B' FROM FIGURE 5

FIGURE NUMBER
19

PROJECT
3626-04-01

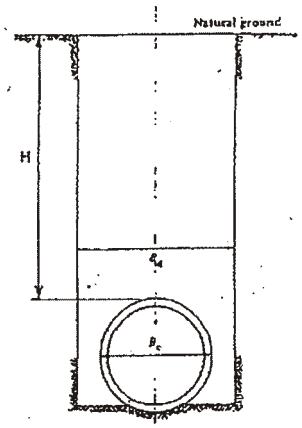
hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs: 3626-04-01 cross sec BB'.cdr



(a)

TYPICAL PIPE BACKFILL

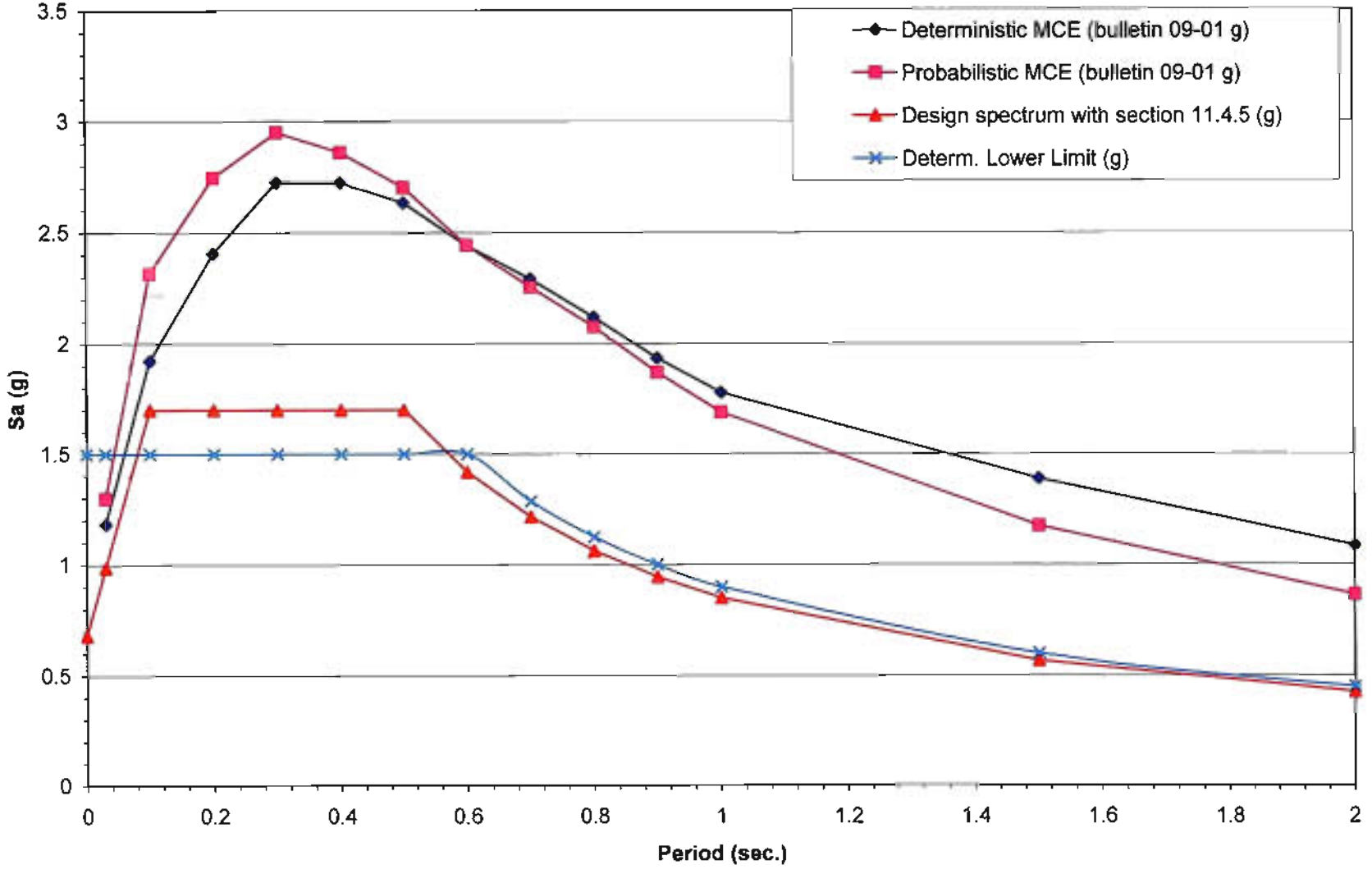


(b)

TYPICAL PIPELINE TRENCH CONDITIONS

CLIENT: PASADENA WATER AND POWER	
LOCATION: SE Corner of Fair Oaks Ave & Glenarm St, CA	
TITLE: TYPICAL PIPELINE TRENCH CONDITION	FIGURE NUMBER: 20
PROJECT: 3626-04-01	
hydrologue, Inc. Consulting Engineers & Geologists	Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs 1.cdr

Probabilistic & Deterministic MCE and Lower Limit

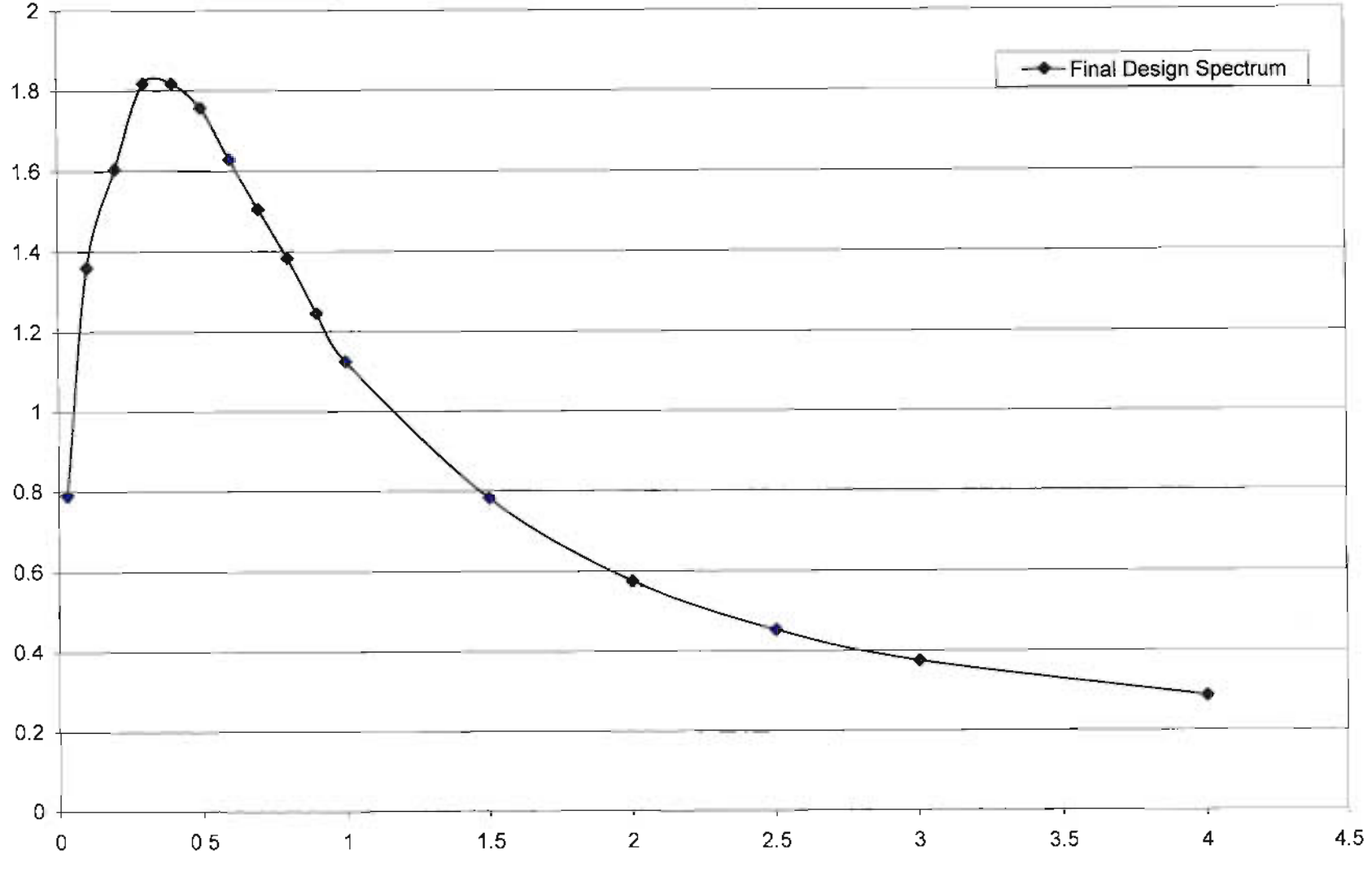


Pasadena Power Plant

SE Corner of Fair Oaks Ave and Glenarm St, Pasadena, CA

Figure 21

Final Design Spectrum



Appendix A

HI Exploratory Boring Logs 2011

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NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES.

Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11**	Boring I.D.: **BH-1**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0							0-4.5" Asphalt 4.5"-9" Base 9"-5.5' Silty clayey sand, brown, moist, moderately compact, with gravel and cobbles.	21.3
						SC	**Natural Ground:**	
5		3/5/18	5.3	117.9			5.5-6.0' Sandy clayey silt, dark brown to black, fine, moist, medium dense with gravel, medium to low plasticity.	>9,999
	SPT	6/12/10				ML		
							6.0-15.0' Silty sand, light brown, fine to medium, moist, moderately dense, with gravel, granitic gravel, micaceous.	
	SPT	5/11/17						
10		21/50(3")	10.1	115.5				43.2
15		34/50	2.2				15.0-20.0' Silty sand, light brown, fine to medium, moist, very dense, trace gravel (~2-3" size gravel), micaceous.	7.4
	SPT	24/50(3")				SM		
20		40/50(4")	5.0	103.0			20'-30.0' Sand, yellowish brown, fine to coarse, moist, moderately dense, with gravel, trace of silt.	23.6
25	SPT	11/50(5")	3.9			SP		15.6
30		11/50(6")	9.1	112.9			30.0'-35.0' Silty sand, yellowish brown, fine, moist, very dense, trace gravel, micaceous, black stain.	
35	SPT	5/7/7	7.7			SM	35.0'-40.0' Silty sand, orange brown, fine to coarse, moist, medium dense, trace gravel.	
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11**	Boring I.D.: **BH-1**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40		70/(6")	7.8	104.4			40.0'-45.0' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel.	
45	SPT	15/33/44	26.1			SM	40.0'-45.0' Silty sand, yellowish brown, fine, moist, very dense, trace gravel.	
50		100(6")	7.8	113.4			50.0'-50.2' Silty clayey sand, brown, fine, moist; very dense, trace gravel. 40.0'-45.0' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel, black stain.	
55							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =50.5 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/9/11-6/10/11**	Boring I.D.: **BH-2**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0							0-4.5" Asphalt 4.5-6" Base	
		16/14/15	7.4	124.3		SC	6"-5.0' Silty clayey sand, brown to dark brown, moist, moderately compact, with gravel and cobbles.	76.2
							Natural Ground:	
5		5/30(0")	11.8	90.2			5-6.5' Sandy clayey silt, dark brown to black, moist, medium dense, with gravel, medium to low plasticity, pieces of metal wire retrieved.	>9,999
	SPT	3/4/7				ML		
	SPT	4/11/16					6.5-8' Silty sand, light brown, fine to coarse, moist, medium dense, with gravel.	
	SPT	6/12/23					8-20' Silty sand, yellowish brown, fine to coarse, moist, dense, with gravel.	
		3/8/50(4")						80.6
10	SPT	11/28/35	2.8					
	SPT	14/38/40					Black spots observed at 13.0'.	
	SPT	19/40/50						
15		100/7"	2.3	96.0		SM		112
20		100(5")	3.0				20.0-26.0' Silty sand, yellowish brown, fine to coarse, moist, very dense, with/and gravel (~2-3" size gravel at the tip of the CA ring sampler).	362
	SPT	50(5")						
25						GP	25' Gravel and cobbles encountered, drilled through and sampled at 26'.	
		100(5")	15.8	99.6			26.0-26.5' Silty sand, yellowish brown, fine to coarse, moist, very dense to dense, with gravel, organic content: 0.6%.	331
	SPT	15/18/28					26.5-30.0' Silty sand, orange brown, fine to medium, moist, very dense, trace gravel.	
30		23/44/50(4")	4.9	103.1		SM	30.0-40.0' Silty sand, yellowish brown, fine to medium, moist, very dense, trace gravel.	
	SPT	12/26/28						
35		43/50(6")	6.7	100.1				
	SPT	20/23/33						
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/9/11-6/10/11**	Boring I.D.: **BH-2**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	80(6") 50(5")	6.5	109.4			40-46.5' Silty sand, yellowish brown, fine to medium, moist, very dense, with gravel.	
45	SPT	43/50(5") 13/11/20	10.1	116.3			46.5-50.0' Silty sand, yellowish brown, fine, moist, very dense to dense, trace gravel.	
50	SPT	70(6") 50(6")	2.8	105.4		SM	50.0-61.5' Silty sand, yellowish brown, fine to medium/coarse, moist, very dense, trace gravel.	
55	SPT	75(6") 20/30/50(4")	6.5	113.1				
60	SPT	48/50(3") 50(4")	4.4	100.3				
65							Total Depth Drilled = 60 feet bgs. Total Depth Sampled =61.5 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
70								
75								
80								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11-6/14/11**	Boring I.D.: **BH-3**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0							0-4" Asphalt 4"-1' Base	18.5
5	SPT	10/10/9 1/2/2	7.0	109.3		SC	1-5' Silty clayey sand, brown, moist, moderately compact, with gravel and cobbles. **Natural Ground:** 5-11.5' Silty clayey sand, brown, moist, loose to moderately compact, with gravel.	
10	SPT	3/2/4 8/6/4	17.4	88.4		ML	11.5-15.0' Sandy clayey silt, dark brown to black, fine, moist, trace gravel, loose, medium to low plasticity.	0
15	SPT	8/12/17 12/20/50	5.2	110.2			15.0'-20' Silty sand, dark yellowish brown, fine to coarse, moist, moderately dense to dense, with gravel. @16.5 Organic Content: 1.9%	2.7
20	SPT	25/50(6") 12/13/16	3.2	106.8			20-22' Silty sand, yellowish brown, fine to coarse, moist, dense to moderately dense, trace gravel.	61.3
						SM	22'-25.5' Silty sand, olive brown, fine, moist, dense to moderately dense, trace gravel.	
25	SPT	19/50(5") 29/22/29	21.3	103.0			25.5-30' Silty sand, yellowish brown, fine, moist, dense to very dense, trace gravel.	9.2
30	SPT	25/40/50(5") 19/20/50(3")	4.1	109.1			30-35' Sand, orange brown, fine to medium, moist, very dense, trace gravel and silt.	
35	SPT	100(9)" 29/50(4")	3.0	109.3		SP	35-41' Sand, yellowish brown, fine to coarse, moist, very dense, trace gravel and silt.	
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11-6/14/11**	Boring I.D.: **BH-3**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	42/50(5") 9/12/18	3.3	105.9		SP	41-45' Silty sand, yellowish brown, fine, moist, very dense to moderately dense.	
45	SPT	19/49/50 15/17/43	19.7	106.9		SM	45-52.5' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace grave and silt.	
50	SPT	37/50(4") 42/40/50(5")	8.2	97.1				
55							Total Depth Drilled = 60 feet bgs. Total Depth Sampled =52.5 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								
70								
75								
80								

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NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES.

Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/10/11**	Boring I.D.: **BH-4**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0							0-5" Asphalt	3,977
							5"-1' Base	
						ML	1-6' Sandy clayey silt, dark brown, moist, moderately compact, with gravel and cobbles.	
5	SPT	2/3/5 1/2/3	15.6	107.1		SM	**Natural Ground:** 6-7' Silty sand, yellowish brown, fine to coarse, moist, moderately loose, with gravel.	>9,999
						ML	7-10' Sandy clayey silt, dark brown to black, fine, moist, trace gravel, loose, medium to low plasticity.	
10	SPT	8/12/44 50(5")	12.4	114.5		SC	10-16.5' Silty clayey sand, dark brown, fine, moist, with gravel and cobbles, dense to very dense, low plasticity, black spots.	1,340
15	SPT	75(2") 21/28/28	4.4			SP	16.5-20' Sand, yellowish brown, fine to medium, moist, very dense, with gravel and silt.	>9,999
20	SPT	12/21/26 12/20/19	20.9	102.8		SC	20-22' Silty clayey sand, olive brown, fine to medium, moist, dense, to very dense, trace gravel, low plasticity.	1,586
							22-30' Sand, light brown, fine to medium, moist, dense to very dense, trace gravel and silt.	
25	SPT	28/40/50(5") 20/30/25	3.5	114.2		SP	@26.5' Black Spots.	3,112
30	SPT	16/33/50 8/15/21	22.4	99.8			30-40' Silty sand, yellowish brown, fine, moist, dense to very dense, trace gravel.	
35	SPT	13/23/50(5") 12/12/12	8.9	119.4		SM		
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/10/11**	Boring I.D.: **BH-4**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	14/35/50(4") 16/27/31	23.3	104.4		ML	40-45' Sandy silt, yellowish brown, fine, moist, very dense, trace gravel.	
45	SPT	24/50(6") 15/26/39	10.7	112.9		SM	45-50' Silty sand, yellowish brown, fine, moist, very dense, trace gravel.	
50	SPT	43/50(4") 30/50(5")	2.5	108.7			50-51.5' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel.	
55							Total Depth Drilled = 60 feet bgs. Total Depth Sampled =51.75 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								
70								
75								
80								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/8/11**	Boring I.D.: **BH-5**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0						SC	0-5' Silty clayey sand, brown, moist to slightly moist, moderately compact, with gravel and cobbles.	
							Natural Ground:	
5		5/3/5	7.3	114.9			5-9.6' Silty sand, dark brown, fine to medium, moist to slightly moist, moderately loose, with gravel.	115
	SPT	5/8/10				SM		716
	SPT	8/10/15						2,748
						SP	9.6-9.8' Sand, grey, fine, moist, very dense.	861
10		16/30/42	7.7	109.0				
	SPT	11/32/46				SM	9.8-12.5' Silty sand, olive brown, fine to medium, moist to slightly moist, dense to moderately dense, with gravel (decomposed granite).	50.2
	SPT	20/32/30					12.5-21.0' Sand, yellowish brown, fine to coarse, moist, very dense, with gravel, trace silt.	
	SPT	13/45/50(5")						
15								
		47/50(3")	2.8	95.4				46.5
	SPT	20/46/50						
	SPT	16/25/29				SP		
20		20/45/50(5")	1.4	110.2			21-22.5' Sand, yellowish brown, fine to coarse, moist, very dense, with gravel, trace silt, decomposed black granite fragments.	68.1
	SPT	20/40/50						
	SPT	100(6")					22.5-24' Sand, dark yellowish brown, fine to medium, moist, very dense, with gravel, trace silt.	
25		40/50(2")	4.2	96.5			24-25.5' Silty sand, reddish brown, fine to medium, moist, very dense, trace gravel.	38.1
	SPT	62(6")					25.45.0' Silty sand, yellowish brown, fine, moist, very dense, trace gravel.	
30		100(4")	3.3	85.3				
	SPT	100(6")				SM		
35		20/50(6")	6.5	102.7				
	SPT	25/50(5")						
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/8/11**	Boring I.D.: **BH-5**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)		PID Reading PPM
40	SPT	16/32/50(5") 11/12/27	25.5	100.2			Silty sand, yellowish brown, fine, moist, very dense, trace gravel continues to 45'.		
45	SPT	22/50(6") 18/30/26	6.4	100.9		SM		45-50'	Silty sand, orange brown, fine to medium, moist, very dense, trace gravel.	
50	SPT	75(6") 50(6")	4.3	115.5				50.55'	Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel.	
55	SPT	62(6") 50(5")	5.5	104.7		SP		55-6.1'	Sand, brown, medium to coarse, moist, very dense, with gravel.	
60	SPT	70(6") 36/50(6")	4.9	112.8				@61 '	Black stains.	16.8
65							Total Depth Drilled = 60 feet bgs. Total Depth Sampled =61.5 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.			
70										
75										
80										

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/14/11**	Boring I.D.: **BH-6**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0						SC	0-5' Silty clayey sand, brown, moist to slightly moist, moderately compact, with gravel and cobbles.	900
							Natural Ground:	
5	SPT	9/11/12 2/2/4	9.1	118.4		SM	5-5.8' Silty sand, dark brown, fine to medium, moist, moderately dense trace gravel.	>9,999
						ML	5.8-8' Sandy clayey silt, dark brown to black, fine to medium, moist, medium dense, trace gravel, medium to low plasticity.	
							8-10' Silty sand, dark brown, fine to medium, moist, moderately dense, trace gravel.	
10	SPT	18/30/50 20/40/50(4")	4.0	127.0			10-20' Silty sand and gravel, olive to light brown, fine to coarse, moist, dense to very dense, granitic gravel, micaceous.	933
15	SPT	42/50(3") 50(6")	2.2				15-20' Silty sand, yellowish brown, fine to coarse, moist, very dense, with gravel. @16 Organic Content: 1.7%	>9,999
20	SPT	40/50(5") 20/40/50(4")	5.3	111.4		SM	12-30' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel.	>9,999
25	SPT	22/50(5") 35/37/32	3.8	120.4				678
30	SPT	27/50(5") 34/35/25	2.6	105.9			30-40.5' Silty sand, yellowish brown, fine to medium, moist, very dense, trace gravel.	
35	SPT	47/50(5") 27/42/50(6")	2.5					
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/14/11**	Boring I.D.: **BH-6**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	37/50(5") 41/19/43	22.7	94.0		SM ML SP ML	40.5-41' Sandy silt, yellowish brown, fine to medium, moist, very dense, low plasticity. 41-41.5' Sand, yellowish brown, fine to medium, moist, very dense, with gravel. 41.5-42.5' Sandy silt, yellowish brown, fine to medium, moist, very dense, low plasticity. 42.5-45' Sand, yellowish brown, fine to medium, moist, very dense, with gravel.	
45	SPT	39/39/50(6") 22/27/47	12.7	106.2		SP SM	45-46.5' Silty sand, yellowish brown, fine, moist, very dense, trace gravel. 46.5-47.5' Silty sand, orange brown, fine, moist, very dense, trace gravel. 47.5-51' Silty sand, brown, fine to coarse, moist, very dense, trace gravel.	
50	SPT	100(6") 50(4")	7.2	86.3				
55							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =51 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								
70								
75								
80								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/14/11**	Boring I.D.: **BH-7**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0						SC	0-5' Silty clayey sand, brown, moist to dry, moderately compact, with gravel and cobbles.	0
5	SPT	5/8/10 3/3/5	18.9	95.7		ML	5-8' Sandy clayey silt, dark brown to black, fine to medium, moist, moderately dense, trace gravel, medium to low plasticity.	>9,999
10	SPT	70(6") 19/23/26	4.2				10-15" Silty sand, yellowish brown, fine to medium, moist, very dense, to dense, with gravel (granitic, maximum size 2-3")	478
15	SPT	65(6") 40/35/40	2.5				15' Pieces of metal wires recovered. **Natural Ground:** 15.5-20' Silty sand, yellowish brown, fine to coarse, moist, very dense, with gravel.	
20	SPT	15/32/38 13/9/11	5.8	99.1		SM	20-30' Silty sand, yellowish brown, fine, moist, dense to moderately dense, with gravel, micaceous.	
25	SPT	15/34/50(6") 7/13/15	12.4	99.2				
30	SPT	15/20/50 10/14/15	22.7	100.4			30-41.5' Sandy silt, yellowish brown, fine, moist, dense to moderately dense.	
35	SPT	10/20/45 10/14/18	15.0	111.9		ML	@35 Organic Content: 0.1%	
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/14/11**	Boring I.D.: **BH-7**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	19/30/50(6") 12/13/18	18.7	108.3		ML	Sandy silt, yellowish brown, fine, moist, dense to moderately dense continues to 41.5'.	
							41.5-50' Silty sand, yellowish brown, fine, moist, very dense to moderately, dense, trace gravel.	
45	SPT	30/50(6") 9/9/17	5.3	95.1		SM		
50	SPT	60(6") 32/50(6")	4.33	109.2			50-51.5' Silty sand, yellowish brown, fine to coarse, moist, very dense, trace gravel.	
							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =51.5 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
55								
60								
65								
70								
75								
80								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/8/11-6/9/11**	Boring I.D.: **BH-8**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0		23/26/25	8.3	125.3		SC	0-1.5' Silty clayey sand, brown, moist to slightly moist, moderately dense, with gravel and cobbles.	356
	SPT	9/6/6						238
						ML	1.5-3.0' Sandy clayey silt, dark brown to black, fine to medium, moist, medium dense, trace gravel, medium to low plasticity.	
	SPT	5/5/4					3.0-4.5' Silty sand, dark brown, coarse to fine, moist, moderately loose, with gravel.	567
5		9/11/11	14.5	98.0		SM	**Natural Ground:**	515
	SPT	3/4/26					4.5-6.0' Silty sand, dark yellowish brown, fine, moist, moderately dense, trace gravel.	20.6
	SPT	2/14/18				ML	6-8.4' Sandy clayey silt, dark brown to black, fine to medium, moist, dense, trace gravel, medium to low plasticity.	
						SC	8.4-9' Silty clayey sand, brown, fine to medium, moist, dense, with gravel.	
		60(6")	4.4	110.6				
10	SPT	25/50(6")					9-13.5' Silty sand, yellowish brown, fine to coarse, moist, very dense, with gravel, @9 organic content: 0.6%, @10.5 Organic Content: 1.1%	227
	SPT	14/50(6")						
	SPT	45/50(5")					13.5-16.0' Silty sand, greyish brown, fine to coarse, moist, very dense, with gravel.	
15		40/50(2")	1.7	118.9				0.5
	SPT	50(6")				SM	16-20.0' Silty sand, yellowish brown, fine to coarse, moist, very dense, with gravel (@20' gravel size of 2.5-3").	
20		43/50(5")	2.0	112.3			20-25.0' Silty sand, yellowish brown, fine to coarse, moist, very dense, with gravel (gravel size: 2.5-3", black spot at 24').	5.7
	SPT	23/33/39						
25		23/50(6")	3.3	99.1			25-26.5' Sand, yellowish brown, fine to medium, moist, very dense, trace silt and gravel.	8.7
	SPT	23/50(6")						
30		65(6")	2.9	111.1				
	SPT	40/50(3")				SP		
35		75(3")	2.0				25-45' Sand, yellowish brown, fine to coarse, moist, very dense, trace silt and gravel.	
	SPT	43/32/50(6")						
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/8/11-6/9/11**	Boring I.D.: **BH-8**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	100(6") 33/30/50(4")	2.1	110.5		SP	Sand, yellowish brown, fine to coarse, moist, very dense, trace silt and gravel continues to 46.5.	
45	SPT	5/6/75(6") 23/50/30	6.8			GP	@45' Pieces of granitic gravel 3" at the tip of spoon.	
						SP	45-52.0' Sand, yellowish brown, fine to coarse, moist, very dense, trace silt and gravel.	
50	SPT	33/50(4") 36/50(4")	10.6	106.3				
55							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =52.0 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								
70								
75								
80								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/9/11**	Boring I.D.: **BH-9**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0	SPT	32/50(4") 8/10/8	2.1	120.3			0-6.5' Silty clayey sand, brown, moist to slightly moist, moderately dense, with gravel and cobbles, organic content: 1.9%.	20.4
	SPT	3/5/4				SC		
5	SPT	5/6/8 2/3/2	17.6	105.3			@4.5 ' Iron oxidation	15.2
	SPT	3/4/7				ML	**Natural Ground:** 6.5-9.0' Sandy clayey silt, dark brown to black, fine to medium, moist, moderately dense, trace gravel, medium to low plasticity, @6.5 organic content: 1.3%, @7.5 organic content: 0.6%.	
10	SPT	9/29/43 6/15/43	5.5	131.0			9.0-10.5' Silty sand, dark brown, fine to medium, moist, moderately dense, with gravel (pea gravel size). 10.5-13.5' Silty sand, brown, medium to coarse, moist, dense, with gravel.	12.3
	SPT	24/50(5")						
	SPT	45/50(4")					13.5-15.0' Silty sand, yellowish brown, medium to coarse, moist, very dense, with gravel.	
15	SPT	65(6") 48/50(5")	2.1	109.7		SM	15-25.0' Silty sand, yellowish brown, medium to coarse, moist, very dense, with gravel .	55.3
20	SPT	27/50(4") 40/50(4")	3.1	112.3				16.5
25	SPT	100(4") 40/17/16	4.1			GP	25-25.7' Sandy gravel, grey to greyish brown, medium to coarse, moist, dense to very dense, maximum gravel seize: 1.5".	55
							25.7-40.0' Silty sand, yellowish brown, fine to medium, moist, very dense to dense, trace gravel .	
30	SPT	27/50(5") 17/27/36	4.0	108.6				658
						SM		
35	SPT	40/50(5") 37/30/35	4.4	108.9				
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/9/11**	Boring I.D.: **BH-9**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	35/50(4") 26/30/24	7.9	110.1			40.0-45.0' Sand, yellowish brown, medium to coarse, moist, dense to very dense, trace silt and gravel (decomposed granitic gravel).	
45	SPT	34/50(4") 33/35/42	6.8	104.0		SP	45-51.5' Sand, yellowish brown, fine to medium, moist, very dense to dense, trace gravel.	
50	SPT	40/50(3") 50(5")	4.3	105.8			51.5-55.0' Sand, yellowish brown, fine to coarse, moist, very dense with gravel.	
55	SPT	60(6") 50(5")	7.7	101.7		SM	55-60' Silty sand, dark yellowish brown, fine, moist, very dense, trace gravel.	
60	SPT	45/50(5") 47/50(6")	1.9	106.0		SP	60-62' Sand, yellowish brown, coarse to medium, moist, very dense, trace gravel.	
65							Total Depth Drilled = 60 feet bgs. Total Depth Sampled =62 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
70								
75								
80								

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NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES.

Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11**	Boring I.D.: **BH-10**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
0							0-5' Silty clayey sand, brown, moist to slightly moist, moderately dense, with gravel and cobbles.	12.9
						SC	**Natural Ground:**	
5	SPT	5/16/15 4/3/4	28.7	70.5			5-7' Silty clayey sand, brown, moist to dry, moderately dense, with gravel.	73.9
	SPT	5/5/4				ML	7-9.5' Sandy clayey silt, dark brown to black, fine to medium, moist, medium dense, trace gravel, medium to low plasticity.	
10	SPT	16/23/33 35/50(5")	5.5	130.4		SC	9.5-11' Silty clayey sand, dark brown to brown, fine to coarse, moist, dense to very dense, with gravel (granitic gravel).	2,653
	SPT	35/50(5")				SM	11-14.0' Silty sand, yellowish brown, fine to coarse, moist, dense to very dense, with gravel.	
15		23/36/50(5")	4.0	115.5			14-20' Sand, yellowish brown, fine, moist, very dense, trace silt and gravel.	44.2
20	SPT	36/50(4") 34/50(6")	2.3	89.2		SP	20-25' Sand, yellowish brown, fine to coarse, moist, very dense, trace silt and gravel.	
							@22' Black spots.	
25	SPT	80(6") 20/40/50	2.2			GP	25-26.8' Sandy gravel, grey to greyish brown, medium to coarse, moist, very dense, maximum gravel seize: 3".	
							26.8-45' Silty sand, yellowish brown, fine to medium, moist, very dense, trace gravel.	
30	SPT	44/50(3") 41/50(5")	4.8	82.2		SM		
35	SPT	48/50(5") 27/30/39	2.7	111.4				
40								

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Project: **Pasadena Power Plant**	Location: **SE Corner of Fair Oaks Ave & Glenarm St, CA**	Project #: **3626-04-01**
Logged By: **ES**	Start/Finish Date: **6/13/11**	Boring I.D.: **BH-10**
1st Water Table (bgs): -	Sampling Method (bgs): **California Modified & Split Spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-58**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading PPM
40	SPT	70(6") 36/50(5")	1.0	107.3			Silty sand, yellowish brown, fine to medium, moist, very dense, trace gravel continues to 45'.	
45	SPT	42/50(6") 33/37/37	2.2	104.8		SM	45-52.25' Silty sand, yellowish brown, fine to coarse, moist, dense to very dense, trace gravel .	
50	SPT	47/50(3") 33/40/40	3.6	105.1				
55							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =52.25 feet bgs. No Groundwater Encountered. Boring Grouted using Bentonite Slurry.	
60								
65								
70								
75								
80								

Appendix B

HI Exploratory Boring Logs 2009, and 2002

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **12/19/09**	Boring I.D.: **B-1**
1st Water Table (bgs):	Sampling Method (bgs):	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): Hole Diameter:	Elevation: **GS**
Rig Type: **CEM-75**	Drilling Contractor:	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-4.0" Asphalt Concrete 4"-10" Base.	
--		20-27-15	7.9	130.5			**Man-made Fill:**	
--						SM	10"-5.0' Sand with silt, moist, moderately compact.	
--							**Natural Ground:**	
5		7-12-17	3.8	118.5			5.0'-10.0' Sand, yellowish brown, fine, moist, moderately dense.	
--	SPT	9-12-12						
--								
--								
10		9-37-50(4")	3.0	123.3			10.0'-15.0' Sand, yellowish brown, fine, moist, moderately dense, few gravel.	
--	SPT	29-50(6")						
--								
--								
15		50(5")	2.4	107.0			15.0'-20.0' Sand, reddish brown, fine to coarse, moist, dense, with gravel.	
--	SPT	24-28-16						
--								
--								
20		50(5")	4.0	109.3			20.0'-30.0' Sand, yellowish brown, fine to coarse, moist, dense, with gravel.	
--	SPT	50(6")						
--								
--								
25		50(6")						
--	SPT	30-50(5")						
--								
--						SP		
--								
30		30-50(6")	14.6	114.0			**Natural Ground:**	
--	SPT	12-13-14					30.0'-40.0' Sand, yellowish brown, fine to medium, moist, dense.	
--								
--								
--								
35		50(5")	14.9	104.1				
--	SPT	23.26-38						
--								
--								
--								
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **12/19/09**	Boring I.D.: **B-1 (Cont.)**
1st Water Table (bgs): **-**	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs): **-**	Wt. of Hammer (lb): **140lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **CEM-55**	Drilling Contractor: **2R Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu ft)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
40	SPT	50(5") 30-20-18	11.3	99.7		SP	40.0'-45.0' Sand, yellowish brown, fine to medium, moist, dense.	
45	SPT	13/40/50(2") 21/28/42	25.8	98.7		ML	45.0'-50.0' Clayey silt, yellowish brown, moist, dense.	
50	SPT	35/39/50(5") 8-12-20	24.2	102.8		SM	@50.0' Silt sand, yellowish brown, fine, moist, dense.	

Total Depth Drilled = 50 feet bgs.
Total Depth Sampled =51.5 feet bgs.
No Groundwater Encountered.
Bored Hole Grouted using Bentonite Slurry.

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/19/09**	Boring I.D.: **B-2**
1st Water Table (bgs): -	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs): -	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R & C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-2.0" Asphalt Concrete 2"-10" Mixture Base. **Man-made Fill:**	0
						CL	10"-5.0' Clay, dark brown, moist, moderately compact.	
5		3/23/37	10.6	106.8			**Natural Ground:**	0
	SPT	23/50(6")					5.0'-20.0' Sand, brown, medium to coarse, very dense, a few gravel.	
10		50(3")						0
	SPT	50(3")	6.2			SP		
15		50(2")						0
	SPT	17/50(5")						
20		27/44/50(5")	13.2	95.0			20.0'-25.0' Silty sand, brown, fine to medium, moist, very dense.	0
	SPT	18/21/25				SM		
25		40/42/35	4.0	118.7			25.0'-32.0' Sand, brown, fine to medium with coarse, moist, very dense.	0
	SPT	29/50(2")				SP		
30		50(5")	6.9					0
	SPT	34/36/47						
35							Total Depth Drilled = 30 feet bgs. Total Depth Sampled =32 feet bgs. No Groundwater Encountered. Bored Hole Grouted using Bentonite Slurry.	
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-3**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **LAR**	Drilling Contractor: **R & C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-6" Concrete.	
						SM	6"-5.0' Silty sand, brown, fine to medium with coarse, moist, few gravels, moderately compact.	0
5	SPT	19/50(6") 35/50(6")	3.7	119.6		SP	5.0'-10.0' Gravelly sand, brown, medium to coarse, slightly moist, very dense	0
10	SPT	27/50(6") 36/50(5")	9.4	109.1		SM	10.0'-15.0' Silty sand, brown, fine to medium, moist, very dense, few gravels.	0
15	SPT	50(5") 27/50(6")	38.2	89.1		ML	15.0'-20.0' Sandy silt, olive brown, very moist, dense.	0
20	SPT	32/27/50(4") 45/50(5")	3.9	111.2		SP	20.0'-26.0' Sand, brown, medium to coarse, moist, very dense.	0
25	SPT	50(5") 50(1")	5.7				@26.0' Refusal.	
30							Total Depth Drilled = 26 feet bgs. Total Depth Sampled =26 feet bgs. No Groundwater Encountered. Bored Hole Grouted using Bentonite Slurry.	
35								
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-4**
1st Water Table (bgs): **-**	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs): **-**	Wt. of Hammer (lb): **140lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **LAR**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-2.0" Asphalt Concrete (no base)	
							Man-made Fill:	0
						SC	2.0"-7.0' Clayey sand, dark brown, moist, moderately compact, a few wood debris.	
5	SPT	5/7/16 5/19/36	11.7	110.2				0
							Natural Ground:	
							7.0'-20.0' Gravelly sand, brown, medium to coarse, moist, very dense.	
10	SPT	50(6") 50(6")	2.7					0
15	SPT	50(5") 50(6")	4.2			SP		0
20	SPT	50(4") 50(6")	4.5				20-25.0' Sand, brown, fine to medium, moist, very dense.	0
						SP		
25	SPT	14/15/18 25/50(5")	13.0	96.5			25-30.0' Gravelly sand, brown, medium to coarse, moist, very dense.	0
						SP		
30	SPT	50(2") 50(6")	12.5				30-45.0' Sand, brown, fine to medium, moist, very dense.	0
						SP		
35	SPT	50(6") 30/50(4")	6.2					0
40								

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Project. **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-4 (Cont.)**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
40	SPT	30/50(6") 30/30/50	13.0	130.4		SP		0
45	SPT	50(3") 50(5")	5.2			SP	45.0'-51'10" Gravelly sand, brown, medium to coarse, moist, very dense.	0
50	SPT	50(5") 45/31/50(5")						0
55								
60								
65								
70								
75								
80								

Total Depth Drilled = 50 feet bgs.
Total Depth Sampled =51.8 feet bgs.
No Groundwater Encountered.
Bored Hole Grouted using Bentonite Slurry.

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-5**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **LAR**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-4" Asphalt Concrete.	
							4"-10" Mixture base.	0
							Man-made Fill:	
							10"-10.0' Gravelly sand, brown, medium to coarse, moist, moderately compact.	
						SP		
5	SPT	50(3") 3/13/12						0
							Natural Ground:	
10	SPT	50/50(3") 22/50(6")	2.4	124.4			10.0'-20.0' Silty sand, light gray, fine to medium with coarse, slightly moist, very dense.	0
						SM		
15	SPT	75(6") 60(6")	2.9					0
20	SPT	100(5") 50(6")	3.1				20.0'-30.0' Gravelly sand, brown to light gray, slightly moist, very dense.	0
						SP		
25	SPT	100(5") 50(6")	1.8					0
30	SPT	100(4") 40/50(6")	7.9				30.0'-35.0' Sand, brown, slightly moist, medium to coarse, very dense.	0
						SP		
35	SPT	50(6") 50(5")	15.4	137.7			35.0'-45.0' Silty sand, light gray, fine to medium, moist, very dense.	0
						SM		
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-5 (Cont.)**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MiniRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **LAR**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
40	SPT	100(5") 50(6")	8.7			SM		0
45	SPT	100(4") 50(6")	3.3			SP	45.0'-50.9' Gravelly sand, brown, medium to coarse, slightly moist, very dense.	0
50	SPT	100(4") 50(6")						0
55							Total Depth Drilled = 50 feet bgs. Total Depth Sampled =50.9 feet bgs. No Groundwater Encountered. Bored Hole Grouted using Bentonite Slurry.	

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-6**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-4" Asphalt Concrete.	0
							4"-10" Mixture base.	
							Man-made Fill:	
						SP	10"-5.0' Sand with gravel, brown, medium to coarse, moist, moderately compact.	
5		3/6/10	21.8	94.3			**Natural Ground:**	0
							5.0'-10.0' Silty sand, brown, fine to medium with coarse, moist, very dense, few gravels.	
						SM		
10	SPT	26/50/34 20/20/22	13.6	103.3			10.0'-15.0' Sandy silt, brown, moist, very dense.	0
						ML		
15	SPT	50(6") 40/50(5")	3.2	111.6			15.0'-25.0' Sand, brown to olive brown, fine to medium with coarse, slightly moist, very dense.	0
20	SPT	50(6") 20/22/50(5")	3.5	110.0		SP		0
25	SPT	50(6") 14/16/18	4.6	122.6			25.0'-30.0' Gravelly sand, olive brown, fine to medium with coarse, moist, dense.	0
						SP		
30	SPT	34/50(6") 27/28/28	9.4	95.0			30.0'-35.0' Sand, olive brown, fine to medium with coarse, moist, very dense.	0
						SP		
35	SPT	22/22/40 26/28/30	21.1	108.2			35.0'-45.0' Sandy silt, brown, moist, very dense.	0
						ML		
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **11/18/09**	Boring I.D.: **B-6 (Cont.)**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
40	SPT	50(3") 37/50(5")	16.4	128.6		ML		0
45	SPT	50(2")/100(3") 50(3")	3.4	108.1		SP	45.0'-50.0' Gravelly sand, brown, medium to coarse, slightly moist, very dense.	0
50	SPT	50(4") 50(6")	12.8	113.7		SM	50.0'-50.9' Silty sand, brown, fine to medium, moist, very dense.	0
55								

Total Depth Drilled = 50 feet bgs.
Total Depth Sampled =50.9 feet bgs.
No Groundwater Encountered.
Bored Hole Grouted using Bentonite Slurry.

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NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES.

Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **SC**	Start/Finish Date: **11/19/09**	Boring I.D.: **B-7**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MiniRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-6" Concrete.	0
							Man-made Fill:	
							6"-10.0' Silty sand, dark brown, fine to medium with coarse, moist, moderately compact.	
5	SPT	7/5/5 2/2/2	8.7	113.1		SM		0
							Natural Ground:	
10	SPT	13/30/50(5") 30/50(4")	6.3	118.4			10.0'-25.0' Gravelly sand, brown, fine to medium with coarse, moist, very dense, few gravels.	0
15	SPT	50(6") 50(6")				SP		0
20	SPT	15/50(6") 50(6")	1.6					0
25	SPT	50(6") 13/15/25	30.8	86.5			25.0'-30.0' Sandy silt, brown, moist, very dense.	0
30	SPT	45/33/50(4") 25/25/36	7.7	103.3		SP	30.0'-40.0' Sand, brown, fine to medium, moist, very dense.	0
35	SPT	50(6") 27/29/30	4.8					0
40								

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **11/19/09**	Boring I.D.: **B-7 (Cont.)**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
40	SPT	50(4") 19/42/30	25.3			SM	40.0'-50.7' Silty sand, brown, fine to medium, moist, very dense.	0
45	SPT	50(5") 50(5")						0
50	SPT	50(3") 50(5")						0
55								

Total Depth Drilled = 50 feet bgs.
Total Depth Sampled =50.7 feet bgs.
No Groundwater Encountered.
Bored Hole Grouted using Bentonite Slurry.

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Project: **Pasadena Power Plant**	Location: **72 East Glenarm Street, Pasadena, CA**	Project #: **3626-00-01**
Logged By: **ES**	Start/Finish Date: **11/19/09**	Boring I.D.: **B-8**
1st Water Table (bgs):	Sampling Method (bgs): **California modified split spoon**	PID: **MinRAE 200**
Last Water Table (bgs):	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **R&C Drilling**	Weather:

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs/cu ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	PID Reading
0							0-6" Concrete.	
							Man-made Fill:	0
							6"-10.0' Sand with silt and gravel, yellowish brown, fine to medium with coarse, moist, moderately compact, few pieces of rounded gravel present.	
5	SPT	17/24/45 15/25/35	6.3	129.3		SM		0
							Natural Ground:	
10	SPT	50(6") 50(6")	4.5				10.0'-15.0' Silty sand, brown to yellowish brown, fine to medium moist, very dense.	0
15	SPT	50(6") 50(6")				GS	15.0'-20.0' Sandy gravel, brown, slightly moist, very dense, fine to medium.	0
20	SPT	50(3") 50(5")	3.3	114.6		SP	20.0'-25.0' Gravelly sand, brown to light gray, slightly moist, very dense, medium to coarse.	0
25	SPT	50(5") 50(6")	7.5	104.1		SP	25.0'-30.6' Sand, brown to light gray, slightly moist, very dense, fine to medium.	0
30	SPT	50(3") 50(4")	2.8					0
35							Total Depth Drilled = 30 feet bgs. Total Depth Sampled =30.6 feet bgs. No Groundwater Encountered. Bored Hole Grouted using Bentonite Slurry.	
40								

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Project: **City of Pasadena**	Location: **NE Corner of Fair Oaks Ave. & State St., Pasadena, CA**	Project #: **2391-00**
Logged By: **MWM**	Start/Finish Date: **March 5 and 6, 2002**	Boring I.D.: **B-1**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0							**Artificial Fill:**	
	ENV	2/2/5					0-3" Asphalt	12:01/ 12.0
		8/8/10	11.5	109.1				
5	ENV SPT	2/2/2					@ 5' Clayey, silty sand, brown, fine to coarse, moist, moderately compact, micaceous	12:08/ 220.0
							Natural Ground:	
						SM		
		15/15/15	8.5	106.1				
10	ENV SPT	4/5/8					@ 10' Clayey, silty sand, mottled brown/ gray/ black, fine to coarse, moist, moderately dense, micaceous	12:18/ 4.6
		15/50 (6")	22.1	93.8				
15	ENV SPT	50 (0") NR					@ 15' Silty clayey sand, brown to black, fine to coarse, moist, moderately dense, micaceous.	12:26/ 3.8
						SC		
		52 (6")	4.3	116.7				
20	ENV SPT	50 (6")					@ 20' Silty sand, brown, fine to coarse, moist, moderately dense, micaceous	12:40/ 3.3
		54 (6") PR	10.6	114.1				
25	ENV SPT	52 (0") NR				SM	@ 25' Silty sand, brown, fine to coarse, moist, moderately dense, micaceous	12:50/ 34.8
		56 (6")	2.6	98.0				
30	ENV SPT	55 (6")				SP	@ 30' Sand, orange-brown, fine to coarse, moist, moderately dense, micaceous	1:00/ 27.2
		49/55	14.8	106.2				
35	ENV SPT	52 (0") NR					@ 35' Silty sand, orange-brown, fine to medium, moist, moderately dense, micaceous, trace coarse sand.	1:10/ 2.5
						SM		
40								

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Project: **City of Pasadena**	Location: **NE Corner of Fair Oaks Ave. & State St., Pasadena, CA**	Project #: **2391-00**
Logged By: **MWM**	Start/Finish Date: **March 5 and 6, 2002**	Boring I.D.: **B-1 con't**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
40	ENV	53(6")	3.6	112.0		SP	@ 40' Sand, orange-brown, fine to coarse, moist, moderately dense, micaceous	1:27/ 1.0
	SPT	52(6")						
45	ENV	52(6")	4.6	15.1			@ 45' Sand, orange-brown, fine to coarse, moist, moderately dense, micaceous	1:36/ 0
	SPT	51(6")						
50	ENV	51(6")	10.4	107.1		SM	@ 50' Silty sand, orange-brown, fine to coarse, moist, moderately dense, micaceous	1:57/ 0
	SPT	57(6")						

Total Depth Drilled = 49.0 feet bgs.
Total Depth Sampled = 50.5 feet bgs.
No Caving
No Groundwater Encountered
Boring backfilled with soil cuttings.

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Project: **City of Pasadena**	Location: **NE Corner of Fair Oaks Ave. & State St., Pasadena, CA**	Project #: **2391-00**
Logged By: **MWM**	Start/Finish Date: **March 5 and 6, 2002**	Boring I.D.: **B-2**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0	ENV	6/6/10					**Artificial Fill:** 0-6" Concrete	2:50/ 1.2
5	ENV SPT	8/10/10 1/1/1	11.2	113.3			@ 5' Clayey, silty sand, brown, fine to coarse, moist, moderately compact. **Natural Ground:**	3:20/ .7
10	ENV SPT	5/5/6 4/4/5	12.2	114.0		SM	@ 10' Silty sand, brown, fine to coarse, moist, moderately dense.	8:34/ 223
15	ENV SPT	51(6") 52(0") NR	22.5	86.0			@ 15' Silty sand, brown, fine to coarse, moist, moderately dense. **Refusal @ 15'**	8:50/ 238
20								
25								
30								
35								
40								

Total Depth Drilled = 14.0 feet bgs.
Total Depth Sampled = 15.5 feet bgs.
No Caving
No Groundwater Encountered
Boring backfilled with soil cuttings.

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Project: **City of Pasadena**	Location: **NE Corner of Fair Oaks Ave. & State St., Pasadena, CA**	Project #: **2391-00**
Logged By: **MWM**	Start/Finish Date: **March 5 and 6, 2002**	Boring I.D.: **B-3**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0	ENV	4/4/6					**Artificial Fill:** 0-3" Asphalt	9:45/ 169
5	ENV SPT	10/10/10 2/2/4	7.5	111.2		SM	@ 5' Silty sand, brown, fine to coarse, moist, moderately compact, some clay. **Natural Ground:**	9:57/ 135
10	ENV SPT	10/10/18 10/12/12	20.7	96.5		SC	@ 10' Silty clayey sand, black, fine to coarse, moist, moderately loose.	10:05/ 261
15	ENV SPT	56(6") 10/51	5 3	99.5			@ 15' Gravelly silty sand, brown, fine to coarse, moist, moderately loose, micaceous	10:16/ 187
20	ENV SPT	49/53 56(6")	7.0	100.9		SM	@ 20' Gravelly silty sand, brown, fine to coarse, moist, moderately dense, micaceous	10:32/ 325
25	ENV SPT	51(6") 53(6")	2.9	120.7		SP	@ 25' Gravelly sand, orange-brown to tan, fine to coarse, moist, dense, micaceous	10:44/ 212
30							Total Depth Drilled = 24.0 feet bgs. Total Depth Sampled = 25.5 feet bgs. No Caving No Groundwater Encountered Boring backfilled with soil cuttings.	
35								
40								

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Project: **City of Pasadena**	Location: **NE Corner of Fair Oaks Ave. & State St., Pasadena, CA**	Project #: **2391-00**
Logged By: **MWM**	Start/Finish Date: **March 5 and 6, 2002**	Boring I.D.: **B-4**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0	ENV	10/10/10					**Artificial Fill:**	11:42/ 3.8
							0-4" Gravel	
							4"-5' Silty sand, brown, fine to coarse, moist, moderately compact, micaceous, trace clay	
5	ENV SPT	10/10/10 2/2/2	6 7	120.2		SM	@ 5' Silty sand, brown, fine to coarse, moist, moderately compact, micaceous, trace clay	11:46/ 31.4
							Natural Ground:	
10	ENV SPT	16/51 56(0") NR	10.6	112.7		SC	@ 10' Silty clayey sand, brown, fine to coarse, moist, moderately dense, micaceous	11:46/ 31.4
15	ENV SPT	55(6") 51(6")	11.6	101.3			@ 15' Silty sand ,orange-brown, fine to coarse, slightly moist, moderately dense, some cobbles, micaceous	12:15/ 87
20	ENV SPT	60(6") 52(6")	4.7	111.5		SM	@ 20' Silty sand and gravel, orange-brown to tan, fine to coarse, slightly moist, moderately dense, some cobbles, micaceous	12:33/ 28.2
25	ENV SPT	60(6") 52(6")	4.0	122.1			@ 25' Silty sand and gravel, orange-brown to tan, fine to coarse, slightly moist, moderately dense, some cobbles, micaceous	
30							Total Depth Drilled = 24.0 feet bgs. Total Depth Sampled = 25.5 feet bgs. No Caving No Groundwater Encountered Boring backfilled with soil cuttings.	
35								
40								

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Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-1**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0							**Artificial Fill:**	
--	ENV	10/10/12					@ 1' Silty sand, brown to dark gray, fine to medium, moist, loose, micaceous.	7:40/ 6.4
--								
--		14/15/15	4.6	100.4				
5	ENV						@ 5' Silty sand, red-brown to gray, fine to medium, slightly moist, moderately loose, micaceous, trace clay.	8:00/ 3.9
--	SPT	5/5/5						
--							**Natural Ground:**	
--		25/51(6")	12.6	120.4		SM		
10	ENV						@ 10' Silty sand, brown-gray to dark brown, fine to coarse, moist, moderately dense, micaceous, trace clay.	8:15/ 5.5
--	SPT	50(6")						
--								
--		52(6")	5.7	121.7				
15	ENV						@ 15' Silty sand, gray to lt. yellow-gray, fine to coarse, slightly moist, moderately dense, micaceous, trace gravel and cobbles..	8:26/ 9.3
--	SPT	50 (4")						
--								
--		50 (6")	2.6	125.2				
20	ENV						@ 20' Gravelly silty sand, lt brown to yellow gray, fine to coarse, slightly moist, dense, micaceous, little cobbles.	8:40/ 29.1
--	SPT	50 (4")						
--						SP		
--		55 (6")	16.7	117.0				
25	ENV						@ 25' Silty sand, gray-green to lt. brown, fine to medium, moist, moderately dense, micaceous, trace gravel.	8:46/ 5.2
--	SPT	52 (4")						
--						SM		
--		54 (6")	6.3	119.2				
30	ENV						@ 30' Silty gravelly sand, orange-brown to yellow, fine to coarse, moist, moderately dense, micaceous, trace cobbles.	8:56/ 6.2
--	SPT	15/20/20						
--								
--		37/30/30	6.1	118.1		SP		
35	ENV						@ 35' Silty gravelly sand, orange-brown to yellow, fine to coarse, moist, moderately dense, micaceous, little cobbles.	9:07/ 3.8
--	SPT	12/12/12						
--								
--								
40								

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Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-1 con't**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
40	ENV SPT	54(6") 50(4")	6.9	130.5			@ 40' Silty gravelly sand, brown to lt.yellow brown, fine to coarse, moist, moderately dense, micaceous	9:15/ 4.5
45	ENV SPT	55(6") 51(3")	5.6	118.0		SP	@ 45' Silty gravelly sand, brown to lt.yellow brown, fine to coarse, moist, moderately dense, micaceous, little cobbles.	9:21/ 7.4
50	ENV SPT	56(6") 52(3")	2.4	128.1			@ 50' Silty gravelly sand, orange-brown, fine to coarse, moist, dense, micaceous, little cobbles.	9:34/ 1.2
55	ENV SPT	40(6") 57(3")	4.1	120.0			@ 55' Silty sand, lt. brown to gray, fine to coarse, slightly moist, moderately dense, micaceous.	9:42/ 2.5
60	ENV SPT	57(6") 51(4") NR	3.6	115.4		SM	@ 60' Gravelly silty sand, brown to lt. brown, fine to coarse, slightly moist moderately dense, micaceous, little cobbles.	9:48/ 3.6
65	ENV SPT	55(6")NR 52(3")	N/A	N/A			@ 65' Gravelly silty sand, brown to yellow brown, fine to coarse, slightly moist, moderately dense, micaceous, little cobbles.	9:53/ 8.1

Total Depth Drilled = 64.0 feet bgs.
Total Depth Sampled = 65.5 feet bgs.
No Caving
No Groundwater Encountered
Boring backfilled with soil cuttings.

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Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-2**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0							**Artificial Fill:**	
	ENV	55(6")					@ 1' Silty sand, brown to dark gray, fine to medium, moist, loose, micaceous, slight odor.	10:23/ 7.4
5	ENV	10/10/12	18.1	96.2		SM	@ 5' Silty sand, brown to gray, fine to medium, slightly moist, moderately loose, micaceous, trace clay.	10:30/ 15.3
	SPT	5/5/5					**Natural Ground:**	
10	ENV	35/35/40	10.4	113.5			@ 10' Clayey silty gravelly sand, brown-gray to black, fine to coarse, moist, moderately dense, micaceous.	10:36/ 19.0
	SPT	5/5/5				SP		
15	ENV	52(6")	5.2	123.0			@ 15' Sandy silt, lt. brown to gray, fine to coarse, slightly moist, moderately dense, micaceous, some cobbles.	11:01/ 38.0
	SPT	54 (6")				ML		
20	ENV	54 (6")NR	N/A	N/A			@ 20' Gravelly sand, lt brown to brown, fine to coarse, slightly moist, moderately dense, micaceous, little cobbles.(SPT recovery only)	25.0
	SPT	52 (3")NR						
25	ENV	51(6")	4.6	97.1		SP	@ 25' Silty gravelly sand, lt. brown to gray, fine to coarse, slightly moist, moderately dense, micaceous.	11:16/ 31.0
	SPT	15/20/20						
30	ENV	54 (6")	21.6	106.3			@ 30' Clayey sandy silt, lt. brown to brown, moist, moderately dense, micaceous.	11:25/ 4.0
	SPT	51(3")				ML		
35	ENV	40/42/53	18.2	110.4			@ 35' Silty gravelly sand, orange-brown, fine to coarse, moist, moderately dense, micaceous, little cobbles.	11:35/ 1.7
	SPT	51(3")				SP		
40								

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Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-2 con't**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
40	ENV SPT	8/8/10 40/40/45	8.3	111.0			@ 40' Silty gravelly sand, brown to lt. brown, fine to coarse, moist, moderately dense, micaceous	11:39/ 5.5
45	ENV SPT	51(6") 50(4")	3.3	112.8		SP	@ 45' Silty gravelly sand, lt. brown to brown, fine to coarse, slightly moist, moderately dense, micaceous, little cobbles.	11:47/ 38.2
50	ENV SPT	40/42/47 17/20/20	5.0	126.2		ML	@ 50' Sandy silt, green-orange-brown, moist, dense, micaceous, trace gravel.	11:56/ 0.6
55	ENV SPT	40/42/47 10/10/10	21 5	95.3			@ 55' Silty sand, lt. brown to orange, fine to medium, very moist, moderately dense, micaceous, trace gravel.	12:02/ 0.6
60	ENV SPT	57(6")NR 51(4") NR	N/A	N/A		SM	@ 60' Gravelly silty sand, brown to lt. brown, fine to coarse, slightly moist moderately dense, micaceous, little cobbles.	N/A
65	ENV SPT	57(6")NR 56(4")	N/A	N/A			@ 65' Gravelly silty sand, brown to lt. brown, fine to coarse, slightly moist, moderately dense, micaceous, little cobbles.	N/A

Total Depth Drilled = 64.0 feet bgs.
Total Depth Sampled = 55.5 feet bgs.
No Caving
No Groundwater Encountered
Boring backfilled with soil cuttings.

hydrologue, Inc.
Consulting Engineers and Geologists

NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES.

Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-3**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
0	ENV	12/12/12				SP	**Artificial Fill:** @ 1' Silty gravelly sand, brown to dark gray, fine to medium, moist, loose, micaceous.	12:45/ 0.2
5	ENV / SPT	20/51(6") 60(6")	6.6	126.6		ML	@ 5' Sandy clayey silt, dark brown to black, moist, moderately compact, micaceous. **Natural Ground:**	12:54/ 1.0
10	ENV / SPT	53(6") 20/50(4")	23.0	105.1			@ 10' Sandy clayey silt, dark gray to black, moist, moderately dense, micaceous.	13:07/ 1.0
15	ENV / SPT	55(6") 51(4")	6.8	121.7			@ 15' Silty gravelly sand, gray to dark gray, fine to coarse, slightly moist, moderately dense, micaceous, trace cobbles..	13:17/ 1.0
20	ENV / SPT	52(6") 50 (4")	3.5	130.7		SP	@ 20' Silty gravelly sand, gray to dark gray, fine to coarse, slightly moist, moderately dense, micaceous, trace cobbles..	13:22/ 0.4
25	ENV / SPT	52 (6") 10/15/15	5.2	121.2			@ 25' Silty gravelly sand, lt. brown to brown, fine to coarse, slightly moist moderately dense, micaceous, trace cobbles..	13:28/ 0.5
30	ENV / SPT	47/47/55 52(4")	11.7	116.0		ML	@ 30' Sandy silt, lt. brown to green, fine to medium, moist, moderately dense, micaceous.	13:33/ 0.5
35	ENV / SPT	57(6") 51(5")	11.9	111.7		SM	@ 35' Silty sand, lt. brown to yellow, fine to medium, moist, moderately dense, micaceous.	13:40/ 0.4
40								

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NOTE: DATA PRESENTED IN THIS LOG IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED AND APPLIES ONLY AT THE SPECIFIC LOCATION AND TIME INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES

Project: **City of Pasadena**	Location: **130 Wallis St, Pasadena, CA (40,000-Gal AST Vicinity)**	Project #: **2540-00**
Logged By: **MWM/GP**	Start/Finish Date: **November 25, 2002**	Boring I.D.: **HB-3 con't**
1st Water Table (bgs): **NA**	Sampling Method (bgs): **CA Modified Split Spoon**	PID: **NA**
Last Water Table (bgs): **NA**	Wt. of Hammer (lb): **140 lb** Hole Diameter: **8"**	Elevation: **GS**
Rig Type: **B-61**	Drilling Contractor: **Excel Drilling**	Weather: **Sunny**

Depth (ft.)	Sample Interval	Blow Count	Moisture Content (%)	Dry Density (lbs./cu. ft.)	Lithology	USCS	Lithologic Description (Soil classification, Color, Grain Size, Moisture, Consistency, Other)	Time/ PID
40	ENV SPT	52(2") 54(6")	2.9	104 1			@ 40' Silty sand, dark brown, fine to medium, moist, moderately dense, micaceous.	13:48 /0.5
45	ENV SPT	47/53(6")NR NR 13(4")	N/A	N/A			@ 45' Silty sand, dark brown, fine to medium, moist, moderately dense, micaceous.	0.3
50	ENV SPT	56(6")NR 52(3")	N/A	N/A		SM	@ 50' Silty sand, dark brown, fine to medium, moist, moderately dense, micaceous.	N/A
55	ENV SPT	56(6") 50(4")	3 3 12	5.8			@ 55' Silty sand, lt. brown to gray, fine to coarse, slightly moist, moderately dense, micaceous.	14:18/ 0.5
60	ENV SPT	57(6") 51(4") NR	N/A	N/A			@ 60' Gravelly silty sand, brown to lt. brown, fine to coarse, slightly moist moderately dense, micaceous, little cobbles.	N/A
65	ENV SPT	55(6")NR 52(3")NR	N/A	N/A			@ 65' Gravelly silty sand, brown to yellow brown, fine to coarse, slightly moist, moderately dense, micaceous, little cobbles.	N/A

Total Depth Drilled = 64.0 feet bgs.
Total Depth Sampled = 65.5 feet bgs.
No Caving
No Groundwater Encountered
Boring backfilled with soil cuttings.

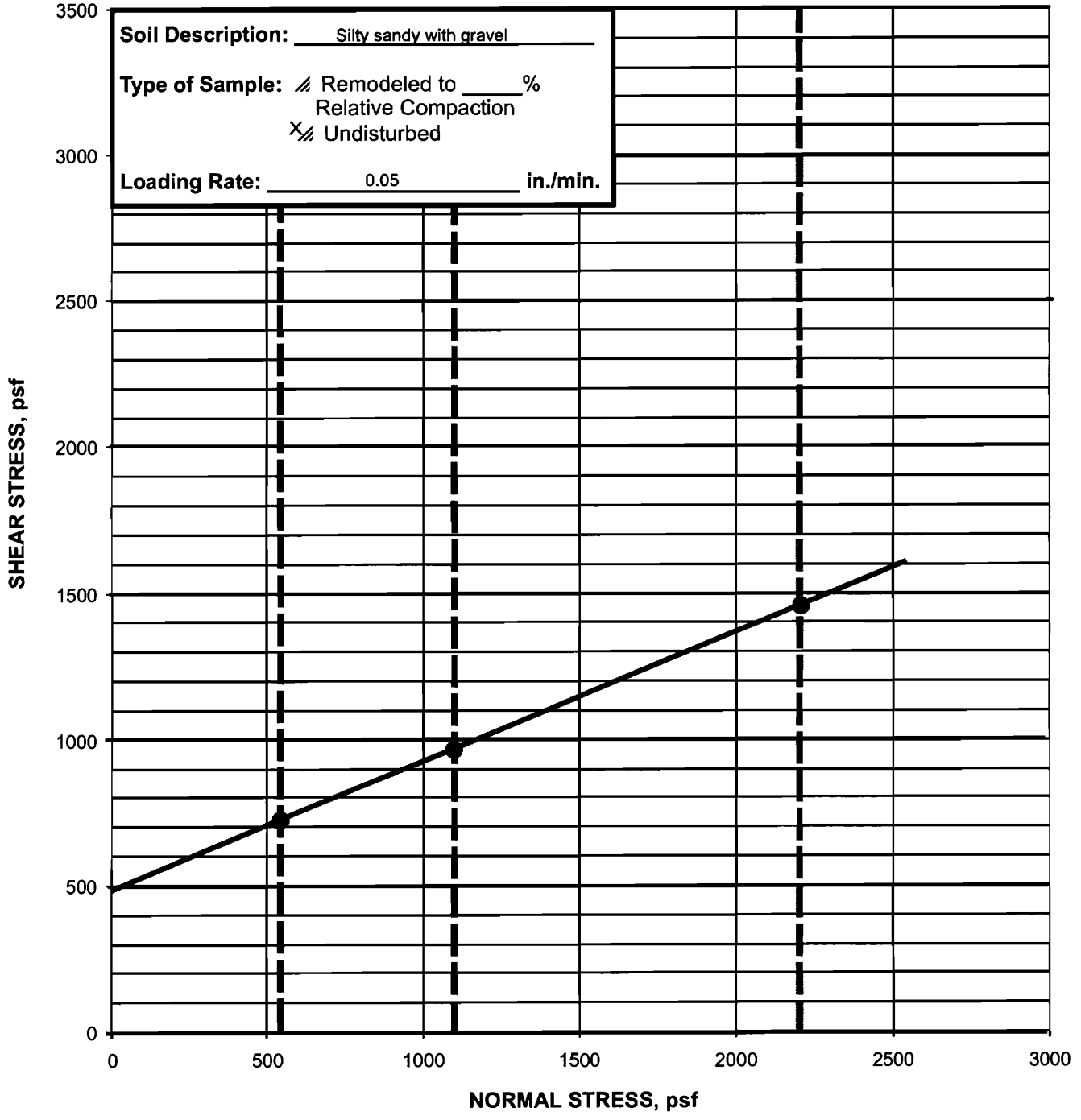
Appendix C

Test Data

DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11-7/15/11 Sample I.D.: BH-1 @ 9.5'

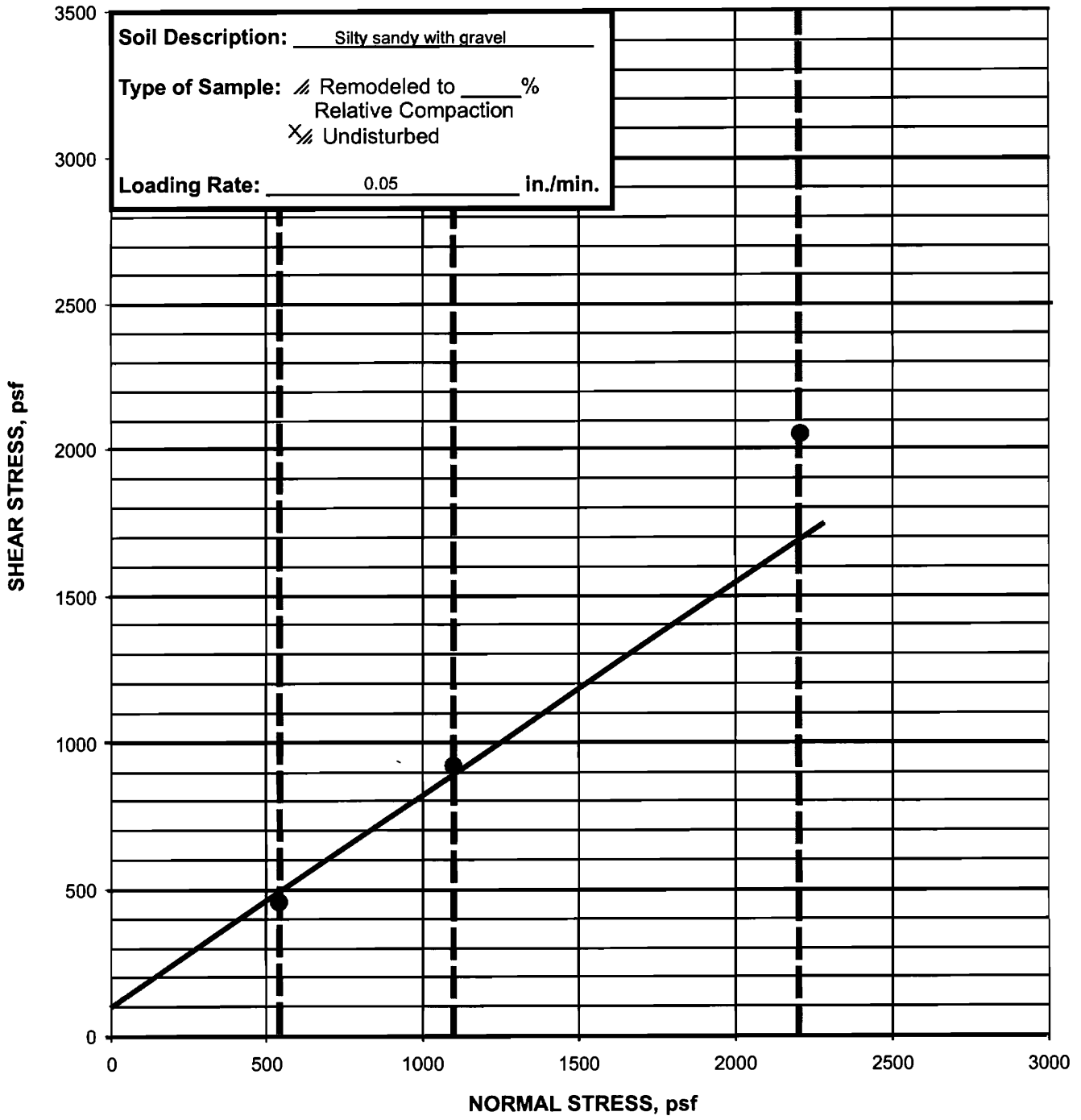


Sample Location	Symbol	Average Moisture Content Before	Average Moisture Content After	Fiction Angle	Cohesion	Remarks
B-1@9.5'	●	7.9	16.9	22.5°	490 psf	Ultimate

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Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/21/11-7/22/11 Sample I.D.: BH-3 @ 15.0'



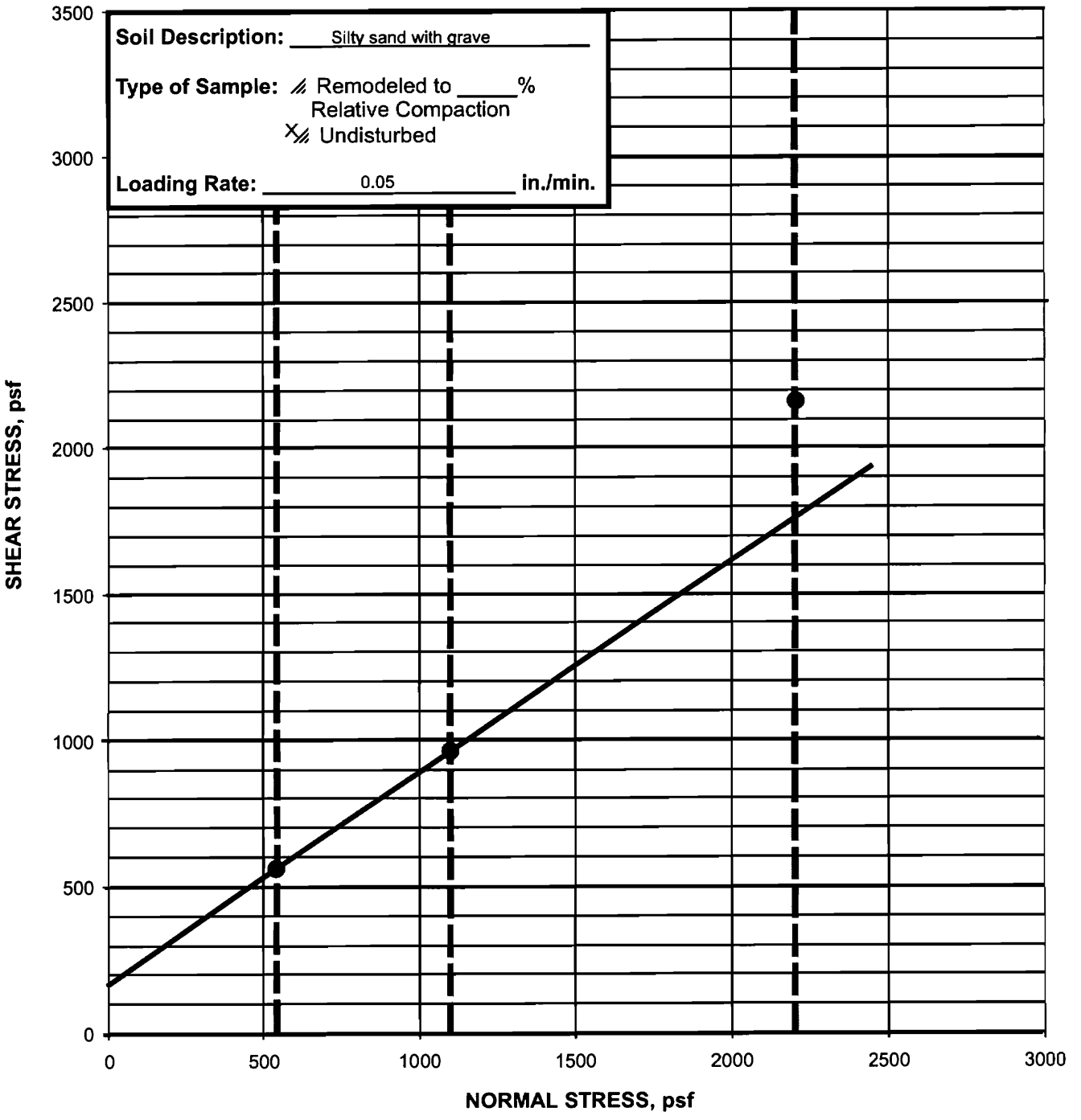
Sample Location	Symbol	Average Moisture Content Before	Average Moisture Content After	Fiction Angle	Cohesion	Remarks
B-3@15'	●	7.0	13.7	34°	100 psf	Ultimate

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DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11-7/15/11 Sample I.D.: BH-5 @ 9.5'



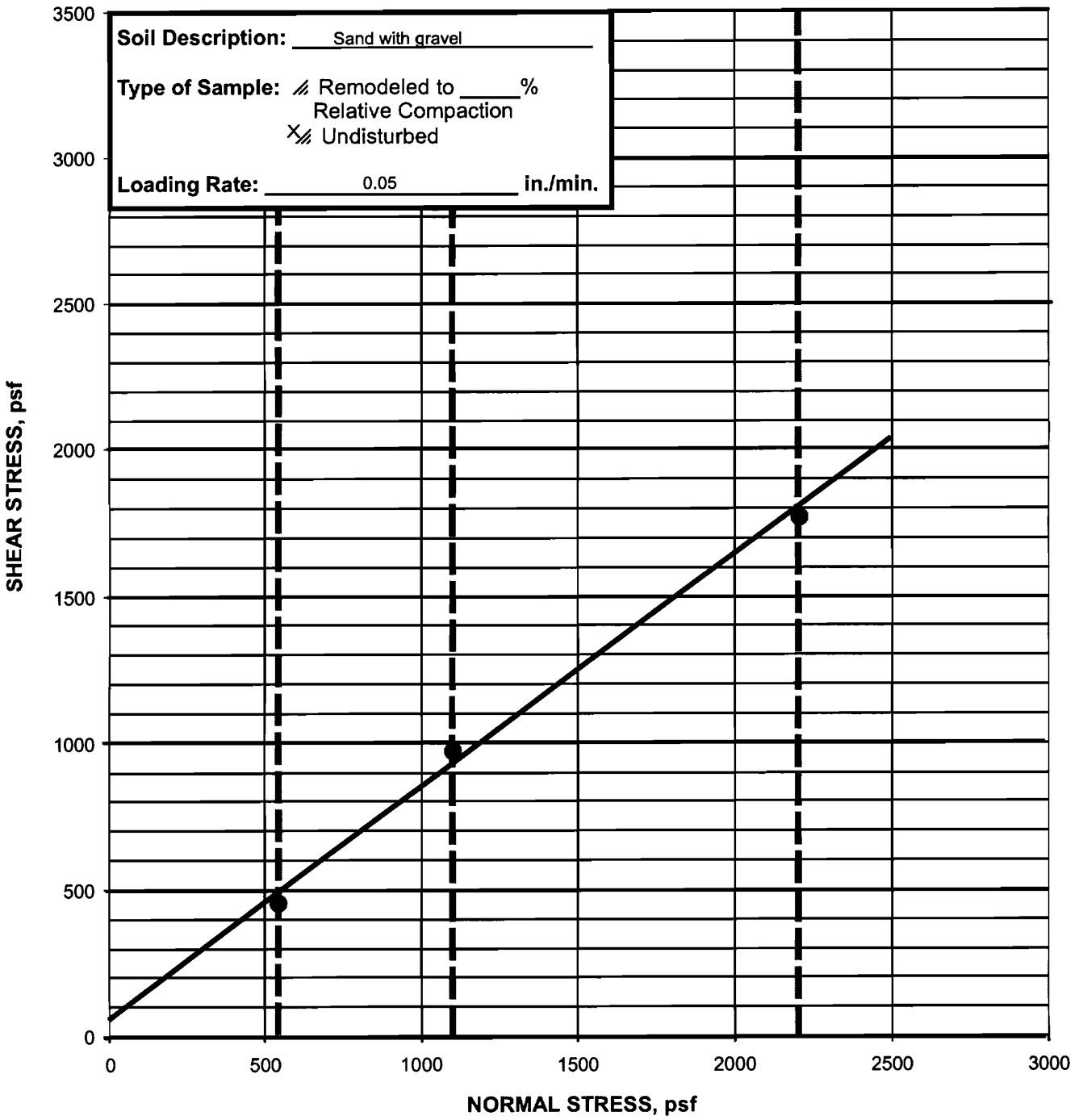
Sample Location	Symbol	Average Moisture Content Before	After	Fiction Angle	Cohesion	Remarks
BH-5@9.5'	●	8.6	19.3	34°	180 psf	Ultimate

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DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11-7/15/11 Sample I.D.: BH-5 @ 15.5'



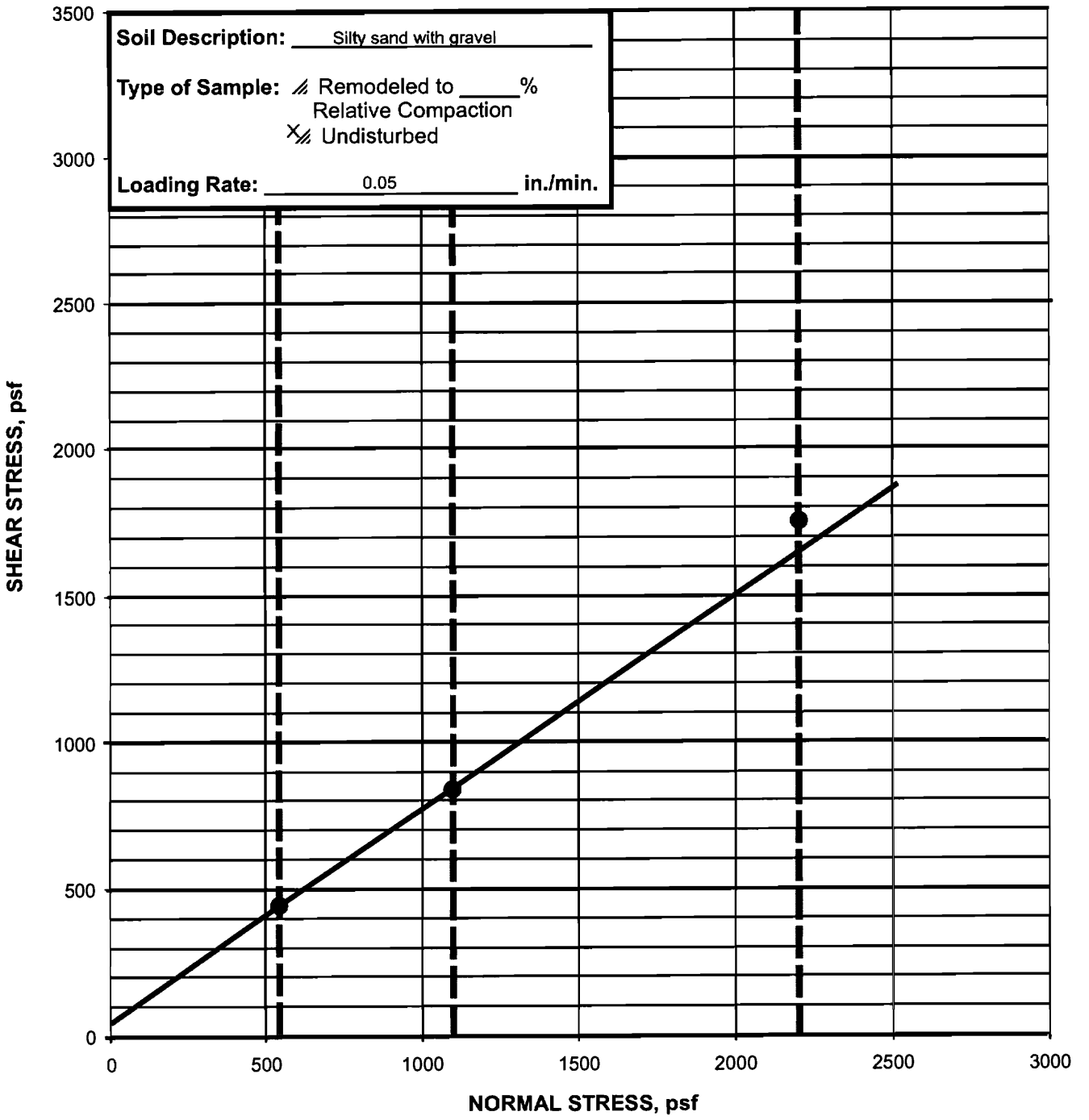
Sample Location	Symbol	Average Moisture Content Before	Average Moisture Content After	Fiction Angle	Cohesion	Remarks
B-5@15.5'	●	4.9	14.9	36°	60 psf	Ultimate

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DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11-7/15/11 Sample I.D.: BH-7 @ 20.0'



Sample Location	Symbol	Average Moisture Content Before	After	Fiction Angle	Cohesion	Remarks
B-7@20.0'	●	7.1	26.6	34°	50 psf	Ultimate

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DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

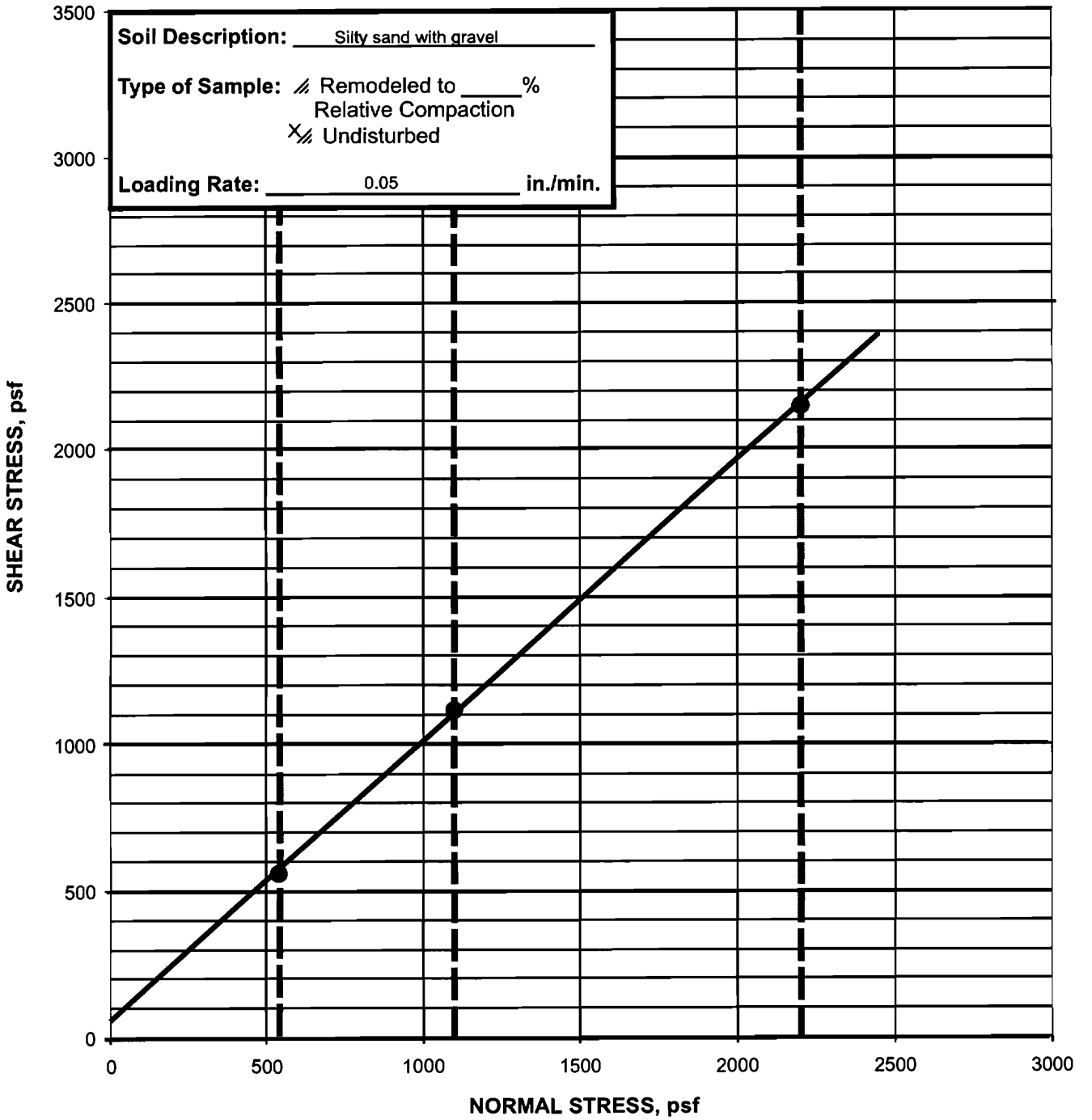
Logged By: ES Start/Finish Date: 7/21/11-7/22/11 Sample I.D.: BH-8 @ 15.0'

Soil Description: Silty sand with gravel

Type of Sample: // Remodeled to _____% Relative Compaction

X// Undisturbed

Loading Rate: 0.05 **in./min.**



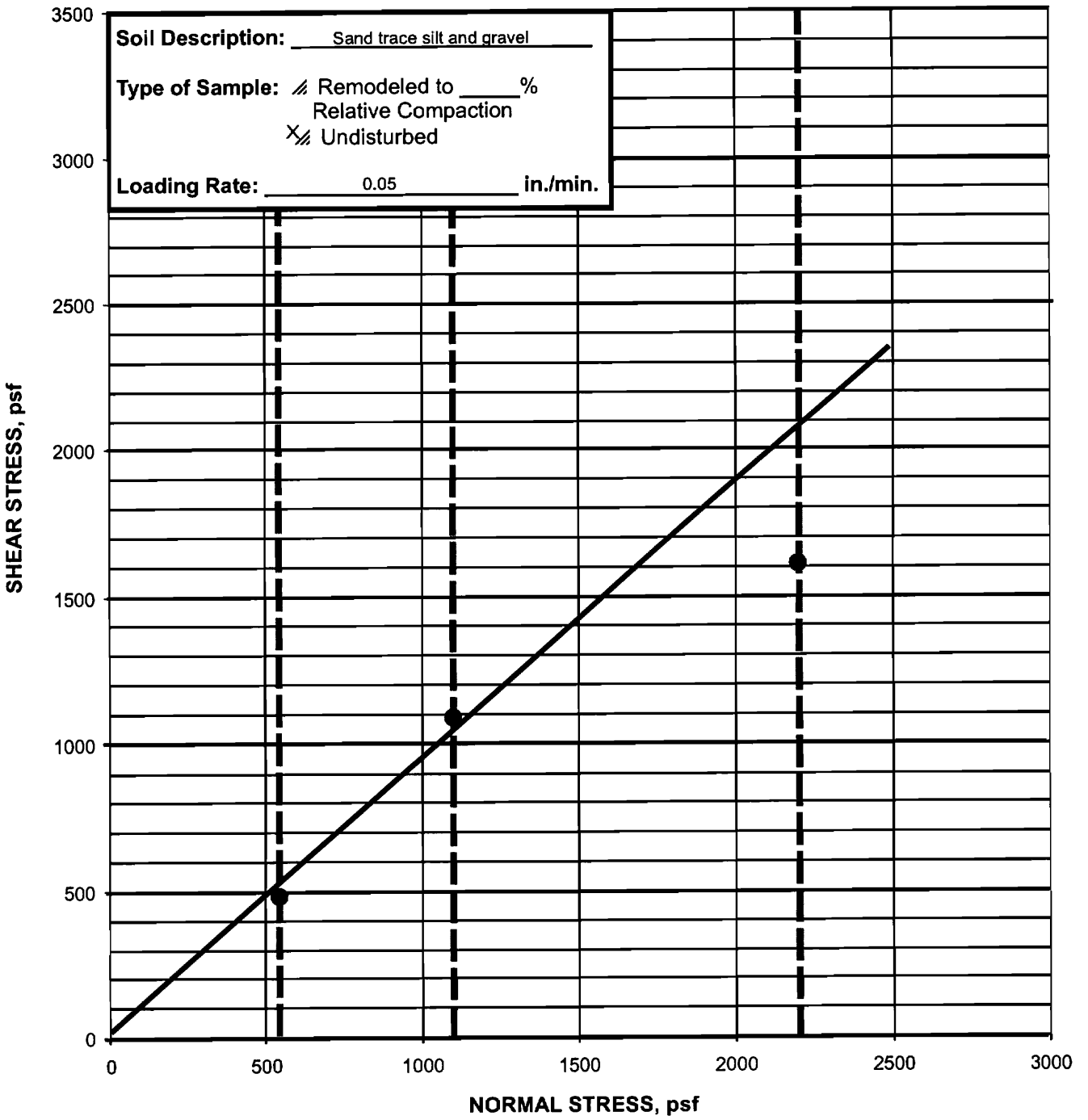
Sample Location	Symbol	Average Moisture Content Before	After	Fiction Angle	Cohesion	Remarks
B-8@15'	●	4.8	13.1	42°	60 psf	Ultimate

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DIRECT SHEAR TESTS

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/21/11-7/22/11 Sample I.D.: BH-10 @ 14.5'



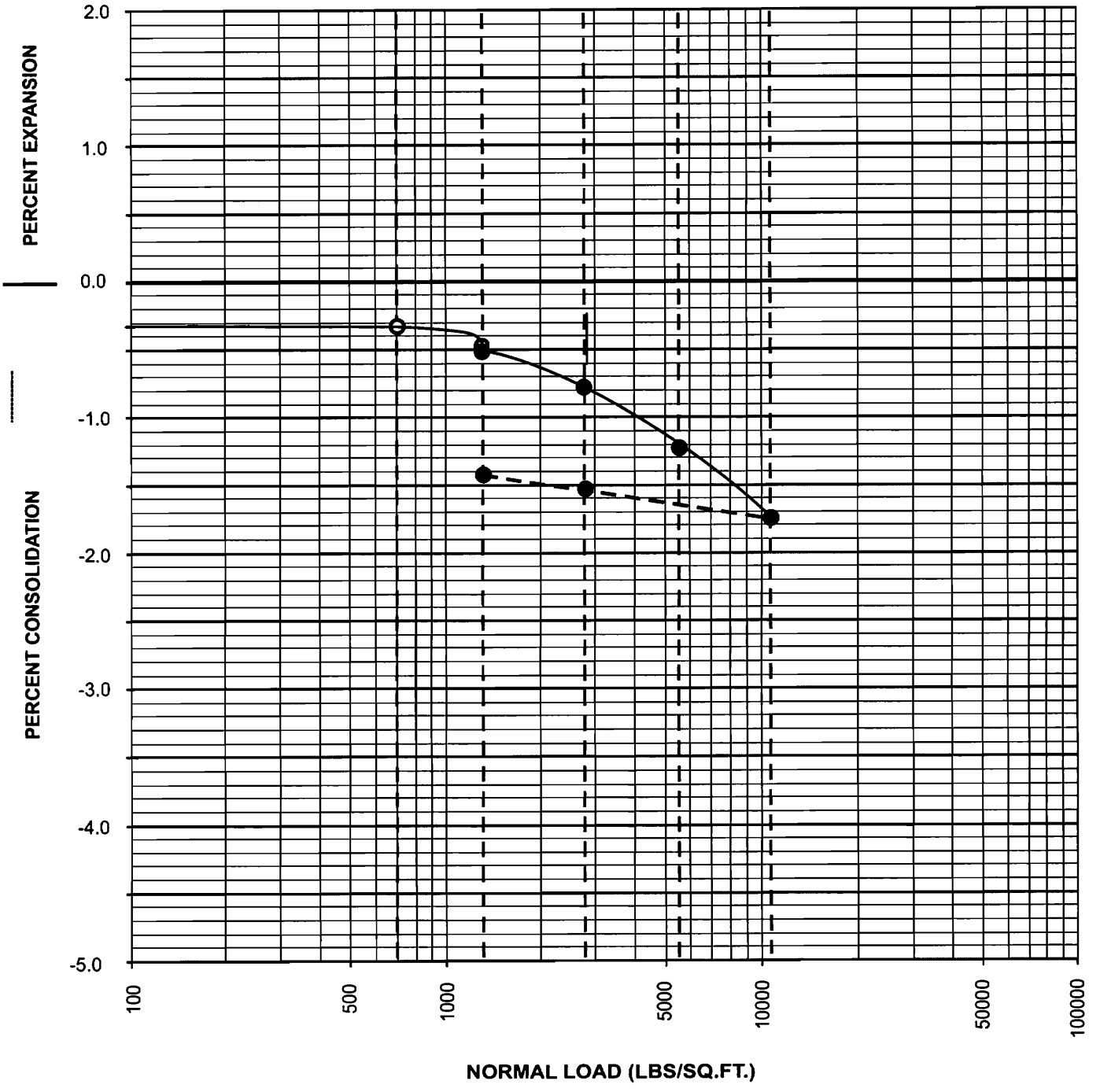
Sample Location	Symbol	Average Moisture Content Before	After	Fiction Angle	Cohesion	Remarks
B-10@14.5'	●	7.8	17.0	41°	20 psf	Ultimate

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LOAD CONSOLIDATION TEST

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11 Sample I.D.: BH-3 @ 10.0'



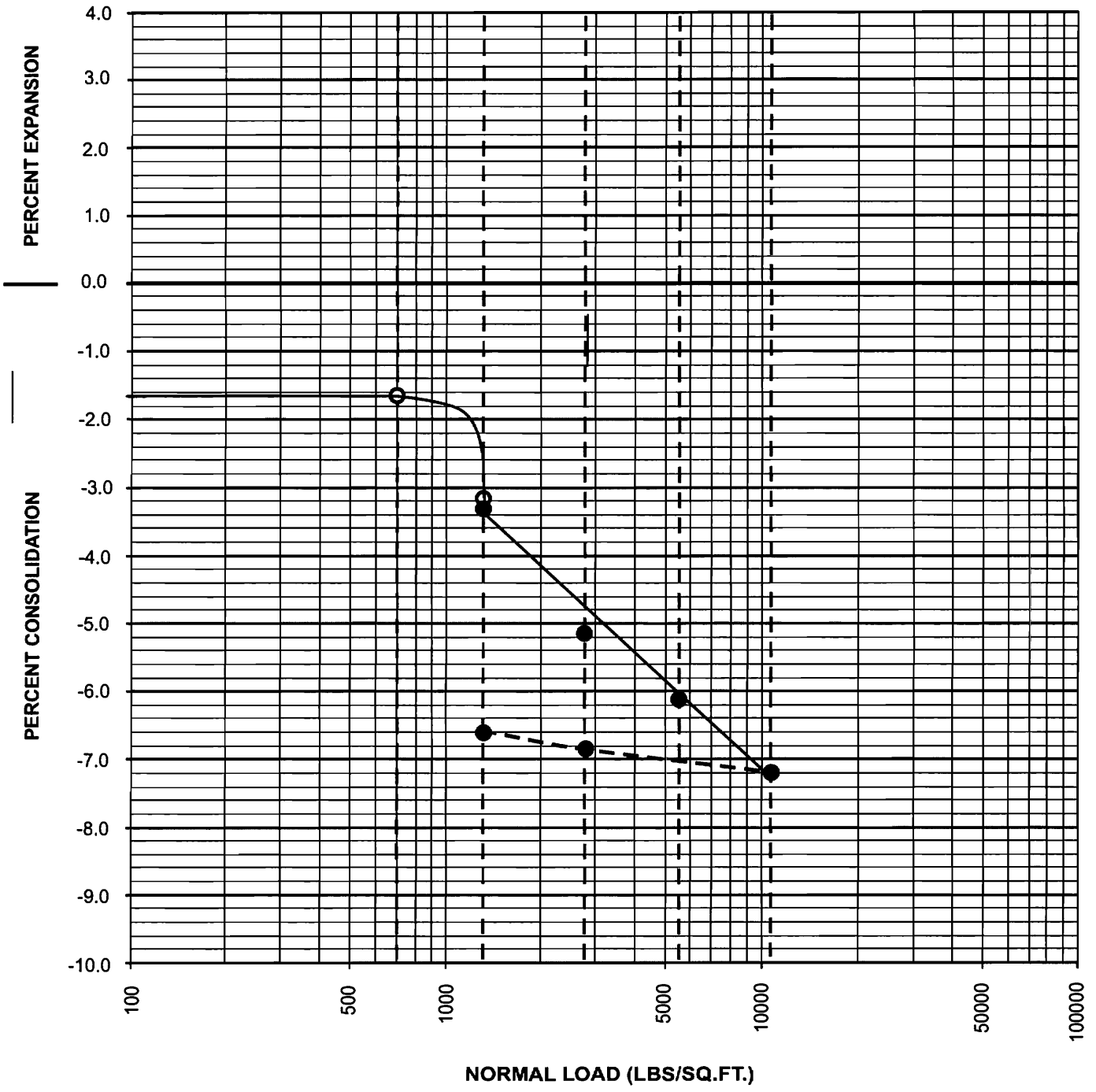
O FIELD MOISTURE
● EFFECT OF ADDING MOISTURE
--- REBOUND

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LOAD CONSOLIDATION TEST

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/14/11 Sample I.D.: BH-4 @ 20.0'



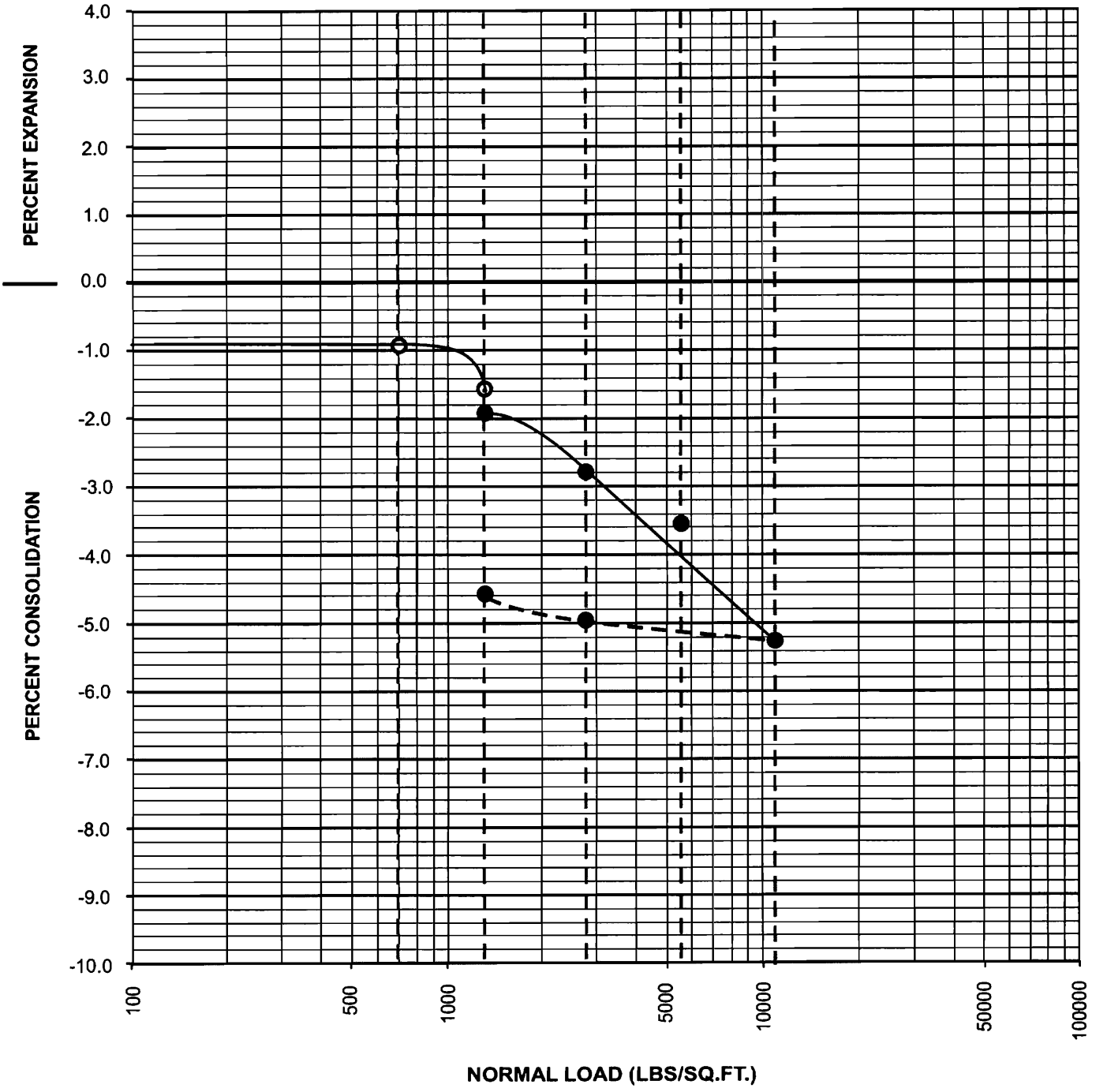
O FIELD MOISTURE
● EFFECT OF ADDING MOISTURE
--- REBOUND

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LOAD CONSOLIDATION TEST

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/22/11 Sample I.D.: BH-6 @ 5-6.5'



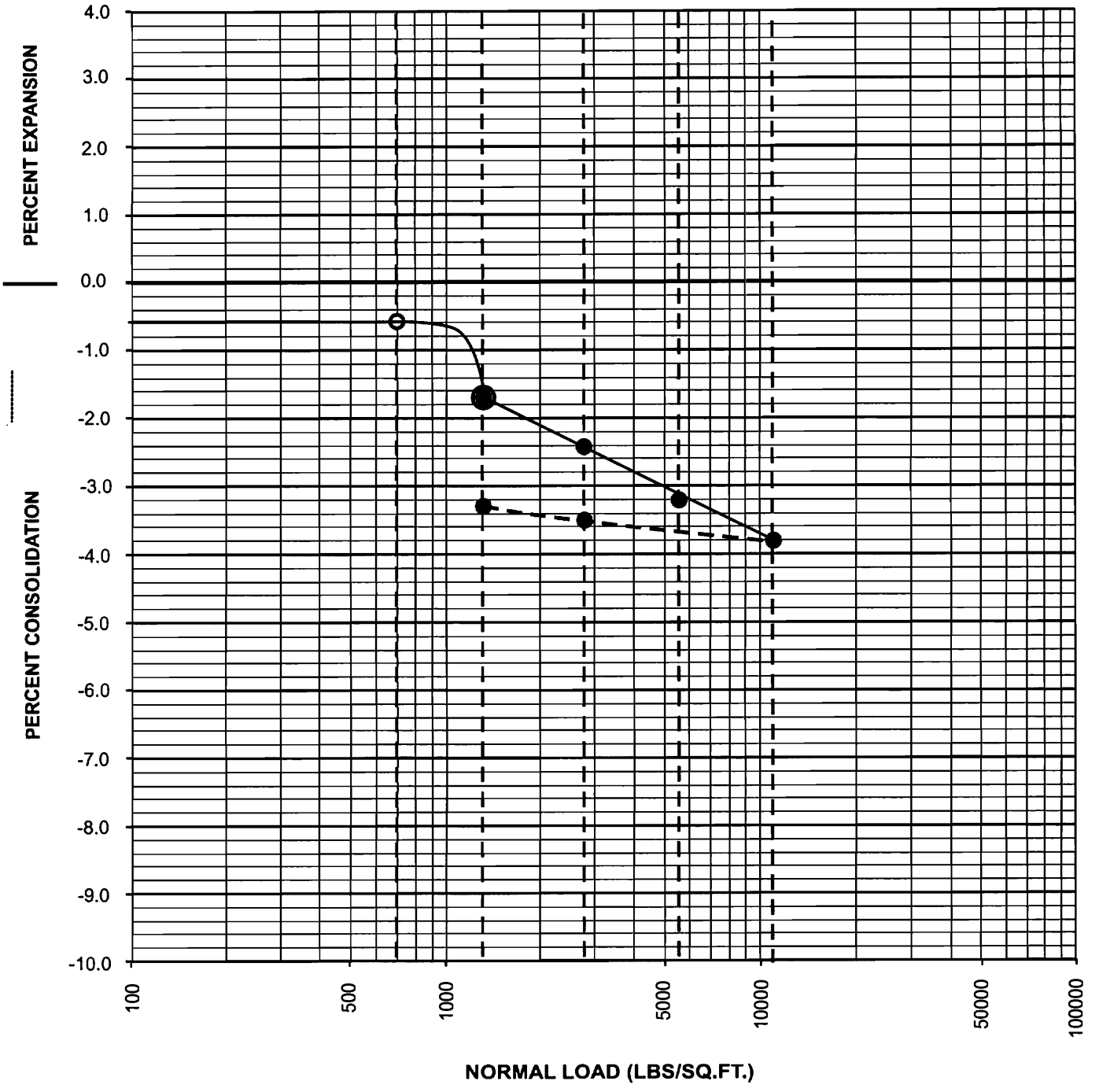
O FIELD MOISTURE
● EFFECT OF ADDING MOISTURE
--- REBOUND

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LOAD CONSOLIDATION TEST

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

Logged By: ES Start/Finish Date: 7/15/11 Sample I.D.: BH-7 @ 30.0'



O FIELD MOISTURE

● EFFECT OF ADDING MOISTURE

--- REBOUND

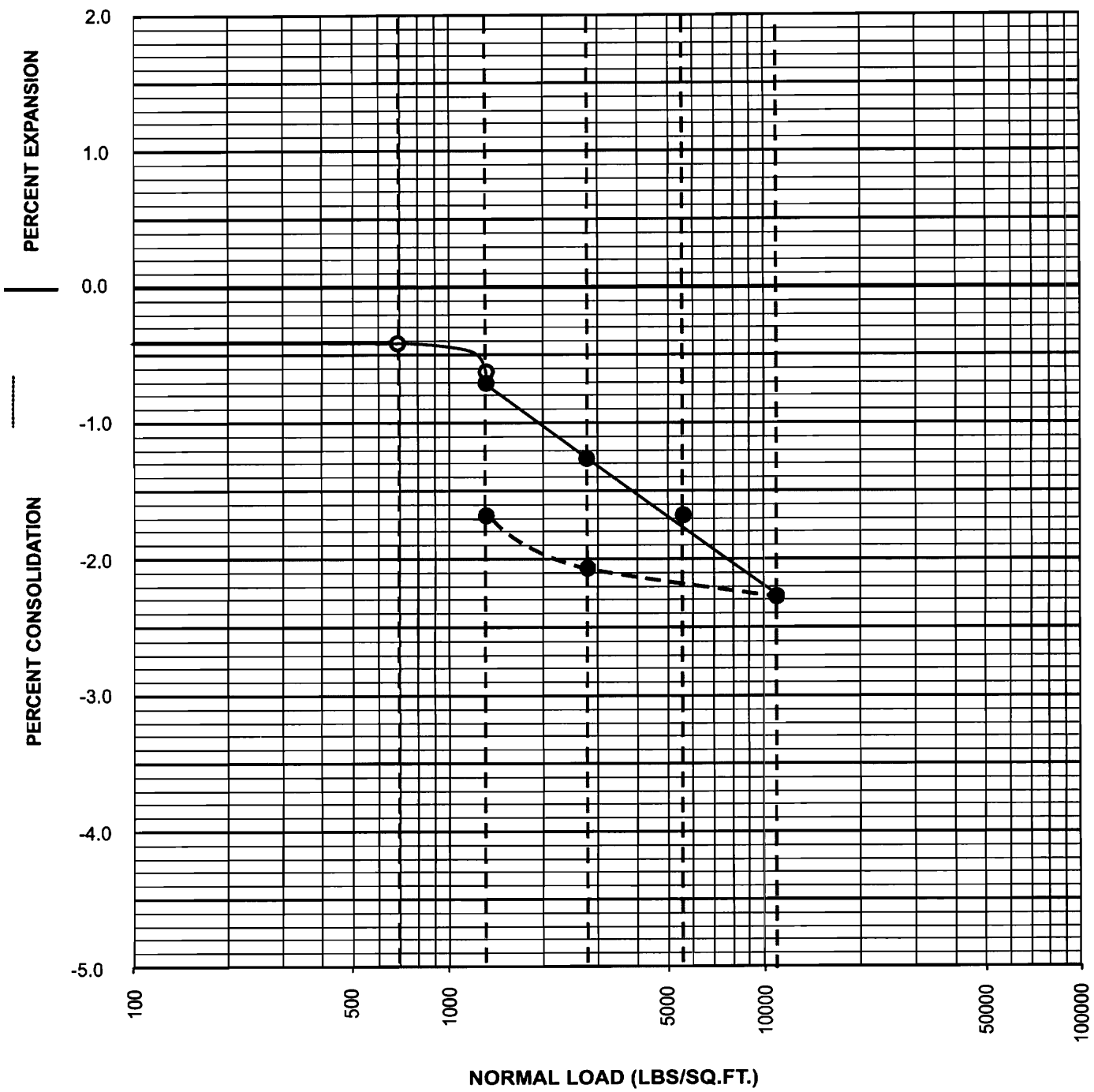
hydrologue, Inc.

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LOAD CONSOLIDATION TEST

Project: Pasadena Power Plant Location: SE Corner of Fair Oaks Ave & Glenarm St, CA Project #: 3626-04-01

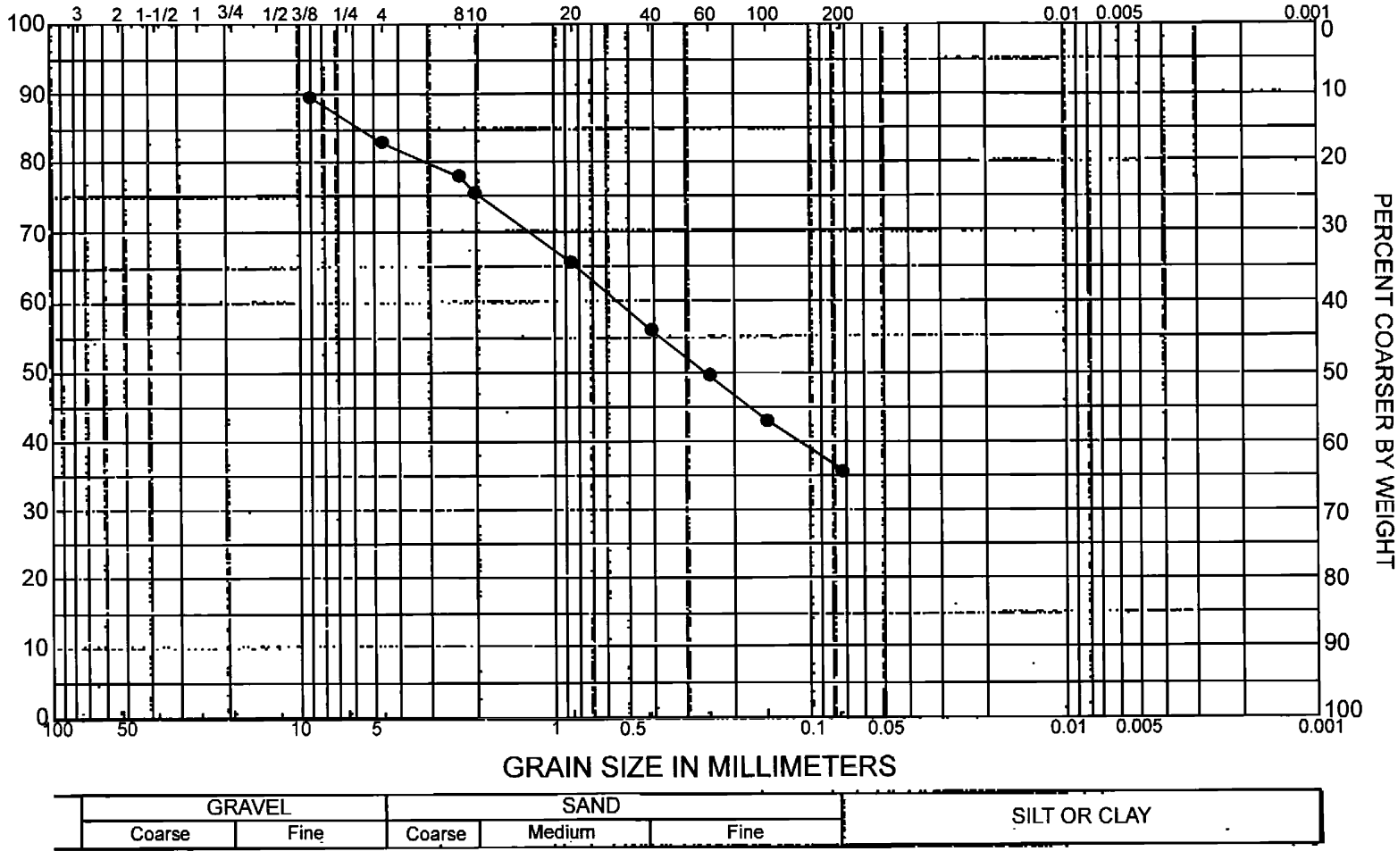
Logged By: ES Start/Finish Date: 7/14/11 Sample I.D.: BH-9 @ 4.5'



O FIELD MOISTURE
● EFFECT OF ADDING MOISTURE
--- REBOUND

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GRAIN SIZE CURVES



Curve No.	Boring No.	Depth ft.	Soil Classification	Natural W/C, %	LL	PL	PI
———	BH-1 bulk sample	1'-5'	Silty Clayey Sand				

PROJECT: Pasadena Power Plant

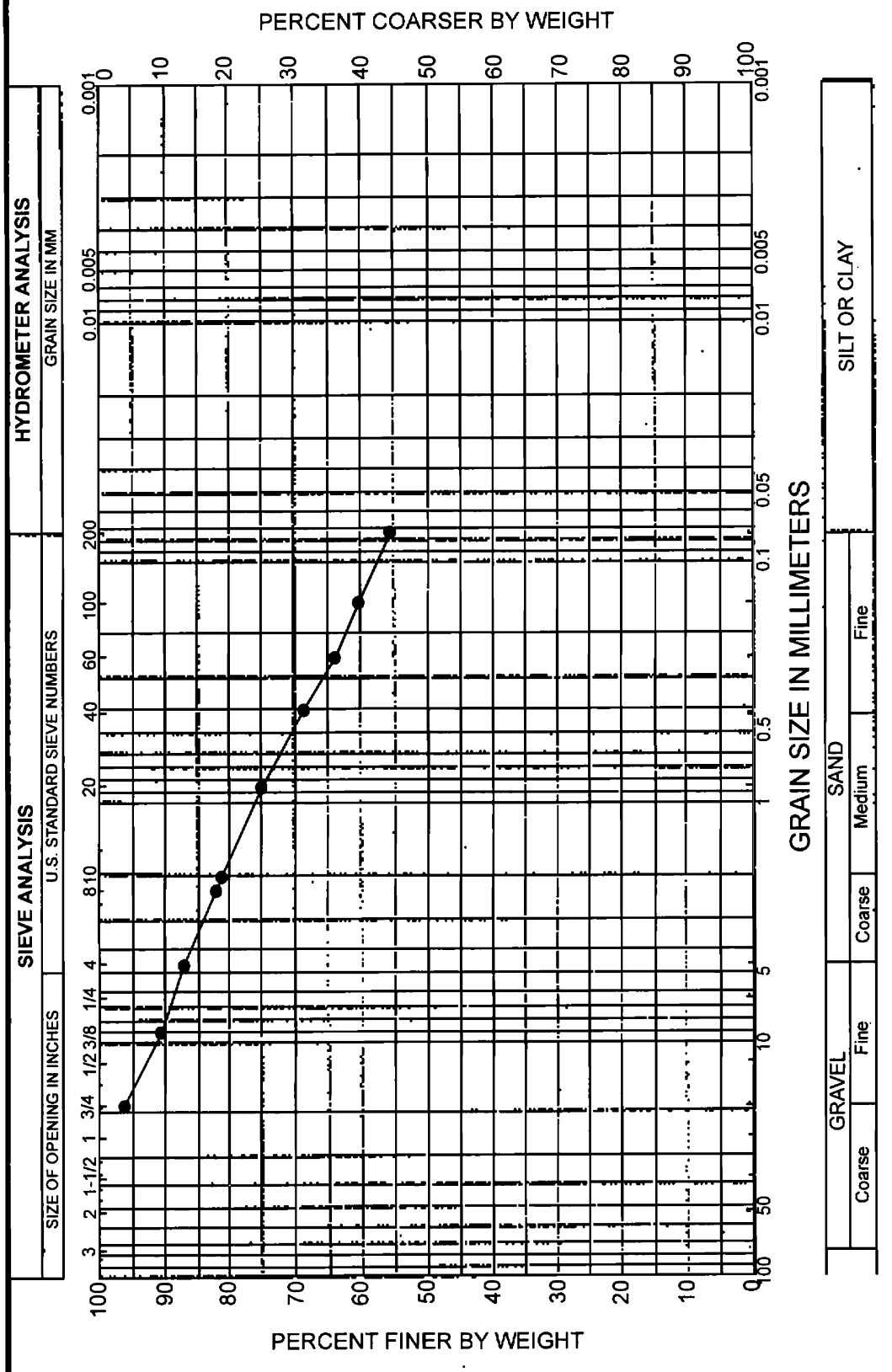
LOCATION: SE Corner of Fair Oaks Ave & Glenarm St, Pasadena, CA

PROJECT NO. 3626-04-01

FIGURE

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GRAIN SIZE CURVES

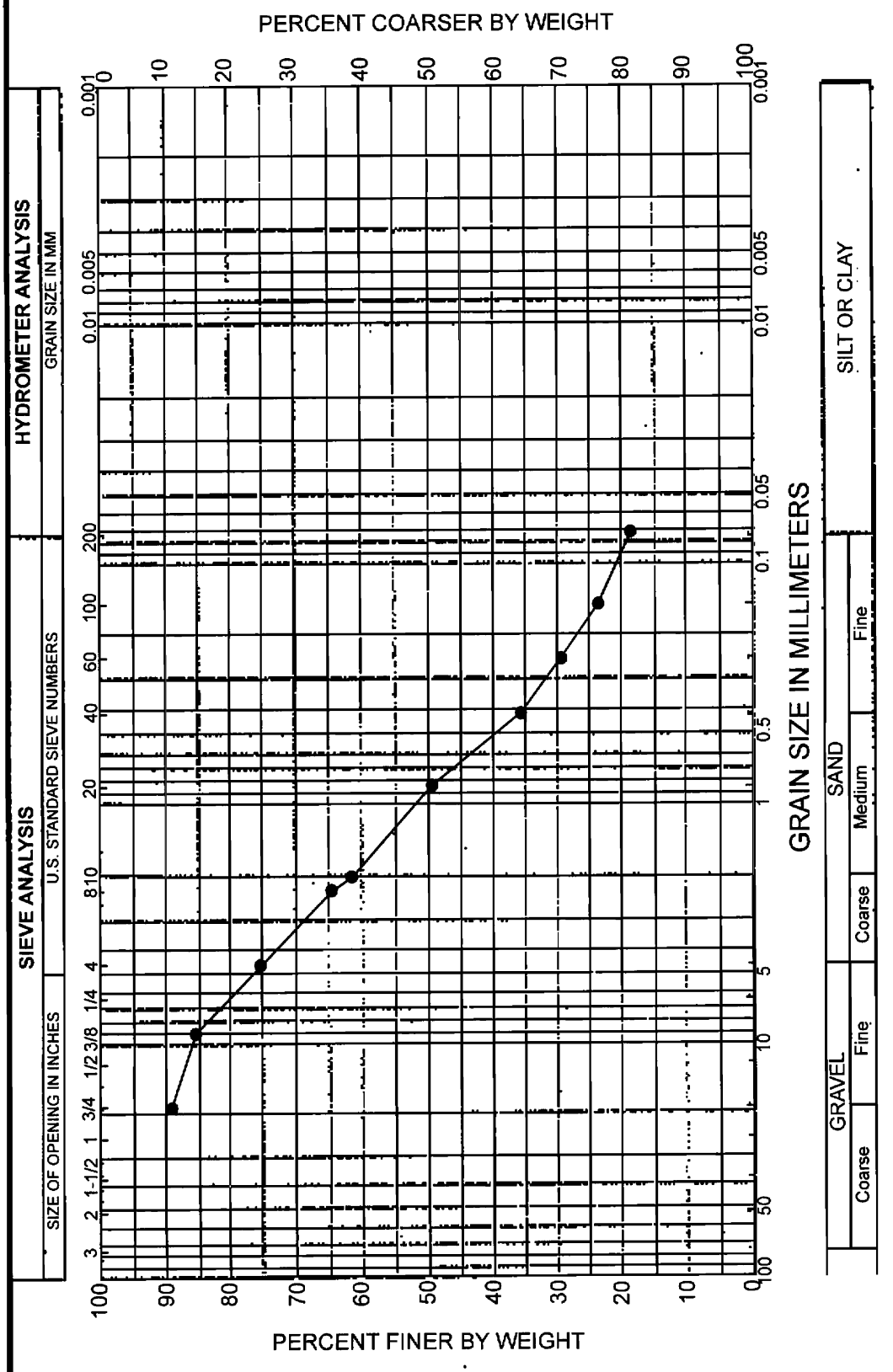


Curve No.	Boring No.	Depth ft.	Soil Classification	Natural W/C, %	LL	PL	PI
——	BH-4 bulk sample	1'-5'	Sandy Clayey Silt				

PROJECT	Pasadena Power Plant	PROJECT NO.	3626-04-01
LOCATION	SE Corner of Fair Oaks Ave & Glenarm St, Pasadena, CA	FIGURE	

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GRAIN SIZE CURVES



Curve No.	Boring No.	Depth ft.	Soil Classification	Natural W/C, %	LL	PL	PI
—·—	BH-8 bulk sample	1'-5'	Silty Clayey Sand				

PROJECT	Pasadena Power Plant	PROJECT NO.	3626-04-01
LOCATION	SE Corner of Fair Oaks Ave & Glenarm St, Pasadena, CA	FIGURE	

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ASSOCIATED LABORATORIES
806 North Batavia - Orange, California 92868 - 714/771-6900 *FAX 714/538-1209*

CLIENT Hydrologue, Inc. (6979)
ATTN: Seyed Mortazavi
2793 East Foothill Blvd.
Pasadena, CA 91107-3400

LAB REQUEST 276809
REPORTED 06/27/2011
RECEIVED 06/16/2011

PROJECT #3626-04-01

SUBMITTER Client

COMMENTS

This laboratory request covers the following listed samples which were analyzed for the parameters indicated on the attached Analytical Result Report. All analyses were conducted using the appropriate methods as indicated on the report. This cover letter is an integral part of the final report.

Order No.	Client Sample Identification
1174485	BH-1 (Bulk)
1174486	BH-2 (Bulk)
1174487	BH-4 (Bulk)
1174488	BH-8 (Bulk)
1174489	BH-9 (Bulk)
1174490	Laboratory Method Blank

Thank you for the opportunity to be of service to your company. Please feel free to call if there are any questions regarding this report or if we can be of further service.

ASSOCIATED LABORATORIES by,

Edward S. Behare, Ph.D.
Vice President

NOTE: Unless notified in writing, all samples will be discarded by appropriate disposal protocol 30 days from date reported.

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TESTING & CONSULTING
Chemical
Microbiological
Environmental

Order #: 1174485 **Client Sample ID:** BH-1 (Bulk)
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	599		mv@25C	06/23/11 DK

Order #: 1174486 **Client Sample ID:** BH-2 (Bulk)
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	566		mv@25C	06/23/11 DK

Order #: 1174487 **Client Sample ID:** BH-4 (Bulk)
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	550		mv@25C	06/23/11 DK

Order #: 1174488 **Client Sample ID:** BH-8 (Bulk)
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	515		mv@25C	06/23/11 DK

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 1174489 **Client Sample ID:** BH-9 (Bulk)
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	563		mv@25C	06/23/11 DK

Order #: 1174490 **Client Sample ID:** Laboratory Method Blank
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
D1498 Oxidation Reduction Potential				
Oxidation Reduction Potential	719		mv@25C	06/23/11 DK

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

ASSOCIATED LABORATORIES
QA REPORT FORM - INORGANICS

QC Sample: LR 276809-485

Matrix: WATER

Prep. Date: June 23, 2011

Analysis Date: June 23, 2011

ID#'s in Batch: LR 276809

SAMPLE RESULT / SAMPLE DUPLICATE

Reporting Units = mV

Test	Method	Sample Result	Sample Duplicate	RPD
REDOX	2580	600	599	0.2

DF = Difference between the duplicate results DF = 10 mV

PREPARATION BLANK / LAB CONTROL SAMPLE RESULTS

PREP BLANK	LCS				
Value	Result	TRUE	% Rec	L. Limit	H. Limit
ND	421	420	100	95%	105%

Value = Preparation Blank Value; ND = Not-Detected
LCS Result = Lab Control Sample Result
True = True Value of LCS
L.Limit / H.Limit = LCS Control Limits

CHAIN-OF-CUSTODY RECORD FORM

hydrologue Inc.
Consulting Engineers & Geologists

276809

PAGE 1 OF 1

PAGE 05/06

ASSOCIATED LABS

714-7719933

07/05/2011 12:07

SIGNATURE	PROJECT number 3626-04-01
PRINTED NAME	PROJECT NAME PPD 85E Slate st. Pasadena, CA
COMPANY hydrologue Inc.	PROJECT MANAGER Seyed Mortazavi
CONDITION/TEMP°C	
TURNAROUND TIME	

GEMS#	SAMPLE ID	DATE		DESCRIPTION	METHODS: TPH GASOLINE 8015M	TEPH CARBON CHAIN C6-C44	TPH DIESEL 8015M w/ SG	TPH GASOLINE + BTEX/MTBE EPA 8260B	MTBE/BTEX/FUEL OXY + 1,2DCA + ETHANOL EPA 8260B	VOCs 624	VOCs 8260B	PCBs 8082	CAM METALS	LEAD TOTAL	Oxidation Reduction	SAMPLE MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	SPECIAL HANDLING
1	BH-1 (Bulk)														/				~~VOA VIALS HCl~~
4	BH-2 (Bulk)														/				
6	BH-4 (Bulk)														/				
8	BH-8 (Bulk)														/				
1	BH-9 (Bulk)														/				

RELINQUISHED BY	DATE	RELINQUISHED BY	DATE	RELINQUISHED BY	DATE	REMARKS
SIGNATURE [signature]		SIGNATURE [signature]	6/16/11	SIGNATURE		
PRINTED NAME Eliza Sahakian	TIME	PRINTED NAME Max Montiel	TIME	PRINTED NAME	TIME	
COMPANY hydrologue Inc		COMPANY Associated Labs	1540	COMPANY		
RECEIVED BY	**DATE**	**RECEIVED BY**	**DATE**	**RECEIVED BY (LAB)**	**DATE**	
SIGNATURE [signature]	6/16/11	SIGNATURE [signature]	6/16/11	SIGNATURE		
PRINTED NAME Max Montiel	TIME	PRINTED NAME K. WACKER	TIME	PRINTED NAME	TIME	
COMPANY Associated Labs	1700	COMPANY ASL	1525	COMPANY		

2627 E. FOOTHILL BOULEVARD, PASADENA, CA 91107 TEL: (626) 585-0606 FAX: (626) 585-0046 info@hydrologue.com

ASSOCIATED LABORATORIES
806 North Batavia – Orange, California 92868 – 714-771-6900 *FAX 714-538-1209*

SAMPLE ACCEPTANCE CHECKLIST

Section 1
Client: Hydroqual
Date Received: 6/16/11
Sample(s) received in cooler: (Yes) No
Shipping Information:
Project:
Sampler's Name: Yes (No)
No (Skip Section 2)

Section 2
Was the cooler packed with: ✓ Ice ___ Ice Packs ___ Bubble Wrap ___ Styrofoam ___ Paper ___ None ___ Other
Cooler or box temperature: 4.8
(Acceptance range is 2 to 6 Deg. C.)

Section 3	YES	NO	N/A
Was a COC received?	✓		
Is it properly completed? (IDs, sampling date and time, signature, test)	✓		
Were custody seals present?		✓	
If Yes – were they intact?			
Were all samples sealed in plastic bags?	✓		
Did all samples arrive intact? If no, indicate below.	✓		
Did all bottle labels agree with COC? (ID, dates and times)	✓		
Were correct containers used for the tests required?	✓		
Was a sufficient amount of sample sent for tests indicated?	✓		
Was there headspace in VOA vials?			✓
Were the containers labeled with correct preservatives?			✓
Was total residual chlorine measured (Fish Bioassay samples only)? *			✓

*: If the answer is no, please inform Fish Bioassay Dept. immediately.

Section 4
Explanations/Comments

Section 5
Was Project Manager notified of discrepancies: Y / N N/A

Completed By: KW Date: 6/16/11

AMERICAN SCIENTIFIC LABORATORIES, LLC
Environmental Testing Services
2520 N. San Fernando Rd., Los Angeles, CA 90065 Tel: (323) 223-9700 Fax: (323) 223-9500

Ordered By

Hydrologue, Inc.
2827 E. Foothill Blvd.
Pasadena, CA 91107

Telephone (626)585-9696
Attn Seyed Mortazavi

Number of Pages 2
Date Received 06/15/2011
Date Reported 06/22/2011

Job Number	Ordered	Client
50240	06/15/2011	HYDRLG

Project ID: 3626-04-01
Project Name:
Site: 85 E. State St.
Pasadena, CA

Enclosed are the results of analyses on 5 samples analyzed as specified on attached chain of custody.

Amolk MOLKY Brar
Laboratory Manager

Rojert G. Araghi
Laboratory Director

American Scientific Laboratories, LLC (ASL) accepts sample materials from clients for analysis with the assumption that all of the information provided to ASL verbally or in writing by our clients (and/or their agents), regarding samples being submitted to ASL, is complete and accurate. ASL accepts all samples subject to the following conditions:
1) ASL is not responsible for verifying any client-provided information regarding any samples submitted to the laboratory.
2) ASL is not responsible for any consequences resulting from any inaccuracies, omissions, or misrepresentations contained in client-provided information regarding samples submitted to the laboratory.

ASL JOB # 50240

CHAIN-OF-CUSTODY RECORD FORM

hydrologue Inc.
Consulting Engineers & Geologists

SIGNATURE	PROJECT number 3626-04-01
PRINTED NAME	PROJECT NAME PPP 85 E Slat. St. Pasadena, CA
COMPANY hydrologue Inc.	PROJECT MANAGER Seyed Mortazavi
CONDITION/TEMP°C	
TURNAROUND TIME	

GEIMS#	SAMPLE ID	DATE		DESCRIPTION	METHODS: TPH GASOLINE 8015M	TEPH CARBON CHAIN C8-C44	TPH DIESEL 8015M w/ SG	TPH GASOLINE + BTEX/MTBE 8260B	MTBE/BTEX/FUEL OXY + 1,2DCA+ EDB ETHANOL EPA 8260B	VOCs 624	VOCs 8260B	PCBs 8080	CAM METALS	LEAD/TOTAL	Sulfate Content	Chloride Content	SAMPLE MATRIX S-SOIL W-WATER A-AIR B-BULK	CONTAINER TYPE SSA-BRASS G-GLASS T-TEFLON V-VOA VOA/WIS	NO. OF CONTAINERS	SPECIAL HANDLING
	BH-1 (Bulk)														/	/	Soil		1	~~VOA VIALS W/ HCL~~ 270034
	BH-2 (Bulk)														/	/	"		1	270035
	BH-4 (Bulk)														/	/	"		1	270036
	BH-8 (Bulk)														/	/	"		1	270037
	BH-9 (Bulk)														/	/	"		1	270038

RELINQUISHED BY	DATE	RELINQUISHED BY	DATE	RELINQUISHED BY	DATE	REMARKS
SIGNATURE		SIGNATURE		SIGNATURE		
PRINTED NAME Elisa Sahakian	TIME	PRINTED NAME	TIME	PRINTED NAME	TIME	
COMPANY hydrologue Inc.		COMPANY		COMPANY		
RECEIVED BY	**DATE**	**RECEIVED BY**	**DATE**	**RECEIVED BY (LAB)**	**DATE**	
SIGNATURE		SIGNATURE		SIGNATURE		
PRINTED NAME	TIME	PRINTED NAME	TIME	PRINTED NAME	TIME	
COMPANY ASL		COMPANY		COMPANY		

... PASADENA, CA 91107 TEL: (626) 585-0606 FAX: (626) 585-0048 info@hydrologue.com

AMERICAN SCIENTIFIC LABORATORIES, LLC
Environmental Testing Services
2520 N. San Fernando Rd., Los Angeles, CA 90065 Tel: (323) 223-9700 Fax: (323) 223-9500

ANALYTICAL RESULTS

Ordered By

Hydrologue, Inc.
2827 E. Foothill Blvd.
Pasadena, CA 91107

Telephone: (626)585-9696
Attn: Seyed Mortazavi

Page: **2**

Project ID: 3626-04-01

Site

85 E. State St.
Pasadena, CA

ASL Job Number	Submitted	Client
50240	06/15/2011	HYDRLG

Method: 300, Anions by Ion Chromatography

QC Batch No: 061611-1

Our Lab I.D.		270034	270035	270036	270037	270038
Client Sample I.D.		BH-1 (Bulk)	BH-2 (Bulk)	BH-4 (Bulk)	BH-8 (Bulk)	BH-9 (Bulk)
Date Sampled		/ /	/ /	/ /	/ /	/ /
Date Prepared		06/16/2011	06/16/2011	06/16/2011	06/16/2011	06/16/2011
Preparation Method						
Date Analyzed		06/16/2011	06/16/2011	06/16/2011	06/16/2011	06/16/2011
Matrix		Soil	Soil	Soil	Soil	Soil
Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Dilution Factor		1	1	1	1	1
Analytes	**PQL**	**Results**	**Results**	**Results**	**Results**	**Results**
Conventionals						
Chloride	10.0	16.5	19.8	14.4	14.0	22.8
Sulfate	10.0	31.4	18.2	ND	34.7	97.8

QUALITY CONTROL REPORT

QC Batch No: 061611-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Conventionals										
Chloride	102	106	3.8	80-120	20					
Sulfate	104	99	4.9	80-120	20					

ANAHEIM TEST LABORATORY

3008 S. ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

TO:

HYDROLOGUE INC.
2827 E. FOOTHILL BLVD.
PASADENA, CA 91107

ELRZA SAHAKIA

DATE: 6/20/11

P.O. NO. TRANSMITTAL

LAB NO. B-4962 1-2

SPECIFICATION: CA 301

MATERIAL: SOIL

PROJECT: 3626-04-01
PPD
85 E. STATE ST.
PASADENA, CA

ANALYTICAL REPORT

"R" VALUE

	BY EXUDATION	BY EXPANSION
1) BH-2, BULK Gray, F.M. Silty Sand & Silty Clay w. Gravel	60	60
2) BH-9, BULK Brown Gray, F.M.Silty Sand & Clay Mixture w. Gravel & Asphalt	73	67

RESPECTFULLY SUBMITTED

WES BRIDGER CHEMIST

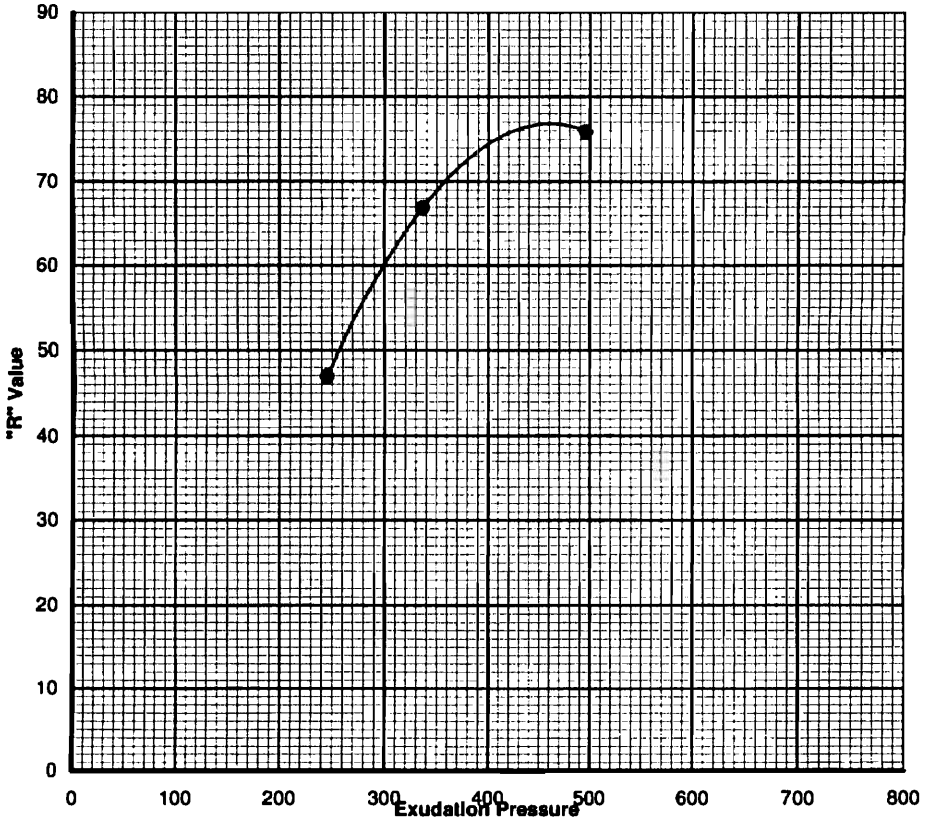
"R" VALUE CA 301

Client: **Job No.:** B 4962-1 **Date:** 6/16/2011

Client Reference No.: **Soil Type:** Gray, F.M. Silty Sand & Silty Clay w. Gravel

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	60	220	300	
Initial Moisture Content	%	6.9	6.9	6.9	
Moisture at Compaction	%	10.5	9.6	8.7	
Briquette Height	in.	2.50	2.49	2.48	
Dry Density	pcf	122.4	125.0	126.8	
EXUDATION PRESSURE	psi	246	337	496	
EXPANSION dial	(x .0001)	0	14	21	
Ph at 1000 pounds	psi	35	26	17	
Ph at 2000 pounds	psi	70	42	30	
Displacement	turns	3.68	3.5	3.48	
"R" Value		47	67	76	
CORRECTED "R" VALUE		47	67	76	

Final "R" Value	
BY EXUDATION: @ 300 psi	**60**
BY EXPANSION: TI = 5.0	**60**



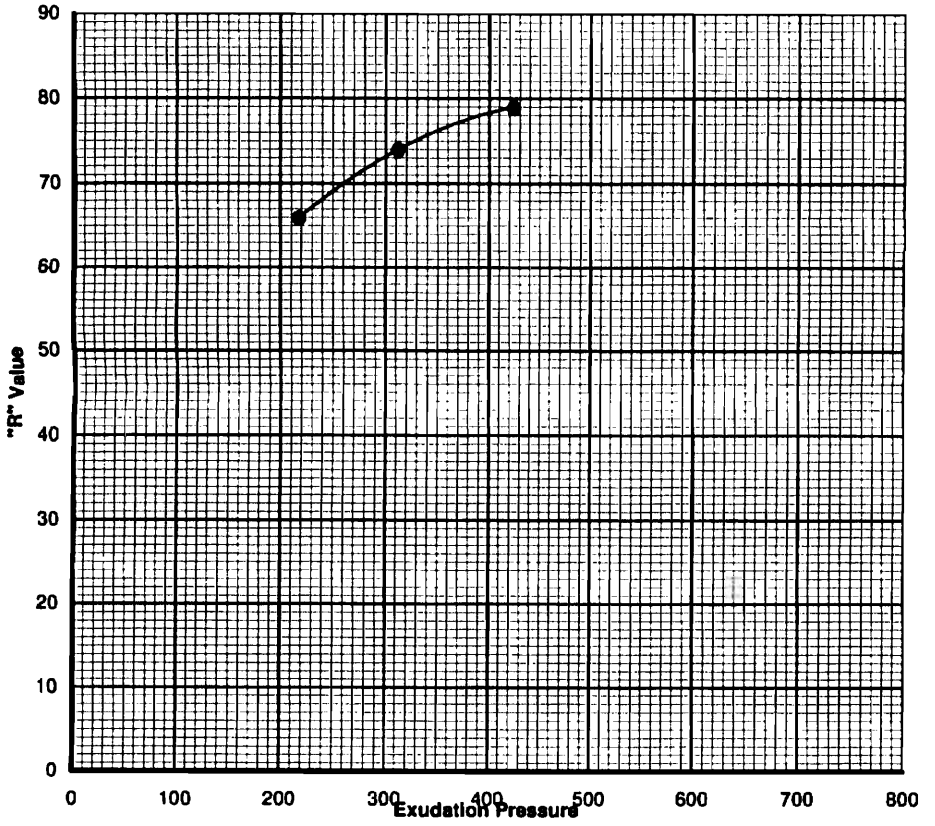
"R" VALUE CA 301

Client: **Job No.:** B 4962-2 **Date:** 6/16/2011

Client Reference No.: **Soil Type:** Brown Gray, F.M Silty Sand & Clay Mixture w. Gravel & Asphalt

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	240	350	300	
Initial Moisture Content	%	4.4	4.4	4.4	
Moisture at Compaction	%	9.2	8.3	8.7	
Briquette Height	in.	2.44	2.43	2.46	
Dry Density	pcf	126.5	127.7	127.3	
EXUDATION PRESSURE	psi	218	424	312	
EXPANSION dial	(x .0001)	3	32	18	
Ph at 1000 pounds	psi	23	13	18	
Ph at 2000 pounds	psi	41	25	32	
Displacement	turns	3.67	3.63	3.6	
"R" Value		66	79	74	
CORRECTED "R" VALUE		66	79	74	

Final "R" Value	
BY EXUDATION: @ 300 psi	73
BY EXPANSION: TI = 5.0	67



Appendix D

Seismic Data

Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 34.1268
Longitude = -118.1494
Spectral Response Accelerations Ss and S1
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.0 ,Fv = 1.0
Data are based on a 0.009999999776482582 deg grid spacing

Period (sec)	Sa (g)
0.2	2.550 (Ss, Site Class B)
1.0	0.850 (S1, Site Class B)

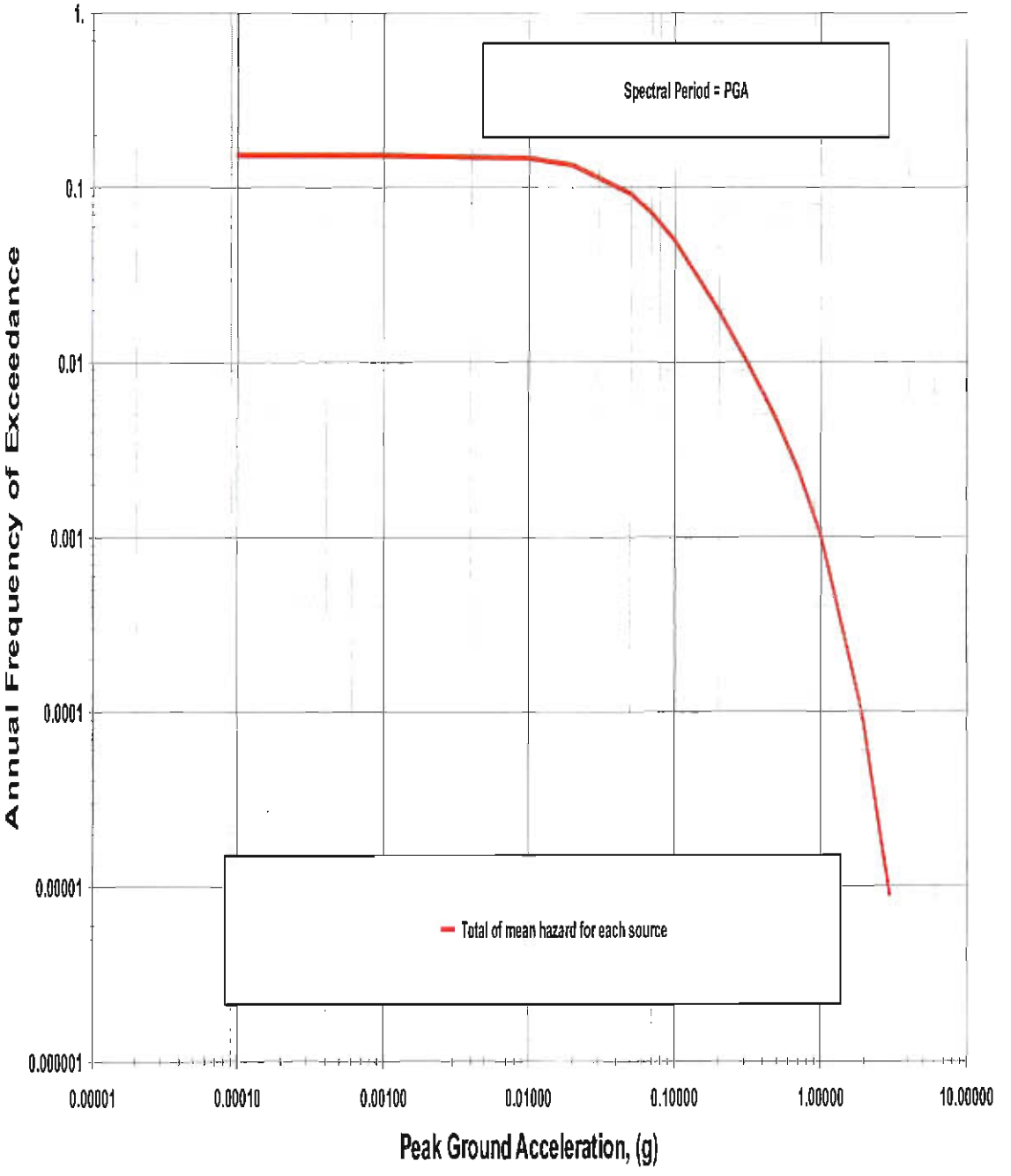
Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 34.1268
Longitude = -118.1494
Spectral Response Accelerations SMs and SM1
SMs = Fa x Ss and SM1 = Fv x S1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)
0.2	2.550 (SMs, Site Class D)
1.0	1.276 (SM1, Site Class D)

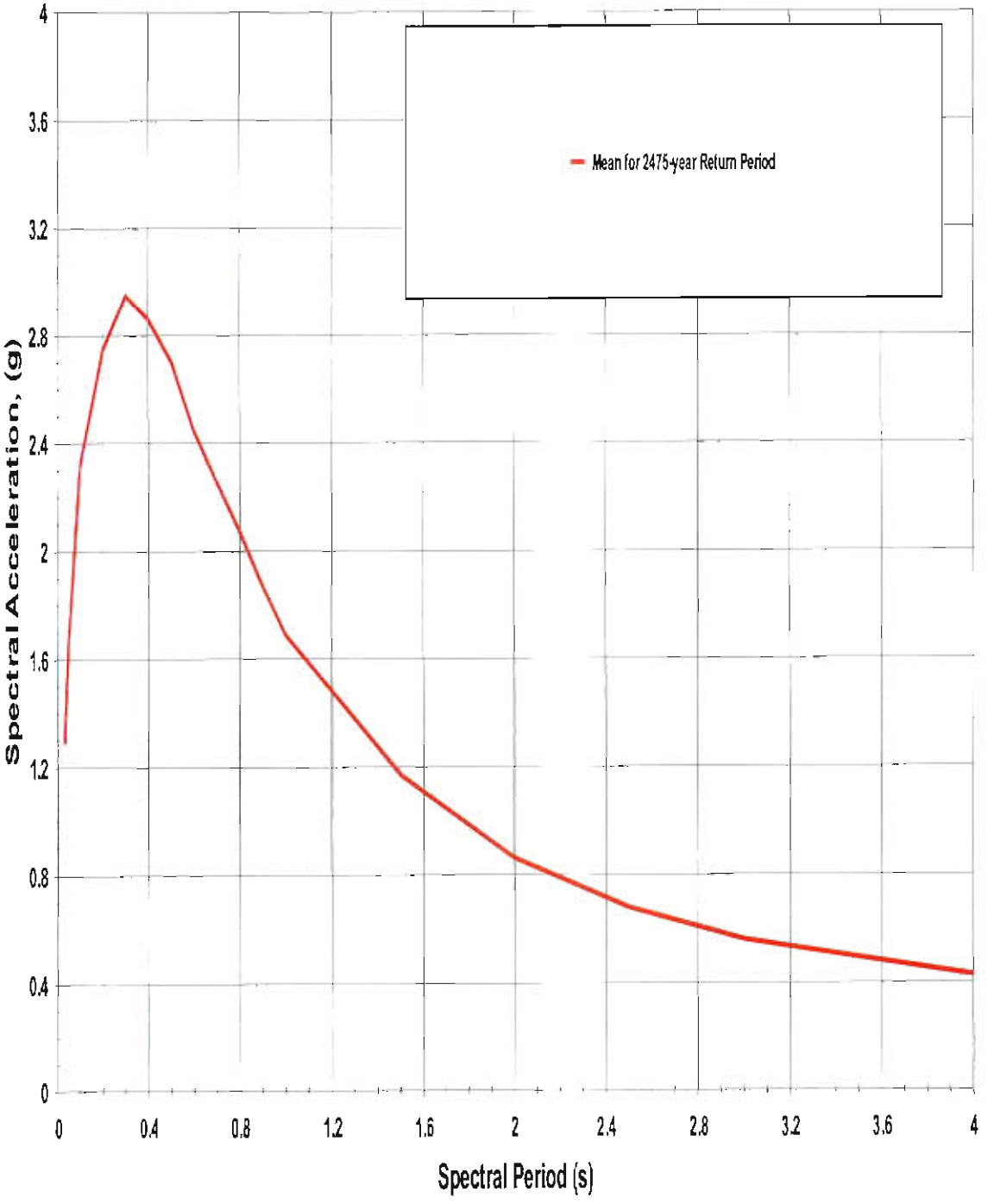
Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 34.1268
Longitude = -118.1494
Design Spectral Response Accelerations SDs and SD1
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)
0.2	1.700 (SDs, Site Class D)
1.0	0.850 (SD1, Site Class D)

Total Hazard
Spectral Response @ 5% Damping - Average Horizontal Component



Uniform Hazard Spectra
Spectral Response @ 5% Damping - Average Horizontal Component

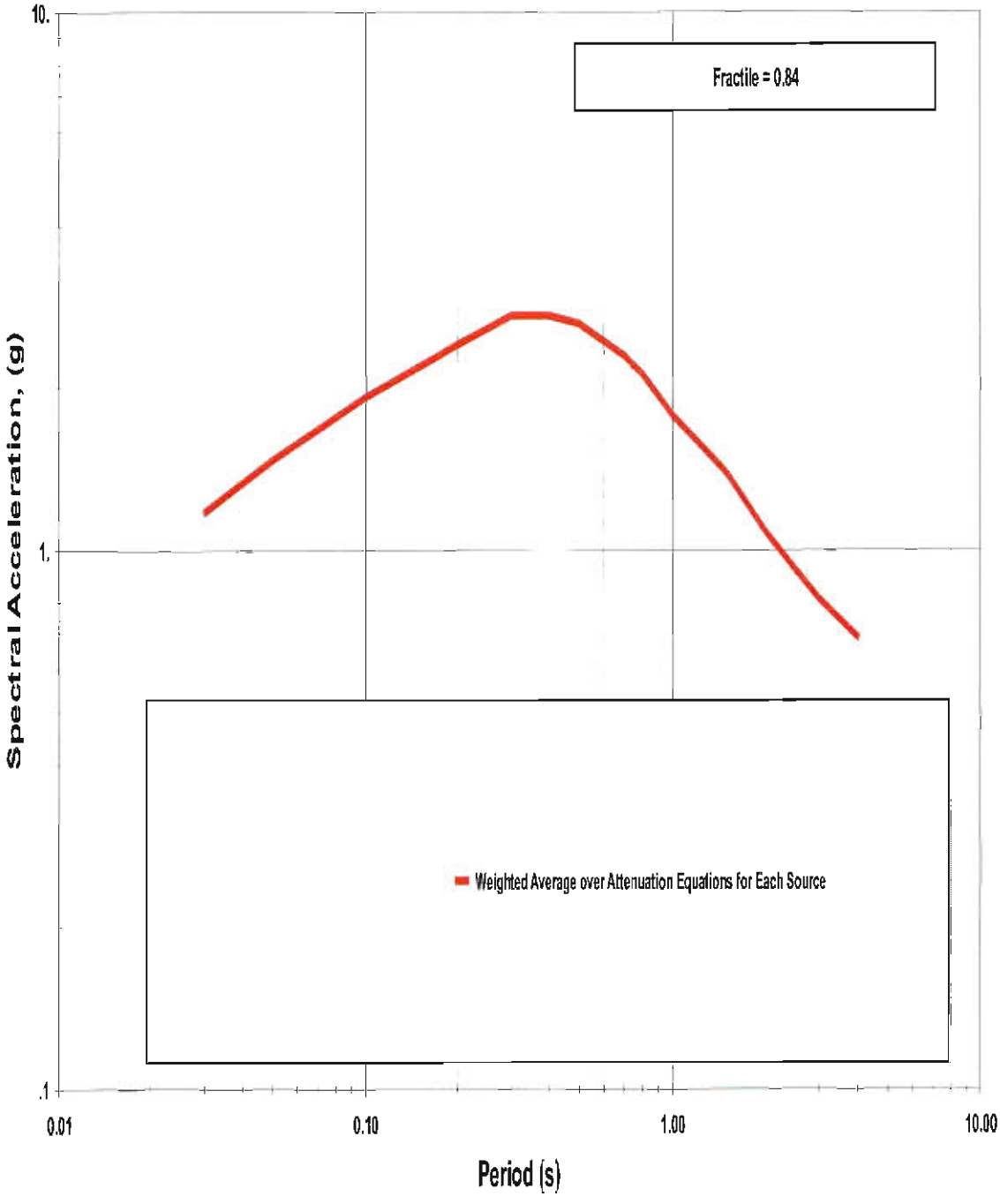


Probabilistic Spectra results for EZ-FRISK 7.60 Build 001

ANNUAL FREQUENCY OF EXCEEDANCE: 4.041e-004
RETURN PERIOD: 2474.9
PROBABILITY OF EXCEEDENCE: 2.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Boore-Atkinson (2008) NGA USGS 2008
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2008) NGA USGS 2008
Column 5: Acceleration (g) for: Chiou-Youngs (2007) NGA USGS 2008

1	2	3	4	5
PGA	1.298e+000	1.309e+000	1.105e+000	1.455e+000
0.05	1.696e+000	1.816e+000	1.317e+000	1.928e+000
0.1	2.316e+000	2.559e+000	1.789e+000	2.500e+000
0.2	2.744e+000	2.944e+000	2.285e+000	2.993e+000
0.3	2.948e+000	* 3.188e+000	2.620e+000	* 3.045e+000
0.4	2.858e+000	* 3.043e+000	2.757e+000	2.778e+000
0.5	2.701e+000	2.798e+000	2.779e+000	2.525e+000
0.6	2.443e+000	2.495e+000	2.528e+000	2.303e+000
0.7	2.255e+000	2.278e+000	2.347e+000	2.139e+000
0.8	2.075e+000	2.063e+000	2.157e+000	2.003e+000
0.9	1.869e+000	1.817e+000	1.958e+000	1.833e+000
1	1.687e+000	1.617e+000	1.759e+000	1.687e+000
1.5	1.173e+000	1.120e+000	1.199e+000	1.198e+000
2	8.622e-001	8.185e-001	8.637e-001	9.065e-001
2.5	6.797e-001	6.310e-001	6.656e-001	7.401e-001
3	5.619e-001	5.183e-001	5.430e-001	6.297e-001
4	4.299e-001	3.723e-001	4.200e-001	5.004e-001

Deterministic Spectra
Spectral Response @ 5% Damping - Average Horizontal Component



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**********************
*                    *
*    E Q F A U L T   *
*                    *
*    Version 3.00    *
*                    *
**********************
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 3626-00

DATE: 01-12-2010

JOB NAME: Pasadena Power Plant

CALCULATION NAME: Power Plant Analysis

FAULT-DATA-FILE NAME: CDMGFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 34.1285
SITE LONGITUDE: 118.1485

SEARCH RADIUS: 100 mi

ATTENUATION RELATION: 14) Campbell & Bozorgnia (1997 Rev.) - Alluvium
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: cdist
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CDMGFLTE.DAT

MINIMUM DEPTH VALUE (km): 3.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT MAXIMUM EARTHQUAKE MAG. (Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
RAYMOND	1.9(3.0)	6.5	0.691	XI
VERDUGO	2.7(4.3)	6.9	0.642	X
UPPER ELYSIAN PARK BLIND THRUST	4.7(7.6)	6.4	0.473	X
HOLLYWOOD	5.1(8.2)	6.4	0.450	X
PUENTE HILLS BLIND THRUST	6.6(10.7)	7.1	0.464	X
SIERRA MADRE	7.3(11.7)	7.2	0.452	X
CLAMSHELL-SAWPIT	9.2(14.8)	6.5	0.283	IX
WHITTIER	12.2(19.7)	6.8	0.215	VIII
SIERRA MADRE (San Fernando)	14.9(23.9)	6.7	0.187	VIII
NEWPORT-INGLEWOOD (L.A.Basin)	15.0(24.2)	7.1	0.216	VIII
SAN GABRIEL	15.2(24.5)	7.2	0.228	IX
SAN JOSE	16.2(26.1)	6.4	0.136	VIII
SANTA MONICA	16.3(26.3)	6.6	0.155	VIII
NORTHRIDGE (E. Oak Ridge)	18.3(29.5)	7.0	0.177	VIII
MALIBU COAST	22.9(36.9)	6.7	0.108	VII
CUCAMONGA	23.1(37.1)	6.9	0.124	VII
CHINO-CENTRAL AVE. (Elsinore)	23.1(37.2)	6.7	0.107	VII
SANTA SUSANA	24.7(39.8)	6.7	0.097	VII
PALOS VERDES	24.9(40.1)	7.3	0.146	VIII
SAN ANDREAS - Cho-Moj M-1b-1	27.2(43.8)	7.8	0.193	VIII
SAN ANDREAS - Whole M-1a	27.2(43.8)	8.0	0.222	IX
SAN ANDREAS - Mojave M-1c-3	27.2(43.8)	7.4	0.143	VIII
SAN ANDREAS - 1857 Rupture M-2a	27.2(43.8)	7.8	0.193	VIII
HOLSER	30.1(48.4)	6.5	0.064	VI
ANACAPA-DUME	33.0(53.1)	7.5	0.119	VII
SIMI-SANTA ROSA	33.6(54.0)	7.0	0.081	VII
SAN JOAQUIN HILLS	33.7(54.3)	6.6	0.059	VI
ELSINORE (GLEN IVY)	34.9(56.2)	6.8	0.064	VI
OAK RIDGE (Onshore)	37.2(59.9)	7.0	0.070	VI
SAN JACINTO-SAN BERNARDINO	37.5(60.4)	6.7	0.054	VI
SAN ANDREAS - San Bernardino M-1	38.8(62.5)	7.5	0.102	VII
SAN ANDREAS - SB-Coach. M-1b-2	38.8(62.5)	7.7	0.120	VII
SAN ANDREAS - SB-Coach. M-2b	38.8(62.5)	7.7	0.120	VII
NEWPORT-INGLEWOOD (Offshore)	39.5(63.6)	7.1	0.071	VI
CLEGHORN	41.1(66.2)	6.5	0.040	V
SAN CAYETANO	42.0(67.6)	7.0	0.059	VI
SAN ANDREAS - Carrizo M-1c-2	44.5(71.6)	7.4	0.079	VII
NORTH FRONTAL FAULT ZONE (West)	52.8(84.9)	7.2	0.051	VI
SAN JACINTO-SAN JACINTO VALLEY	52.9(85.2)	6.9	0.041	V
SANTA YNEZ (East)	53.1(85.5)	7.1	0.049	VI

DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG. (Mw)	ESTIMATED MAX. EARTHQUAKE EVENT: PEAK SITE ACCEL. g	ESTIMATED MAX. EARTHQUAKE EVENT: EST. SITE INTENSITY MOD.MERC.
ELSINORE (TEMECULA)	56.8(91.4)	6.8	0.034	V
VENTURA - PITAS POINT	59.0(95.0)	6.9	0.034	V
CORONADO BANK	60.8(97.8)	7.6	0.064	VI
GARLOCK (West)	62.6(100.7)	7.3	0.047	VI
OAK RIDGE(Blind Thrust Offshore)	62.6(100.7)	7.1	0.037	V
M.RIDGE-ARROYO PARIDA-SANTA ANA	63.7(102.5)	7.2	0.039	V
CHANNEL IS. THRUST (Eastern)	64.1(103.2)	7.5	0.049	VI
PLEITO THRUST	64.4(103.7)	7.0	0.033	V
OAK RIDGE MID-CHANNEL STRUCTURE	65.1(104.8)	6.6	0.023	IV
HELENDALE - S. LOCKHARDT	65.4(105.2)	7.3	0.044	VI
RED MOUNTAIN	68.5(110.2)	7.0	0.030	V
BIG PINE	68.6(110.4)	6.9	0.029	V
LENWOOD-LOCKHART-OLD WOMAN SPRGS	75.1(120.9)	7.5	0.044	VI
SAN JACINTO-ANZA	75.4(121.3)	7.2	0.034	V
WHITE WOLF	76.0(122.3)	7.3	0.033	V
NORTH FRONTAL FAULT ZONE (East)	77.2(124.3)	6.7	0.020	IV
SANTA CRUZ ISLAND	78.8(126.8)	7.0	0.024	V
GARLOCK (East)	80.2(129.0)	7.5	0.041	V
ROSE CANYON	81.0(130.3)	7.2	0.031	V
PINTO MOUNTAIN	81.8(131.7)	7.2	0.030	V
ELSINORE (JULIAN)	83.1(133.8)	7.1	0.027	V
GRAVEL HILLS - HARPER LAKE	85.1(137.0)	7.1	0.026	V
LANDERS	87.0(140.0)	7.3	0.031	V
JOHNSON VALLEY (Northern)	88.0(141.6)	6.7	0.018	IV
SANTA YNEZ (West)	88.4(142.2)	7.1	0.025	V
NORTH CHANNEL SLOPE	88.7(142.8)	7.4	0.028	V
BLACKWATER	89.5(144.1)	7.1	0.025	V
CALICO - HIDALGO	92.2(148.4)	7.3	0.028	V
EMERSON So. - COPPER MTN.	96.1(154.7)	7.0	0.021	IV
So. SIERRA NEVADA	96.5(155.3)	7.3	0.023	IV
SAN ANDREAS - Coachella M-1c-S	97.1(156.2)	7.2	0.024	V
BURNT MTN.	99.4(159.9)	6.5	0.013	III

-END OF SEARCH- 72 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE RAYMOND FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 1.9 MILES (3.0 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.6907 g

PPP.OUT

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**************************
*                        *
*    E Q S E A R C H     *
*                        *
*     Version 3.00       *
*                        *
**************************
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ESTIMATION OF
PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS

JOB NUMBER: 3626-00

DATE: 01-12-2010

JOB NAME: Pasadena Power Plant

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT

MAGNITUDE RANGE:
MINIMUM MAGNITUDE: 5.00
MAXIMUM MAGNITUDE: 9.00

SITE COORDINATES:
SITE LATITUDE: 34.1285
SITE LONGITUDE: 118.1485

SEARCH DATES:
START DATE: 1800
END DATE: 2000

SEARCH RADIUS:
100.0 mi
160.9 km

ATTENUATION RELATION: 14) Campbell & Bozorgnia (1997 Rev.) - Alluvium
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
ASSUMED SOURCE TYPE: DS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
SCOND: 0 Depth Source: A
Basement Depth: 5.00 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km): 3.0

PPP.OUT

EARTHQUAKE SEARCH RESULTS

Page 1

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
MGI	34.1000	118.1000	07/11/1855	415 0.0	0.0	6.30	0.519	X	3.4(5.5)
PAS	34.0730	118.0980	10/04/1987	105938.2	8.2	5.30	0.211	VIII	4.8(7.7)
PAS	34.0610	118.0790	10/01/1987	144220.0	9.5	5.90	0.287	IX	6.1(9.8)
MGI	34.0800	118.2600	07/16/1920	18 8 0.0	0.0	5.00	0.115	VII	7.2(11.6)
T-A	34.0000	118.2500	09/23/1827	0 0 0.0	0.0	5.00	0.076	VII	10.6(17.1)
T-A	34.0000	118.2500	01/10/1856	0 0 0.0	0.0	5.00	0.076	VII	10.6(17.1)
T-A	34.0000	118.2500	03/26/1860	0 0 0.0	0.0	5.00	0.076	VII	10.6(17.1)
MGI	34.0000	118.0000	12/25/1903	1745 0.0	0.0	5.00	0.064	VI	12.3(19.8)
MGI	34.0000	118.3000	09/03/1905	540 0.0	0.0	5.30	0.081	VII	12.4(19.9)
GSP	34.2620	118.0020	06/28/1991	144354.5	11.0	5.40	0.087	VII	12.4(20.0)
DMG	34.2000	117.9000	08/28/1889	215 0.0	0.0	5.50	0.074	VII	15.0(24.2)
GSP	34.2310	118.4750	03/20/1994	212012.3	13.0	5.30	0.043	VI	19.9(32.1)
DMG	33.8500	118.2670	03/11/1933	1425 0.0	0.0	5.00	0.033	V	20.4(32.8)
DMG	34.3080	118.4540	02/09/1971	144346.7	6.2	5.20	0.036	V	21.4(34.4)
MGI	34.0000	118.5000	11/19/1918	2018 0.0	0.0	5.00	0.030	V	22.0(35.4)
DMG	34.0000	118.5000	08/04/1927	1224 0.0	0.0	5.00	0.030	V	22.0(35.4)
GSP	34.2130	118.5370	01/17/1994	123055.4	18.0	6.70	0.107	VII	22.9(36.9)
DMG	33.7830	118.1330	10/02/1933	91017.6	0.0	5.40	0.037	V	23.9(38.4)
DMG	34.4110	118.4010	02/09/1971	14 041.8	8.4	6.40	0.080	VII	24.2(39.0)
DMG	34.4110	118.4010	02/09/1971	141028.0	8.0	5.30	0.033	V	24.2(39.0)
DMG	34.4110	118.4010	02/09/1971	14 1 8.0	8.0	5.80	0.050	VI	24.2(39.0)
DMG	34.4110	118.4010	02/09/1971	14 244.0	8.0	5.80	0.050	VI	24.2(39.0)
DMG	33.7830	118.2500	11/14/1941	84136.3	0.0	5.40	0.035	V	24.5(39.5)
GSP	34.1400	117.7000	02/28/1990	234336.6	5.0	5.20	0.028	V	25.6(41.3)
DMG	33.7500	118.0830	03/13/1933	131828.0	0.0	5.30	0.029	V	26.4(42.5)
DMG	33.7500	118.0830	03/11/1933	323 0.0	0.0	5.00	0.023	IV	26.4(42.5)
DMG	33.7500	118.0830	03/11/1933	230 0.0	0.0	5.10	0.025	V	26.4(42.5)
DMG	33.7500	118.0830	03/11/1933	2 9 0.0	0.0	5.00	0.023	IV	26.4(42.5)
DMG	33.7500	118.0830	03/11/1933	910 0.0	0.0	5.10	0.025	V	26.4(42.5)
GSB	34.3010	118.5650	01/17/1994	204602.4	9.0	5.20	0.027	V	26.6(42.8)
DMG	34.5190	118.1980	08/23/1952	10 9 7.1	13.1	5.00	0.022	IV	27.1(43.6)
GSP	34.3050	118.5790	01/29/1994	112036.0	1.0	5.10	0.024	IV	27.4(44.1)
DMG	34.3000	118.6000	04/04/1893	1940 0.0	0.0	6.00	0.047	VI	28.4(45.6)
DMG	33.7000	118.0670	03/11/1933	85457.0	0.0	5.10	0.021	IV	29.9(48.2)
DMG	33.7000	118.0670	03/11/1933	51022.0	0.0	5.10	0.021	IV	29.9(48.2)
DMG	33.9500	118.6320	08/31/1930	04036.0	0.0	5.20	0.022	IV	30.3(48.7)
PAS	33.9190	118.6270	01/19/1989	65328.8	11.9	5.00	0.018	IV	31.0(49.8)
DMG	33.6830	118.0500	03/11/1933	658 3.0	0.0	5.50	0.027	V	31.3(50.3)
GSP	34.3780	118.6180	01/19/1994	211144.9	11.0	5.10	0.019	IV	31.8(51.3)
DMG	34.3700	117.6500	12/08/1812	15 0 0.0	0.0	7.00	0.083	VII	33.0(53.1)
PAS	33.9440	118.6810	01/01/1979	231438.9	11.3	5.00	0.017	IV	33.0(53.1)
DMG	34.3000	117.6000	07/30/1894	512 0.0	0.0	6.00	0.037	V	33.5(53.9)
GSP	34.3690	118.6720	04/26/1997	103730.7	16.0	5.10	0.017	IV	34.2(55.0)

GSP	34.3260	118.6980	01/17/1994	233330.7	9.0	5.60	0.026	V	34.2(55.0)
GSP	34.3940	118.6690	06/26/1995	084028.9	13.0	5.00	0.016	IV	34.9(56.2)
GSP	34.3770	118.6980	01/18/1994	004308.9	11.0	5.20	0.018	IV	35.7(57.5)
DMG	34.2700	117.5400	09/12/1970	143053.0	8.0	5.40	0.021	IV	36.1(58.1)
DMG	33.6170	118.0170	03/14/1933	19 150.0	0.0	5.10	0.016	IV	36.1(58.1)
GSB	34.3790	118.7110	01/19/1994	210928.6	14.0	5.50	0.022	IV	36.5(58.7)
DMG	33.6170	117.9670	03/11/1933	154 7.8	0.0	6.30	0.041	V	36.8(59.2)
MGI	34.0000	117.5000	12/16/1858	10 0 0.0	0.0	7.00	0.068	VI	38.1(61.4)
MGI	33.8000	117.6000	04/22/1918	2115 0.0	0.0	5.00	0.013	III	38.7(62.3)
DMG	34.3000	117.5000	07/22/1899	2032 0.0	0.0	6.50	0.045	VI	38.9(62.6)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.5750	117.9830	03/11/1933	518 4.0	0.0	5.20	0.015	IV	39.4(63.4)
DMG	34.2000	117.4000	07/22/1899	046 0.0	0.0	5.50	0.017	IV	43.0(69.3)
DMG	33.6990	117.5110	05/31/1938	83455.4	10.0	5.50	0.015	IV	47.0(75.7)
MGI	34.1000	117.3000	07/15/1905	2041 0.0	0.0	5.30	0.012	III	48.5(78.1)
DMG	34.0000	119.0000	09/24/1827	4 0 0.0	0.0	7.00	0.047	VI	49.5(79.7)
MGI	34.0000	119.0000	12/14/1912	0 0 0.0	0.0	5.70	0.017	IV	49.5(79.7)
DMG	34.0650	119.0350	02/21/1973	144557.3	8.0	5.90	0.019	IV	50.9(81.9)
DMG	33.7000	117.4000	05/13/1910	620 0.0	0.0	5.00	0.009	III	52.1(83.8)
DMG	33.7000	117.4000	05/15/1910	1547 0.0	0.0	6.00	0.020	IV	52.1(83.8)
DMG	33.7000	117.4000	04/11/1910	757 0.0	0.0	5.00	0.009	III	52.1(83.8)
DMG	34.0000	117.2500	07/23/1923	73026.0	0.0	6.25	0.024	V	52.1(83.9)
DMG	33.9000	117.2000	12/19/1880	0 0 0.0	0.0	6.00	0.018	IV	56.5(91.0)
T-A	34.8300	118.7500	11/27/1852	0 0 0.0	0.0	7.00	0.037	V	59.3(95.4)
DMG	34.2000	117.1000	09/20/1907	154 0.0	0.0	6.00	0.016	IV	60.1(96.7)
DMG	34.7000	119.0000	10/23/1916	254 0.0	0.0	5.50	0.010	III	62.5(100.6)
PAS	33.6710	119.1110	09/04/1981	155050.3	5.0	5.30	0.008	III	63.6(102.3)
PAS	34.9430	118.7430	06/10/1988	23 643.0	6.8	5.40	0.009	III	65.6(105.6)
DMG	34.8670	118.9330	09/21/1941	1953 7.2	0.0	5.20	0.007	II	67.8(109.1)
DMG	34.2670	116.9670	08/29/1943	34513.0	0.0	5.50	0.009	III	68.1(109.7)
DMG	34.9000	118.9000	10/23/1916	244 0.0	0.0	6.00	0.013	III	68.3(109.9)
DMG	33.8000	117.0000	12/25/1899	1225 0.0	0.0	6.40	0.018	IV	69.6(112.0)
DMG	34.9500	118.8670	07/21/1952	121936.0	0.0	5.30	0.007	II	69.9(112.5)
T-A	34.9200	118.9200	01/20/1857	0 0 0.0	0.0	5.00	0.006	II	70.1(112.8)
T-A	34.9200	118.9200	05/23/1857	0 0 0.0	0.0	5.00	0.006	II	70.1(112.8)
DMG	34.9000	118.9500	08/01/1952	13 430.0	0.0	5.10	0.006	II	70.1(112.8)
DMG	34.1800	116.9200	01/16/1930	02433.9	0.0	5.20	0.007	II	70.3(113.1)
DMG	34.1800	116.9200	01/16/1930	034 3.6	0.0	5.10	0.006	II	70.3(113.1)
DMG	33.7500	117.0000	06/06/1918	2232 0.0	0.0	5.00	0.006	II	70.8(113.9)
DMG	33.7500	117.0000	04/21/1918	223225.0	0.0	6.80	0.024	V	70.8(113.9)
DMG	34.8000	119.1000	09/05/1883	1230 0.0	0.0	6.00	0.013	III	71.3(114.7)
DMG	34.1000	119.4000	05/19/1893	035 0.0	0.0	5.50	0.008	III	71.6(115.2)
DMG	35.0000	118.8330	07/23/1952	75319.0	0.0	5.40	0.008	II	71.7(115.3)
DMG	35.0000	118.8330	07/23/1952	181351.0	0.0	5.20	0.007	II	71.7(115.3)
GSP	34.3400	116.9000	11/27/1992	160057.5	1.0	5.30	0.007	II	72.7(117.1)
DMG	34.9320	118.9760	03/01/1963	02557.9	13.9	5.00	0.005	II	72.8(117.1)
GSP	34.3690	116.8970	12/04/1992	020857.5	3.0	5.30	0.007	II	73.3(118.0)
DMG	34.9410	118.9870	11/15/1961	53855.5	10.7	5.00	0.005	II	73.6(118.5)
GSP	34.1950	116.8620	08/17/1992	204152.1	11.0	5.30	0.007	II	73.6(118.5)
GSP	34.1630	116.8550	06/28/1992	144321.0	6.0	5.30	0.007	II	73.9(119.0)

GSP	35.2100	118.0660	07/11/1992	181416.2	10.0	5.70	0.009	III	74.8(120.4)
GSP	34.2390	116.8370	07/09/1992	014357.6	0.0	5.30	0.007	II	75.3(121.2)
DMG	33.9500	116.8500	09/28/1946	719 9.0	0.0	5.00	0.005	II	75.3(121.2)
GSN	34.2030	116.8270	06/28/1992	150530.7	5.0	6.70	0.020	IV	75.7(121.8)
DMG	35.1500	118.6330	01/27/1954	141948.0	0.0	5.00	0.005	II	75.7(121.8)
DMG	34.9830	118.9830	05/23/1954	235243.0	0.0	5.10	0.006	II	75.7(121.8)
DMG	33.7100	116.9250	09/23/1963	144152.6	16.5	5.00	0.005	II	75.8(122.0)
DMG	33.9860	119.4750	08/06/1973	232917.0	16.9	5.00	0.005	II	76.5(123.1)
DMG	34.1000	116.8000	10/24/1935	1448 7.6	0.0	5.10	0.005	II	77.1(124.1)
DMG	35.0000	119.0000	02/16/1919	1557 0.0	0.0	5.00	0.005	II	77.2(124.3)
DMG	35.0000	119.0000	07/21/1952	12 531.0	0.0	6.40	0.016	IV	77.2(124.3)
DMG	35.1330	118.7670	07/21/1952	194122.0	0.0	5.50	0.007	II	77.7(125.1)
DMG	34.0000	119.5000	02/18/1926	1818 0.0	0.0	5.00	0.005	II	77.8(125.2)
DMG	35.0000	119.0170	01/12/1954	233349.0	0.0	5.90	0.010	III	77.8(125.3)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.0000	119.0170	07/21/1952	115214.0	0.0	7.70	0.043	VI	77.8(125.3)
DMG	35.1830	118.6500	07/21/1952	151358.0	0.0	5.10	0.005	II	78.2(125.8)
DMG	35.0000	119.0330	07/21/1952	12 2 0.0	0.0	5.60	0.008	III	78.4(126.2)
DMG	35.2330	118.5330	07/21/1952	174244.0	0.0	5.10	0.005	II	79.3(127.6)
DMG	34.5000	119.5000	08/05/1930	1125 0.0	0.0	5.00	0.005	II	81.2(130.7)
DMG	34.5000	119.5000	06/29/1926	2321 0.0	0.0	5.50	0.007	II	81.2(130.7)
PAS	32.9710	117.8700	07/13/1986	1347 8.2	6.0	5.30	0.006	II	81.5(131.2)
DMG	33.9760	116.7210	06/12/1944	104534.7	10.0	5.10	0.005	II	82.3(132.5)
DMG	33.9940	116.7120	06/12/1944	111636.0	10.0	5.30	0.006	II	82.7(133.1)
DMG	34.1000	116.7000	02/07/1889	520 0.0	0.0	5.30	0.006	II	82.8(133.3)
DMG	33.2910	119.1930	10/24/1969	82912.1	10.0	5.10	0.005	II	83.3(134.1)
DMG	34.3670	119.5830	07/01/1941	75054.8	0.0	5.90	0.009	III	83.5(134.4)
DMG	35.3110	118.4990	07/25/1952	1313 8.2	2.8	5.00	0.004	I	84.0(135.2)
DMG	35.2170	118.8170	07/23/1952	1317 5.0	0.0	5.70	0.008	II	84.2(135.5)
DMG	35.3170	118.4940	07/25/1952	19 944.6	5.5	5.70	0.008	II	84.4(135.8)
DMG	35.3150	118.5160	07/25/1952	194323.7	11.2	5.70	0.008	II	84.5(136.0)
DMG	35.3330	118.6000	07/31/1952	12 9 9.0	0.0	5.80	0.008	III	87.0(140.0)
PAS	33.9980	116.6060	07/08/1986	92044.5	11.7	5.60	0.007	II	88.7(142.7)
DMG	34.1180	119.7020	07/05/1968	04517.2	5.9	5.20	0.005	II	88.8(142.9)
DMG	35.3000	118.8000	12/23/1905	2223 0.0	0.0	5.00	0.004	I	88.9(143.1)
GSP	35.1490	119.1040	05/28/1993	044740.6	21.0	5.20	0.005	II	88.9(143.1)
DMG	35.3670	118.5830	07/23/1952	31923.0	0.0	5.00	0.004	I	89.0(143.2)
DMG	35.3670	118.5830	07/23/1952	03832.0	0.0	6.10	0.010	III	89.0(143.2)
PAS	34.3470	119.6960	08/13/1978	225453.4	12.8	5.10	0.004	I	89.6(144.2)
T-A	34.5000	119.6700	06/01/1893	12 0 0.0	0.0	5.00	0.004	I	90.5(145.6)
MGI	34.4000	119.7000	03/25/1806	8 0 0.0	0.0	5.00	0.004	I	90.5(145.6)
DMG	32.8170	118.3500	12/26/1951	04654.0	0.0	5.90	0.008	III	91.3(146.9)
DMG	33.0000	117.3000	11/22/1800	2130 0.0	0.0	6.50	0.013	III	91.9(148.0)
GSP	34.3410	116.5290	06/28/1992	124053.5	6.0	5.20	0.004	I	93.6(150.6)
DMG	35.3330	118.9170	08/22/1952	224124.0	0.0	5.80	0.007	II	93.9(151.1)
DMG	34.2000	119.8000	12/21/1812	19 0 0.0	0.0	7.00	0.019	IV	94.5(152.0)
DMG	34.0170	116.5000	07/24/1947	221046.0	0.0	5.50	0.006	II	94.6(152.2)
DMG	34.0170	116.5000	07/25/1947	61949.0	0.0	5.20	0.004	I	94.6(152.2)
DMG	34.0170	116.5000	07/26/1947	24941.0	0.0	5.10	0.004	I	94.6(152.2)
DMG	34.0170	116.5000	07/25/1947	04631.0	0.0	5.00	0.004	I	94.6(152.2)

MGI	34.3000	119.8000	07/03/1925	1821 0.0	0.0	5.30	0.005	II	95.0(152.9)
MGI	34.3000	119.8000	07/03/1925	1638 0.0	0.0	5.30	0.005	II	95.0(152.9)
DMG	34.3000	119.8000	06/29/1925	144216.0	0.0	6.25	0.010	III	95.0(152.9)
DMG	35.3830	118.8500	07/29/1952	7 347.0	0.0	6.10	0.009	III	95.3(153.4)
GSP	34.9700	116.8190	03/18/1997	152447.7	1.0	5.10	0.004	I	95.3(153.4)
DMG	33.2670	119.4500	11/18/1947	2159 3.0	0.0	5.00	0.004	I	95.5(153.7)
DMG	35.4000	118.8170	07/29/1952	8 146.0	0.0	5.10	0.004	I	95.6(153.9)
GSP	34.3320	116.4620	07/01/1992	074029.9	9.0	5.40	0.005	II	97.3(156.6)
T-A	34.4200	119.8200	00/00/1862	0 0 0.0	0.0	5.70	0.006	II	97.5(156.8)
GSN	34.2010	116.4360	06/28/1992	115734.1	1.0	7.60	0.029	V	98.0(157.6)
PAS	34.5160	116.4950	06/01/1975	13849.2	4.5	5.20	0.004	I	98.0(157.7)
GSP	34.1390	116.4310	06/28/1992	123640.6	10.0	5.10	0.004	I	98.2(158.0)
PAS	34.3270	116.4450	03/15/1979	21 716.5	2.5	5.20	0.004	I	98.2(158.0)
DMG	35.5000	118.7000	01/06/1905	1430 0.0	0.0	5.00	0.003	I	99.7(160.5)
GSP	34.1080	116.4040	06/29/1992	141338.8	9.0	5.40	0.005	II	99.7(160.5)

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-END OF SEARCH- 156 EARTHQUAKES FOUND WITHIN THE SPECIFIED SEARCH AREA.

TIME PERIOD OF SEARCH: 1800 TO 2000

LENGTH OF SEARCH TIME: 201 years

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 3.4 MILES (5.5 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.7

LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.519 g

COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
a-value= 1.582
b-value= 0.386
beta-value= 0.888

TABLE OF MAGNITUDES AND EXCEEDANCES:

Earthquake Magnitude	Number of Times Exceeded	Cumulative No. / Year
4.0	156	0.77612
4.5	156	0.77612
5.0	156	0.77612
5.5	57	0.28358
6.0	28	0.13930
6.5	12	0.05970
7.0	7	0.03483
7.5	2	0.00995

Appendix E

Guide Specifications for Drilled Pile Installation

GUIDE SPECIFICATIONS FOR DRILLED PILE INSTALLATION

1. Pile installation shall be performed during continuous observation by Hydrologue, Inc. (HI) to confirm that the recommended undisturbed native materials are penetrated, that depths of installed piles are at least as large as indicated on the foundation plan, and that pile installation has been performed as specified herein. The contractor shall provide access and necessary facilities, including drop lights, at contractor expense to accommodate pile observations.

2. Pile installation shall be performed such that compliance with all safety rules and requirements is achieved, including requirements of the State of California Construction Safety Orders Section 1542 or the latest replacement.

3. Pile lengths indicated on the plans are approximate. Actual lengths of piles to be installed will depend upon the depth to suitable supporting materials.

4. Piles shall be located as indicated on the drawings. Any pile installed, having a center more than 3 inches off of plan center lines will require structural analysis. The cost of such analysis and any work and/or materials resulting from correcting an error in location of piles shall be borne by the contractor.

5. Piles shafts shall be machine-drilled. The pile excavation shall be plumb to a tolerance of not more than 1 inch in 6 feet.

6. Where caving soils are encountered, casing or other methods approved by HI shall be used to support pile excavations. The inside diameter of casing shall be larger than the diameter of the pile as indicated on the foundation plans, so that drilling can be accomplished within the casing. Drilling fluids shall not be used to support the excavation without the specific recommendation of the drilling fluid manufacturer with respect to use in pile installation, and approval by the owner and HI. If drilling fluids are used, concrete must be placed with a pipe or tremie extending to the bottom of the excavation. The concrete level must be maintained above the bottom of the pipe such that drilling fluid does not contaminate placed concrete. If groundwater is encountered, pile excavations shall be dewatered, casing will be required, and concrete shall be tremied from the bottom of the pile hole upward.

7. At the completion of drilling, secure covers shall be placed over open pile excavations. Concrete placement shall begin within 4 hours after completion of drilling. Placed concrete shall have a slump of 6 inches, with a tolerance of ± 1 inch. Concrete shall not be allowed to fall freely more than 6 feet, in accordance with the 1991 Standard Specifications for Public Works Construction (1991 Edition) Section 303-1.8.3. Concrete pumps, tremies or other such devices shall be used to comply with this requirement. Casing may be raised slowly as the pile excavation is filled with concrete, provided that the bottom of the casing is never less than 2 feet **below** the level of the concrete. Concrete placement shall continue until suitable concrete extends to the top of the pile excavation. The tremie or concrete

pump pipe may be raised slowly as the pile excavation is filled with concrete, provided that the bottom of the pipe is never more than 6 feet above the level of the concrete. Concrete placement shall be continuous without interruption, and at such a rate that fresh concrete will not be deposited on concrete hardened sufficiently to form seams or planes of weakness.

8. Piles spaced closer than 5 pile diameters center-to-center shall be drilled and filled with concrete alternately, allowing at least 12 hours after concrete placement in a pile before drilling an adjacent pile.

9. Reinforcement shall be rigidly installed and secured to prevent movement or dislodgement during concrete placement.

10. In the event that pile installation procedures specified above are not adhered to, the owner may require the contractor to core the pile to confirm that a continuous concrete pile has been installed. The cost of such coring will be borne by the contractor.

11. Any piles deemed by the owner to be defective shall be replaced with substitute piles as directed by the owner. Cost of installation of such substitute piles will be borne by the contractor. Costs associated with analysis and design of substitute piles shall also be borne by the contractor.

Appendix F

R-09Z3B3 & R-09Z3B6
Boring Logs from Reference 10

TABLE A-1
Summary of Field Exploration

Soil Boring Number	Study Zone	Ground Surface Elevation[a] (feet)	Exploration Depth (feet)	Piezometer Installed?	Groundwater Table Elevation[b] (feet)
R-09-Z1B2	1	498.9	282	No	NM
R-09-Z1B3	1	343.2	303	Yes	313.3
R-09-Z1B4	1	388.6	325	Yes	353.2
R-09-Z1B5	1	442.2	502	Yes	419.5
R-09-Z1B6	1	447.2	400	Yes	425.7
R-09-Z1B7	1	480.5	300	Yes	440.5
R-09-Z1B8	1	419.6	200	Yes	394.6
R-09-Z2B1	2	451.0	150	Yes	437.1
R-09-Z2B2	2	601.1	282	No	NM
R-09-Z2B3	2	546.9	350	Yes	498.9
R-09-Z2B4	2	558.1	400	Yes	548.1
R-09-Z2B5	2	452.4	300	Yes	441.6
R-09-Z3B1	3	885.1	300	Yes	861.2
R-09-Z3B2	3	781.4	275	Yes	637.0
R-09-Z3B3	3	802.0	275	Yes	666.0
R-09-Z3B4	3	768.0	276	No	NM
R-09-Z3B5	3	698.2	402	Yes	675.7
R-09-Z3B6	3	750.0	326	Yes	698.8
R-09-Z3B7	3	596.7	326	Yes	582.2
R-09-Z3B8	3	594.3	275	Yes	NM[c]
R-09-Z3B9	3	624.3	300	Yes	550.4
R-09-Z3B10	3	626.8	375	Yes	578.3
R-09-Z3B11	3	533.1	275	Yes	375.1
R-09-Z3B12	3	501.0	275	Yes	488.2
R-09-Z4B4	4	454.4	277	Yes	408.1

Notes:
[a]Surveyed by Coast Surveying, Inc., June 2009, datum NAVD 88.
[b]Because some of the piezometers were not developed, groundwater may not be stabilized at the time of reading.
[c]Well cap stuck, could not access piezometer.
NM = Not Measured

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
J. Castle, B. Schell	2-4-09	2-13-09	34° 7' 52.6146" / 118° 9' 17.823" NAD83	R-09-Z3B3
DRILLING CONTRACTOR: Cascade Drilling Inc.			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta Bellefontaine St at St. John Ave	SURFACE ELEVATION: 801.99 ft NAVD 88
DRILLING METHOD: Rotary Wash			DRILL RIG: Speed Star 30K	BOREHOLE DIAMETER: 6 in
SAMPLER TYPE(S) AND SIZE(S) (ID): SPT (1.4"), Cal (2.4"), PQ core (3.2")			SPT HAMMER TYPE: Automatic Hammer 140 lb. 30 inch drop	HAMMER EFFICIENCY, ERI: 70%
BOREHOLE BACKFILL AND COMPLETION: Piezometer Installed on Completion			GROUNDWATER READINGS: DURING DRILLING NM; AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING: 275.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	0		GRASS and LANDSCAPE (Fill).											
	1		SILTY SAND (SM); Loose to dense, yellowish brown, fine to medium grained.											
799.99	2													
	3													
797.99	4													
	5													
795.99	6													
	7													
793.99	8													
	9													
791.99	10		Dense, yellowish brown, moist, fine SAND, micaceous, mottled brown, oxidized.		S1	9 12 15	27	100						
	11													
789.99	12													
	13													
787.99	14													
	15		Poorly graded SAND with GRAVEL (SP); dense, yellowish brown, moist, coarse SAND, micaceous, GRAVEL to 3/4" dia, subangular, granitic source.		D2	28 50/5		100						
785.99	16													
	17													
783.99	18													
	19													
781.99	20				S3	16 29 36	65	100						
	21													
779.99	22													
	23													
777.99	24													
	25													

(continued)

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Department of Transportation
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Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY: K.T		DATE: 6-22-09	SHEET: 1 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	25		Poorly graded SAND with GRAVEL (SP) *(continued)*.		D4	20 50/5		100						
775.99	26		Same as above.											
	27		GRAVEL to 1.5" to 2 1/4" dia.											
773.99	28													
	29													
771.99	30				S5	12 22 33	55	100						
	31													
769.99	32													
	33													
767.99	34													
	35		GRAVEL to 2 1/4" dia.		D6	50/6		100						
765.99	36													
	37													
763.99	38													
	39													
761.99	40		SILTY SAND (SM): very dense, yellowish brown and strong brown, moist, fine to very fine SAND, micaceous, oxidized.		S7	18 24 38	62	100						
	41													
759.99	42													
	43													
757.99	44													
	45		Note: Sampler Jammed with rock that fell into hole		D8	50/6		0						
755.99	46		Assume Silty SAND as above.											
	47													
753.99	48													
	49													
751.99	50		No recovery.		D9	24 50/3		0						
	51													
749.99	52													
	53													
747.99	54													
	55													

(continued)

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REPORT TITLE: BORING RECORD
HOLE ID: R-09-Z3B3
DIST.: 7 | COUNTY: LA | ROUTE: 710 | POSTMILE: D/D | EA: 7-08-169
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY
BRIDGE NUMBER | PREPARED BY: K.T | DATE: 6-22-09 | SHEET: 2 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		SILT (ML); yellowish brown, moist, finely micaceous, non plastic fines.	X	S10	17 50/1		100						
745.99	56		GRAVELLY SILT (ML); medium stiff, 50% fine DIORITE GRAVEL to 1" dia, subrounded to subangular, oxidized.											
	57													
743.99	58													
	59													
741.99	60		SILT (ML); yellowish brown, moist, finely micaceous.		D11	50/0.5		100						
	61		Poorly graded SAND with GRAVEL (SP); very dense, dark yellowish brown, moist, about 10% fine GRAVEL to 1" dia, subangular DIORITE, coarse to fine SAND, uncemented, unbedded.											
738.99	62													
	63													
737.99	64													
	65		SILTY SAND (SM); very dense, mottled colors vary from yellowish brown to brown, predominantly medium SAND with trace coarse SAND and fine gravel, moist.		S12	29 39 50/4		100						
735.99	66													
	67													
733.99	68													
	69													
731.99	70		SILTY CLAY (CL-ML); hard, varies from brown to dark yellowish brown, moist, medium plastic; 0.2" to 0.4" thick beds, horizontal bedding, oxidized, trace of organic material.		D13	19 50/5		100						
	71													
729.99	72		SILTY SAND (SM); dense, mottled brown to yellowish brown, moist, predominantly fine grained with trace of coarse SAND and fine GRAVEL, 20% silt, dendritic manganese.											
	73													
727.99	74													
	75				S14	50/6		100						
725.99	76													
	77													
723.99	78													
	79													
721.99	80		SILTY SAND with GRAVEL (SM); very stiff, varies from dark brown to dark yellowish brown, mottled; increase in fine GRAVEL towards bottom, light brown, subrounded to subangular DIORITE, 0.5" dia, unbedded, one 0.08"-thick vein.		D15	9 18 27	45	100						2-10% GRAVEL
	81													
719.99	82													
	83													
717.99	84													
	85													

(continued)

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REPORT TITLE: BORING RECORD				HOLE ID: R-09-Z3B3
DIST.: 7	COUNTY: LA	ROUTE: 710	POSTMILE: D/D	EA: 7-08-169
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY: K.T		DATE: 6-22-09	SHEET: 3 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	85		Well-graded SAND with GRAVEL (SW); very dense, yellowish brown, moist, about 30% fine GRAVEL, subangular to subrounded DIORITE rocks up to 1.5" dia.		S16	50/6		100						See note at end of log regarding RQD.
715.99	86													
	87													
713.99	88													
	89													
711.99	90				D17	32 39 41	80	100				PP = 2.75		
	91		SILTY SAND (SM); very dense, varies from brown to yellowish brown, moist, about 50% SILT at top, grading down to 30% SILT with fine SAND, sharp contact 20° dip, igneous and metamorphic GRAVEL at bottom, more oxidized and more rounded than above.											
709.99	92													
	93													
707.99	94													
	95				S18	23 34 50	84	100						
705.99	96		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense and stiff, brown to yellowish brown, moist, GRAVEL up to 1/4" dia, 2" to 4"-thick horizontal bedding.											
	97													
703.99	98													
	99													
701.99	100		SILTY SAND (SM); very dense, varies from mottled yellowish brown to brown, moist, fine SAND, micaceous, trace coarse SAND, oxidized.		D19	10 50/5		100						
	101													
699.99	102													
	103													
697.99	104													
	105				S20	20 50/6		100						
695.99	106													
	107													
693.99	108													
	109													
691.99	110		Trace fine GRAVEL to 1/4" dia..		D21	20 50/6		100						
	111													
689.99	112													
	113													
687.99	114													
	115													

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	4 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	115													
685.99	118		No recovery.		S22	20 50/6		0						See note at end of log regarding RQD.
	117													
683.99	118													
	119													
681.99	120		Poorly graded SAND with GRAVEL (SP); very dense, yellowish brown, moist, feldspar rich granitic GRAVEL to 1.5" dia, subangular.		S23	50/6		100						
	121													
679.99	122													
	123													
677.99	124													
	125		Well-graded GRAVEL (GW); fractured pieces of weathered DIORITE and GRANITE, hard, 10% dark minerals, oxidized.		D24	50/5		100						
675.99	126													
	127				C1			55						
673.99	128											PP = 3		
	129		SILT (ML); very stiff, nonplastic, slightly micaceous.											
671.99	130		SILTY SAND (SM); with CLAY, very stiff, varies from brown to dark yellowish brown, moist, slightly plastic, about 50% fine sand, 5% clay, sharp lower contact.		C2			100				PP = 3		
	131													
669.99	132		Well-graded GRAVEL with SAND (GW); hard to decomposed DIORITE, GABBRO and GNEISS rocks larger than 2.5" dia, some COBBLES..											
	133				C3			55						
667.99	134		SILTY SAND (SM); dense to medium dense, varies from dark yellow to brown, fine SAND with about 5% medium sand, 10% - 20% silt.											
	135													
665.99	136		Well-graded GRAVEL with SAND (GW); COBBLES (20%) and trace of BOULDERS with fine to coarse SAND matrix. Dense, multi colored, moist, hard to decomposed DIORITE, QUARTZ DIORITE, GABBRO, GRANITE, GNEISS rocks, well rounded to subrounded.											Lost core 136.5 to 140' depth
	137													
663.99	138													
	139													
661.99	140				C4			58						Lost core
	141				C5			67						
659.99	142													
	143													
657.99	144				C6			22						Lost core
	145													

(continued)

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DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	5 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	145		Well-graded GRAVEL with SAND (GW) *(continued)*.											See note at end of log regarding RQD.
655.99	146				C7			42						Difficult to drill
	147				C8			27						
653.99	148													
	149													
651.99	150													
	151													
649.99	152		Poorly graded SAND with GRAVEL (SP); dense, reddish brown, 30%-40% gravel to 2.75" dia. In very coarse SAND. Igneous and metamorphic rocks, hard to decomposed, subrounded to rounded, horizontal bedding.		C9			76						
	153													most likely Pleistocene age soil horizon based on oxidation and density
647.99	154		Yellowish brown, moist. Wide variety of igneous and metamorphic, hard to decomposed rock.		C10			100						
	155													
645.99	156		COBBLES with some well graded SAND with GRAVEL, about 60% COBBLES, matrix consists of medium dense to dense, brown and yellowish brown, moist, medium to coarse SAND, Rocks are well rounded to subrounded igneous and metamorphic rocks, hard to decomposed.											
	157													
643.99	158													
	159				C11			0						
641.99	160													
	161													
639.99	162													
	163													
637.99	164				C12			50						
	165													
635.99	166													
	167													
633.99	168		Poorly graded SAND (SP); dense, yellowish brown, moist, coarse sand.											
	169		SILT (ML); stiff, yellowish brown, moist, micaceous. no bedding.		C13			60						Lost core at top
631.99	170		Well-graded SAND with GRAVEL (SW); dense, yellowish brown, coarse SAND, subangular igneous and metamorphic GRAVEL up to 4" dia.											
	171													
629.99	172													
	173													
627.99	174				C14			60						
	175													

(continued)

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BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	6 of 10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	175		Well-graded SAND with GRAVEL (SW) *(continued)*.		C14			60							See note at end of log regarding RQD.
625.99	176														
	177														
623.99	178		Gabbro boulder, soft, crumbly.												
	179				C15			70							
621.99	180		COBBLES , BOULDERS, GRAVEL; multi colored, 50% COBBLES, 10% BOULDERS, 30% GRAVEL, 10% coarse SAND matrix, rounded to subrounded, spherical, hard to decomposed and crumbly, some oxidized, some fresh.												
	181														
619.99	182														
	183														
617.99	184				C16			48							
	185														
615.99	186														
	187														
613.99	188														
	189														
611.99	190		IGNEOUS and METAMORPHIC ROCKS (DIORITE, QUARTZ DIORITE, QUARTZ MONZONITE, FOLIATED DIORITE, GNEISS). Intersecting intrusive bodies and dikes. FAULT GOUGE, intensely sheared and altered to soft to stiff SANDY CLAY with trace of GRAVEL, light gray to bluish green, high plasticity, SAND varies from fine to coarse.		C17			92	0						Sheared and altered rock, fault gouge
	191														
609.99	192														
	193														
607.99	194				C18			67	0			PP = 3.5 to 4.5			
	195														
605.99	196														
	197				C19			87	0			PP = 4.5			
603.99	198														
	199														
601.99	200														
	201														
599.99	202														Lost core
	203														
597.99	204				C20			79	0						FAULT GOUGE
	205														
	206														

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	7 of 10

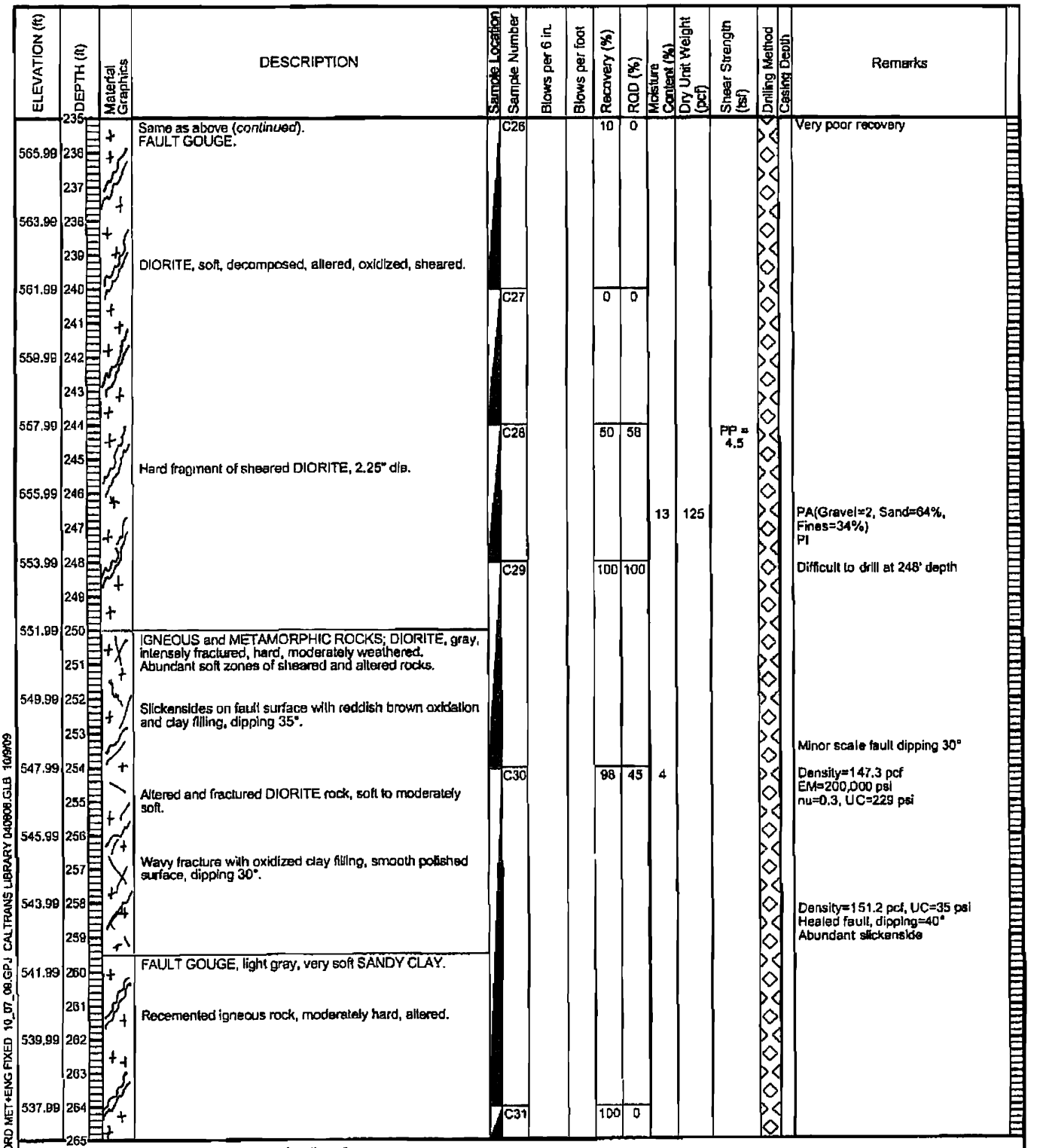
ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	205		Same as above *(continued)*.		C20			79	0					See note at end of log regarding RQD.
595.99	206													
	207		FAULT GOUGE.											
593.99	208													
	209													
591.99	210													Lost core
	211				C21			75	0			PP = 4.5		
589.99	212		Varies from dark gray to bluish green, sheared, altered igneous and metamorphic rocks in SANDY CLAY matrix, about 50% dark minerals, joints and shears dipping 35° to 45°.											Clay filling small scale fault, dipping 40°
	213													
587.99	214													
	215													
585.99	216													Lost core
	217													
583.99	218				C22			83	0					
	219													
581.99	220													
	221													
579.99	222				C23			40	0					
	223													
577.99	224													Lost core
	225													
575.99	226													
	227				C24			73	0					
573.99	228													
	229													
571.99	230													
	231				C25			58	0					
569.99	232		Hard zones with highly fractured and sheared decomposed igneous and metamorphic rocks.											
	233													
567.99	234													
	235													

(continued)

CALTRANS BORING RECORD MET+ENG FIXED 10_07_09.GPJ CALTRANS LIBRARY 040808.GLB 10/9/09

Department of Transportation
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Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	8 of 10



(continued)

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE: BORING RECORD				HOLE ID: R-09-Z3B3
DIST.: 7	COUNTY: LA	ROUTE: 710	POSTMILE: D/D	EA: 7-08-169
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY: K.T		DATE: 6-22-09	SHEET: 9 of 10

CALTRANS BORING RECORD MET+ENG FIXED 10_07_08.GPJ CALTRANS LIBRARY 040808.GLB 10/9/09

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	265		*(continued).*		C31			100	0						See note at end of log regarding RQD.
535.99	266		1.25" wide shattered zone, moderately hard.												
	267														
533.99	268		Calcite crystals to 1/4" size.												
	269														
531.99	270														
	271				C32			98	0			PP = 4.5			Density=148.7 pcf. EM=45,000 psi, nu=0.23 UC=92 psi. Petrographic Thin section on one of hard fragments, Hydrothermally altered DIORITE, Plagioclase 40%,Hornblende 29%, Chlorite 8%, Quartz 8%, biotite 5%, Kspar 1%, Calcite 3%, weak directional fabric
529.99	272		(Altered DIORITE); medium gray, predominantly very soft, locally hard, intensely fractured, small scale faults, dipping 50° to 70°, recrystallization along fault plane, abundant FeO on joint and fault surfaces.												
	273														
527.99	274														
	275		Intensely fractured.												
525.99	276		Bottom of borehole at 275.6 ft bgs Backfilled with Grout.												
	277		RQD values provided in the boring logs are based on intact core pieces obtained between two natural discontinuities.												
523.99	278														
	279		Majority of cores obtained in this boring are weak and do not meet the "sound core" definition provided in standard test method for RQD ASTM D 6032. These RQD values should not be used to evaluate the rock mass quality.												
521.99	280														
	281		Borehole converted to piezometer at the completion of drilling.												
519.99	282														
	283														
517.99	284														
	285														
515.99	286														
	287														
513.99	288														
	289														
511.99	290														
	291														
509.99	292														
	293														
507.99	294														
	295														

CALTRANS BORING RECORD MET+ENG FIXED 10_07_09.GPJ CALTRANS LIBRARY 040908.GLB 10/9/09

Department of Transportation
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Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B3
DIST.	COUNTY	ROUTE	POSTMILE	EA
7	LA	710	D/D	7-08-169
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	K.T		6-22-09	10 of 10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
M. Torsiello	2-17-09	3-11-09	34° 7' 31.5586" / 118° 8' 54.6144" NAD83	R-09-Z3B6
DRILLING CONTRACTOR: Cascade Drilling Inc.			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta State St. s/o Railroad St. w/o SR-110	SURFACE ELEVATION: 750.0 ft NAVD 88
DRILLING METHOD: Rotary Wash			DRILL RIG: Ingersoll Rand A400	BOREHOLE DIAMETER: 6 in
SAMPLER TYPE(S) AND SIZE(S) (ID): SPT(1.4"), Cal (2.4"), PQ core (3.2")			SPT HAMMER TYPE: Automatic Hammer 140 lb. 30 inch drop	HAMMER EFFICIENCY, ERI: 75%
BOREHOLE BACKFILL AND COMPLETION: Piezometer Installed on Completion			GROUNDWATER READINGS: DURING DRILLING: NM; AFTER DRILLING (DATE): 51.2 ft on07/01/09	TOTAL DEPTH OF BORING: 326.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		ASPHALT and CONCRETE.												
	1		Poorly graded SAND (SP); very dark grayish brown; dry to moist; coarse to medium SAND; trace fines.												Hand Auger to 5'
748.00	2														
	3														
746.00	4														
	5		SILTY SAND (SM); medium dense; very dark brown; dry to moist; medium to fine SAND; little fines; trace clay, trace coarse angular sand.		S01	4 5 6	11	100		6					PA VOC = 0.0 ppm
744.00	6														
	7														
742.00	8														
	9														
740.00	10		SILTY SAND with GRAVEL (SM); very dense; very dark brown; few coarse to fine GRAVEL; coarse SAND.		S02	17 38 50/1"		92		8	128				PA VOC = 0.0 ppm
	11		Well-graded SAND (SW); very dense, light gray, moist, trace fine gravel, fine to coarse sand; (Decomposed Topanga Formation).												
738.00	12														
	13														
736.00	14														
	15				S03	50/3"		17							VOC = 0.0 ppm
734.00	16														
	17														
732.00	18														
	19														
730.00	20		Gray.		S04	50/3"		17							VOC = 0.0 ppm
	21														
728.00	22														
	23														
726.00	24														
	25														

(continued)

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Department of Transportation
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Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST. 07	COUNTY LA	ROUTE 710	POSTMILE D/D	EA 07-187900
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER N/A	PREPARED BY D. Jankly		DATE 7-13-09	SHEET 1 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method Casing Depth	Remarks
	26		No Recovery.		S06	50/2.6"		0						See note at end of log regarding RQD.
724.00	26													
	27													
722.00	28													
	29													
720.00	30		No Recovery.		S08	50/2.5"		0						
	31													
718.00	32													
	33													
716.00	34													
	35		No Recovery.		C07			0	0					
714.00	36													
	37													
712.00	38				C08			0	0					
	39													
710.00	40													
	41													
708.00	42													
	43		SEDIMENTARY ROCK: TOPANGA FORMATION (Tt) CONGLOMERATE; granule to cobble, fine to coarse sand, light gray, moderately weathered, soft to moderately soft, majority of matrix washed out, granule to pebble sized clasts observed.		C09			5	0					
706.00	44													
	45													
704.00	46													
	47													
702.00	48		Isolated calcite-cementation, moderately hard zones recovered.		C10			5	0					
	49													
700.00	50													
	51													
698.00	52													
	53				C11			0	0					
696.00	54													
	55													

(continued)

CALTRANS BORING RECORD MET+ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040608.GLB 7/24/09

Department of Transportation
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Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE: BORING RECORD
HOLE ID: R-09-Z3B6

DIST.	COUNTY	ROUTE	POSTMILE	EA
07	LA	710	D/D	07-187900

PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
N/A	D. Jankly	7-13-09	2 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55				C11			0	0					See note at end of log regarding RQD.
694.00	56													
	57													
692.00	58		Light gray, moderately to slightly weathered, soft to moderately hard. Matrix is fine to coarse grained sand. No visible structure. Granule to cobble sized clasts composed of hard to very hard intrusive rock (generally dioritic in nature), subangular to rounded.		C12			30	0					
	59													VOC = 0.0 ppm
690.00	60													
	61													
688.00	62													
	63				C13			7	0					
686.00	64													
	65													
684.00	66													
	67													
682.00	68		Slightly weathered, soft to moderately hard, granule to cobble sized clasts.		C14			18	13					
	69													
680.00	70													
	71													
678.00	72													
	73													
676.00	74													
	75													
674.00	76													
	77													
672.00	78		Slightly weathered to fresh, clasts are hard.		C15			15	5					
	79													VOC = 0.0 ppm
670.00	80													
	81													
668.00	82													
	83													
666.00	84													
	85													

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Department of Transportation
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Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST.	COUNTY	ROUTE	POSTMILE	EA
07	LA	710	D/D	07-187900
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
N/A	D. Jankly		7-13-09	3 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	85				C15			15	5					See note at end of log regarding RQD.
664.00	86													
	87													
662.00	88		Medium gray.		C16			8	3					VOC = 0.0 ppm
	89													
660.00	90													
	91													
658.00	92													
	93													
656.00	94													
	95													
654.00	96													
	97													
652.00	98				C17			7	0					
	99													
650.00	100													
	101													
648.00	102													
	103													
646.00	104													
	105													
644.00	106													
	107													
642.00	108		Coarse grained sand matrix.		C18			13	0					VOC = 0.0 ppm
	109													
640.00	110													
	111													
638.00	112													
	113				C19			18	0					
636.00	114		Clasts up to 3" intersected.											
	115													

(continued)

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Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST. 07	COUNTY LA	ROUTE 710	POSTMILE D/D	EA 07-187900
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER N/A	PREPARED BY D. Jankly		DATE 7-13-09	SHEET 4 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	115				C19			18	0					See note at end of log regarding RQD.
634.00	116													
	117													
632.00	118		Pressuremeter test at 118' to 122'.											
	119													
630.00	120													
	121													
628.00	122													
	123				C20			0	0					
626.00	124													
	125													
624.00	126				C21			0	0					
	127													
622.00	128		Pressuremeter test at 128' to 133'.											
	129													
620.00	130													
	131													
618.00	132													
	133		Greenish gray.		C22			20	8					
616.00	134		At EL. 616.4 ft, observed incipient joint, dipping 0°.											VOC = 0.0 ppm
	135													
614.00	136													
	137													
612.00	138													
	139													
610.00	140													
	141													
608.00	142													
	143		Slightly weathered, soft, incipient joint (tight with no infill), dipping 70°, very hard clasts up to 8" intersected.		C23			47	13					
606.00	144													
	145													

(continued)

CALTRANS BORING RECORD WET+ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040808.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE: BORING RECORD				HOLE ID: R-09-Z3B6
DIST.: 07	COUNTY: LA	ROUTE: 710	POSTMILE: D/D	EA: 07-187900
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER: N/A	PREPARED BY: D. Jankly		DATE: 7-13-09	SHEET: 5 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	145				C23			47	13					See note at end of log regarding RQD. VOC = 0.0 ppm
604.00	146													
	147													
602.00	148		Medium gray, slightly weathered to fresh, very soft to soft.		C24			27	0					VOC = 0.0 ppm
	149													
600.00	150													
	151													
598.00	152													
	153		Matrix is very soft, clasts are very hard. Intact sandstone matrix up to 7" thick observed.		C25			45	12					
596.00	154													
	155													VOC = 0.0 ppm
594.00	156													
	157													
592.00	158				C26			45	17					
	159													
590.00	160		Intact coarse grained sandstone matrix up to 5.5" thick observed, moderately soft. Very hard diorite clasts up to 5" also observed.											VOC = 0.0 ppm
	161													
588.00	162													
	163		Fresh, very soft, granule and pebble sized clasts within fine to medium grained sandstone matrix.											VOC = 0.0 ppm
586.00	164		Pressuremeter test at 163' to 170'.											
	165													
584.00	166													
	167													
582.00	168													
	169													
580.00	170				C27			44	0					VOC = 0.0 ppm
	171		Roughly 6 inches of reddish brown aphanitic igneous rocks.											
578.00	172													
	173		Greenish gray, slightly weathered to fresh, Hard granule, pebble and cobble sized clasts within fine to coarse grained very soft sandstone matrix.		C28			67	7	11				PA
576.00	174													VOC = 0.0 ppm
	175													

(continued)

CALTRANS BORING RECORD MET-ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040606.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST. 07	COUNTY LA	ROUTE 710	POSTMILE D/D	EA 07-187900
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER N/A	PREPARED BY D. Jankly		DATE 7-13-09	SHEET 6 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	175				C26			67	7						See note at end of log regarding RQD. PL
574.00	176														
	177														
572.00	178		Light bluish gray to greenish gray, slightly weathered.		C29			90	12						
	179														VOC = 0.0 ppm
570.00	180														
	181														
568.00	182														
	183				C30			100	0						
566.00	184		Joint (moderately rough, 4mm aperture, no infill), dipping 20°. Slightly weathered to fresh, intensely fractured, pebble sized clast, white, very hard, subangular. Pressuremeter test at 184.5' to 193'.												VOC = 0.0 ppm
	185														
564.00	186														
	187														
562.00	188														
	189														
560.00	190		Abundant pebbles between 190' and 191'.												
	191		Roughly 4" thick medium to coarse grained sandstone lens, greenish gray.												
558.00	192		Some polished surfaces observed, possible gouge zone.												
	193		(SANDSTONE), medium-grained to granule, medium gray, slightly weathered, moderately fractured, bedding plane separation dipping 30°, seven joints observed between 193'-196', dips range from 10 to 70 degrees. Intensely fractured.		C31			98	30						
556.00	194														
	195														PTS CAI
554.00	196		Joint (tight, rough), dipping 20 to 60°, three joints observed between 195.6' and 196'. PTS - Quartz Diorite clast: Plutonic rock with allotriomorphic-granular texture. Poorly indurated conglomerate,												
	197														VOC = 0.0 ppm
552.00	198		Incipient joint dipping 60°, Coarse grained sandstone, easily friable. Massive, greenish gray, Clasts up to 7" intersected.		C32			100	29						PL
	199		Three rough to moderately rough joints observed between 198.7' to 199.3'.												VOC = 0.0 ppm
550.00	200		Numerous joints observed between 200' and 202' dipping 0 degrees.		C33			78	0						
	201														
548.00	202		Random fracture (smooth, 1mm aperture), dipping 60°.												VOC = 0.0 ppm
	203		Shear dipping 75°, clay lined, slickensided.		C34			90	72						
546.00	204		Shear (slickensided, tight clay lining), dipping 75°.												
	205		Shear (slickensided, slightly open with silt lining).												

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CALTRANS BORING RECORD MET-ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040616.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST. 07	COUNTY LA	ROUTE 710	POSTMILE D/D	EA 07-187900
PROJECT OR BRIDGE NAME SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER N/A	PREPARED BY D. Jankly		DATE 7-13-09	SHEET 7 of 12

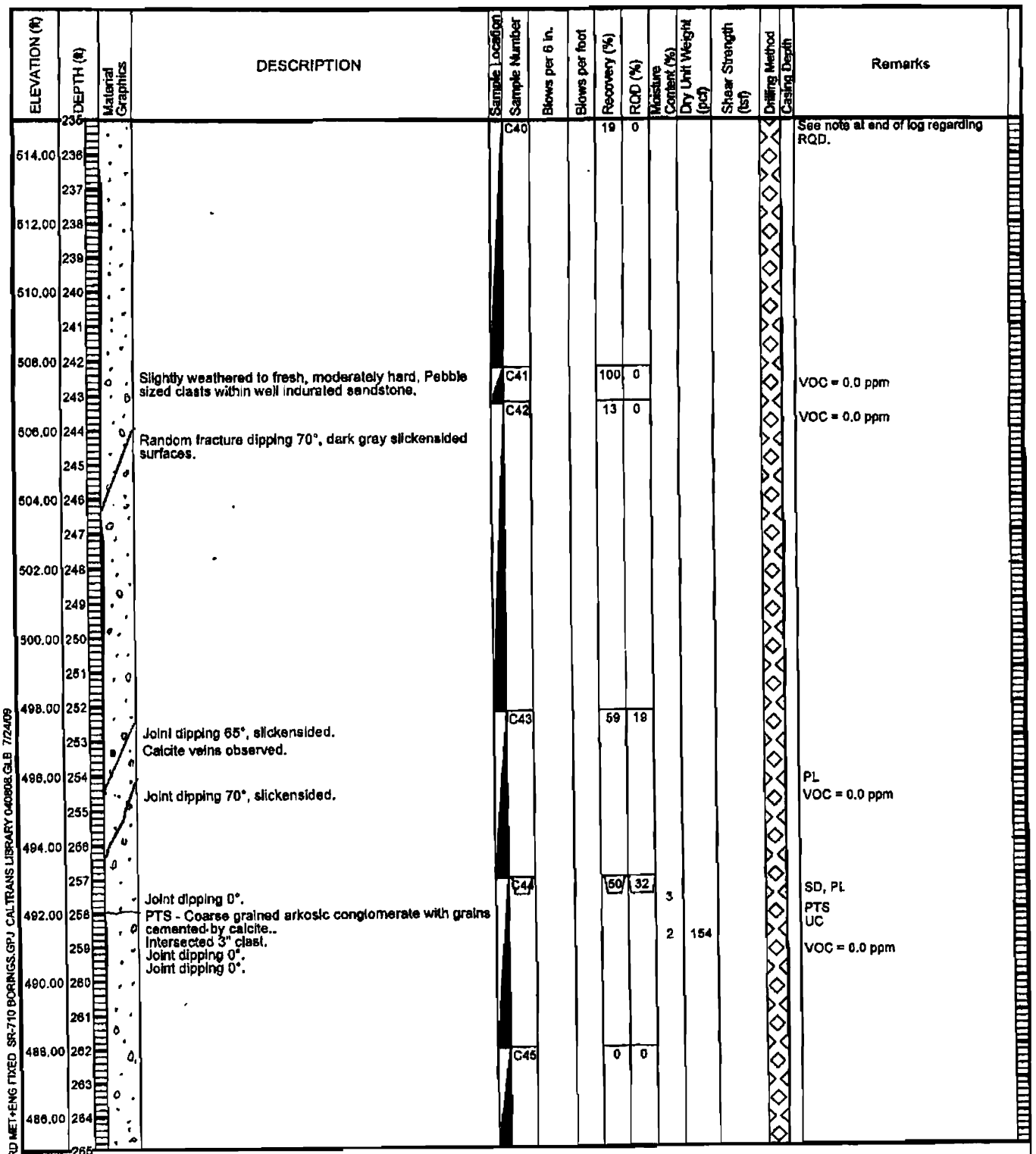
ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method Casing Depth	Remarks
	205		dipping 50°.		C34			90	72					See note at end of log regarding RQD,
544.00	206		Very thickly bedded, moderately fractured, bedding joint (possibly slickensided, slightly open with very thin clay lining), dipping 30°.											VOC = 0.0 ppm
	207		Random fracture (slightly open, polished), dipping 70°. Joint (tight, smooth), dipping 30 to 40°, two joints observed.											
542.00	208		Joint (slightly open, slightly rough), dipping 20°.											
	209		Bedding joint dipping 35°.							4	148			UC, PL
540.00	210		Joint dipping 0°.											
	211		Incipient joint dipping 0°. Incipient joint dipping 0°. Joint dipping 0°.											
538.00	212													
	213				C35			98	87					
536.00	214		Joint. Joint dipping 0°. Very thinly bedded, bedding joint dipping 45°.											
	215		Joint dipping 0°. Very thickly bedded, slightly weathered, Light gray, coarse angular sandstone matrix.											VOC = 0.0 ppm
534.00	216		Joint dipping 0°. Joint dipping 0°.											PL
	217		Joint dipping 0°. Joint dipping 0°.											
532.00	218		Joint dipping 0°. Joint dipping 0°. Joint dipping 0°.							2	149			UC
	219		6" thick lens with medium grained sandstone matrix. Joint dipping 0°.											
530.00	220													
	221		Moderately soft, bedding joint dipping 40°.							3	142			UC, PL
528.00	222		Joint dipping 0°. Joint dipping 0°.											PL
	223		Joint dipping 0°. Granule to cobble sized clasts.		C36			57	13					VOC = 0.0 ppm
526.00	224													
	225													
524.00	226				C37			67	32					VOC = 0.0 ppm
	227		Bedding joint dipping 35°.							2	152			UC, PL
522.00	228		Sandstone lens, light gray, fine to coarse grained, friable.											
	229													
520.00	230		Sandstone lens, gray, fine to medium grained.		C38			83	83					VOC = 0.0 ppm
			(CONGLOMERATE), pebble to gravel sized clasts, subangular to angular, local slickensided surfaces.		C39			63	22					
	231													VOC = 0.1 ppm
518.00	232				C40			19	0					VOC = 0.0 ppm
	233		Sandstone, medium to coarse grained, angular, friable, possibly sheared.											
516.00	234													
	235													

(continued)

CALTRANS BORING RECORD MET-ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040808.GLB 7/24/08

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST.	COUNTY	ROUTE	POSTMILE	EA
07	LA	710	D/D	07-187900
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
N/A	D. Jankly		7-13-09	8 of 12



(continued)

CALTRANS BORING RECORD MET+ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040908.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE: BORING RECORD				HOLE ID: R-09-Z3B6
DIST.: 07	COUNTY: LA	ROUTE: 710	POSTMILE: D/D	EA: 07-187900
PROJECT OR BRIDGE NAME: SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER: N/A	PREPARED BY: D. Jankly		DATE: 7-13-09	SHEET: 9 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method Casing Depth	Remarks
	265				C45			0	0					See note at end of log regarding RQD.
484.00	266													
	267		Slightly weathered, Clasts are 1/2" to 1" dia., diorite pebbles, very hard, some slickensided surfaces.		C46			32	10					VOC = 0.0 ppm
482.00	268		Joint dipping 70°, slickensided, intersected 6" clast.											
	269													
480.00	270													
	271													
478.00	272				C47			27	0					
	273		Sandstone, dark bluish gray, moderately soft, fine to medium grained, subangular to angular, poorly cemented.											VOC = 0.0 ppm
476.00	274													
	275													
474.00	276													
	277		Sandstone as above with few diorite derived pebbles.		C48			38	0					
472.00	278		Conglomerate, pebble sized clasts within sandstone matrix.											VOC = 0.2 ppm
	279		Bedding joint dipping 35°.											
470.00	280													
	281													
468.00	282		Joint dipping 35°.		C49			45	19					
	283		Joint dipping 70°. Well cemented, fine grained matrix. Decreased cementation, moderately soft.											VOC = 0.0 ppm
466.00	284		Intersected 4" clast.											PL
	285													
464.00	286													
	287		Sandstone, soft, fine to medium grained, soft, poorly cemented.		C50			20	0					
462.00	288		Some angular to subangular pebbles.											VOC = 0.0 ppm
	289													
460.00	290													
	291													
458.00	292		Moderately soft, joint dipping 75°, slickensided.		C51			15	0					VOC = 0.0 ppm
	293													
456.00	294													
	295													

(continued)

CALTRANS BORING RECORD MET-ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040808.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST.	COUNTY	ROUTE	POSTMILE	EA
07	LA	710	D/D	07-187900
PROJECT OR BRIDGE NAME				
SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
N/A	D. Jankly		7-13-09	10 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	295				C51			15	0						See note at end of log regarding RQD.
454.00	296														
	297		**SHEAR ZONE AT El. 453' to El. 424'**												
452.00	298		Sandstone, massive, bluish gray, moderately to slightly weathered, very soft to soft, fine to medium grained. Some coarse, angular pebbles. Trace fines.		C52			46	24						PL
	299									6					PA
450.00	300		Bedrock is sheared and friable.												VOC = 0.0 ppm
	301														
448.00	302														
	303				C53			100	87						VOC = 0.4 ppm
446.00	304		Bedding joint dipping 20°, Sandstone, white with black minerals, appears decomposed due to shearing.												
	305									12					PA
444.00	306		Joint dipping 77°, slickensided.												
	307														
442.00	308		Joint dipping 80°, Unit is friable, highly sheared, black gouge within joints.		C54			100	48						
	309		Bedding joint dipping 25°.												
440.00	310														
	311		Bedding joint dipping 25°, Unit is sheared, continuing from El. 453'.												
438.00	312		Sandstone is very soft and friable, pebbles within sandstone are decomposed and easily friable, numerous slickensided surfaces.												VOC = 0.2 ppm
	313		Moderately to slightly weathered, soft, sandstone to siltstone, numerous near vertical slickensided surfaces 80 to 90 degree dip.		C55			100	72						
436.00	314		Bedding joint dipping 25°, Local 3/8" thick beds of sandstone and siltstone.												
	315		Possibly decomposed diorite, very dark gray. Numerous gray, clay lined slickensided surfaces which are friable.												
434.00	316														VOC = 0.6 ppm
	317		Joint dipping 40°, Likely continuation of shear zone from El. 453'.												
432.00	318		Joint dipping 10°.		C56			69	63						
	319		Joint. Sandstone with some pebbles, gray to dark gray, friable, numerous slickensided surfaces. Moderately soft.												
430.00	320														
	321		Bedding joint (2mm aperture, slickensided, clay lined), dipping 30°, Likely continuation of shear zone from El. 453'.												
428.00	322		Soft.												VOC = 0.9 ppm
	323														
426.00	324														
	325														

(continued)

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Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE: **BORING RECORD**

HOLE ID: **R-09-Z3B6**

DIST.	COUNTY	ROUTE	POSTMILE	EA
07	LA	710	D/D	07-187900

PROJECT OR BRIDGE NAME: **SR-710 TUNNEL TECHNICAL STUDY**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
N/A	D. Jankiy	7-13-09	11 of 12

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	325				C58			89	63						
424.00	326		Bottom of Boring El. 424.0'.												
	327														
422.00	328		RQD values provided in the boring logs are based on intact core pieces obtained between two natural discontinuities.. Majority of cores obtained in this boring are weak and does not meet the "sound core" definition provided in standard test method for RQD ASTM D 6032. These RQD values should not be used to evaluate the rock mass quality.. Bottom of borehole at 326.0 ft bgs Borehole converted to piezometer at the completion of drilling.											
	329														
420.00	330														
	331														
418.00	332														
	333														
416.00	334														
	335														
414.00	336														
	337														
412.00	338														
	339														
410.00	340														
	341														
408.00	342														
	343														
406.00	344														
	345														
404.00	346														
	347														
402.00	348														
	349														
400.00	350														
	351														
398.00	352														
	353														
396.00	354														
	356														

CALTRANS BORING RECORD MET+ENG FIXED SR-710 BORINGS.GPJ CALTRANS LIBRARY 040808.GLB 7/24/09

Department of Transportation
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - South 1

REPORT TITLE				HOLE ID
BORING RECORD				R-09-Z3B6
DIST. 07	COUNTY LA	ROUTE 710	POSTMILE D/D	EA 07-187900
PROJECT OR BRIDGE NAME SR-710 TUNNEL TECHNICAL STUDY				
BRIDGE NUMBER N/A	PREPARED BY D. Jankly		DATE 7-13-09	SHEET 12 of 12

Appendix G

Table B-1 from Reference 10

Groundwater Monitoring

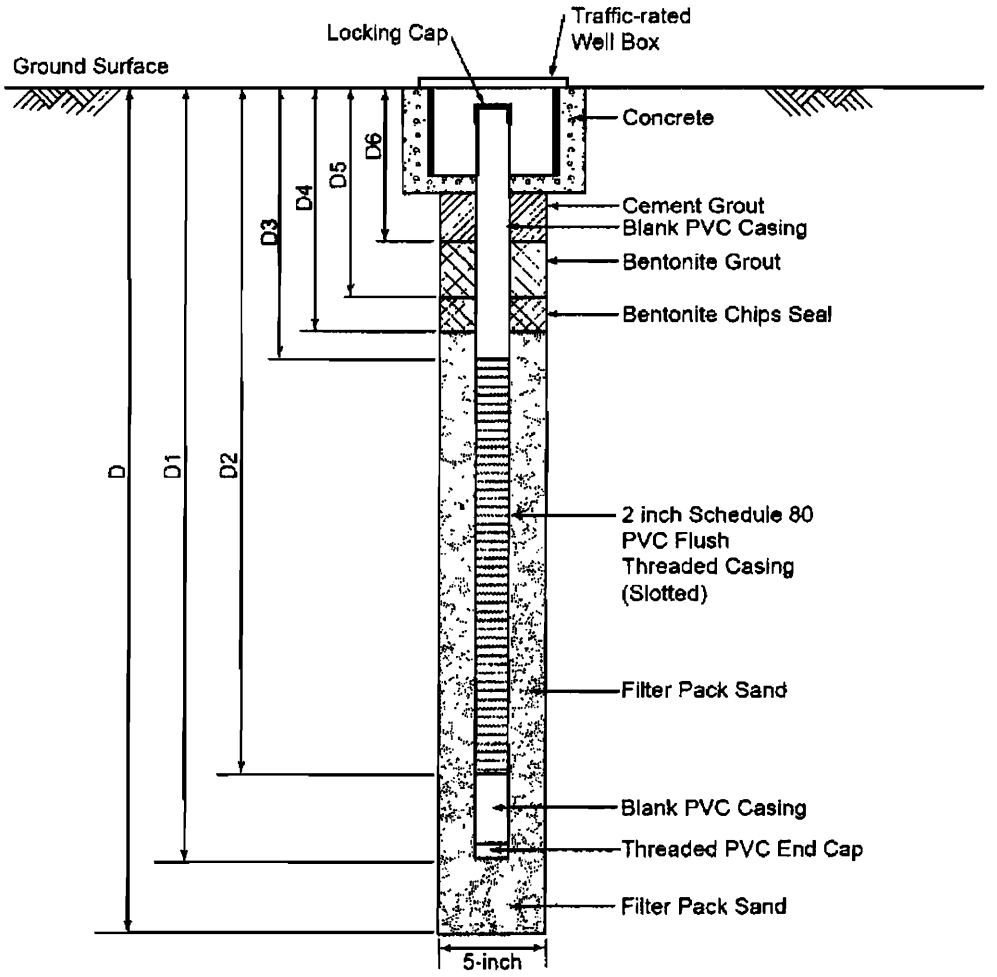
Details of typical piezometer installation are shown in Figure B-1. The piezometers were constructed using 2-inch-diameter polyvinyl chloride (PVC) Schedule 80 pipe set in the borehole. The bottom of the pipe was slotted and capped, and the annular space around the slotted pipe was backfilled with Monterey No. 3 clean sand. Approximately 100 feet of screen interval were used in each piezometer, 25 feet below invert and 25 feet above crown of the anticipated tunnel. The area above the sand was sealed with bentonite chips, the remaining annulus was filled with bentonite grout, and the annulus within upper 8 feet was filled with cement grout. Each piezometer was completed with a locking cap and traffic-rated well box, except at boring locations R-09-Z1B8 and R-09-Z3B2 where standpipes were used because of grassland at the surface.

TABLE B-1
Summary of Piezometers Installation

Boring/ Piezometer Designation	Ground Surface Elevation (feet)	Depth of Piezometer (feet)	Depth to top of Screen (feet)	Depth to Bottom of Screen (feet)	Date Measured	Groundwater Elevation[1] (feet)
R-09-Z1B3	343.2	300	190	290	7/1/09	313.3
R-09-Z1B4	388.6	325	215	315	7/1/09	353.2
R-09-Z1B5	442.2	500	390	490	7/1/09	419.5
R-09-Z1B6	447.2	390	280	380	7/1/09	425.7
R-09-Z1B7	480.5	285	175	275	7/1/09	440.5
R-09-Z1B8	419.6	200	90	190	7/1/09	394.6
R-09-Z2B1	451	150	40	140	7/1/09	437.1
R-09-Z2B3	546.9	350	240	340	7/1/09	498.9
R-09-Z2B4	558.1	371	261	361	7/1/09	548.1
R-09-Z2B5	452.4	277	167	267	7/1/09	441.6
R-09-Z3B1	885.1	285	175	275	7/1/09	861.2
R-09-Z3B2	781.4	275	165	265	7/1/09	637.0
R-09-Z3B3	802	276	80	180	7/1/09	668.0
R-09-Z3B5	698.2	400	290	390	7/1/09	675.7
R-09-Z3B6	750	324	214	314	7/1/09	698.8
R-09-Z3B7	596.7	320	210	310	7/9/09	582.2
R-09-Z3B8	594.3	275	165	265	-	**
R-09-Z3B9	624.3	300	190	290	7/1/09	550.4
R-09-Z3B10	626.8	375	265	365	7/1/09	578.3
R-09-Z3B11	533.1	275	165	265	7/1/09	375.1
R-09-Z3B12	501	240	130	230	7/1/09	488.2
R-09-Z4B4	454.4	275	155	265	7/1/09	408.1

136
51.2

** – Well cap stuck, could not access piezometer.
1 –Because some of the piezometers were not developed, groundwater may not be stabilized at the time of reading.



Total Depth (D)	200 - 525 ft
Total Depth of Casing (D1)	185 - 510 ft
Depth to Bottom of Well Screen (D2)	175 - 500 ft
Depth to Top of Well Screen (D3)	75 - 400 ft
Depth to Bottom of Top Seal (D4)	70 - 395 ft
Depth to Top of Top Seal (D5)	65 - 390 ft
Depth to Bottom of Cement Grout (D6)	8 ft
Well Casing Diameter	2-inch
Well Screen Slot Size	0.020-inch
Filter Pack Sand Type	Monterey No. 3
Bentonite Seal Type	Medium Chips

NOT TO SCALE

FIGURE B-1
TYPICAL PIEZOMETER CONSTRUCTION DETAILS
SR-710 TUNNEL TECHNICAL STUDY

CH2MHILL

ES1C20080135CC378\12.03.04 SR710 typical well at 1:09

Appendix H

City of Pasadena Safety Element, Pages 26 through 30

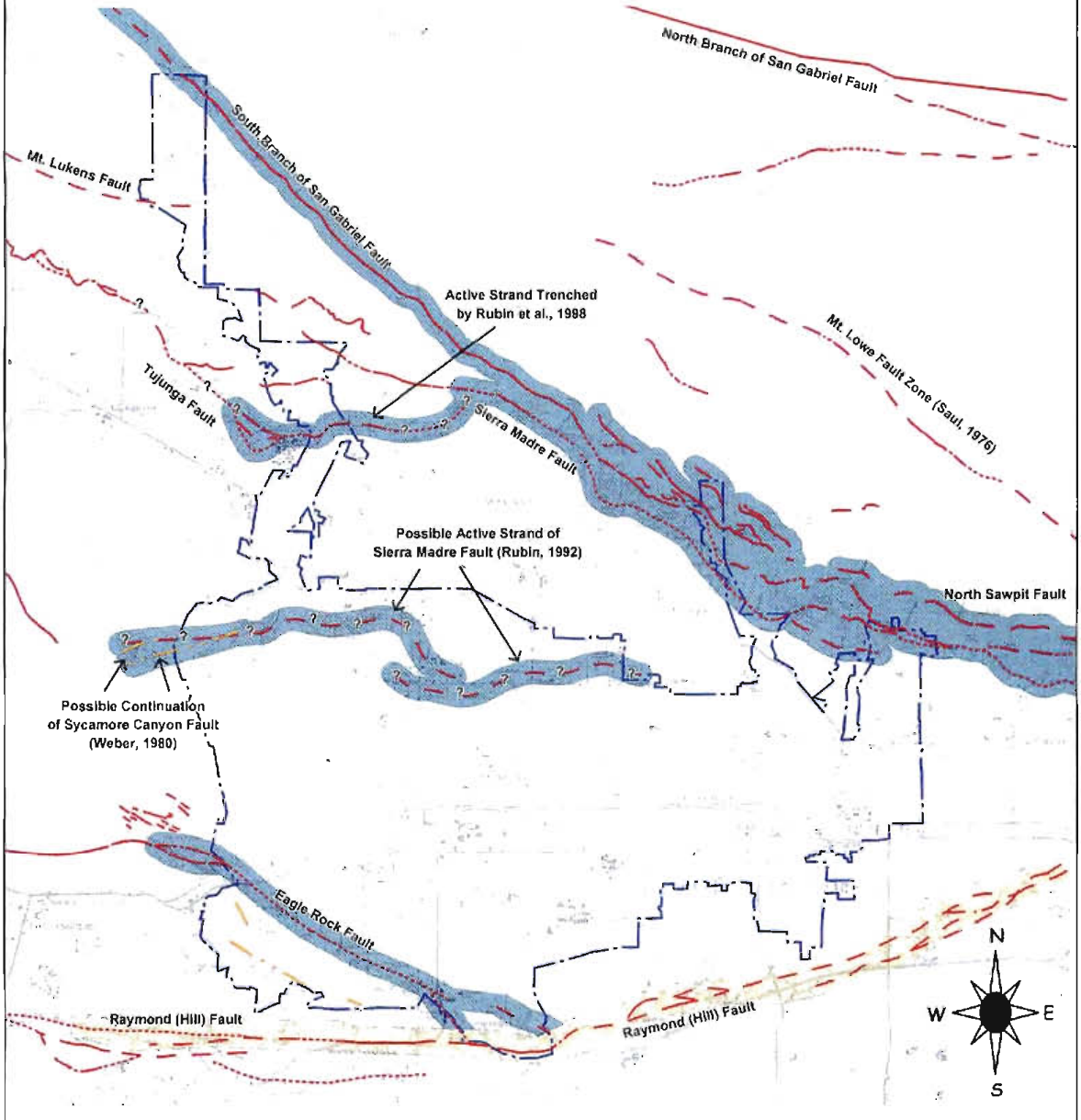
NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

Fault lines on the map are used solely to approximate the fault location. The width and location of the faults should not be used in lieu of site-specific investigations, evaluation, and design.

Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. All faults may not be shown. This map should be amended as new data become available and are validated.

Earth Consultants International (ECI) makes no representations or warranties regarding the accuracy of the data from which these maps were derived. ECI shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to any claim by any user or third party on account of, or arising from, the use of this map.



Base Map: USGS Topographic Map from SureRASTER MAPS
Source: Weber, 1980; Crook and others, 1987; Dibblee, 1989; Dibblee, 1998; California Division of Mines and Geology, 1977; Jennings, 1994; Rubin, 1992; Rubin et al., 1998

Scale: 1:64,000

1 0 1 2 3 Kilometers

0.5 0 0.5 1 1.5 Miles

EXPLANATION

- Lineaments observed in aerial photographs (Weber, 1980)
- Alquist-Priolo Earthquake Fault Zone
- Fault Hazard Management Zones
- Fault; solid where location known, dashed where approximate, dotted where concealed, queried where inferred. (?–?)
- Pasadena City Boundary

CITY OF PASADENA INCORPORATED JUNE 1886

Earth Consultants International

Project Number: 2022
Date: June, 2002

Fault Map

Pasadena, California

Plate 1-2

SAFETY ELEMENT GOALS AND POLICIES

The following are recommendations for the Safety Element policy framework for the City of Pasadena based on findings presented in the Technical Background Report.

SEISMIC HAZARDS:

Goal S-1: Minimize injury and loss of life, property damage, and other impacts caused by seismic shaking, fault rupture, ground failure, earthquake-induced landslides, and other earthquake-induced ground deformation.

Policy S-1: The City will monitor development or re-development within the Fault Hazard Management Zones identified for both the Sierra Madre and Raymond faults.

Program S1-1: The City will cooperate with State and Federal agencies in conducting geological investigations of the Sierra Madre and Raymond faults. The City will investigate the possibility of partnering with the Earthquake Hazards Program of the U.S. Geological Survey to better identify the active traces of the Sierra Madre fault.

Program S1-2: The City shall require geological studies, such as fault-trenching, of the ***defined traces*** of the Sierra Madre and the Raymond fault traces shown on Plate P-1. The studies shall be conducted by State-certified engineering geologists following the guidelines established in the Alquist-Priolo Earthquake Fault Studies Act. This should apply to the development and redevelopment of residential, commercial or industrial parcels or tracts that amount to 5,000 square feet or more. The City Geologist shall review the fault studies to ensure that the excavations were conducted with an acceptable level of effort to determine whether or not there are active faults through the proposed development, and that suitable fault setbacks are defined.

Program S1-3: The City will require geological studies of the ***less well-defined traces*** of the Sierra Madre fault shown on Plate P-1 for critical facilities proposed within this zone. The studies shall be conducted by State-certified engineering geologists.

Policy S-2: The City will ensure that current geologic knowledge and State-certified professional review are incorporated into the design, planning and construction stages of a project, and that site-specific data are applied to each project.

Program S2-1: The City shall retain on staff, or on a contract basis, a State-certified engineering geologist and a geotechnical engineer to review all geotechnical studies for proposed development or redevelopment, including fault studies (Programs S1-1 through S1-3), and to review grading operations (Programs S2-3 and S2-4). These individuals, whether on staff or under contract to the City, are referred to herein as the City Geologist and City Geotechnical Engineer, respectively.

Program S2-2: The City will modify the fault hazard management zones for the Raymond and Sierra Madre faults as data obtained from the implementation of Programs S1-1 through S1-3 become available. Modification of the map will be conducted by or under the direction of the City Geologist.

Program S2-3: The City shall require geological and geotechnical investigations in areas of potential seismic or geologic hazards as part of the environmental and development review process. The City shall not approve proposals and projects for development or redevelopment which do not provide for mitigation of seismic or geologic hazards to the satisfaction of the responsible agencies.

Program S2-4: The City shall continue to require preliminary geological investigations of tract sites by State-registered geotechnical engineers and certified engineering geologists (in accordance with the California Building Code).

Program S2-5: The City shall continue to require liquefaction assessment studies in areas identified as susceptible to liquefaction in accordance with the California Geological Survey Special Publication 117 Guidelines, and the Southern California Earthquake Center's procedures to implement Special Publication 117.

Policy S-3: The City will strive to ensure that the design of new, and the performance of existing structures address the appropriate earthquake hazards.

Program S3-1: The City shall continue to enforce the seismic design provisions for Seismic Zone 4 of the California Building Code, including near-source seismic conditions.

Program S3-2: The City will identify un-retrofitted buildings, including tilt-up construction, non-ductile reinforced concrete, and tuck-under parking and other soft-story construction. A catalog of these buildings in the City will be completed.

Program S3-3: The City shall prepare a plan for structural retrofit of such buildings identified under Program S3-2.

Program S3-4: The City will disclose to the buyer through City occupancy programs the potential problems with unbolted foundations in pre-1935 residences.

Program S3-5: The City will require prior to the reconstruction of damaged / destroyed buildings in hazard management zones, especially fault zones, to prove that the site can be safely restored using earthquake-resistant building techniques and land development policies as identified under Program S-1.2.

Policy S-4: The City will ensure to the fullest extent possible that, in the event of a major disaster, essential structures and facilities remain safe and functional, as required by current law. Essential facilities include hospitals, police stations, fire stations, emergency operation centers, communication centers, generators and substations, and reservoirs.

Program S-4.1: The City will continue to encourage the participation of the Planning and Development Departments during the early, conceptual stages of a critical facility project to assess its feasibility, with emphasis on issues such as surface fault rupture potential, liquefaction susceptibility, and inundation potential.

Program S-4.2: The City will encourage compliance with the 1974 Hospital Facilities Seismic Safety Act, the 1986 California Earthquake Hazards Reduction Act and SB 1953. The City will continue to work with the Huntington Memorial Hospital and state agencies to ensure that the hospital buildings will remain occupiable and operational following a maximum magnitude earthquake on the Raymond or Sierra Madre faults.

Program S-4.3: The City will seek cooperative agreements with regional hospitals outside City limits that can provide medical assistance in the event that the Huntington Hospital does not have sufficient beds to accommodate all of the casualties resulting from an earthquake or other disaster. Open areas, such as parks and school fields, from which victims could be airlifted to regional hospitals if necessary will be identified as part of this program.

Policy S-5: The City will continue earthquake strengthening and provisions for alternate or back-up essential services, such as water, sewer, electricity, and natural gas pipelines and connections throughout the City. First priority for this program should be for the essential services within the identified fault hazard management zones.

Program S-5.1: The City shall conduct seismic analysis of essential infrastructure such as water, sewer, electricity, and natural gas lines and make any structural changes necessary to withstand seismic activities. This may include additional strengthening, shoring and/or flexible pipelines in areas that cross fault hazard zones.

Policy S-6: The City will ensure to the fullest extent possible that, in the event of a major disaster, dependent care and high-occupancy facilities will remain safe.

Program S-6.1: The City's Building Department shall continue to review existing and proposed projects to ensure that stairways and elevators in high-occupancy buildings are adequately strengthened.

Program S-6.2: The City's Fire Department, as part of their annual review of businesses and dependent care facilities, shall encourage and educate the owners or operators of these facilities about emergency generators, and the value of securely anchoring computers, shelving, and other non-structural elements.

Policy S-7: The City will educate the public on the hazards that can pose a risk to the City and its residents, and will describe loss reduction strategies that can be used to mitigate the specific hazards identified.

Program S-7.1: The City will regularly review the technical data on public safety and seismic safety for use in the planning process and undertake a technical update to the Safety Element as needed. This includes the periodic update of the maps that support the Technical Background Report with newly developed data obtained in response to geological studies undertaken for fault, liquefaction or landslide studies. Where sufficient data are developed to indicate that an area currently identified as susceptible to liquefaction is NOT liquefiable, modify the map to eliminate the need for future studies in that area. Results of these findings will be submitted to the California Geological Survey.

SAFETY ELEMENT GOALS AND POLICIES

Program S-7.2: The City will continue to develop an effective system for communicating information about risk and loss reduction strategies to City staff in all departments responsible for implementing the programs defined in the Safety Element.

Program S-7.3: The City will develop a web-based system to communicate to the City's residents, workers and visitors the hazards specific to the City, and, most importantly, to describe the loss reduction strategies that homeowners and workers can implement at home and the work place to reduce their risk.

GEOLOGIC HAZARDS

Grading and construction operations are necessary to correct for unstable soils, soil erosion, landsliding and flooding (debris and/or mudflows) in hillside areas. This is sometimes in conflict with the desire to preserve the aesthetic or natural conditions of the existing topography. There must be a balance of the two objectives.

Goal G-1: Minimize the risk to life or limb, and property damage resulting from soil and slope instability.

Policy G-1: Whenever possible, mitigation of geologic hazards will be conducted without violating the property owners' rights to modify or improve their investment, along with preserving the aesthetic or natural conditions of the area through minimal grading. When these goals are in conflict, protection of life and property will take precedence.

Program G1-1: In the areas of Pasadena susceptible to slope instability, the City will require geotechnical investigations that include engineering analyses of slope stability, provide surface and subsurface drainage specifications, and provide detailed design for fill placement and excavation.

Program G1-2: The City will discourage any grading beyond that which is necessary to create adequate and safe building pads. The City Geologist and Geotechnical Engineer shall conduct regular inspection of grading operations to maximize site safety and compatibility with community character.

Program G1-3: In the hillside or mountainous areas of Pasadena, the City will discourage excessive grading of slopes greater than 3:1 (horizontal:vertical), and will encourage varied slope ratios on design slopes to reduce the visual impact of grading.

Program G-1.4: The City shall prohibit cut or fill slopes steeper than 2:1.

Program G-1.5: The City will not permit the reconstruction of structures meant for human habitation that were damaged or destroyed by failed slopes unless the applicant can prove that the remedial measures proposed will improve the unstable slope conditions making the site suitable for redevelopment.

Policy G-2: The City will continue to participate in regional programs designed to protect the groundwater resources of the Raymond Basin while protecting the area from the hazard of regional ground subsidence.

Program G-2.1: The City will continue to encourage water conservation through public education.

Program G-2.2: The City will participate in a technical group consisting of representatives from various cities in the Raymond Basin brought together to evaluate the feasibility of implementing artificial recharge programs, protecting groundwater quality, monitoring the ground water, and publishing annual reports on basin conditions.

FLOOD HAZARDS:

Goal F-1: Minimize injury, loss of life, property damage, and economic and social disruption caused by flood and inundation hazards.

Policy F1-1: The City will discourage development in flood hazard areas and will strengthen the City's maintenance program for storm water detention basins, culverts and storm drains to minimize future flooding events.

Program F-1.1: The City will continue to participate in the National Flood Insurance Program.

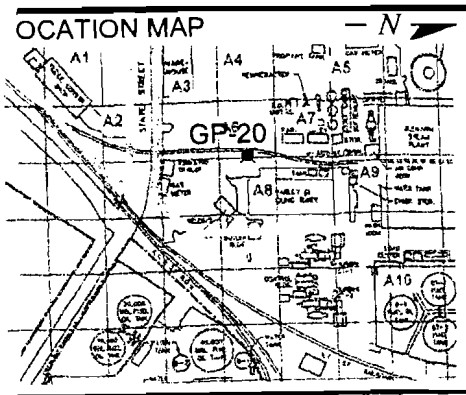
Program F-1.2: The City shall, in cooperation with the Los Angeles County Flood Control Department, conduct studies of drainage and dam improvements in selected areas at the base of the San Gabriel Mountains and the San Rafael Hills, to identify where improvements may be necessary.

Program F-1.3: The City shall encourage the development of parks and recreational facilities in the Arroyo Seco area,

Appendix I

PEG/IT Boring Logs from Reference 3

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

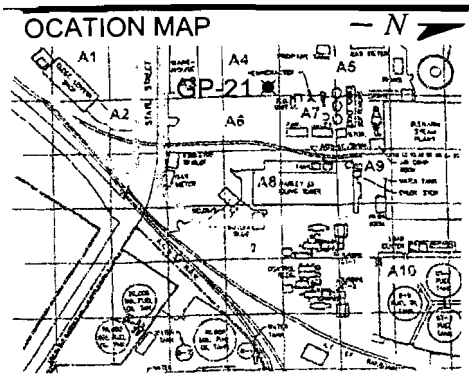
BORING NO. GP-20
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	23.3		1				SW	WELL GRADED SAND: dark brown to black; fine to coarse grained sand; visible petroleum stain; very faint oil odor.
				2					
				3					
				4					
	Dp	18.3		5					@ 5': as above; dark brown to gray brown; faint to moderate hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	20		7					@ 7': as above.
				8					
				9					
	Dp	32.3		10					@ 10': as above; light grayish brown; no stain; no hydrocarbon odor.
				11					
				12					
				13					
				14					BOTTOM OF BORING 12'
				15					
				16					
				17					
				18					
				19					
				20					
				21					

OCATION MAP



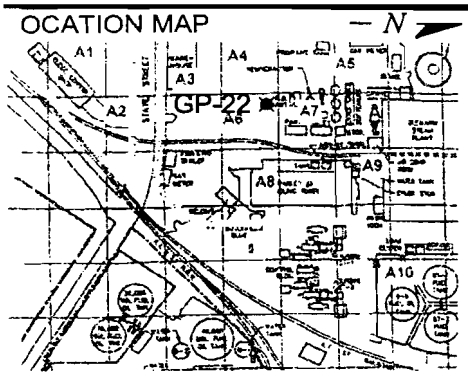
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-21
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT	Dry	0		1				ASPHALT: 4"
				2				FILL MATERIAL: sandy silt and silty sand mixed with brick; concrete; gravel; no hydrocarbon odor.
				3				
				4				
	Dry	0		5				@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	0		7			CL	CLAY: silty; dark brown; moderate to high plasticity; some silt; no hydrocarbon odor.
				8				
				9				BOTTOM OF BORING 8'
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



PACIFIC ENVIRONMENTAL GROUP, INC.

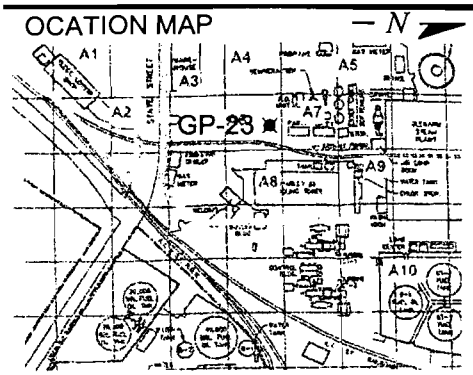
BORING NO. GP-22
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT	Dry	0.7		1					ASPHALT: 4" FILL MATERIAL: sandy silt and silty sand mixed with brick; concrete; gravel; no hydrocarbon odor.
	Dry	0.9		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS	Dp	0		7				CL	CLAY: silty; dark brown; moderate to high plasticity; some silt; no hydrocarbon odor.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

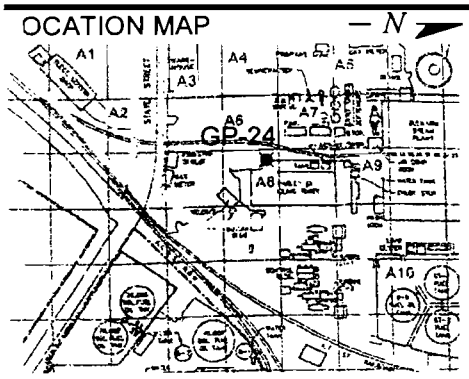
BORING NO. GP-23
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 4"
	Dry	0		1					FILL MATERIAL: sandy silt and silty sand mixed with brick; concrete; gravel; no hydrocarbon odor.
				2					
				3					
				4					
	Dry	0		5					@ 5': as above; some rusted iron debris.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	0		7				CL	CLAY: silty; dark brown; moderate to high plasticity; some silt; no hydrocarbon odor.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

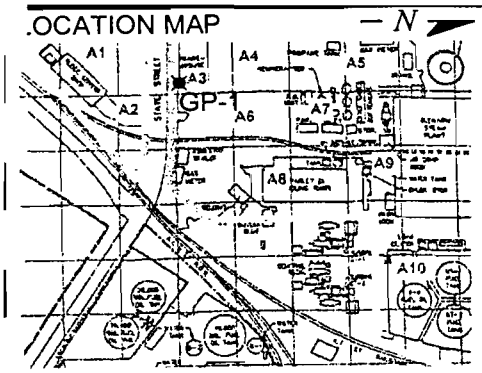
BORING NO. GP-24
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 4"
BACKFILLED WITH BENTONITE CHIPS	Dry	24.1		1	■		ML	SANDY SILT: (Alluvium); clayey; low to moderate plasticity; medium olive brown; with very fine to very coarse grained sand; some clay; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	10.1		5	■			@ 5': as above.
				6				
	Dp	4.9		7	■			@ 7': as above.
				8			SP	SAND: (Alluvium); silty; light reddish brown; very fine to very coarse grained sand; trace silt; poorly sorted; poorly graded; no hydrocarbon odor.
				9				
				10				BOTTOM OF BORING 8'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

LOCATION MAP



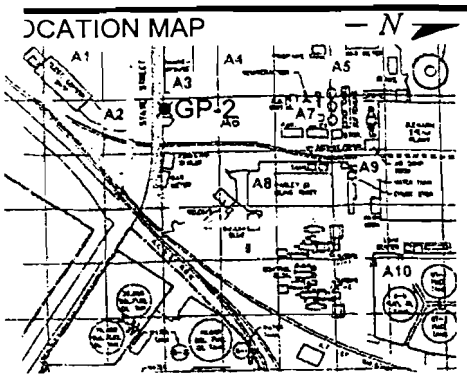
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-1
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/23/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	4.3		1				SM	SILTY SAND: dark brown; scattered brick debris; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	2.3		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	3.0		7					@ 7': as above.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



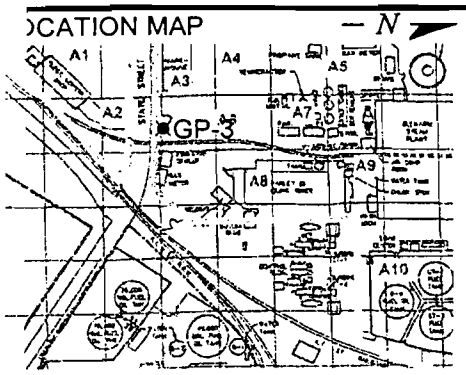
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-2
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dry	4.0		1			SW	WELL GRADED SAND: dark black; visible petroleum stain; odor of old degraded oil.
				2				
				3				@ 3': no staining.
				4				
	Dry	5.1		5			ML	SILT TO SANDY SILT: brown to dark brown; no stain; no hydrocarbon odor.
				6				
	Dry	5.0		7			SW	WELL GRADED SAND: brown to reddish brown; no stain; no hydrocarbon odor.
				8				
				9				
				10				BOTTOM OF BORING 8'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



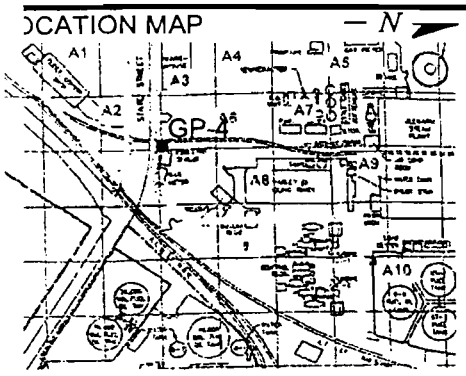
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-3
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									BRICK DEBRIS: 1'
BACKFILLED WITH BENTONITE CHIPS	Dry	4.9		1				SW	WELL GRADED SAND: dark brown to blackish brown; visible petroleum stain; very slight to no hydrocarbon odor.
				2					
				3					@ 3.5': no staining.
				4					
	Dry	6.5		5					@ 5': as above; brown to dark reddish brown; no stain; no hydrocarbon odor.
				6					
	Dry	9.0		7					@ 7': as above.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



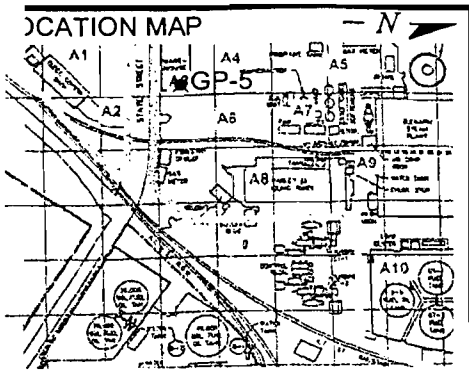
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-4
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dry	10.2		1			ML	SILT TO SANDY SILT: dark brown, brown to black; slight petroleum staining; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	7.1		5			SW	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
				6				
	Dp	8.9		7			CL	SILTY CLAY TO CLAY: dark brown to blackish brown; low plasticity; visible petroleum stain; very faint degraded oil odor.
				8				
				9				@ 9': decrease in staining.
				10				
				11				
	Dp	6.9		12			SW	WELL GRADED SAND: buff to light gray; fine to very coarse grained sand; no stain; no hydrocarbon odor.
				13				
				14				BOTTOM OF BORING 12'
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



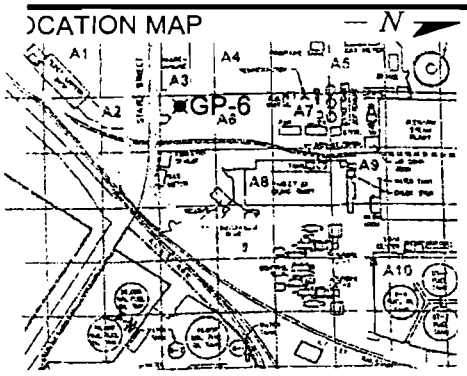
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-5
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
	Dp	5.6		1			SM	SILTY SAND: dark reddish brown; no stain; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	7.6		5				@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	12		7				@ 7': as above.
				8				BOTTOM OF BORING 8'
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



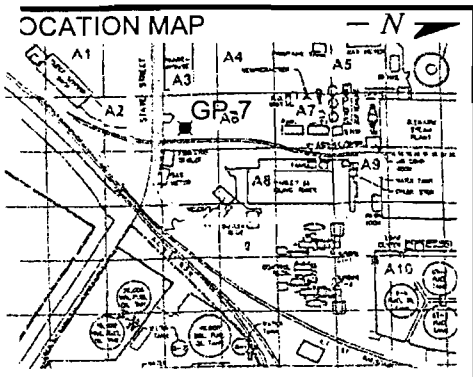
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-6
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	6.2		1				SW	WELL GRADED SAND: brown to reddish brown; fine grained sand to gravel size; no stain; no hydrocarbon odor.
				2					
				3					@ 3': as above; brick and cobble debris.
				4					
	Dry	5.0		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dry	5.2		7					@ 7': as above.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



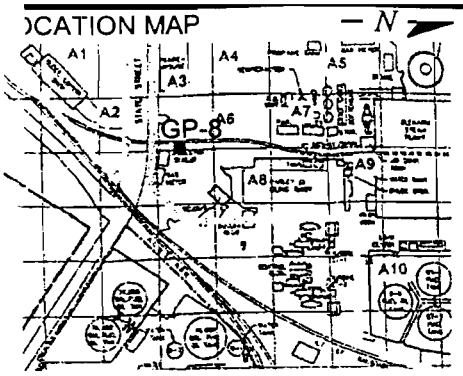
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-7
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	6.3		1				SM	SILTY SAND: dark brown to reddish brown; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dry	9.8		5				SW	WELL GRADED SAND: dark brown to reddish brown; no stain; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dry	12.2		7				ML	CLAYEY SILT: dark brown to black; low plasticity; visible petroleum stain; faint hydrocarbon odor.
				8					
				9					@ 9': decrease in staining.
	Dry	6.4		10					
				11				SW	WELL GRADED SAND: reddish brown to buff; no stain; no hydrocarbon odor.
				12					
				13					
				14					BOTTOM OF BORING 12'
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



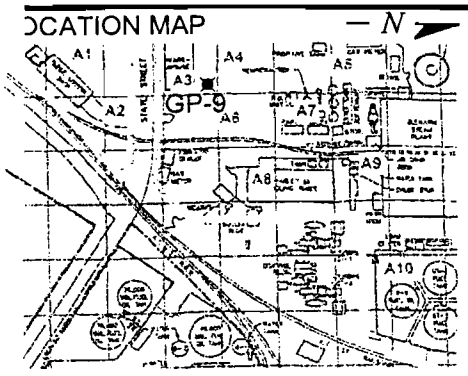
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-8
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dp	7.6		1				SW	WELL GRADED SAND: reddish brown; visible petroleum stain from surface to 1'; no hydrocarbon odor
				2					
				3					@ 3': no staining.
				4					
	Dp	11.7		5				SM	SILTY SAND: reddish brown; slight staining; no hydrocarbon odor.
				6					
	Dp	12.2		7				SW	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



PACIFIC ENVIRONMENTAL GROUP, INC.

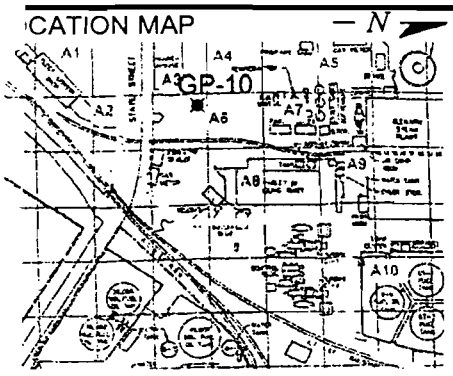
BORING NO. GP-9
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	8.5		1				SM	SILTY SAND: dark brown; fine to medium grained sand; no visible staining; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	19.2		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	14.1		7					@ 7': as above.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

CATION MAP



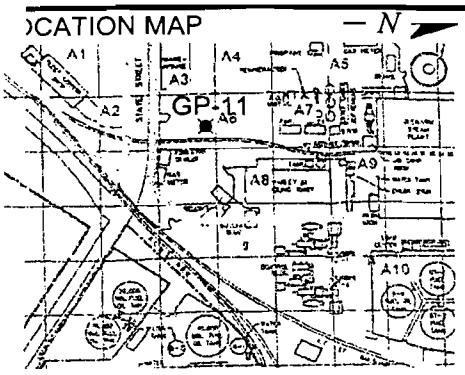
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-10
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

OREHOLE BACKFILL		MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHA										ASPHALT: 3"
		Dp	15.2		1				SW	WELL SORTED SAND: reddish brown; fine grained sand to pebble size; no stain; no hydrocarbon odor.
					2					
					3					
					4					
		Dp	17.4		5					@ 5': as above.
					6					
BACKFILLED WITH BENTONITE CHIPS		Dp	19.0		7					@ 7': as above.
					8					
					9					BOTTOM OF BORING 8'
					10					
					11					
					12					
					13					
					14					
					15					
					16					
					17					
					18					
					19					
					20					
					21					
					22					



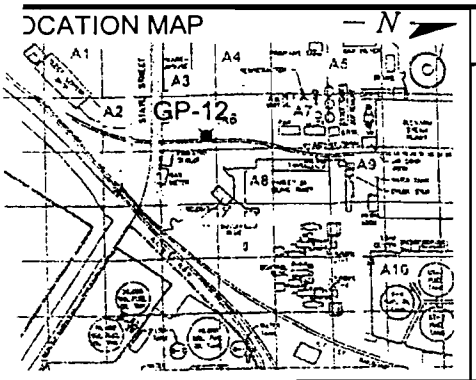
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-11
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	7.2		1				SW	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	8.8		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	9.7		7					@ 7': as above; black; petroleum stain; very faint oiley odor.
				8					
				9					
				10					
				11					
	Dp	5.2		12					@ 12': as above; reddish brown; fine to very coarse grained sand; no stain; no hydrocarbon odor.
				13					
				14					BOTTOM OF BORING 12'
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



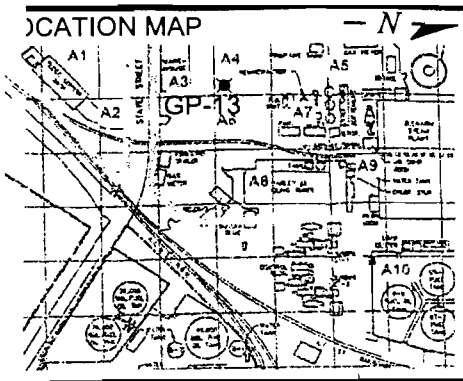
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-12
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	5.8		1				SM	SILTY SAND: reddish brown; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	6.2		5					@ 5': as above; reddish brown with occassional dark black streaks; scattered visible staining; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	6.1		7					@ 7': as above; no stain; no hydrocarbon odor.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



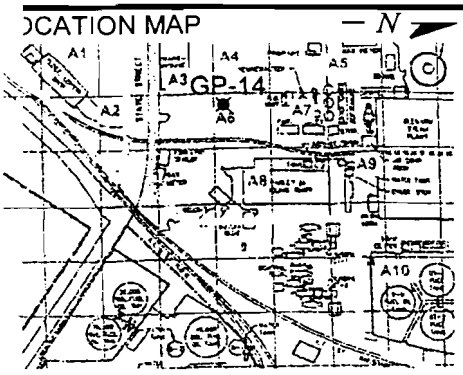
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-13
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dp	23.5		1			SW	WELL GRADED SAND: reddish brown; fine to very coarse grained sand; no stain; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	12.2		5				@ 5': as above.
				6				
	Dp	15.3		7				@ 7': as above.
				8				
				9				BOTTOM OF BORING 8'
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



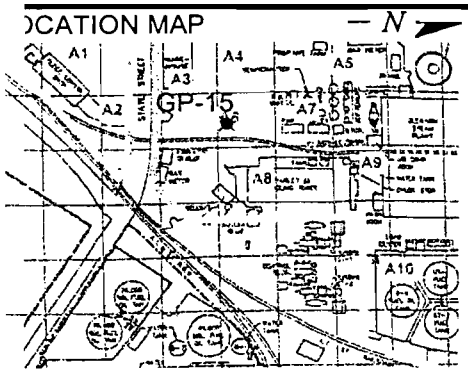
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-14
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
	Dp	17.1		1			SW	WELL GRADED SAND: reddish brown to black; visible petroleum stain; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	21.3		5				@ 5': as above; black; very faint oil odor.
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	18.0		7				@ 7': as above; reddish brown to black; no hydrocarbon odor.
				8				
				9				
				10				BOTTOM OF BORING 8'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-15
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

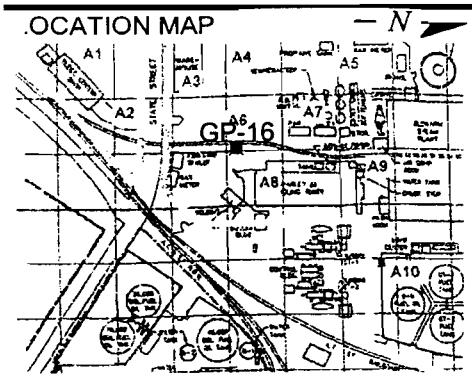
CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPH.									ASPHALT: 3"
	Dp	47.1		1				SM	SILTY SAND: dark brown to black; visible petroleum stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	29.3		5					@ 5': as above; reddish brown; no stain.
				6					
	Dp	52.9		7					@ 7': as above.
				8					
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

BACKFILLED WITH BENTONITE CHIPS

BOTTOM OF BORING 8'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

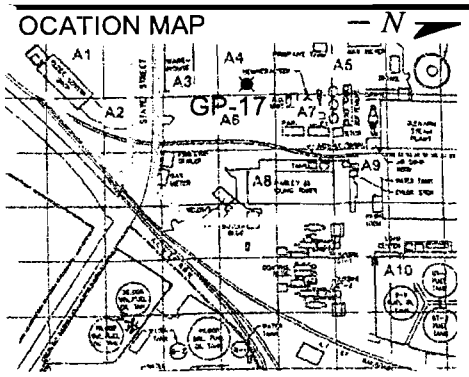
BORING NO. GP-16
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dry	42.7		1			SW	WELL SORTED SAND: dark brown to black; fine to coarse grained sand; visible petroleum stain.
	Dp	32.1		5				@ 5': as above; reddish brown; no stain; no hydrocarbon odor.
	Dp	0		7				@ 7': as above; dark brown to black; visible petroleum stain; no hydrocarbon odor.
	Dp	37.1		10				@ 10': as above; reddish brown to buff; no stain; no hydrocarbon odor.
				12				BOTTOM OF BORING 12'

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

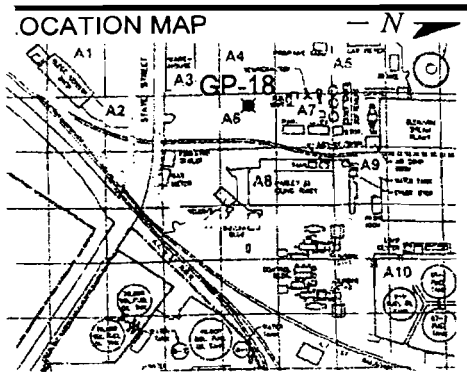
BORING NO. GP-17
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
	Dp	70.0		1			SW	WELL SORTED SAND: reddish brown; fine to medium grained sand; no stain; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	45.1		5				@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	0		7			CL	SILTY CLAY: dark brown to black; low plasticity; visible petroleum stain; very faint to no hydrocarbon odor.
				8				
				9				
				10				
				11				
	Dp	21.5		12			SW	WELL SORTED SAND: reddish brown; fine to medium grained sand; no stain; no hydrocarbon odor.
				13				
				14				BOTTOM OF BORING 12'
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

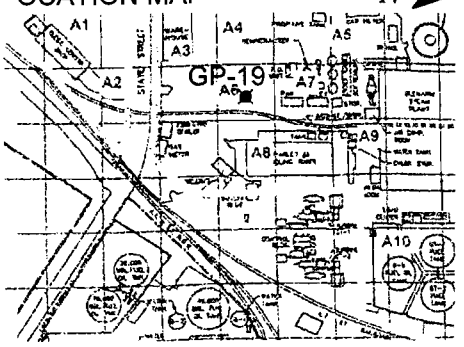
BORING NO. GP-18
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	24.4		1				SW	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	26.8		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	18.0		7					@ 7': as above.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

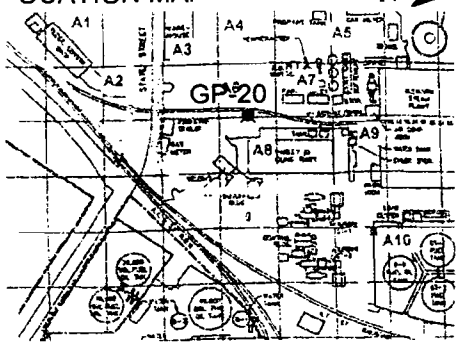
BORING NO. GP-19
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	29.5		1				SW	WELL SORTED SAND: dark brown to blackish brown; fine to coarse grained sand; visible petroleum stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	32.0		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	51.1		7				SM	SILTY SAND: dark brown to blackish brown; fine to medium grained sand; visible petroleum stain; very faint degraded oil odor.
				8					
				9					
				10					
				11					
	Dp	0		12				SW	WELL SORTED SAND: reddish brown; fine to very coarse grained sand; no stain; no hydrocarbon odor.
				13					
				14					BOTTOM OF BORING 12'
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-20
PAGE 1 OF 1

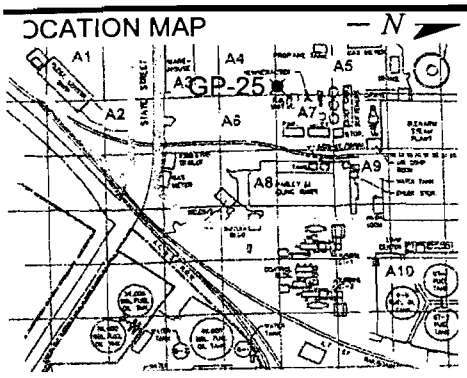
PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	23.3		1				SW	WELL GRADED SAND: dark brown to black; fine to coarse grained sand; visible petroleum stain; very faint oil odor.
				2					
				3					
				4					
	Dp	18.3		5					@ 5': as above; dark brown to gray brown; faint to moderate hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	20		7					@ 7': as above.
				8					
				9					
	Dp	32.3		10					@ 10': as above; light grayish brown; no stain; no hydrocarbon odor.
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

BOTTOM OF BORING 12'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

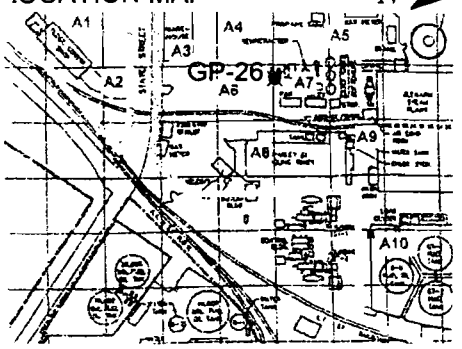
BORING NO. GP-25
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	0		1				SW	WELL GRADED SAND: reddish brown; fine to medium grained sand; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	18.8		5				GW	GRAVEL: 1/4" gravel bed; no stain; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	25.2		7				SM	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

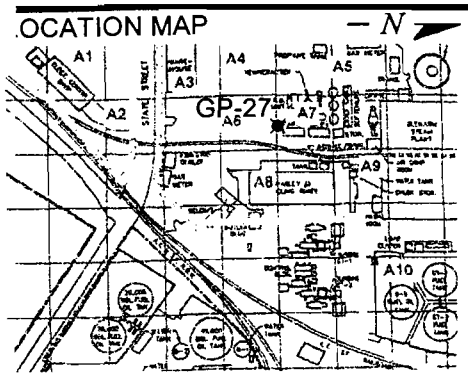
BORING NO. GP-26
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	0		1	■			SW	WELL GRADED SAND: reddish brown; fine to coarse grained sand; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	3.2		5	■			GW	GRAVEL: 1/4"; clean; no stain; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	0		7	■			CL	CLAY: brown; moderate plasticity; no stain; no hydrocarbon odor.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

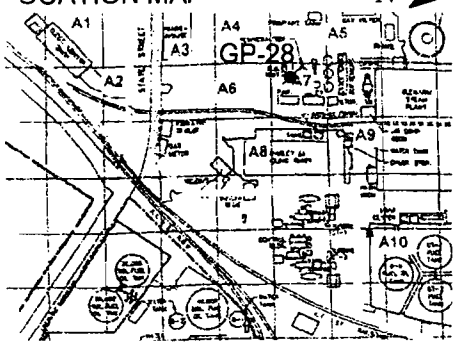
BORING NO. GP-27
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: DIRECT PUSH
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	6.9		1					FILL MATERIAL: silty gravelly sand mixed with construction debris; brick; concrete; mortar; nails.
				2					
				3					
				4					
	Dry	0		5					@ 5': as above.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	10.8		7				CL	SILTY CLAY: (Alluvium); sandy; medium brown; low to moderate plasticity; with silt; some very fine to very coarse grained sand; poorly graded; poorly sorted; no hydrocarbon odor.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

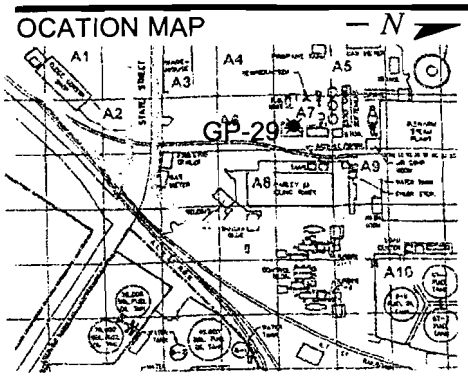
BORING NO. GP-28
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	32.5		1				SW	WELL GRADED SAND: reddish brown to dark brown; fine to very coarse grained sand; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	27.1		5				GW	GRAVEL: fill.
BACKFILLED WITH BENTONITE CHIPS				6					
	Mst	31.1		7				CL	CLAY: light brown to brown; moderate to high plasticity; no stain; no hydrocarbon odor.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

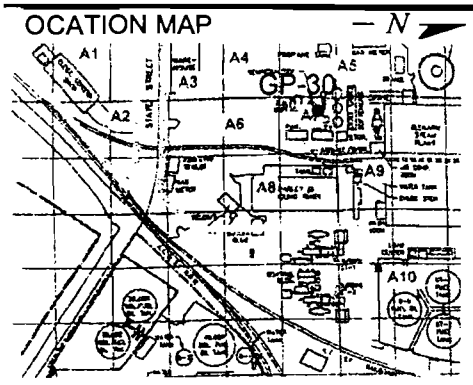
BORING NO. GP-29
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dp	9.2		1				SW	WELL SORTED SAND: brown to dark brown; very fine to coarse grained sand; no stain; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	6.7		5				SM	SILTY SAND: brown to dark brown; no stain; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	7.0		7				CL	CLAY: brown; moderate plasticity; no stain; no hydrocarbon odor.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



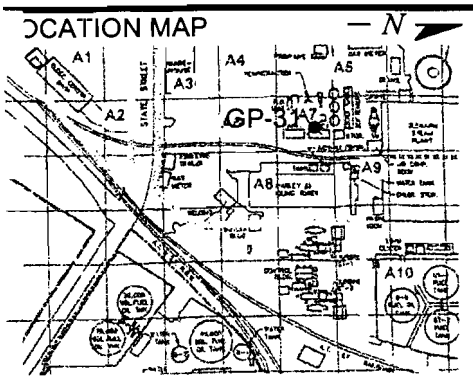
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-30
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. MCCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 4"
	Dp	8.2		1–2			SM	WELL GRADED SAND: reddish brown; no stain; no hydrocarbon odor.
	Dp	6.5		4–5			CL	CLAY: medium brown; moderate plasticity; debris; no stain; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS	Dp	7.0		7–8				@ 8': as above.
				9–22				BOTTOM OF BORING 8'



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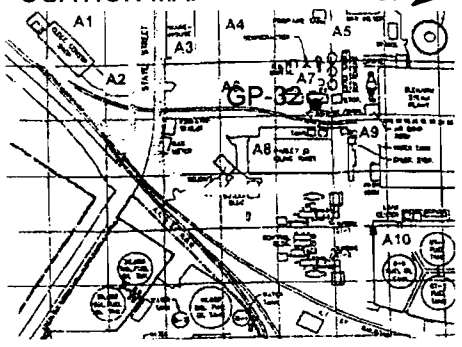
BORING NO. GP-31
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. McCULLOUGH
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dp	10.2		1				SP	SAND: light brown; predominantly medium grained; no stain; no hydrocarbon odor.
				2					
				3					DEBRIS: brick; gravel.
				4					
	Dp	12.0		5				SW	
				6					
	Dp	8.7		7				CL	CLAY: light brown to black in places; visible petroleum stain; no hydrocarbon odor.
				8					
				9					
				10					
	Dp	7.2		11				SM	SILTY SAND: no stain; no hydrocarbon odor.
				12					BOTTOM OF BORING 12'
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

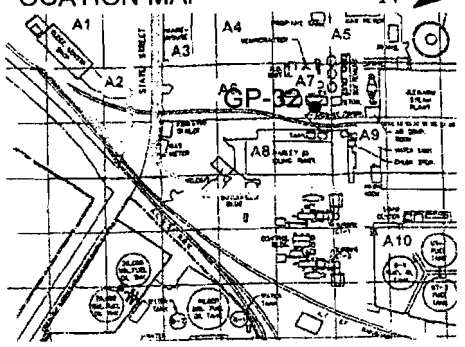
BORING NO. GP-32
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
BACKFILLED WITH BENTONITE CHIPS	Dry	10.7		1			CL	SANDY CLAY: (Alluvium); silty; olive brown; low to moderate plasticity; very fine to very coarse grained sand; some silt; no hydrocarbon odor.
	Dp	7.2		5				@ 5': as above.
	Dp	42.1		7				@ 7': as above; trace coarse gravel; hydrocarbon staining.
	Dp	10.1		10				@ 10': as above; very light hydrocarbon staining.
				12			SW	SAND: (Alluvium); gravelly; fine to medium textured; light orangish brown; medium to very coarse sand; some fine to coarse gravel; poorly sorted; poorly graded; no hydrocarbon odor.
								BOTTOM OF BORING 12'

OCATION MAP



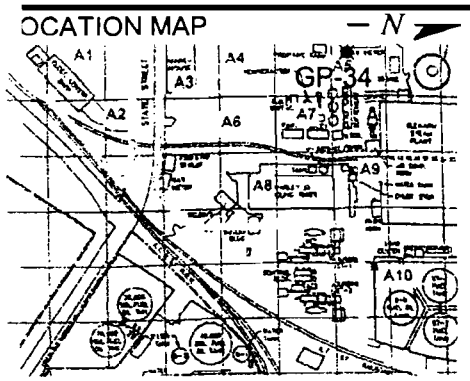
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-33
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
	Dry	0		1			CL	SANDY CLAY: (Alluvium); silty; olive brown with mottled black coloring; low to moderate plasticity; very fine to very coarse grained sand; trace silt; no hydrocarbon odor.
				2				
				3				
				4				
	Dp	17.4		5			SM	SANDY SILT: (Alluvium); clayey; gravelly; olive brown; low to moderate plasticity; very fine to very coarse sand; some clay; trace gravel; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	19.9		7				@ 7': as above
				8				
				9				
				10				BOTTOM OF BORING 8'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				



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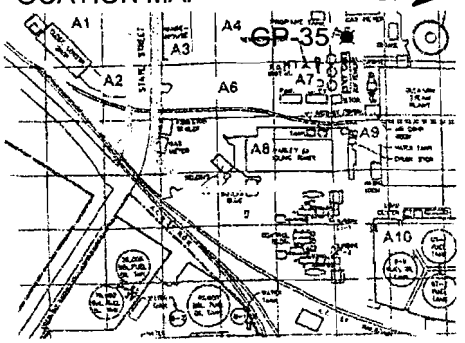
BORING NO. GP-34
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 6'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT / BACKFILLED WITH BENTONITE CHIPS				1					ASPHALT: 3"
				2				ML	SILT: (Alluvium); clayey; medium grayish brown; low plasticity; some clay; no hydrocarbon odor.
				3					
				4					
				5				SM	SILTY SAND: (Alluvium); gravelly; medium grayish brown; coarse texture; some coarse gravel; well rounded to subangular; poorly sorted; poorly graded; no hydrocarbon odor.
				6					REFUSAL @ 6'
				7					
				8					
				9					
				10					BOTTOM OF BORING 6'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP — N



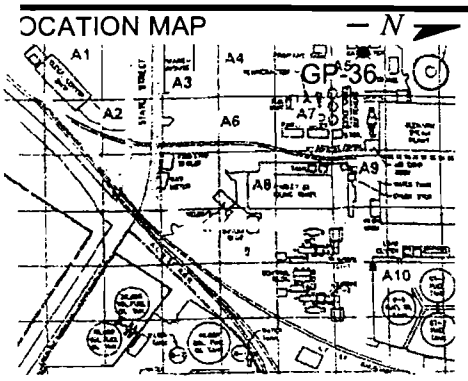
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-35
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT				1					ASPHALT: 3"
				1				ML	SILT: (Alluvium); clayey; medium grayish brown; low to moderate plasticity; some clay; no hydrocarbon odor.
				2					
				3					
				4					
				5				SM	SILTY SAND: (Alluvium); gravelly; medium grayish brown; coarse texture; some very coarse gravel; well rounded to subangular; poorly sorted; poorly graded; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					@ 7': as above.
				7					
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



PACIFIC ENVIRONMENTAL GROUP, INC.

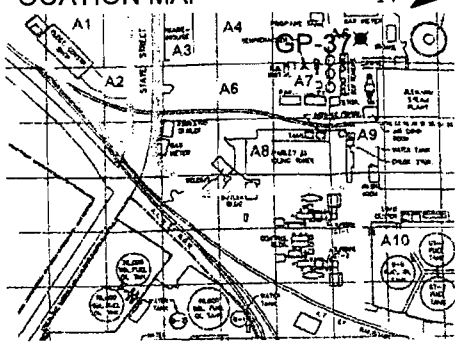
BORING NO. GP-36
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT								ASPHALT: 3"
	Dry	3.0		1			ML	SILT: (Alluvium); clayey; medium grayish brown; low to moderate plasticity; some clay; no hydrocarbon odor.
				2				
				3				
				4			SW	SAND: (Alluvium); gravelly; medium grayish brown; fine texture; very fine to medium grained sand; trace fine gravel; poorly sorted; poorly graded; no hydrocarbon odor.
	Dry	7.1		5				
BACKFILLED WITH BENTONITE CHIPS				6				
	Dp	12.1		7			SM	SILTY SAND: (Alluvium); gravelly; medium grayish brown; coarse texture; very fine to very coarse grained sand; trace coarse gravel; with silt; some dark gray zones; no hydrocarbon odor.
				8				
				9				
				10				BOTTOM OF BORING 8'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

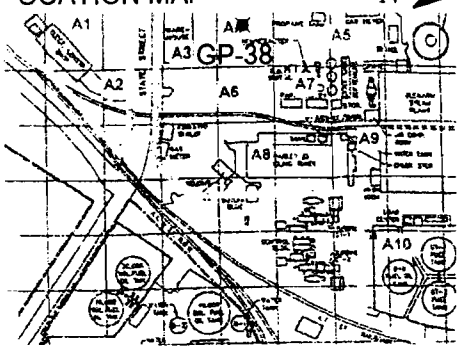
BORING NO. GP-37
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 3"
	Dry	10.7		1				ML	SILT: (Alluvium); clayey; medium grayish brown; low to moderate plasticity; some clay; no hydrocarbon odor.
				2					
				3				SW	SAND: (Alluvium); gravelly; medium grayish brown; fine texture; very fine to medium grained sand; trace fine gravel; poorly sorted; poorly graded; no hydrocarbon odor.
				4					@ 4.5' to 5': black zone.
	Dry	30.1		5					
BACKFILLED WITH BENTONITE CHIPS				6					
	Dry	7.3		7				SM	SILTY SAND: (Alluvium); gravelly; medium grayish brown; coarse texture; very fine to very coarse grained sand; trace coarse gravel; with silt; no hydrocarbon odor.
				8					
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

OCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

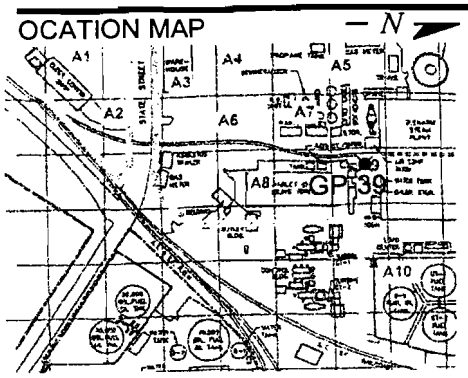
BORING NO. GP-38
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL		MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 4"
		Dry	0		1			SM	SILTY SAND: (Alluvium); olive brown; low to moderate plasticity; fine to very coarse grained sand; no hydrocarbon odor.
					2				
					3				
					4				
		Dp	0		5				@ 5': as above; trace fine gravel.
BACKFILLED WITH BENTONITE CHIPS					6				
		Dp	0		7				@ 7': as above; trace coarse gravel.
					8				
					9				
					10				BOTTOM OF BORING 8'
					11				
					12				
					13				
					14				
					15				
					16				
					17				
					18				
					19				
					20				
					21				
					22				

OCATION MAP



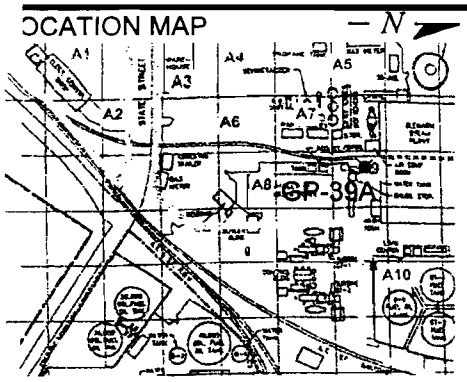
PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-39
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 4"
	Dry	0		1				SM	SILTY SAND: (Alluvium); clayey; gravelly; grayish olive; overall fine texture; with silt; trace clay; trace very coarse gravel; well rounded to subangular; no hydrocarbon odor.
				2					
				3					
				4					
	Dp	9.7		5				CL	SILTY CLAY: clayey; gravelly; black; low to moderate plasticity; very fine to very coarse grained sand in places; trace very coarse gravel; well rounded to subangular; black possibly from hydrocarbon staining; no hydrocarbon odor.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	14.5		7					@ 7': as above; medium grayish olive.
				8					BOTTOM OF BORING 8'
				9					
				10					
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					



PACIFIC ENVIRONMENTAL GROUP, INC.

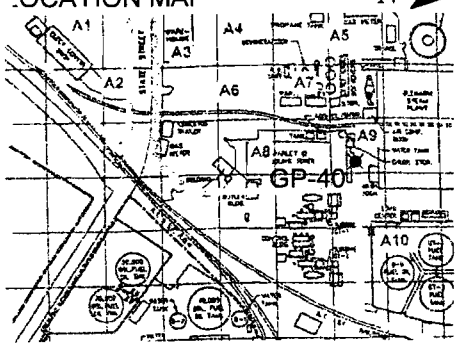
BORING NO. GP-39A
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 10.5'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT BACKFILLED WITH BENTONITE CHIPS				1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22				SM CL GW	ASPHALT: 4" SILTY SAND: (Alluvium); clayey; gravelly; grayish olive; overall fine texture; with silt; trace clay; trace very coarse gravel; well rounded to subangular; no hydrocarbon odor. SILTY CLAY: gravelly in places; black; low to moderate plasticity; very fine to very coarse grained sand; trace very coarse gravel; well rounded to subangular; black possibly from hydrocarbon staining; no hydrocarbon odor. @ 7': as above; medium grayish olive. GRAVELLY SAND: silty; olive brown; very coarse texture; very fine to very coarse sand; very fine to very coarse gravel; trace silt; poorly sorted; poorly graded; no hydrocarbon odor. BOTTOM OF BORING 10.5'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. GP-40
PAGE 1 OF 1

PROJECT NO. 640-001.1B
LOGGED BY: P. TEENSMA
DRILLER: VIRONEX
DRILLING METHOD: DIRECT PUSH
SAMPLING METHOD: ACETATE LINERS
CASING TYPE: NA
SLOT SIZE: NA
GRAVEL PACK: NA

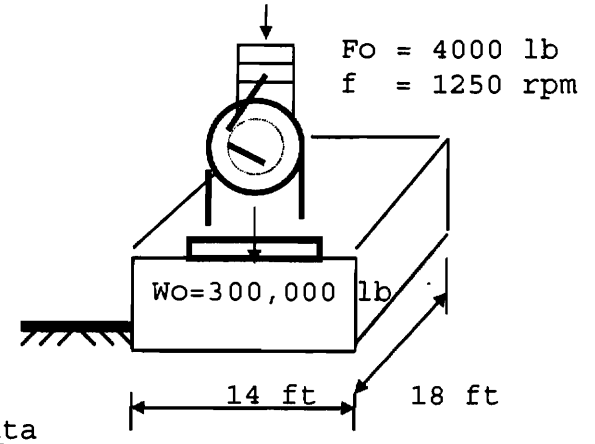
CLIENT: CITY OF PASADENA
DATE DRILLED: 8/20/99
LOCATION: 72 E. GLENARM STREET
HOLE DIAMETER: 1.5"
HOLE DEPTH: 8'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

BOREHOLE BACKFILL	MOISTURE CONTENT	PID (ppm)	PENETRATION (BLOWS/ FT)	DEPTH (FEET)	RECOVERY	SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY/REMARKS
ASPHALT									ASPHALT: 4"
	Dry	3.7		1				ML / CL	SANDY SILT to CLAY: (Alluvium); gravelly; low to moderate plasticity; very fine to very coarse grained sand; trace very fine gravel; poorly sorted; poorly graded; no hydrocarbon odor.
	Wt			2					
				3					@ 3': as above; some hydrocarbon staining.
				4					
	Wt	17.2		5					@ 5': as above; very coarse gravel; moderate hydrocarbon staining.
BACKFILLED WITH BENTONITE CHIPS				6					
	Dp	10.1		7					@ 7': as above; some hydrocarbon staining.
				8				SW	SAND: (Alluvium); gravelly; coarse texture; medium to coarse grained sand; trace fine gravel; subangular to well rounded; poorly sorted; poorly graded; no hydrocarbon odor.
				9					
				10					BOTTOM OF BORING 8'
				11					
				12					
				13					
				14					
				15					
				16					
				17					
				18					
				19					
				20					
				21					
				22					

Appendix J

Pages 26-29 of Reference 36

A. VIBRATION IN VERTICAL MODE



Equipment Data

Given a high speed generator with a frequency dependent amplitude

$F_o := 4000 \cdot lb$

Weight of vibrating equipment and foundation block Wo=300,000lb

Operating frequency f=1250 rpm $f := 20.83 \cdot sec^{-1}$ cycles/sec;

$\omega := f \cdot 2 \cdot \pi$ $\omega = 130.879 \cdot sec^{-1}$ rad/sec; Dimension: $B := 18 \cdot ft$ $L := 14 \cdot ft$

Soil Properties

Total unit weight $\gamma_t := 120 \cdot \frac{lb}{ft^3}$ Poisson's ratio $\nu := 0.35$;

Shear Modulus $G := 6700 \cdot \frac{lb}{in^2}$

Equivalent Radius

$r_0 := \sqrt{\frac{B \cdot L}{\pi}}$ $r_0 = 8.956$

Spring Constant

$K_z := \frac{4 \cdot G \cdot r_0}{1 - \nu}$ $K_z = 5.318$

Mass Ratio

$\rho := \frac{\gamma_t}{32.2 \cdot \frac{ft}{sec^2}}$ $m := \frac{W_o}{32.2 \cdot \frac{ft}{sec^2}}$ $B_z := \frac{(1 - \nu) \cdot m}{4 \cdot \rho \cdot r_0^3}$

$\rho = 3.727$ $m = 9.317$ $B_z = 0.565$

Damping Ratio

$D_z := \frac{0.425}{\sqrt{B_z}}$

$D_z = 0.565$

Static Amplitude

$A_s := \frac{F_o}{K_z}$

$A_s = 9.027 \cdot 10^{-4} \cdot in$

Natural Frequency

$\omega_n := \sqrt{\frac{K_z}{m}}$

$\omega_n = 75.548 \cdot sec^{-1}$ rad/sec

Dynamic Amplitude

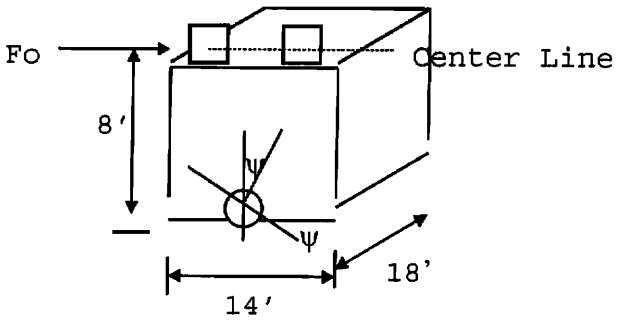
$\frac{\omega}{\omega_n} = 1.732$ Then from Figure 7 (B) and for D = 0.56 M = 1.1

$A_{max} := A_s \cdot M$ $A_{max} = 9.929 \cdot 10^{-4} \cdot in$ Maximum dynamic amplitude

Figure 8

Example Calculation of Vertical, Horizontal, and Rocking Motions

B. EXAMPLE CALCULATION FOR HORIZONTAL TRANSLATION AND ROCKING



Equipment Data

Assume constant amplitude $F_0 := 300 \cdot lb$ Dimensions $B := 18 \cdot ft$ $L := 14 \cdot ft$

Weight of foundation and machinery $W := 400000 \cdot lb$

Mass Moment of Inertia around axis of rotation $I_\psi := 400000 \cdot lb \cdot ft \cdot sec^2$

Operating Frequency f=350 rpm $f := 5.8 \cdot sec^{-1}$ cycles/sec $\omega := f \cdot 2 \cdot \pi$

ω = 36.442 rad/sec

Soil Properties

Total Unit Weight $\gamma_t := 120 \cdot \frac{lb}{ft^3}$ Poisson's Ratio $\nu := 0.35$

Shear Modulus $G := 6700 \cdot \frac{lb}{in^2}$

HORIZONTAL TRANSLATION ONLY

Equivalent Radius

$r_0 := \sqrt{\frac{B \cdot L}{\pi}}$

r_0 = 8.956

Spring Constant

$K_x := \frac{32 \cdot (1 - \nu) \cdot G \cdot r_0}{7 - 8 \cdot \nu}$

K_x = 4.279

Mass Ratio

$m = \frac{400000 \cdot lb}{32.2 \cdot \frac{ft}{sec^2}}$

m = 1.242

$\rho := \frac{120 \cdot \frac{lb}{ft^3}}{32.2 \cdot \frac{ft}{sec^2}}$

ρ = 3.727

$B_x := \frac{7 - 8 \cdot \nu}{32 \cdot (1 - \nu)} \cdot \frac{m}{\rho \cdot r_0^3}$

B_x = 0.937

Damping Ratio

$D_x := \frac{0.288}{\sqrt{B_x}}$

D_x = 0.298

Static Displacement

$A_s := \frac{F_o}{K_x}$

A_s = 8.413

Natural Frequency

$\omega_n := \sqrt{\frac{K_x}{m}}$

ω_n = 58.693 rad/sec

Figure 8 (Continued)
Example Calculation of Vertical, Horizontal, and Rocking Motions

Dynamic Amplitude

$\frac{\omega}{\omega_n} = 0.621$ From Figure 7 (A), $M := 1.4$

$A_{max} := A_s \cdot M$

$A_{max} = 1.178$ Maximum Horizontal Movement

ROCKING ALONE

$r_0 := \left(\frac{B \cdot L^3}{3 \cdot \pi}\right)^{\left(\frac{1}{4}\right)}$ $B_\psi := \frac{3 \cdot (1 - \nu)}{8} \cdot \frac{I_\psi}{\rho \cdot r_0^5}$ $F_0 := (300\,lb) \cdot (8 \cdot ft)$

$r_0 = 8.508$ $B_\psi = 0.454$ $F_0 = 2.88$

Spring Constant

$K_\psi := \frac{8 \cdot G \cdot r_0^3}{3 \cdot (1 - \nu)}$

$K_\psi = 2.926$ lb*in/rad

Damping Ratio

$D_\psi := \frac{0.15}{\left(1 + B_\psi\right) \cdot \sqrt{B_\psi}}$

$D_\psi = 0.153$

Natural Frequency

$\omega_n := \sqrt{\frac{K_\psi}{I_\psi}}$

$\omega_n = 78.07$

Static Rotation

$A_\psi := \frac{F_0}{K_\psi}$

$A_\psi = 9.844$ radians

Dynamic Amplitude

$\omega := 131 \cdot sec^{-1}$ From Figure 7 (A), $M := 0.4$

$\frac{\omega}{\omega_n} = 1.678$ Maximum Rocking Movement Horizontal Motion At Machine Centerline

$A_{\psi.max} := A_\psi \cdot M$ Movement $:= A_{\psi.max} \cdot (8 \cdot ft)$

$A_{\psi.max} = 3.938$ Movement $= 3.15$ radians

NOTE:

Above analysis is approximate since horizontal and rocking modes are coupled.

A lower bound estimate of first mode frequency may be calculated based on natural frequency w_n for rocking mode alone, and horizontal translation mode alone.

Figure 8 (Continued)
Example Calculation of Vertical, Horizontal, and Rocking Motion

1.4.1.5 Dynamic Soil Properties. Guidance on dynamic soil properties and their determination is given in Sections 2 and 3.

There are several interrelated criteria for design of foundations for machinery. The most fundamental is that the vibratory movement be held to a level below that which could damage the machinery or cause settlement of loose soils. In many cases there are too many unknowns to solve this problem. The other criterion is to proportion the foundation such that resonance with the operating frequency of the machine is avoided. For high frequency machines (say over 1000 rpm) it is common to "low tune" the foundation, so that the foundation frequency is less than half the operating frequency. For low frequency machines (say under 300 rpm) it is common to "high tune" the foundation, so that the fundamental frequency is at least twice the operating frequency.

1.4.2 Design to Avoid Resonance. Settlements from vibratory loads and displacements of the machinery itself in all directions are accentuated if imposed vibrations are resonant with the natural frequency of the foundation soil system. Both the amplitude of foundation motion and the unbalanced exciting force are increased at resonance. Compact cohesionless soils will be densified to some degree with accompanying settlement. Avoidance of resonance is particularly important in cohesionless materials, but should be considered for all soils. To avoid resonance, the following guidelines may be considered for initial design to be verified by the previous methods.

1.4.2.1 High-Speed Machinery. For machinery with operating speeds exceeding about 1000 rpm, provide a foundation with natural frequency no higher than one-half of the operating value, as follows:

a) Decrease natural frequency by increasing the weight of foundation block, analyze vibrations in accordance with the methods discussed.

b) During starting and stopping the machine will operate briefly at the resonant frequency of the foundation. Compute probable amplitudes at both resonant and operating

Appendix K

Dynamic Shear Modulus & Material Damping, Jonathan D. Bray

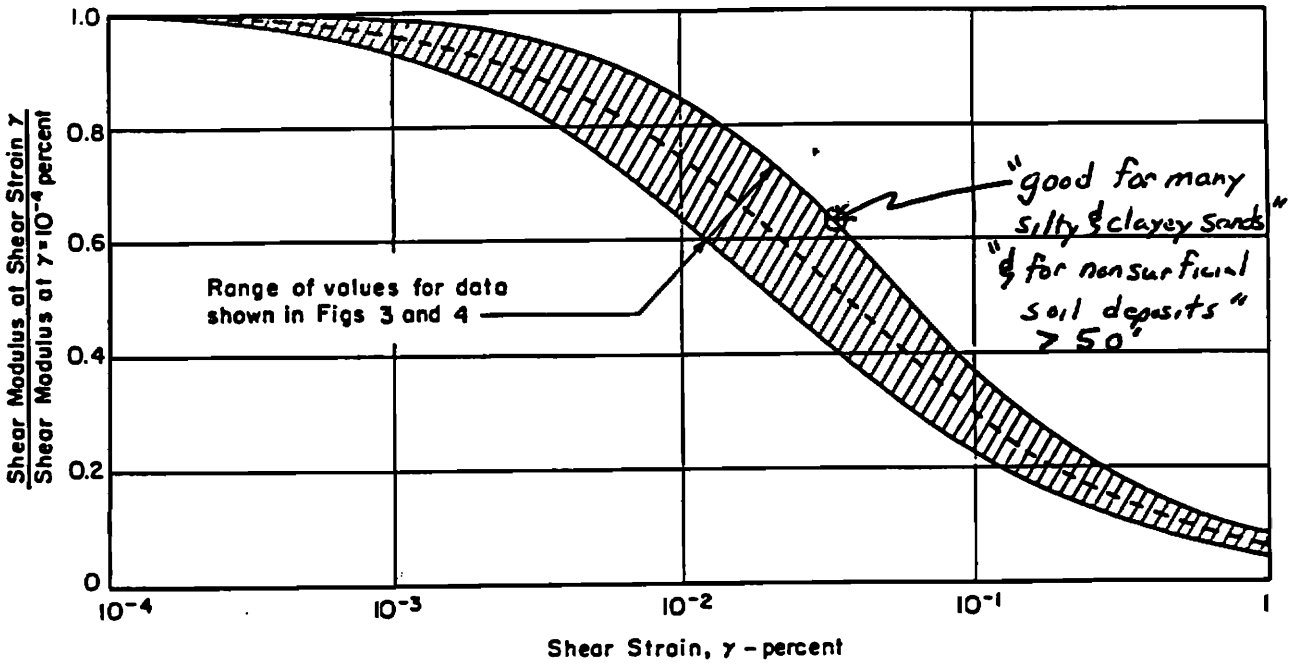
"Dynamic Shear Modulus & Material Damping"

Jonathan D. Bray, Ph.D., P.E.
Professor of Geotechnical Engineering
University of California at Berkeley

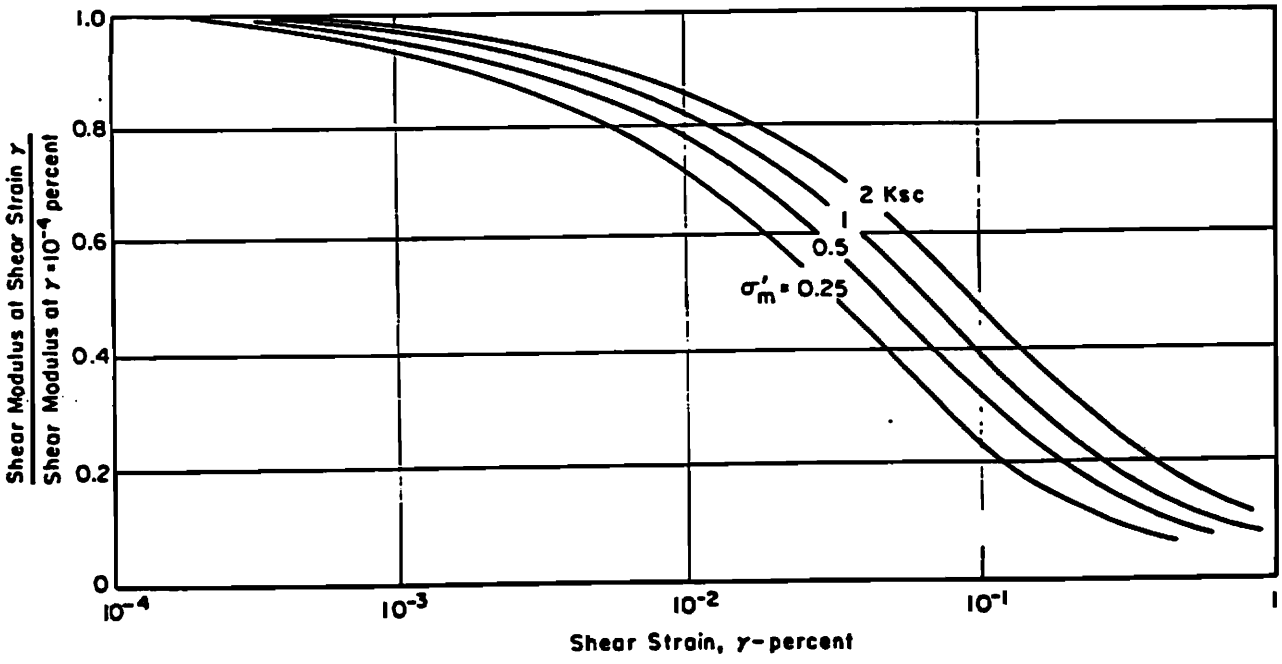
Abstract

Considerable effort has been devoted toward developing analytical techniques for evaluating the seismic response of soil deposits. Practicing engineers often employ these analytical procedures in the evaluation of potential seismic hazards at project sites. Yet, the accuracy and reliability of seismic response analyses are highly dependent on the characterization of the subsurface conditions and the evaluation of the dynamic properties of the critical soil strata. Specifically, the results of dynamic analyses are often quite sensitive to the shear modulus and material damping ratio versus shear strain relationships employed by the engineer. The overheads for a discussion of this topic are enclosed, as well as a recent paper by Stokoe et al. (2004) on this topic.

Holocene Sands (depths ≲ 100 ft)

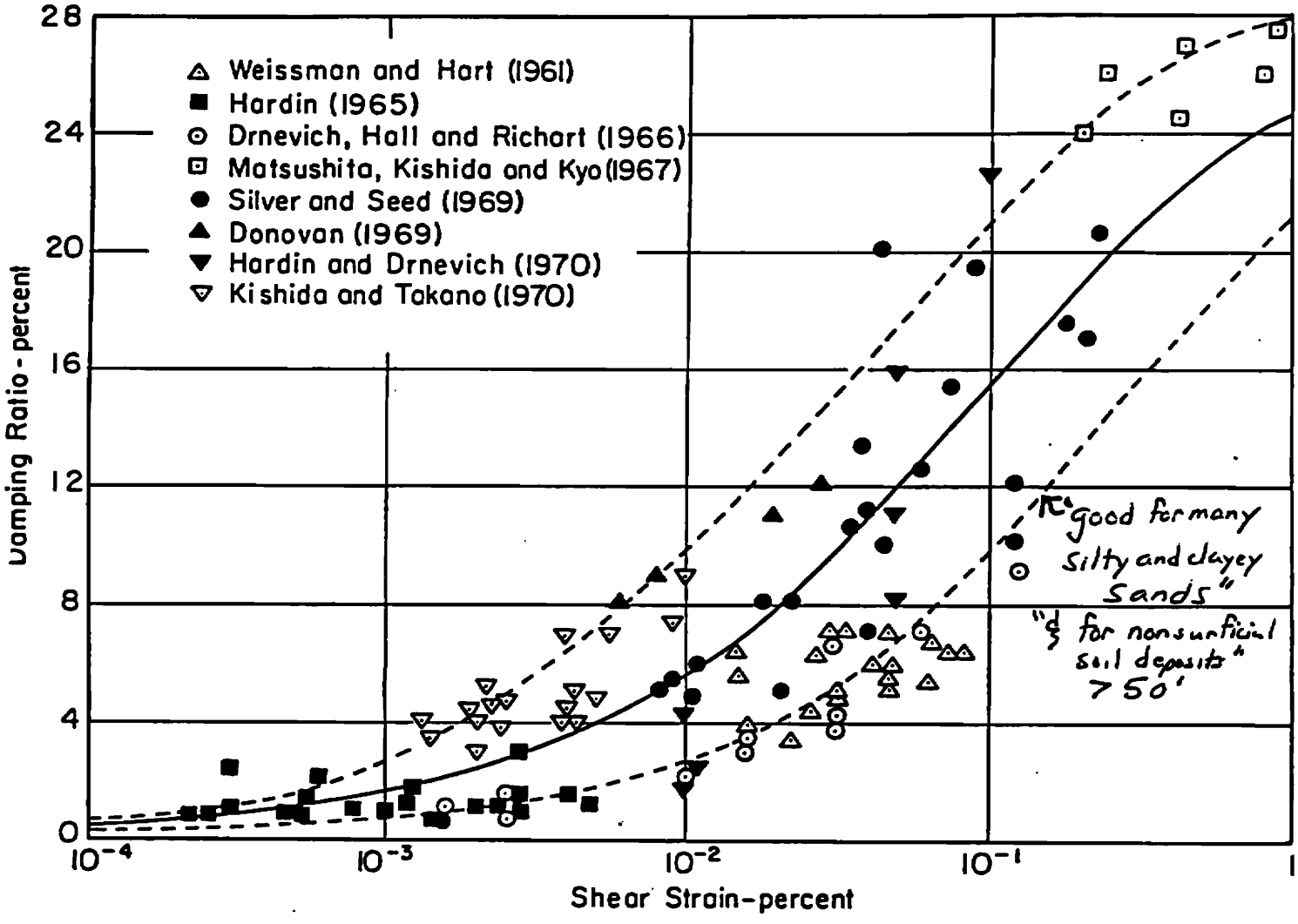


VARIATION OF SHEAR MODULUS WITH SHEAR STRAIN FOR SANDS
(after Seed and Idriss, 1970)



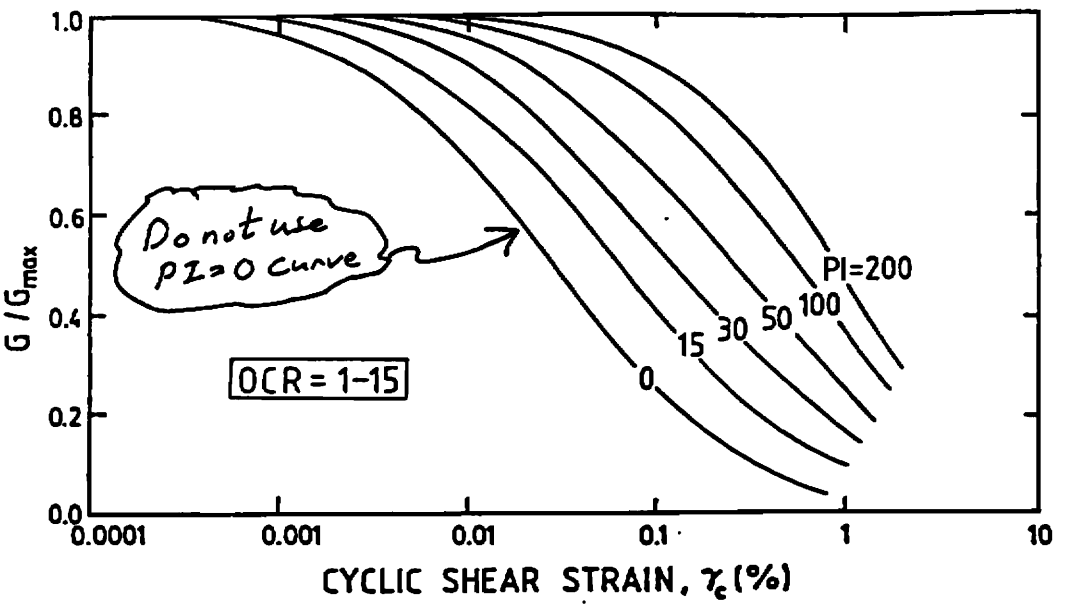
VARIATION OF SHEAR MODULUS WITH SHEAR STRAIN FOR SANDS
(after Iwasaki et al., 1976)

SANDS (Holocene or Fill; depths ≳ 100')

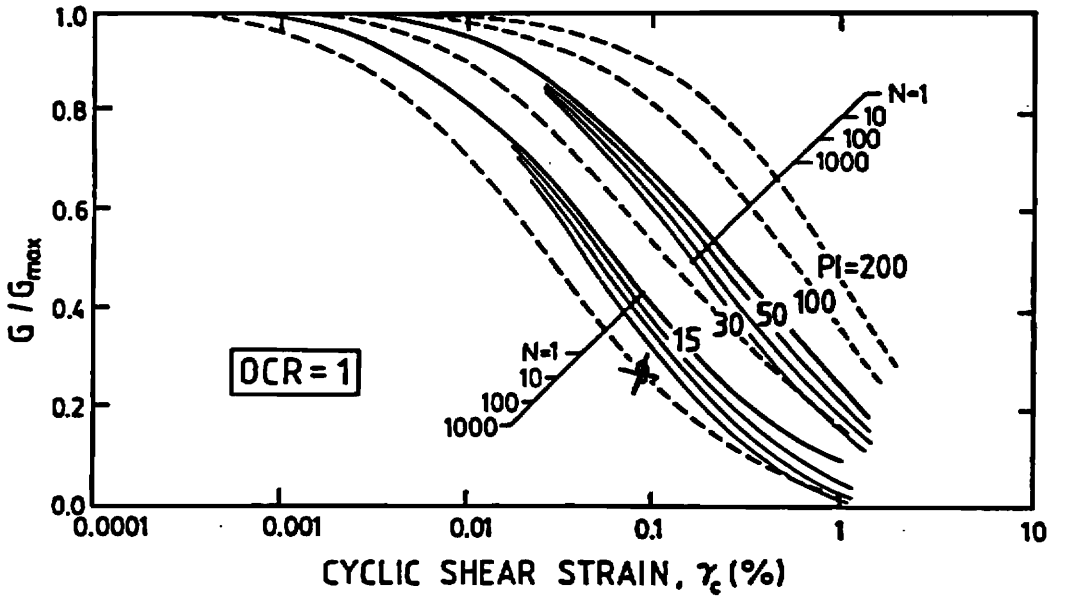


(after Seed and Idriss, 1970)

CLAYS (PI ≠ 0)
(Z ≲ 100') (largely Holocene soils)



(after Vucetic and Dobry, 1991)



(after Vucetic and Dobry, 1991)

1.0 INTRODUCTION

Hydrologue, Inc. (HI) has been retained by the City of Pasadena to conduct a limited phase II environmental site assessment for the site located at the southeast corner of the intersection of Fair Oaks Avenue and Glenarm Street in the City of Pasadena, California (hereinafter referred to as "Site") (Figure 1), in the northwestern portion of the City of Pasadena Power Plant, the south side of the Glenarm Building where the Glenarm Repowering Project (GT-5 Combined Cycle Installation) will be constructed (Figures 2 & 3).

This limited assessment consisted of collecting split soil samples during geotechnical drilling for analytical testing. The soils engineering investigation for the proposed GT-5 Combined Cycle generator was also conducted by Hydrologue, Inc. and reported separately.

2.0 DESCRIPTION OF SITE

The Site is located at the southeast corner of the intersection of South Fair Oaks Avenue and East Glenarm Street in Pasadena, California (Figure 1). The Site was first developed in the early 20th century with the existing warehouse building in its southwest corner. The Site now contains an inactive oil-and-natural-gas-fired electric generating station used by the Pasadena Water and Power Department from 1906 through 1977.

In 1906, the Pasadena Water and Power Department constructed the original steam-plant building. The facility was demolished before construction of the tank farm in 1971. The existing non-operational steam plant (i.e. the Glenarm Building) occupies the Site's northwestern corner and currently consists of two attached buildings, including an eastern building, constructed in the early 1920s, and a western building, constructed in the early 1930s. Each of the extant buildings includes boiler and turbine generator systems. Both systems in the west building remain in place but Pasadena Water and Power Department removed the systems from the east building during the 1950s. The Pasadena Water and Power Department later installed a few machine tools in the former boiler area of the east building. Some of those machine tools remain.

The topography of the Site is relatively flat. Mixed land uses surround the Site and include a commercial building, The Metropolitan Transit Authority-owned Gold Line light rail right of way (ROW) and the City of Pasadena Water and Power's Broadway Steam Plant to the east, a Southern California Edison substation and the Water and Power Department Electrical and Maintenance shop to the south, and several commercial businesses to the west. Residential areas of Pasadena and South Pasadena are within 1,000 feet of the site to the west and south respectively.

3.0 PROPOSED DEVELOPMENT

We understand that the proposed project consists of the construction of the Glenarm Repowering Project (GT-5 Combined Cycle Installation) (Figures 2 & 3).

4.0 BACKGROUND

Two environmental investigation reports were made available to us by the City of Pasadena Department of Water and Power. These reports partially cover the present Site (Figures 4 & 5):

4.1 Summary of Additional Soil Assessment Activities (Phase III) Reference 3

The report was prepared by Pacific Environmental Group and the IT Group PEG/IT and dated September 3, 1999.

The scope of PEG/IT work included drilling forty soil borings to assess subsurface soil conditions at the Site (Figures 2 & 3). Soil borings were located in areas of concern identified in PEG/IT's Phase II Report (PEG/IT, 1999b). The Phase II Report recommended further subsurface environmental assessment to better define impact to the soils in focused areas. The report also includes a risk-based review to determine whether potential restrictions to development of the Site may be warranted due to impacted soil.

The assessment was performed primarily in the central portion of the Site, but also included a few additional locations as shown in Figures 4 & 5 of the referenced report. The locations included the area near boring B-8A, at which the Phase II investigation identified a concentration of mercury. Although mercury concentrations appeared to attenuate with depth, the Phase II investigation did not define the lateral extent. The Phase II Report also suggested further investigation for volatile organic compounds (VOCs), lead, copper, and heavy hydrocarbon impact near borings B-10A through B-10F. Although lead and copper concentrations appeared to attenuate with depth, the vertical and lateral extent of the impact was not defined to regulatory action limits. Lastly, the area near borings B-12 and B-13A required further investigation for vertical and lateral definition of lead concentrations. Lead concentrations identified by the Phase II Report in this area increased with depth.

4.1.1 Subsurface Conditions

Subsurface lithologies encountered during drilling and sampling consisted primarily of sandy silt and silty sands to the total depth explored, though many borings also contained lithologies that ranged from clays to gravelly sands. Some possible hydrocarbon was observed in samples collected from the various soil borings, as noted on boring PEG/IT logs. Appendix C contains the complete PEG/IT borings logs.

The highest PID reading recorded by PEG/IT was 70.0 parts per million by volume from the sample collected from boring GP-17 at l.5' bgs.

The geologists noted that borings GP-39A and GP-40 contained a lithology zone that appeared impacted by hydrocarbons, based on its dark gray to black color and hydrocarbon-like odor. However, analytical results indicated that no TPH existed at any of the samples above, and laboratory reporting limits and TRPH analysis determined that only a small concentration of

TRPH existed above laboratory detection limits. This black layer of silt and clay was observed at an approximate depth of 3 to 7 feet bgs and contained sharp upper and lower contacts indicative of the presence of artificial fill material. The lateral extent of this material is not known.

4.1.2 Analytical Results for Volatile Organic Compounds (VOCs)

PEG/IT analyzed the samples collected from boring GP-10 at 5-feet bgs, boring GP-15 at 5-feet bgs, and boring GP-34 at 5-feet bgs for VOCs (Figure 4). Laboratory analyses did not detect any VOCs above method detection limits in these samples.

4.1.3 Analytical Results for Polychlorinated Biphenyls (PCBs)

PEG/IT reported that laboratory analyses did not detect concentrations of PCBs above laboratory method detection limits in samples analyzed for PCBs. The samples analyzed for PCBs were GP-40 at 1.5-feet bgs, GP-4, GP-11, GP-14, GP-19, GP-39, and GP-40 at 5-feet bgs and GP-7 at 7-feet bgs (Figures 4 & 5). Table 1 of the PEG/IT report (Appendix D) summarizes PCB data, including laboratory reporting limits.

4.1.4 Analytical Results for Total Recoverable Petroleum Hydrocarbons (TRPH) and Total Petroleum Hydrocarbons (TPH) Fuel Characterization

The laboratory detected TPH above method detection limits in 17 of the 44 samples analyzed for TPH fuel characterization. The 17 samples were collected from a total of eleven borings. Sixteen samples contained carbon22 to carbon33 (oil) range hydrocarbons, two contained carbon10 to carbon22 (diesel) range hydrocarbons, and two contained carbon6 to carbon10 (gasoline) range hydrocarbons. The detectable levels of TPH in all samples ranged from 100 mg/kg to 3,810 mg/kg, with the highest concentration (oil range) found in boring GP-14 at 7-feet bgs. The next highest concentration detected in a sample other than GP-14 (9,000 ppm TRPH @ 5’ depth and 3,810 ppm oil range TPH @ 7’ depth, inside present Site) occurred in the sample from boring GP-15 (outside of present Site) at 1.5-feet bgs. TPH concentrations appear to attenuate laterally to the north, east, and west. With the exception of borings GP-10 (280 ppm oil range TPH @ 7’ depth, inside the Site) and B-5 (from Phase II), no TPH impact to soil was observed south of boring GP-14. In general, TPH concentrations in most borings attenuate with depth (Figure 5).

The most common fuel type detected appears to be motor oil or similar heavy hydrocarbons. Based on this determination and the apparently dark stained soils at GP-39 and GP-40 for which the laboratory detected no TPH, PEG/IT, in consultation with the Water and Power Department, requested Associated Laboratory to analyze selected samples for TRPH in an effort to confirm that no petroleum hydrocarbons existed outside the normal TPH range. Those samples with high TPH levels were also found to contain higher TRPH levels. TRPH was detected in one sample from boring GP-40 at a concentration of 44 mg/kg, well below the Site clean-up level of 10,000 ppm (Figure 5). Table 2 of the PEG/IT report (Appendix D) summarizes analytical results for TPH fuel characterization and TRPH.

4.1.5 Analytical Results for Lead

PEG/IT reported total lead concentration for 83 samples collected from 34 borings. If any total lead concentrations exceeded the 50 ppm, PEG/IT directed the laboratory to perform a soluble lead analysis on that sample for STLC comparison. Additional samples were analyzed by the California Toxicity Characteristic Leaching Procedure in order to obtain preliminary data for possible waste disposal characterization.

Detected total lead concentrations exceeded 50 ppm in 23 samples. The Laboratory analyzed each of these samples for soluble lead and found that five samples contained soluble lead at a concentration that exceeded the STLC threshold and two samples contained soluble lead at the STLC threshold. The highest soluble lead concentration was found in the sample from boring GP-19 (outside present Site) at 1.5-feet bgs (36.4 mg/kg). Most other elevated levels of total lead and soluble lead also occurred in the upper 1.5-feet bgs samples. Furthermore, at most boring locations, lead levels attenuated with depth (Figures 4 & 5). Analytical results for lead are summarized in Table 3 of the PEG/IT report (Appendix D). If the excavated soil from areas where elevated soluble lead in soil sample is reported is planned to be disposed off-site, the stock pile soil samples should be tested for soluble lead prior to its disposal.

4.1.6 Analytical Results for Copper

PEG/IT reported the total copper concentrations for 48 samples collected from 20 soil borings. All samples contained some copper concentrations, but none contained total copper exceeding the TTLC threshold for copper. Moreover, none of the samples were determined to contain copper at or more than ten times the STLC threshold. Table 4 of PEG/IT report (Appendix D) summarizes copper regulatory limits and analytical results. It should be noted that the mercury concentration of soil sample collected from boring 8A was not confirmed in confirmatory soil samples collected by PEG/IT.

4.1.7 Analytical Results for Mercury

PEG/IT reported total mercury concentrations for samples collected at GP-34 through GP-37, GP-39, and GP-40 at depths of 1.5- and 5-feet bgs. Although most samples contained low levels of mercury, no samples contained detectable mercury concentrations that exceeded TTLC (20 ppm) or ten times STLC (0.2 ppm) for mercury. Table 5 of the PEG/IT repot (Appendix D) summarizes mercury regulatory limits and analytical results.

4.1.8 Analytical Results for Title 22 Metals

Four soil samples collected at depths of 1.5 and the 5 feet bgs from borings GP-39 and GP-40 were analyzed for Title 22 Metals. The 5 feet bgs samples were collected in the center of the black stained layer. Although various metal concentrations were detected in each of the above referenced soil samples, only the total lead concentration of soil samples collected at a depth of 1.5 feet from boring GP-40 exceeded 50 ppm (75.3 mg/kg). TTLC threshold concentration for lead is 1,000 ppm. All other analytes were below the TTLC and ten times the STLC levels.

Based on known analytical data from the Phase II and the Phase III performed by PEG/IT and the risk-based review performed by Gradient (subsidiary of PEG/IT), PEG/IT required no further action at this Site.

4.2 Report of Soils Investigation, Pasadena Water and Power Plant

This report was prepared by Hunter-Kennedy and Associates, Inc., for Southwest Industries and is dated July 30, 2003 (Reference 4).

Hunter-Kennedy reported that to make way for Site improvements, soil from selected areas in the Pasadena Water and Power Plants was tested and where necessary, excavated and disposed of off-Site. This operation was conducted beginning in October 2002 and continued through March 2003. The overall activities can be broadly classified into three project areas: Marley Cooling Tower foundation adjacent acid lines, duct banks and other associated structures; Burn Tank; and East-West Tanks. Only the Marley Cooling Tower foundation partially overlaps the present Site.

As a part of the removal of the Marley Cooling Tower foundation adjacent acid lines, duct banks and other associated structures by Southwest Industries, Hunter-Kennedy performed soil sampling and analytical testing for the underlying soil. The Marley Cooling Tower was located in the western portion of the "Glenarm power plant". The Hunter-Kennedy testing found that the soil beneath the Marley Cooling Tower was contaminated to a depth of 10 feet with varying degrees of petroleum related hydrocarbons and lead. Uncovered during the testing excavation was: (1) an area to the south of the tower (hereafter referred to as the "Oil Pit") which contained contaminated soil to a depth of 22 feet, and (2) a "tank ring" which appeared to be an old tank foundation at a depth of 10 feet near the south east corner of the tower. This tank ring area was contaminated to a depth of 12 feet. The soil underlying the duct banks, acid line and other associated structures generally did not contain levels of contaminants above the specified action levels for this project.

Soil underneath the Marley Cooling tower that contained varying concentration of petroleum hydrocarbons and lead was excavated to a depth of 10 feet at the southern end of the cooling tower and 5 feet at the northern end, 22 feet at the Oil Pit location, and 12 feet at the tank ring location (see figure 5). Excavated soil was placed in stockpiles and tested for profiling purposes for off-site disposal.

Sample locations were determined based upon the specified collection of one sample per 50 foot grid. A total of 25 samples were initially collected at depths of 1 and 5 feet below the surface (after the foundation was removed).

4.2.1 Cooling Tower

4.2.1.1 Initial Investigation (Figure 1a of the Hunter-Kennedy report, Appendix G)

The initial sample (PPPI) was collected ahead of the scheduled grid sampling when discolored soil was discovered after demolition of a small utility building located just southeast of the

cooling tower. This sample was analyzed for CAM metals and STLC lead. The results were below action levels.

On October 7 through October 16, 2002, soil samples were collected from 13 locations (samples A 1-1 through C 15-5) from depths of 1 and 5 feet.

At 9 locations, the laboratory analysis did not detect contaminant levels above the limits established for the project. However, at the remaining locations, petroleum hydrocarbon levels in excess of 10,000 mg/kg in three samples (A5-5, B5-5 and C5-5) and metal concentrations exceeding the STLC limit in 17 samples were detected.

4.2.1.2 Additional Investigation (Figure 1b of the Hunter-Kennedy report, Appendix G)

Based upon these results, additional samples were collected on January 15 and 20, 2003, in a 15-foot grid pattern at depths of 9 feet (wall/face samples) and 10 feet (bottom). These samples were analyzed for Petroleum hydrocarbons in the C10-20 and C20-30 ranges and soluble lead (STLC). Petroleum hydrocarbon levels detected in these samples were below the action levels. Laboratory results reported one sample with STLC levels above the action levels. A confirmation sample (LCS) collected March 3, 2003 did not find detectable levels of STLC lead.

4.2.1.3 Tank Ring (Figure 1c of the Hunter-Kennedy report, Appendix G)

As the excavation of the soil near the southeast portion of the cooling tower area was extended to a depth of 10 feet, a "tank ring" was discovered. The ring was a three-foot wide concrete ribbon, approximately 30 feet in diameter. The soil within the ring was discolored (black). The visually discolored soil was removed to a depth of 12 feet. One sample contained petroleum hydrocarbon levels above the action level. Three samples were collected at the 12-foot level and analyzed for petroleum hydrocarbons C10-20 and C20-30 and soluble lead (STLC). None of the results exceeded action levels.

4.2.1.3 New Storm Drain Trench (Figure 1c of the Hunter-Kennedy report, Appendix G)

While excavating a trench for the installation of a new storm drain under the former cooling tower location, a discolored area at an approximate depth of 12 feet was observed. Three samples were collected; two from the bottom at a depth of 12 feet and one from the wall face at a depth of 10 feet. Petroleum hydrocarbon levels in the samples were below action levels.

4.2.1.4 Conclusion

Contamination, primarily petroleum hydrocarbons or soluble lead, was detected to depths of 5 feet under the former Marley Cooling Tower (excavated 10 feet); 10 feet at the tank ring (excavated 12 feet); and 19 feet at the oil pit (excavated 22 feet). Elevated results reported in the soil below the "pipeline" were not confirmed by the follow-up tests.

Soil underlying the Burn Tank had elevated concentration of petroleum hydrocarbons and soluble lead detected to depths of 8 feet. The burn tank area was excavated to a depth of 10 feet below ground surface. Soil underneath the Marley Cooling tower that contained varying concentration of

petroleum hydrocarbons and lead was excavated to a depth of 10 feet at the southern end of the cooling tower and 5 feet at the northern end, 22 feet at the Oil Pit location, and 12 feet at the tank ring location (see figure 5). Excavated soil was properly disposed off-Site.

No chemical of concerns were detected at or above action levels in the soil underlying the East-West Tanks.

5.0 PRE-DRILLING

Prior to drilling activities, a Site visit was conducted by HI staff and Principal Geologists. The locations of the proposed borings were discussed with the City of Pasadena Project Managers and adjusted to avoid buried obstacles identified in a previous geophysical survey of the Site. Due to the existence of underground pipes and utilities, several adjustments were necessary. A Site-specific Health and Safety Plan was prepared and followed during field activities. Health and safety issues related to the Site conditions and drilling activities were discussed with the drilling crew.

6.0 FIELD EXPLORATION

Subsurface conditions were explored by drilling 10 soil borings; 3 to a depth of 60 feet below ground surface (bgs), and seven to 50-feet bgs. Soil borings were placed in the vicinity of the requested boring locations by Power Engineers, Inc. Soil borings were drilled by R & C Drilling using a drilling rig equipped with hollow-stem augers to observe and sample the materials potentially affected by the previous Site operation (Figures 2 & 3). Soil samples were collected at 5 foot intervals from each boring using six 2½-inch diameter by 1-inch long and two 2½-inch diameter by 3-inch long brass tubes mounted within a 2½-inch inside diameter Modified California split-spoon drive sampler. A Hydrologue geologist supervised drilling operations and logged all soil borings in accordance with the Unified Soil Classification System (Appendix A). Additionally, a Standard Penetration Test was performed at each sampling interval using a Standard Split Spoon Sampler. All drilling equipments were steam-cleaned prior to being used.

All sampling equipment was cleaned prior to drilling at each boring location. Following sample collection, all sampling equipment, including the brass rings, were brushed clean in a solution of non-phosphate cleanser and rinsed with tap and distilled water and then shaken to remove excess moisture.

The sampler was attached to sampling rods, lowered to the sampling depth, and then was driven 18-inches into the formation. Blow counts per last 12-inches of penetration of the sampler were recorded to evaluate the consistency of the formation. No groundwater was encountered during drilling.

After sample recovery, the ends of the lowest 3-inch long brass tube were covered with Teflon sheets and plastic caps and secured with silicon tape.

Additionally, samples planned to be analytically tested for Volatile Organic Compounds (VOCs) were prepared using the EPA SW5035 Method from the bottom sampling ring as described below. The sampling and preservation protocols use the ESS Lock N' Load 5035 Soil Syringe Sampler. The Soil Syringe Sampler is a one-time use tool which collects approximately 5 grams of soil. The soil collected from the Soil Syringe Sampler is then transferred into pre-weighed 40-mL vials with appropriate preservatives.

Method 5035 requirements for sampling and preserving soil followed as detailed below:

- VOA vial prepared with sodium bisulfate preservative (5ml of de-ionized ultrapure water and 1 gram of Sodium Bisulfate preservative) – low level volatiles. In the field, HI staff measured 5 grams of soil using a Soil Syringe Sampler and added it to the VOA vial. Since the entire sample is consumed during each test, HI used two VOA vials per soil sample.
- VOA vial prepared with methanol preservative (10 ml of methanol (MeOH)) – high level volatiles. In the field, HI staff measured 10 grams of soil using a Soil Syringe Sampler and added it to the VOA vial. Each methanol sample can be analyzed more than once; therefore, only one method VOA was needed. The methanol solution becomes the actual representation of the soil sample being submitted. Since the MeOH virtually "masks" the low-level analytes, only volatiles with concentrations exceeding 200 ppb appear when analyzed.
- Standard boring sleeve followed by preservation in the lab – both high and low level volatiles.

The soil samples were labeled with the sample identification, date and time of sampling and the HI project number, and delivered to an off-Site state certified laboratory for hazardous waste testing. Prior to use, all the tubes were washed in a non-phosphate cleanser solution rinsed with tap water and then distilled water.

For each sampling interval within the borings, the soil contained in the second 3-inch long sleeve from the tip of the sampler was used for headspace analysis to determine if volatile hydrocarbon vapors were emanating directly from the soil using a photoionization detector (PID) MiniRAE 2000 Portable VOC Monitor, calibrated against an isobutylene gas standard. Each sample was placed in an airtight Ziploc™ plastic bag. The Ziploc plastic bags were placed in the sun for approximately 5 minutes and the headspace in each bag was analyzed using a PID. The headspace readings were recorded on the boring logs (Appendix A).

The soil samples were logged on requisite chain-of-custody record forms (Appendix B) and immediately delivered to American Scientific Laboratory (ASL), a State of California Certified Hazardous Waste Testing Laboratory (Certificate # 2200). The soil samples were labeled with the sample identification, date and time of sampling and the HI project number.

7.0 EQUIPMENT DECONTAMINATION

All hollow stem augers were steam-cleaned prior to being used. Following sample collection, all sampling equipment, including the brass rings, were brushed clean in a solution of non-phosphate cleanser and rinsed with tap and distilled water and then shaken to remove excess moisture.

8.0 FIELD QAULITY ASSURANCE/QUALITY CONTROL

For field quality assurance/quality control (QA/QC) purposes, field/equipment blanks and trip blanks were prepared daily, along with the collected soil samples. The field/equipment blanks are used to demonstrate whether the sampling procedures have any positive interference on the analytical results. The field/equipment blanks were prepared by flushing the decontaminated sampling equipment with purified water and collecting the water in sample containers. The trip blanks were supplied by ASL and are used to provide a measure of the potential positive interference introduced by sample preservation, transportation, and storage. The aforementioned QA/QC blanks were handled and processed in exactly the same manner as other samples, as described above. In addition to the requested analysis, ASL analyzed QA/QC samples which consisted of the analysis of matrix spike/matrix spike duplicates, method blanks, check samples and standards. Copies of the laboratory reports are included in Appendix B.

9.0 PHYSICAL SITE LOCATION

The coordinates of the Site are approximately 118.1494º west longitude, 34.1268º north latitudes. The Site is located at an elevation of approximately 752 feet above Mean Sea Level (MSL). The local surface drainage and topographic pattern is generally to the southeast and locally to the east, with a local topographic gradient of approximately 0.01 foot/foot, toward the east (Figure 1).

10.0 GEOLOGIC SETTING

The City of Pasadena Power Plant (Site) is located along the northeastern side of the Raymond Hills and eastern side of Grace Hill at the terminus of the Alhambra Wash in the southern portion of the City of Pasadena and Raymond Basin, a structurally elevated low relief surface lying to the northwest of the prominent San Gabriel Basin. The Raymond Basin is a triangular shaped alluvial plain that abuts the steep and high San Gabriel Mountains to the north and the moderate relief San Rafael Hills to the west. The active Raymond Fault forms the south-southeast boundary and separates the Raymond and San Gabriel Basins.

The Pasadena/Altadena/Sierra Madre areas are considered seismically active, where moderate sized earthquakes occur infrequently and active and potentially active faults abound. The east-west trending San Gabriel Mountains raise more than one mile above the basin floor with the steep southerly flank of the range, representing a recessed fault scarp of the Sierra Madre fault zone. The north side of the San Gabriel Mountains is bounded by the active San Andreas Fault and represents the main boundary between the North American and Pacific tectonic plates. The Raymond fault is trending east-northeast, a branch, and closely related to the Sierra Madre Fault that separates the Raymond and San Gabriel Basins. All of these faults have ruptured historically and have produced moderate to major earthquakes.

As a result of the continued movement between the plate boundaries, major north to south compressive forces are created across the region. These have resulted in uplift of mountains and

chains of hills and depressing adjoining basins shaping a sequence of east-west trending uplands which collectively form the Transverse Ranges Physiographic Provence of Southern California. The adjacent basin floors are filled as a result of the uplands erosion and transport of sedimentary deposits. In the vicinity of the Site, alluvium of Pleistocene and Holocene age was deposited by rivers and streams flowing south from the San Gabriel Mountain and San Rafael Hills. The San Rafael Hills are characterized by small- and medium-sized rounded hills and intervening valleys.

These drainages migrated back and forth, forming broad coalescing alluvial fans. Today the Raymond Basin is filled with several hundred feet of alluvial materials. Underlying the alluvium is a thick sequence of Tertiary age sedimentary rocks and below that is basement rock composed of granitic intrusive rocks of Mesozoic age and pre-Cambrian (?) metasediments. The depth to basement rock varies from a few feet near the mountain and hill fronts to nearly 2,000 feet in the southerly portion of the basin.

A major geomorphic feature in the area is the Arroyo Seco, which extends through Pasadena down the west-central part of the area and veers southwesterly near the Pasadena/South Pasadena city boundary. The Arroyo Seco is a steep-walled, flat-floored ravine about 500 to 1,000 feet wide and 50 feet deep. The arroyo widens into a relatively flat plain in South Pasadena. This change in relief is related to the Raymond Fault scarp, which crosses the area on the southern side of Raymond Hill. This scarp is a result of vertical fault displacement. Relief across the scarp is about 40 or 50 feet, but has been highly modified by urban development.

The San Gabriel Valley, which encompasses the southeastern side of Raymond Basin, is essentially a flat, gently south-sloping surface consisting of ancient (Pleistocene age) alluvial fans, flood plain, and basin fill alluvium. Elevations in the northern part of the Valley are in the 800- to 900-foot range, whereas in the south, elevations are in the 400- to 500-foot range. The flatness of the San Gabriel Valley surface is interrupted by several small hills and knolls which are outliers of the Repetto and San Rafael Hills. The largest of these hills is Raymond Hill, which is about 90 feet high. A smaller knoll just northwest of Raymond Hill is called Grace Hill. The other knolls are not named and are relatively subtle features that go largely unnoticed by the general public. Although subtle, these small knolls are important for understanding the geology of the region because they are bedrock exposures that reveal information regarding the surrounding subsurface geology.

11.0 STRATIGRAPHY

The majority of rocks in the area consist of Tertiary age (16 million years old) marine sedimentary rocks of the Topanga Formation. It is important to recognize that the geologic profile in Figure 9 is idealized and simplified to represent the entire zone. The south of the area (Figure 6) consists primarily of rock formations, whereas the east, west and north sides of the area have thick alluvial deposits over the rock formations.

Quaternary-age alluvium occurs at the Site proximity to a depth of approximately 200 feet (190 feet at R-09Z3B3), and at the south side of the Pasadena Power Plant where it is much thinner and on the order of 0 to 50 feet (43 feet at R-09-Z3B6). Alluvium at the proximity of the Site consists

of clay, silt, and sand with a major component of gravel and cobbles and some boulders, all composed of igneous and metamorphic rocks.

The principal formation in the southernmost portion of area (Figure 7) is the Fernando Formation which consists of soft and weak massive claystone and siltstone. The Fernando Formation overlies the Puente Formation in the southern part of the area (Figure 7). The contact is sharp and possibly unconformable (Dibblee, 1992).

The sedimentary rock at the proximity of the Site is composed of the Topanga Formation and includes a wide variety of rock types ranging from coarse-grained rocks such as breccia, conglomerate, and sandstone to fine-grained sandstone and siltstone with minor claystone (mudstone). The part of the Topanga Formation north of the Raymond Fault is predominantly sandstone, conglomerate, and breccia. The Topanga Formation also has intrusive volcanic rocks. For example, a 10-foot-thick zone of hard volcanic rock was encountered in a previous Caltrans study within boring EMI-2, immediately south of the Raymond Fault.

The bedrock northern side of the Site, north of the San Rafael Fault, consists of the Cretaceous age (approximately 120 to 160 million years ago) basement complex that is generally mapped in exposures of the San Rafael Hills as Wilson Diorite or Quartz Diorite (Dibblee, 1989c; Lamar, 1970).

12.0 GROUNDWATER CONDITIONS WITHIN RAYMOND BASIN

The Raymond Basin and San Gabriel Basin, to the southeast, have been extensively utilized for groundwater resources. Water wells drilled in both basins have produced good aquifer data for the groundwater depth and flow direction. Groundwater is resupplied to the Raymond Basin from surface runoff in the San Gabriel Mountains. The Raymond Fault to the south forms a very effective groundwater barrier causing groundwater to cascade over the fault and fall about 200 feet.

The groundwater surface elevation ranges from about 1,400-feet near the mountain front in the north to 450-feet near the Raymond Fault. In the past, springs and small ponds have formed to the south of the Raymond Fault scarp. The groundwater in the basin is unconfined and has a southeast gradient of 0.02 to 0.06 -foot per foot. Perched groundwater was not encountered to the depth explored at the Site (60 feet bgs). Reported highest groundwater depth at the Site proximity was about 50 feet bgs. Reported groundwater depth by the Caltrans consultant on the south side of the Site (south of San Rafael Fault in boring R-09-Z3B6) was 51.2 and on the north side of the Site was 136 feet (north of San Rafael Fault in boring R-09Z3B3). Both borings were converted to pizometers after drilling.

13.0 TECTONIC SETTING

Tectonic processes (faulting and earthquakes) are very active in the Site region. Figures 6 to 9 show the Site location relative to known active and potentially active faults. Obviously, the closer

a site is to an active fault, the greater potential there is for surface rupture and high earthquake ground motions. The Site does not lie close to any known active fault capable of surface fault rupture. However, the queried and buried trace of the San Rafael Fault is shown to cross or skirt the extreme corner of Jacob Parking Lot, east of Old Power Plant Building (Figures 6 to 9). It should be noted that in Figure 6 the fault is shown to cross through the Pasadena Power Plant entering from the west and exiting from the southeast corner along the Alhambra Wash. The nomenclature Eagle Rock or San Rafael faults were kept identical to their referenced sources in the figures 6 to 8.

The faults that trend mostly to the east-west are those associated with the Transverse Ranges. They produce mostly reverse (thrust) movement along north dipping planes which trend along southerly facing upland flanks. The active thrusts in the region include the Sierra Madre, Cucamonga, Raymond, and Santa Monica-Hollywood Faults. Another type of thrust fault is a blind thrust. These faults also are associated with the same process that elevated the Transverse Ranges, but the fault has remained buried and undetectable unless it produces an earthquake. The Raymond Fault, projecting along the south side of the Raymond Basin, at one time, may have been a blind thrust but because of continued activity it ruptured the ground surface.

The dominant fault system in the region is associated with the San Andreas Fault Zone. The system moves in a right lateral northwest trending direction with locally some vertical movement. The San Jacinto, Whittier-Elsinore, Newport-Inglewood, Palos Verdes and Mojave Desert Faults are coupled with the San Andreas (plate boundary) system. All of these faults have ruptured historically and produced moderate to major sized earthquakes.

14.0 STRUCTURAL GEOLOGY

As shown in Figure 9, the geologic strata are deformed into a series of folds and faults. Most of the folds and faults are continuations of geologic structures in the Santa Monica Mountains and the Elysian Hills to the southwest. These structures trend southeasterly through the Repetto Hills and continue below the flat-lying Quaternary alluvium of the San Gabriel Valley. The major folds are the Elysian Park Anticline and the South Pasadena Anticline.

The folding shown in Figure 9 is generalized and simplified. In reality, there are numerous small-scale folds within the larger fold trends. Frequent changes in bedding orientation due both to folding and faulting should be expected at depth.

Many of the faults are intra-formational features, meaning that the faults offset rocks of the same type. However, some of the faults could comprise highly fractured or clayey gouge zones.

15.0 LOCAL AND REGIONAL FAULTING

The potentially active Sierra Madre Fault Zone is over 60-miles long and is located just about 5.6 miles to the north of the Site. The fault displays dominantly reverse (vertical) movement and forms a very irregular and deeply incised scarp which, in places, may be several hundred feet

high. The fault zone strikes roughly east-west and locally dips northward at 18 to 70 degrees beneath the San Gabriel Mountains. Locally, at the foot of the range, the fault has been mapped most notably with basement rock thrust southward over older alluvium. A potentially active fault is one that has ruptured in the last two million years, but no evidence has been found to suggest rupture in the last 10,000-years. This infers that the fault has a relatively long recurrence interval.

The Sierra Madre Fault, in the Pasadena, Altadena and Sierra Madre areas, has not been placed into an active category or an Alquist-Priolo Earthquake Fault Zone as designated by the California Division of Mines and Geology. The potential for direct surface fault rupture through the subject Site is judged to be nil based on available geologic and fault related technical data. The upper bound (moment magnitude) earthquake assigned to the Sierra Madre Fault is M6.7 and the calculated slip rate is 3.0 mm per year. The fault is assigned to a Type B category. The entire Raymond Basin lies in Seismic Zone 4. Because of the proximity of this potentially active fault, it may produce significant ground motion effects should it rupture in the area closest to the Site and produce a major earthquake.

The faults of most interest to the proposed Power Plant project are the active faults that might result in ground rupture and displacement during an earthquake, and faults that might generate strong shaking of project facilities. The faults of most interest to the project are the Raymond Fault, the San Rafael Fault, and the Eagle Rock Fault.

The faults of greatest significance to the project are described in detail below. The locations of these faults are shown in Figures 6 to 8, and in the representative geologic profiles (Figures 9). These faults represent earthquake shaking hazards, but only the Raymond and Alhambra Wash faults located outside of the Site are identified as Alquist-Priolo Earthquake Fault Zones (APEQFZ), which implies a surface rupture potential. Such a designation indicates the fault is well known and its location is well defined. Other potentially active faults may not be identified as APEQFZ because their locations are not well defined and/or they have not generated earthquakes in historical times. The City of Pasadena Safety Element (City of Pasadena, 2003) has designated a "fault hazard management zone" for the Eagle Rock Fault, which means that geological studies are required for determining the potential for fault rupture before development occurs within the zone.

The active Raymond Fault Trace strikes east-northeast, 1.0 mile south of the Site, along the south boundary of the Raymond Basin. The fault is 12 to 15.5 miles long depending upon which interpretation is accepted, dips to the north beneath the basin at generally a high angle, and has produced lateral and vertical displacements. A well-developed scarp to 100-feet high along with sag ponds, offset drainages, back tilted surfaces, springs, a groundwater barrier and pressure ridges suggest its surface rupture is relatively young. Carbon dating gave movement within the last 2,500-years. The fault has been assigned to a Type B Category with an upper bound (moment) magnitude earthquake of 6.5, and a slip rate of 0.1 to 0.4 mm per year.

The State of California (CGS) has established an APEQFZ along the Raymond Fault from the San Gabriel Mountains in the east to near the intersection of Avenue 50 and York Boulevard in the west. The Raymond Fault extends southwesterly from the Sierra Madre Fault Zone at the base of the San Gabriel Mountains through the communities of Monrovia, Arcadia, San Marino, and

Pasadena to the Raymond Hill area of South Pasadena, where the Raymond Fault trends more westerly through the communities of South Pasadena, Highland Park, and possibly into Los Angeles. The fault forms a gentle arc, convex toward the south across the alluvial deposits of the San Gabriel Valley. The fault is best expressed in the San Marino to South Pasadena area, where if forms a prominent escarpment up to about 150 feet high.

A prominent linear gravity anomaly extending easterly from the southern margin of the Santa Monica Mountains, under the Los Angeles River plain, and into the Repetto Hills indicates that the Hollywood fault may extend easterly into the Repetto Hills, and has led to the interpretation by some that the Hollywood and Raymond Faults may be interconnected. Others (Dolan, Reference 15) have postulated that the Raymond Fault is directly connected with the Hollywood Fault and other faults within the southern frontal fault system of the Transverse Ranges. The westerly continuation of the Raymond Fault into the Los Angeles River floodplain is uncertain. For the purposes of this study, it is assumed that the Raymond and Hollywood Faults are independent features.

The most recent major rupture on the Raymond Fault occurred in the Holocene time, about 1,000 to 2,000 years ago (Crook et al., 1987; Weaver and Dolan, 2000, Reference 15). The largest earthquake within the project area in historical times was the 1988 Pasadena Earthquake with a magnitude (M_L) of 5.0; this shock was interpreted by Jones et al. (1990) to have occurred on the Raymond Fault.

Currently, most geoscientists consider the Raymond Fault to be a left-lateral reverse-oblique fault that dips steeply (approximately 80 degrees) to the north. Geological trenching studies across the fault scarp indicate average rates of fault slip between 0.1 and 0.4 millimeters per year (mm/yr). More recently, the rate of slip has been estimated to be about 1.5 mm/yr and the recurrence interval at 3,300 years (Dolan et al., 2000; Cao et al., 2003; Weaver and Dolan, 2000, Reference 15). The maximum earthquake estimated by the CGS is in the range of M_w= 6.0 to 7.0.

The nature of potential surface displacements on the Raymond Fault is poorly known. Due to the lack of earthquake history on the Raymond Fault, seismic design for the fault must be based on empirical fault/earthquake relationships, based on a length of 12 miles, a down-dip width of 10 miles, and average slip of 1.6 to 3.3 feet. A maximum earthquake of Mw=6.7 is estimated.

Eagle Rock and San Rafael Faults

The Eagle Rock and San Rafael Faults, in the Pasadena area, have not been placed into an active category or APEQFZ Fault Zone as designated by the California Division of Mines and Geology. Existing geological maps (Lamar, 1970; Dibblee, 1989; Yerkes and Campbell, 2005; and City of Pasadena, 2002) show different locations for the Eagle Rock and San Rafael Faults. The principal difference is that Lamar's (1970) map shows the San Rafael and Eagle Rock Faults as separate features. The San Rafael Fault extends southeasterly from within the San Rafael Hills to the north edge of Grace Hill, Raymond Hill and the smaller associated knolls, essentially along the same trace as Dibblee's Eagle Rock Fault. At the eastern end Lamar splits the fault into two splays or branches; one extends through the top of Raymond Hill (south of the Pasadena Power Plant) and the other is a dotted line (that is, a subsurface fault) trending more easterly, along East Glenarm

Street, past Arroyo Parkway and into the hills north of the main trace of the Raymond Fault. Lamar maps the Eagle Rock Fault to the south of the San Rafael Fault within the knolls and projecting south of Raymond Hill. The differences between the fault mapping are not really significant from an earthquake hazard perspective, but the differences might be important for the Pasadena Power Plant projects, in that if there is only one fault (as indicated by Dibblee), the fault crosses the Power Plant, while in the case of two separate faults (as indicated by Lamar) it may be located outside of the Site. Borehole R-09-Z3B3 excavated during Caltrans study (Reference 16) encountered a significant zone of fault gouge believed to be the San Rafael Fault. The Eagle Rock and San Rafael Faults do not extend across the Raymond Fault.

Both the Eagle Rock and San Rafael Faults are considered potentially active faults, as defined above. According to the Caltrans Seismic Design Criteria (2009) fault database, the Eagle Rock Fault is estimated as having a maximum earthquake magnitude of 6.8.

Although the San Rafael Fault is not well documented, the approximate magnitude of its maximum earthquake can be estimated using empirical relationships on earthquake magnitude and fault length. According to these empirical relationships, the maximum magnitude could be about 6.0.

The so-called Eagle Rock/San Rafael Faults (San Rafael fault is the northern branch of the Eagle Rock fault at the proximity of Pasadena Power Plant, by those researchers who believes that Eagle Rock fault bifurcate at the proximity of the Pasadena Power Plant) have been discussed by numerous geoscientists over the past few decades and are shown on several geological maps, notably Lamar (1970), Crook et al. (1987), and Dibblee (1989), as well as several others (e.g. California Division of Mines and Geology, 1978). All of these investigations except CDMG (1978) were regional studies and did not really focus on the Eagle Rock/San Rafael Faults. Consequently, none of these maps show the faults in the same location. However, the CDMG (1978) categorically states that no evidence of Holocene activity has been found in any investigation. Based on the CDMG (1978) and Caltrans/Metropolitan Transportation Agency findings and on our own investigation, as discussed below, we believe that the fault is not active.

In this study the Eagle Rock and San Rafael Faults are considered as two discrete faults as shown by Lamar (1970); the southern fault is the Eagle Rock Fault, extending from the Eagle Rock area, crossing Arroyo Seco, and into the small hills and knolls west of Raymond Hill (Figure 8). The northern fault is the San Rafael Fault; this fault is basically parallel to the Eagle Rock Fault and similarly passes through Arroyo Seco, but extends to the north side of the Raymond and Grace Hills, at the proximity of the City of the Pasadena Power Plant.

Lamar shows the San Rafael Fault bifurcating near Raymond Hill with one branch cutting through the rocks at the top of Raymond Hill and the other branch under the alluvium north of the hill extending towards Blair and Allendale schools. Although in the Caltrans/Metropolitan Transportation Agency the southern branch is shown on their geological maps included in the final 710 tunnel report, they could not find any evidence of such a fault on aerial photographs or during field geological mapping or drilling.

In addition to the CDMG (1978) fault evaluation report, the Caltrans/Metropolitan Transportation Agency investigation (Reference 15), Wilson Geosciences (Diaz-Yourman and Associates, 2007, Reference 22), are investigations that treated the Eagle Rock-San Rafael Faults as their primary focus.

The only location in the area where the fault can be identified is in Arroyo Seco where the fault extends under the La Loma Bridge. The recent investigation by Wilson Geosciences (WGI) excavated a trench on the west side of Arroyo Seco and found faulting within the Tertiary-age Topanga Formation rocks. The fault was entirely within Tertiary-age rocks and did not displace the overlying Quaternary alluvium. Although the faults in their trench exposure may not represent the main branch of the fault, the location is consistent with the change in rock type contact from igneous rocks on the north to the Tertiary-age Topanga Formation on the south. The trench exposure, in conjunction with boreholes and seismic refraction data, locates the fault location quite closely to the eastern end of the bridge. This location is slightly north of the location on Lamar's map and has a slightly more easterly trend than the Lamar or Dibblee maps.

The Caltrans/Metropolitan Transportation Agency drilled several boreholes in the area. Three of the holes revealed important information relative to the San Rafael Fault (R-09-Z3B3, R09-Z3B6, and R-06EM3). The boring R09-Z3B6 is located on State Street just south of the railway and near the Pasadena Power Plant and borings R-09-Z3B3 and R06EM3 are located about 5,000 feet west of the Pasadena Power Plant along Pasadena Avenue (Figure 7).

Boring R-06EM3 was drilled in the park along Pasadena Avenue north of Arlington Drive. This boring was drilled to a depth of 201 feet and encountered alluvium to a 50 feet depth below ground surface (bgs) and Topanga Formation from 50 feet to the bottom of the hole. There was no indication of faulting; therefore the San Rafael Fault must be north of the boring. In addition, there was no indication of a southern branch as shown by Lamar.

Boring R-09-Z3B3 was drilled about 800 feet to the north of R-06EM3 in the grassy median just south of Bellefontaine Street (Reference 16). This boring was drilled to a depth of 275 feet and encountered old alluvium (Pleistocene age) to 185.5 feet bgs, and light-gray clay fault gouge from 185.5 to the bottom of the hole. This clay consisted of intensely sheared, altered, pulverized, highly plastic clay and sandy clay. Reportedly, petrographic thin-section analysis of included pebbles indicated an origin from dioritic igneous rock. The apparent great thickness of gouge (i.e. 90 feet) is interpreted by the Caltrans/Metropolitan Transportation Agency to be due to the borehole extending down a steeply dipping fault. Geometric calculations indicate about an 80 degree northerly dip; the true thickness of the zone is probably more on the order of 20 to 40 feet. In any event, this gouge places the surface projection of the fault quite close to the intersection of Hurlbut Street and Pasadena Avenue (Reference 16).

The third boring, R09-Z3B6, was on State Street just south of the railway tracks, just northeast of Raymond Hill and just west of the power plant (Reference 16). This boring extended to a depth of 326 feet bgs and encountered about 15 feet of alluvium overlying Topanga sandstone and conglomerate. This boring suggests that there is no north-dipping fault through the top of Raymond Hill as shown by Lamar and Dibblee. Furthermore, Caltrans/Metropolitan

Transportation Agency believes that the lack of any apparent faulting indicates that the northern splay of Lamar's fault must be north of the boring (within the City of Pasadena Power Plant).

A seismic-reflection line was run along Raymond Avenue from Glenarm Street to the north (Reference 16). The seismic-reflection line did not reveal any major faults, indicating that any faulting is south of Glenarm Street. Projecting the San Rafael Fault to the southeast based on these 3 borings and the seismic-reflection line places the fault directly through the Jacob Parking Lot. Groundwater was reported at depths of 51.5 and 136 feet in borings R-09-Z3B6 and R-09Z3B3 located at south and north of the San Rafael Fault respectively. A drop of 32.8 feet in groundwater elevations in the above borings is interpreted to be related to the San Rafael Fault. The lack of groundwater in boring JP-1, located at northeast corner of the Jacob Parking Lot and drilled to 60 feet below ground surface and existence of the saturated soil encountered in borings JP-2 and B-1 at depth of 50 feet below ground surface may suggest that the San Rafael Fault is located between borings JP-1 and JP-2. Further investigation is needed to confirm or refute this interpretation.

Although Hydrologue believes the San Rafael Fault may cross the Jacob Parking Lot, we recognize that the location may be somewhat imprecise. It appears to be located outside of the proposed Repowering Project GT-5 Combined Cycle. Reportedly Caltrans/Metropolitan Transportation Agency aerial-photograph analysis and geological mapping did not find any evidence of Holocene activity on the San Rafael Fault. As mapped, the fault trend crosses within Pleistocene-age alluvial deposits. The Pleistocene age is well established by numerous carbon 14 dates (Crook et al., 1987). In support of the Pleistocene age, Caltrans boreholes found weathered, oxidized alluvium with crumbly clasts and multiple pedogenic soil horizons.

Crook et al. (1987) indicate two ages of alluvium along the San Rafael Fault trend; these are less recent alluvium Qal_2 and older alluvium Qal_3 at the Site proximity. Reportedly, Caltrans/Metropolitan Transportation Agency analysis of vintage Fairchild aerial photographs (late 1920s to 1950s) did not reveal any evidence of topographic fault scarps along the trace of the San Rafael Fault in either less recent or the older Holocene alluvium indicating that the fault has not been active in latest Quaternary time. The only surficial indication of a fault is the crude alignment of the widely spaced knolls and hills (i.e. Grace Hill, Raymond Hill, etc). This type of geomorphology is typical of what geologists call a fault-line scarp. A fault-line scarp is a scarp that represents the eroded remnant of an ancient fault. Such a feature is consistent with a Pleistocene age of latest displacement on the San Rafael Fault.

Reportedly, according to the borehole data adjacent to Blair and Allendale schools, near-surface stratigraphic relationships, revealed in the shallow geotechnical borings, indicate lack of Holocene activity on the San Rafael Fault (Reference 20). These borings indicate a black, clayey soil similar to one we observed during grading operations related to the construction of GT1 and GT2 within the Pasadena Power Plant, overlie the Pleistocene alluvium (this layer was not observed during our recent investigations, References 1 & 2). This black soil is widespread throughout the area and is characteristic of a well-developed organic soil horizon on the Pleistocene alluvium. Although there are no carbon dates available for this soil, the thickness alone indicates a substantial age, perhaps several thousand years. The presence of carbonate nodules in the material supports advanced age. However, these clayey horizons are typically

"cumulative" soil horizons that are difficult to date precisely. The consistent thickness, and consistent depth of this unit across the area indicates tectonic stability, and that there has not been any Holocene fault displacement at the Site.

In conclusion, based on the above, Hydrologue believes the present data indicate that the San Rafael Fault may pass through the Jacob Parking Lot, but also it has not been active in Holocene time.

16.0 SOIL CONDITION

Fill

Man-made fill was encountered to a depth of approximately 5 to 15 feet below ground surface (bgs) in the exploratory borings. The man-made fill consists of dark brown to brown clayey, silty sand and fine to coarse gravelly sand in moist and moderately compact conditions. Deeper man-made fill may be present in unexplored areas of the Site.

Natural Ground

Subsurface lithology encountered during drilling and sampling consisted primarily of sandy silt and silty sands to the total depth explored, though many borings also contained lithology that ranged from clayey to gravelly sands. Some black, clayey soil was observed in samples collected from the various soil borings, as noted on boring logs. This black soil is widespread throughout the area and is characteristic of a well-developed organic soil horizon on the Pleistocene alluvium. Appendix A contains the complete borings logs for the current phase of work.

The Site is underlain by stream channel deposits of gravel, sand and silt (Qg) and alluvial fan outwash from major canyon grades northward into Q_a. The Site appears to be within the northern terminus of the Alhambra Wash. The Qg deposits underlying the Alhambra Wash intersect a concealed portion of the Eagle Rock Fault. According to Figure 10, the north side of the Site is covered with Holocene young Alluvial Fan Deposits, Qyf1, while the southeast of the Raymond Hills is covered with Pleistocene Alluvial Fan Deposits, Qof4gs. The contact between the two units at the proximity of the Site is not shown. Raymond Hill and Grace Hill are mapped as pre-Quaternary bedrock.

Almost adjacent to the east and west sides of the Site is alluvium Q_{of} consisting of older dissected surfacial sediments alluvial fans from the San Gabriel Mountains, according to the Geologic Map of the Pasadena Quadrangle by Thomas W. Dibblee, Jr. dated 1989 (Figure 6).

At the Site, beneath the man-made fill, brown sandy silt, gravelly sand, and silty sand in moist and moderately dense to dense conditions were encountered.

Site Groundwater

Groundwater was not encountered at the Site to the depth explored (60 feet bgs). Based on the Los Angeles County Department of Public Works (LACDPW), the closest active well near the Site is Well No. 4057H (personal communication with Miguel Osorio of LACDPW, December 17, 2009), located two blocks northeast of the Site at the intersection of Ohio Street and South Euclid Avenue. The depth to groundwater was measured at approximately 120.7 feet bgs on May 10, 2004. Ground surface elevation at this well is about 750 feet above mean sea level (MSL).

The closest inactive well near the Site is Well No. 4056C, located near the railroad tracks at the intersection of Thomas Guide Grid Lines 6 and 7 (just south of Fillmore Street). The depth to water was last measured at approximately 164.3 feet bgs on October 25, 1974. The ground surface elevation at this well is about 757.8 feet MSL.

A groundwater well was discovered beneath a concrete block and slab during the demolition activities at the vicinity of the gas turbine generators GT1 and GT2 at the Pasadena Power Plant. The demolition contractor excavated the perimeter of the well to approximately 15 feet below ground surface using a backhoe. A 12-inch steel conductor casing and a 2-inch diameter steel inner pipe was observed. The gap between the inner pipe and outer casing was filled with soil but the inner pipe casing was found open and the depth to water was measured by the contractor using a measuring tape and found to be about 85 feet below ground surface (bgs) with at least 5 feet of water. This is consistent with the depth to water reported by the LACDPW measured on May 16, 2002 from the nearby Well No. 4057H.

17.0 LABORATORY ANALYSIS

The collected soil samples were logged on requisite chain-of-custody record forms and delivered to American Scientific Laboratory (ASL), a State of California certified hazardous waste testing laboratory (Certificate # 2200), at the end of each day of field work. The selected samples were analytically tested for Semi-Volatile Organic Compounds (SVOCs) using EPA Method 8270C, Volatile Organic Compounds (VOCs) using EPA Method 8260B, Polychlorinated Biphenyls (PCBs) using EPA Method 8082, Total Lead Concentration using Method SW 6010B, total Hexavalent Chromium using Method SW 7196, Total Petroleum Hydrocarbons (TPH) Carbon Chain using EPA Method 8015M, and Total Recoverable Petroleum Hydrocarbons (TRPH) EPA Method 418.1. No soil sample was tested for soluble lead or Hexavalent Chromium concentrations for the purpose of their comparison with their respective STLC. However, it is recommended to test all stock pile soils for soluble lead prior to their off-site disposal.

The soil samples collected at the surface were analyzed for Polychlorinated Biphenyls (PCBs), lead, and hexavalent chromium,) using EPA Methods 8082, 6010B, and 7196 respectively.

The soil samples collected at a depth of 5, 10 and 15 feet below ground surface were analyzed for Semi-Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs) and Total Petroleum Hydrocarbons (TPH) carbon chain using EPA Methods 8270C, 8260B and modified 8015.

All collected soil samples from the surface to a depth of 25 feet bgs were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) using EPA Method 418.1.

In addition to the requested analysis, ASL analyzed QA/QC samples which consisted of the analysis of matrix spike/matrix spike duplicates, method blanks, check samples and standards. Copies of the laboratory reports are included in Appendix B.

18.0 DISCUSSION

Table 1 through 7 summarizes the analytical testing results for soil samples collected and analytically tested during this investigation at the subject Site.

Table 1: Concentrations of Lead Detected in shallow Soil Samples milligrams/kilogram (mg/kg)

Sample I.D.	Total Lead Concentration	Site Cleanup level ppm	ASL Laboratory Report No.
BH-1@S	17	750	50219
BH-1@5-6.5'	2.53	750	50219
BH-1@9.5-11'	1.27	750	50219
BH-1@15-16.5	0.553	750	50219
BH-2@S	56.7	750	50196
BH-2@5-6,5'	36.4	750	50196
BH-3@S	36.1	750	50219
BH-3@5'	30.6	750	50219
BH-3@10-11.5'	122	750	50219
BH-3@15-16.5'	4.6	750	50223
BH-4@S	33.4	750	50209
BH-4@5-6.5'	28	750	50209
BH-4@10-11.5	24.7	750	50209
BH-4@15-16.5'	8.85	750	50209
BH-5@S	31.8	750	50177
BH-5@5'	5.66	750	50177
BH-5@9.5-11'	1.77	750	50177
BH-5@15.5-16.25'	1.31	750	50177
BH-6@S	47.9	750	50223
BH-6@5-6.5'	543	750	50223
BH-6@10-11.5'	1.87	750	50223
BH-6@15-16.5'	1.64	750	50223
BH-7@S	105	750	50223
BH-7@5-6.5'	662	750	50223
BH-7@10-11.5'	27.9	750	50223
BH-7@15-16.5'	5.28	750	50223
BH-8@S	58.1	750	50177
BH-8@4.5-6'	16.9	750	50177
BH-8@9-10.5'	2.08	750	50177
BH-8@15-16.5'	1.3	750	50177
BH-9@S	15.8	750	50196
BH-9@4.5-6'	334	750	50196
BH-9@9-10.5'	1.38	750	50196
BH-9@9.5-11'	1.79	750	50209
BH-9@15.5-17'	1.82	750	50209
BH-9@15-16.5	1.91	750	50196
BH-10@S	215	750	50219
BH-10@5-6.5'	198	750	50219
BH-10@9.5-11'	2.04	750	50219
BH-10@14-15.5	1.64	750	50219

ND = Not Detected
Clean-up level for total lead concentration, previously established, for this area is 750 mg/Kg,

Table 2: Detected Hexavalent Chromium using Ion Chromatography in Soil Samples, milligrams/kilogram (mg/kg)

Sample	Chromium (VI) mg/kg	Site Cleanup level ppm	ASL REPORT NO
BH-1@5-6.5'	0.51	37	50219
BH-8@S	0.75	37	50177
BH-9@4.5-6'	1.08	37	50196
BH-10@S	2.22	37	50219
BH-10@5-6.5'	0.52	37	50219
California's Human-Exposure Based Screening Number for Residential sites mg/Kg	17		
California's Human-Exposure Based Screening Number for Commercial/Industrial sites mg/Kg	37		
US EPA's Preliminary Remediation Goal for Residential site mg/Kg	30		

Table 3: Detected Total Recoverable Petroleum Hydrocarbons (TRPH) Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TRPH mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@S	109.00	10,000	50219
BH-1@5-6.5'	206.00	10,000	50219
BH-2@5-6.5"	66.00	10,000	50196
BH-3@S	744.00	10,000	50219
BH-3@5'	196.00	10,000	50219
BH-3@10-11.5'	11.20	10,000	50219
BH-4@S	1,220.00	10,000	50209
BH-4@5-6.5	83.20	10,000	50209
BH-4@10-11.5'	140.00	10,000	50209
BH-4@15-16.5'	2,060.00	10,000	50209
BH-5@S	624.00	10,000	50177
BH-6@S	640.00	10,000	50223
BH-6@5-6.5'	120.00	10,000	50223
BH-7@S	896.00	10,000	50223
BH-7@5-6.5'	60.80	10,000	50223
BH-7@10-11.5'	64.00	10,000	50223
BH-8@S	2,690.00	10,000	50177
BH-9@S	276.00	10,000	50196
BH-9@4.5-6'	108.00	10,000	50196

BH-9@9.5-11'	70.80	10,000	50209
BH-9@20-21.5"	24.00	10,000	50209
BH-10@S	868.00	10,000	50219
BH-10@5-6.5'	928.00	10,000	50219
Previously Established Site Clean-up Level by CH2MHILL mg/Kg	10,000		

Table 4: Detected TPH DROs (Diesel Range) Organics Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TPH DROs mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@5-6.5'	29.4	2000	50219
BH-2@5-6.5'	47.7	2000	50196
BH-4@S	30.4	2000	50209
BH-4@15-16.5'	416	2000	50209
BH-5@S	238	2000	50177
BH-8@S	714	2000	50177
BH-9@4.5-6'	41.6	2000	50196
BH-9@9.5-11'	12.1	2000	50209
BH-10@S	100	2000	50219
BH-10@5-6.5'	82.4	2000	50219
Soil Screening level for* Residential sites in mg/kg	110(HQ = 0.2)-540 (HQ= 1)		
Soil Screening level for* Industrial sites in mg/kg	450(HQ = 0.2)-2200(HQ= 1)		

*** Environmental Screening Level "ESL" Tables (reference 27)**
HQ: hazard quotient/Hazard Index

Table 5: Detected TPH OROs (Oil Range) Organics Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TPH OROs mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@5-6.5'	87	10,000	50219
BH-3@5'	76.8	10,000	50219
BH-3@S	177	10,000	50219
BH-4@S	107	10,000	50209
BH-4@5-6.5'	51.8	10,000	50209
BH-4@10-11.5'	87.4	10,000	50209
BH-4@15-16.5'	840	10,000	50209
BH-5@S	323	10,000	50177
BH-7@S	229	10,000	50223
BH-8@S	406	10,000	50177
BH-9@S	57.4	10,000	50196
BH-10@S	123	10,000	50219
BH-10@5-6,5'	176	10,000	50219
Soil Screening level	370 (HQ = 0.2)-1800 (HQ= 1)		

for* Residential sites in mg/kg			
Soil Screening level for* Industrial sites in mg/kg	3700(HQ = 0.2)-18000 (HQ= 1)		

*** Environmental Screening Level "ESL" Tables (reference 27)**
HQ: hazard quotient/Hazard Index

The middle distillates category TPH-DROs includes diesel fuel, kerosene, Stoddard solvent, home heating fuel, jet fuel and similar petroleum mixtures. Residual fuels TPH-ORO include heavy petroleum products such as No. 6 fuel oil (Bunker C), lubricating oils, oil and grease, waste oil and asphalts.

Table 6: Detected Volatile Organic Compounds (VOCs) Concentrations in Soil Samples, micrograms/kilogram (µg/kg)

Sample I. D.	VOCs I.D,	VOCs Concentrations ug/Kg	Site Cleanup level ug/kg	ASL REPORT NO.	Soil Screening level* for industrial sites in ug/kg
BH-3@ 10-11.5'	Bromobenzene	2.26	9,000	50219	9200 (PRG)**
BH-4@15-16.5'	Bromobenzene	19.5	9,000	50209	
	Ethylbenzene	2.00	3,000	50209	3,300
	o-Xylene	2.72	2,000	50209	2300 (total Xylenes)
	m&p Xylenes	5.50	2,000	50209	2300 (total Xylenes)
BH-9@ 9-10.5	Benzene	2.08	40	50196	44

*** Environmental Screening Level "ESL" Tables (reference 27)**
** California Department of Toxic Substances Control (DTSC) Preliminary Remedial Goal

Table 7: Detected Semi-Volatile Organic Compounds (SVOCs) Concentrations in Soil Samples, micrograms/kilogram (µg/kg)

SVOCs I.D.	BH-2@5-6.5' ug/Kg	BH-9@4.5-6' ug/Kg	Site Cleanup level ug/kg	ASL REPORT NO.	Soil* Screening level for industrial sites in ug/kg
Benz(a)anthracene	1,340	1,710	12,000	50196	12,000
Benzo(a)pyrene	948	**1,500**	1,600		1,500
Benzo(b)fluoranthene	1,250	2,230	15,000		15,000
Benzo(k)fluoranthene	478	1,400	27,000		27,000
Chrysene	1,440	2,260	23,000		23,000

Flouranthene	1,130	4,610	60,000		60,000
Phenanthrene	ND	2,100	11,000		11,000
Pyrene	1,410	4,230	85,000		85,000

*** Environmental Screening Level "ESL" Tables (reference 27)**

LEAD

Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total lead using EPA Method 6010 B. Lead was detected in all soil samples. Detected total lead concentrations vary from 0.553 to 662 mg/Kg. None of the total lead concentrations exceeds 750 mg/Kg, the clean-up level previously established for this area by Hunter-Kennedy and Associates (Reference 4).

It should be noted that total lead concentrations of three soil samples exceeded 250 mg/Kg (BH-6 @ 5-6.5', BH-7 @5-6.5' and BH-9 @4.5-6'). It should also be noted that 1,400 ppm of lead was reported for the soil sample collected at 1.5' bgs at the GP-32 location, and the extent of shallow soil contaminated with lead is defined by the lead concentration of soil samples reported for GP-31, and GP-33. Also the extent of lead-impacted soil in BH-7 is defined by lead concentrations reported for confirmation soil samples A1, B1 and C1 (Figure 5). The extent of lead impacted soil at the proximity of BH-9 is determined by the reported lead concentration of GP17 (268 @1.5' and 10.8 @ 5'ppm), GP-21(428 @ 1.5' ppm and ND @ 5'), GP22, and GP25 soil samples. In addition to these three samples, the total lead concentration of soil samples BH-2 at surface and BH-10 @ 5-6.5' exceed 50 ppm (10 times the STLC threshold for lead).

Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above mentioned locations is planned for off-Site disposal, then the excavated soil should be stock piled and a WET test should be made on stock pile soil samples to determine the soluble lead concentration of the stock piled soil for soil disposal purposes.

Chromium VI

Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total Chromium VI using Method SW 7196. Chromium VI concentrations were detected in only 5 soil samples. The detected concentrations vary from 0.51 mg/kg in BH-1@5-6' to 2.22 mg/kg in BH-10 at the surface. None of the detected Chromium VI concentrations exceed Chromium VI STLC threshold, California's Human-Exposure Based Screening Number for Residential or Commercial/Industrial sites or DTSC Preliminary Remedial Goal for Chromium VI and recommended site clean-up level for chromium VI and no further action is necessary.

Total Recoverable Petroleum Hydrocarbons TRPH

Sixty soil samples collected from the surface, 5, 10, 15, 20 and 25 feet below ground surface were tested for Total Recoverable Petroleum Hydrocarbons TRPH using EPA Method 418.1. TRPH

concentrations were detected in 23 soil samples (Table 3). The detected TRPH concentrations vary from 11.20 to 2,690 mg/kg. Detected TRPH concentrations of only three soil samples exceed 1,000 mg/kg (BH-4 @ S (1,220 mg/kg), BH-4 @ 15-16.5' (2,060 mg/kg), and BH-8 @ surface (2,690 mg/kg)).

None of the detected TRPH concentrations exceed its previously established clean-up levels for the area (References 3 & 4).

We understand that a TRPH cleanup level of 10,000 ppm was previously proposed by CH2MHILL for the City of Pasadena Power Plant and is considered acceptable by the Pasadena Fire Department, which is the regulatory oversight agency for the Site. Based on the above-mentioned analytical results, TRPH concentrations do not exceed the CH2MHILL proposed action level.

The above-mentioned TRPH concentrations are considered non-problematic based on comparison with the ESL tables for deep soil screening levels for industrial soil (when groundwater is the drinking water source). The reported concentrations are well below the soil screening level for industrial and commercial land uses.

If the soil at the vicinity of the locations where TRPH concentrations exceed 1000 ppm is planned for off-Site disposal then the excavated soil should be stock piled and should be analytically tested for TPH and VOCs using EPA Method 8015 M and 8260B or per soil disposal facility requirements. The horizontal extent of TRPH-impacted soil that potentially will be disposed off-site is not defined.

TPH DROs and TPH OROs

Forty soil samples collected from the surface, 5, 10 and 15 feet below ground surface were tested for TPH DROs and TPH OROs using EPA Method 8015M. TPH-DROs Extractable Range Organics C_{10}- C_{28}, TPH-OROs Heavy Extractable Range Organics TPH C_{28+} . Detected TPH DROs and TPH-OROs are shown in Tables 4 and 5, respectively.

TPH-DROs were detected in only 10 soil samples. The detected concentration varies from 12.1 mg/kg in BH-9@9.5-11' to 714 mg/kg in BH-8 at surface. TPH-OROs were detected in only 13 soil samples. The detected concentration varies from 12.1 mg/kg in BH-9@9.5-11' to 714 mg/kg in BH-8 at the surface. TPH-OROs were detected in only 13 soil samples. The detected concentration varies from 87 mg/kg in BH-1@ 5-6.5' to 840 mg/kg in BH-4@15-16.5. The detected TPH-DROs and TPH-OROs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses and no further action is required.

Volatile Organic Compounds (VOCs)

Thirty soil samples collected from 5, 10 and 15 feet below ground surface were tested for Volatile Organic Compounds using EPA Method 8260B. Benzene was detected at 2.08 ug/kg only in soil sample BH-9@9-10.5'. Bromobenzene was detected at 2.26 and 19.5 ug/kg in soil samples BH-3@10-11. and BH-4@15-16.5', respectively. Ethylebenzene, toluene, o-Xylene and m&pXylenes

were detected in soil sample BH-4@15-16.' at concentrations of 2.00, 19.40, 2.72, and 5.50 ug/kg respectively. The above-mentioned VOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses.

Semi Volatile Organic Compounds (SVOCs)

Thirty soil samples collected from 5, 10 and 15 feet below ground surface were tested for Semi Volatile Organic Compounds SVOCs using EPA Method 8270C. SVOCs were detected in only two soil samples: BH-2@5-6.5' and BH-9@4.5-6. Concentrations of Benzo(a)anthracene from 1,340 to 1,710 ug/kg, Benzo(a)pyrene 948 to 1,500 ug/kg, Benzo(b)fluoranthene 1,250 to 2,230 ug/kg, Benzo(k)fluoranthene 478 to 1,400 ug/kg, Chrysene 1,440 to 2,260 ug/kg, Flouranthene 1,130 to 4,610 ug/kg, Phenanthrene at from ND to 2,100 ug/kg and Pyrene 1,410 to 4,230 ug/kg. The above-mentioned SVOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses except for Benzo(a)pyrene concentration of BH-9@4.5-6' which is at 1,500 ug/kg and is equal to screening level of SFWQCB.

PCBs

Ten soil samples collected from the surface were tested for PCBs using EPA Method 8082. No PCBs concentration was detected in any soil samples analytically tested for PCBs except for Aroclor-1254 (PCB-1254) at 78 ug/kg in soil sample BH-6@ surface.

The above-mentioned PCB concentration is considered non problematic based on comparison with DTSC Preliminary Remedial Goal (PRGs) for industrial sites. The reported PCB concentration is well below the soil screening level for industrial and commercial land uses.

TRIP AND EQUIPMENT QA/QC

No concentrations of analytes were detected in Trip Blank and Equipment Blank samples (Appendix B).

19.0 CONCLUSIONS

Based on the above-discussed data, Hydrologue recommends no further action, except for the removal of the shallow soils in the proximity of GP-32. For off-Site disposal of shallow soils in the proximity of soil boring GP-32, we recommend additional testing on the soil stockpile samples for the purpose of soil profiling for off-Site disposal.

Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above mentioned locations is planned for off-Site disposal, then the excavated soil should be stock piled and a WET test should be made on stock pile soil samples to determine the soluble lead concentration of the stock piled soil for soil disposal purposes.

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21.0 LIMITATIONS

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by environmental consultants practicing in this or similar localities. The findings and conclusions presented herein are based primarily upon the analyses of test results from the soil samples during this study. This report has been prepared exclusively for the City of Pasadena Water and Power (CLIENT) and other authorized parties for the subject Site at a specific point in time, and hence it DOES NOT contain sufficient information for other parties or other uses (with the exception of jurisdictional regulatory agency(s). CLIENT shall be the sole beneficiary of this report, and no third party shall be an intended beneficiary unless so stated in writing. No other third party shall have the right to rely on HI's opinions rendered in connection with this report without HI's written consent. This report is also for the use and review of the jurisdictional regulatory agency(s). This report shall not create any rights or benefits to parties other than CLIENT, HI and other expressly named parties. The conclusions and recommendations included in this report are based on information contained or referenced herein, and our best judgment. No other warranty, expressed or implied, is made as to the professional advice contained in this report. No right or interest in the contract associated with this report may be assigned by either HI or CLIENT without the written permission of the other party, and any attempted assignment shall be wholly void and totally ineffective for all purposes. No delegation of any duty owed by either HI or CLIENT may be made without the written permission of the other party. This report is prepared subject to the terms and conditions in the contract related to this report and which was expressly negotiated, agreed to and acknowledged by CLIENT.

All work has been conducted in accordance with generally accepted practices in the fields of environmental engineering, geology, and hydrogeology that exist in this or similar localities at this time. No other warranty, either expressed or implied, is made. The fact that HI finds no recognized environmental conditions after performing the work described herein does not constitute a warranty by HI that this property is free of contamination. HI's opinion about the condition of this Site does not constitute a warranty of any kind. It is impossible to guarantee that any property is free from contamination without testing every square inch of the property for every conceivable hazardous substance, which would obviously be prohibitively expensive. Due to the inherent limits of time and cost, some uncertainty about Site conditions will always remain.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 DESCRIPTION OF SITE 1

3.0 PROPOSED DEVELOPMENT 1

4.0 BACKGROUND 2

5.0 PRE-DRILLING 7

6.0 FIELD EXPLORATION 7

7.0 EQUIPMENT DECONTAMINATION 8

8.0 FIELD QAULITY ASSURANCE/QUALITY CONTROL 9

9.0 PHYSICAL SITE LOCATION 9

10.0 GEOLOGIC SETTING 9

11.0 STRATIGRAPHY 10

12.0 GROUNDWATER CONDITIONS WITHIN RAYMOND BASIN 11

13.0 TECTONIC SETTING 11

14.0 STRUCTURAL GEOLOGY 12

15.0 LOCAL AND REGIONAL FAULTING 12

16.0 SOIL CONDITION 18

17.0 LABORATORY ANALYSIS 19

18.0 DISCUSSION 21

19.0 CONCLUSIONS 28

20.0 REFERENCES 29

21.0 LIMITATIONS 31

FIGURES

Figure 1	Site Location Map
Figure 2	Boring Locations, Aerial Photograph Background
Figure 3	Boring Locations, Proposed GT-5, MW Combined Cycle
Figure 4	PEG/IT Borings
Figure 5	PEG/IT Borings
Figure 6	Geology Map
Figure 7	Geological Map
Figure 8	Map of San Rafael Fault and Features
Figure 9	Representative Geological Profile for Zone 3
Figure 10	Quaternary Geology Map
Figure 11	Historical Highest Groundwater Contour Map
Figure 12	Cross Section A-A' from Figure 2
Figure 13	Cross Section B-B' from Figure 2

APPENDICES

Appendix A	Lithologic Boring Logs
Appendix B	Analytical Test Results and Chain of Custody Records
Appendix C	Lithologic Boring Logs from PEG/IT Report (Reference 3)
Appendix D	Tables from PEG/IT Report (Reference 3)
Appendix E	Figures from PEG/IT Report (Reference 3)
Appendix F	Tables from Hunter-Kennedy Report (Reference 4)
Appendix G	Figures from Hunter-Kennedy Report (Reference 4)

EXECUTIVE SUMMARY

This report presents the findings of a Limited Phase II Environmental Site Assessment for the site located at the southeast corner of the intersection of Fair Oaks Avenue and Glenarm Street in the City of Pasadena, California (hereinafter referred to as "Site") (Figure 1), in the northwestern portion of the City of Pasadena Power Plant, on the south side of Glenarm Building where the Glenarm Repowering Project (GT-5 Combined Cycle Installation) will be constructed (Figures 2 & 3).

This limited assessment consisted of collecting split soil samples during geotechnical drilling for analytical testing from June 8 through June 14, 2011. Subsurface conditions were explored by drilling 10 soil borings: three to a depth of 60 feet below ground surface (bgs) and seven to 50-feet bgs. Soil borings were placed in the vicinity of the requested boring locations by Power Engineers, Inc. A soil engineering investigation for the proposed GT-5 Combined Cycle Generator was also conducted by Hydrologue, Inc. and reported separately.

The selected samples were analytically tested for Semi-Volatile Organic Compounds (SVOCs) using EPA Method 8270C, Volatile Organic Compounds (VOCs) using EPA Method 8260B, Polychlorinated Biphenyls (PCBs) using EPA Method 8082, Total Lead Concentration using Method SW 6010B, Total Hexavalent Chromium using Method SW 7196, Total Petroleum Hydrocarbons (TPH) Carbon Chain using EPA Method 8015M, and Total Recoverable Petroleum Hydrocarbons (TRPH) EPA Method 418.1. The soil samples collected at the surface were analyzed for Polychlorinated Biphenyls (PCBs), lead, and hexavalent chromium using EPA Methods 8082, 6010B, and 7196 respectively.

The soil samples collected at depths of 5, 10 and 15 feet below ground surface were analyzed for Semi-Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs) and Total Petroleum Hydrocarbons (TPH) carbon chain using EPA Methods 8270C, 8260B and modified 8015.

All collected soil samples between the surface and a depth of 25 feet bgs were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) using EPA Method 418.1.

Based on information obtained by HI during the performance of this Phase II environmental assessment, we conclude the following:

- Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total lead using EPA Method 6010B. Lead was detected in all soil samples. Detected total lead concentrations vary from 0.553 to 662 mg/Kg. None of the total lead concentrations exceeds 750 mg/Kg, the clean-up level previously established for this area (Reference 4).

  Shallow soil contamination in the area of GP32 (reported total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. In addition to the excavated soil in area of GP-32, if the soil at the vicinity of the locations where total lead concentration in excess of 50 ppm was detected is planned for off-Site disposal, then the excavated soil from these locations should be stock piled and a WET test should be made

on stock pile soil samples to determine the soluble lead concentration of the soil samples for soil disposal purposes.

- Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total Chromium VI using Method SW 7196. Chromium VI concentrations were detected in only 5 soil samples. The detected concentrations vary from 0.51 mg/kg in BH-1@5-6' to 2.22 mg/kg in BH-10 at the surface. None of the detected Chromium VI concentrations exceed its STLC threshold, California's Human-Exposure Based Screening Number for Residential or Commercial/Industrial sites or DTSC Preliminary Remedial Goal for Chromium VI.

- Sixty soil samples collected from the surface and depths of 5, 10, 15, 20 and 25 feet below ground surface were tested for Total Recoverable Petroleum Hydrocarbons TRPH using EPA Method 418.1. TRPH concentrations were detected in 23 soil samples (Table 3). The detected TRPH concentrations vary from 11.20 to 2,690 mg/kg. Detected TRPH concentrations of only three soil samples exceed 1,000 mg/kg (BH-4 @ S (1,220 mg/kg), BH-4 @ 15-16.5' (2,060 mg/kg), and BH-8 @ surface (2,690 mg/kg)).

  None of the detected TRPH concentrations exceed the previously established clean-up level for the area (References 3 & 4).

- If the soil at the vicinity of the locations where TRPH concentrations exceed 1000 ppm is planned for off-Site disposal then the excavated soil should be stock piled and should be analytically tested for TPH and VOCs using EPA Method 8015 M and 8260B or per soil disposal facility requirements. The horizontal extent of TRPH-impacted soil that potentially will be disposed off-site is not defined.

- Forty soil samples collected from the surface depths of 5, 10 and 15 feet below ground surface were tested for TPH DROs and TPH OROs using EPA Method 8015M. TPH-DROs Extractable Range Organics C_{10}- C_{28}, TPH-OROs Heavy Extractable Range Organics TPH C_{28+}

  The detected TPH-DROs and TPH-OROs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source). The reported concentrations are well below the soil screening level for industrial and commercial land uses.

- Thirty soil samples collected from depths of 5, 10 and 15 feet below ground surface were tested for Volatile Organic Compounds using EPA Method 8260B. The detected VOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source). The reported concentrations are well below the soil screening level for industrial and commercial land uses.

- Thirty soil samples collected from depths of 5, 10 and 15 feet below ground surface were tested for Semi Volatile Organic Compounds SVOCs using EPA Method 8270C. SVOCs

were detected in only two soil samples: BH-2@5-6.5' and BH-9@4.5-6. The detected SVOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source). The reported concentrations are well below the soil screening level for industrial and commercial land uses except for Benzo(a)pyrene concentration of BH-9@4.5-6' which is at 1,500 ug/kg and is equal to screening level.

- Ten soil samples collected from the surface were tested for Polychlorinated biphenyls PCBs using EPA Method 8082. No PCBs concentration was detected in any soil samples analytically tested for PCBs except for Aroclor-1254 (PCB-1254) at 78 ug/kg in soil sample BH-6@ surface.

  The above-mentioned PCB concentration is considered non-problematic based on comparison with DTSC Preliminary Remedial Goal (PRGs) for industrial sites. The reported PCBs concentration is well below the soil screening level for industrial and commercial land uses.

- Based on the above, Hydrologue recommends no further action, except for the removal of the shallow soils in the proximity of GP-32.

- Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above mentioned locations is planned for off-Site disposal, then the excavated soil should be stock piled and a WET test should be made on stock pile soil samples to determine the soluble lead concentration of the stock piled soil for soil disposal purposes.

LIMITED PHASE II ENVIRONMENTAL INVESTIGATION
PROPOSED GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

Site:

Proposed Glenarm Repowering Project
(GT-5 Combined Cycle Installation)
City of Pasadena Power Plant
Southeast corner of the intersection of
Fair Oaks Avenue and East Glenarm Street
Pasadena, California 91105

Prepared for:

City of Pasadena
Water and Power Department
85 East State Street
Pasadena, California 91105-3418

July 29, 2011

HI Project No. 3626-04-02

Prepared by:
hydrologue, Inc.

Seyed M. Mortazavi
Principal Engineer
P.G. No. 5326
R.E.A.II No. 20118

LIMITED PHASE II ENVIRONMENTAL INVESTIGATION
PROPOSED GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

Site:

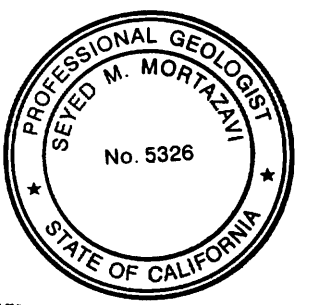
Proposed Glenarm Repowering Project
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Southeast corner of the intersection of
Fair Oaks Avenue and East Glenarm Street
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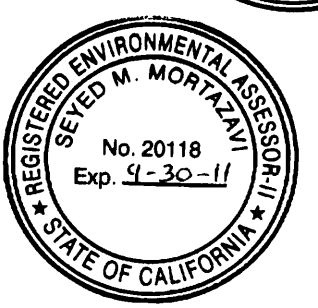
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TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 DESCRIPTION OF SITE 1

3.0 PROPOSED DEVELOPMENT 1

4.0 BACKGROUND 2

5.0 PRE-DRILLING 7

6.0 FIELD EXPLORATION 7

7.0 EQUIPMENT DECONTAMINATION 8

8.0 FIELD QAULITY ASSURANCE/QUALITY CONTROL 9

9.0 PHYSICAL SITE LOCATION 9

10.0 GEOLOGIC SETTING 9

11.0 STRATIGRAPHY 10

12.0 GROUNDWATER CONDITIONS WITHIN RAYMOND BASIN 11

13.0 TECTONIC SETTING 11

14.0 STRUCTURAL GEOLOGY 12

15.0 LOCAL AND REGIONAL FAULTING 12

16.0 SOIL CONDITION 18

17.0 LABORATORY ANALYSIS 19

18.0 DISCUSSION 21

19.0 CONCLUSIONS 28

20.0 REFERENCES 29

21.0 LIMITATIONS 31

FIGURES

Figure 1	Site Location Map
Figure 2	Boring Locations, Aerial Photograph Background
Figure 3	Boring Locations, Proposed GT-5, MW Combined Cycle
Figure 4	PEG/IT Borings
Figure 5	PEG/IT Borings
Figure 6	Geology Map
Figure 7	Geological Map
Figure 8	Map of San Rafael Fault and Features
Figure 9	Representative Geological Profile for Zone 3
Figure 10	Quaternary Geology Map
Figure 11	Historical Highest Groundwater Contour Map
Figure 12	Cross Section A-A' from Figure 2
Figure 13	Cross Section B-B' from Figure 2

APPENDICES

Appendix A	Lithologic Boring Logs
Appendix B	Analytical Test Results and Chain of Custody Records
Appendix C	Lithologic Boring Logs from PEG/IT Report (Reference 3)
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Appendix E	Figures from PEG/IT Report (Reference 3)
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1.0 INTRODUCTION

Hydrologue, Inc. (HI) has been retained by the City of Pasadena to conduct a limited phase II environmental site assessment for the site located at the southeast corner of the intersection of Fair Oaks Avenue and Glenarm Street in the City of Pasadena, California (hereinafter referred to as "Site") (Figure 1), in the northwestern portion of the City of Pasadena Power Plant, the south side of the Glenarm Building where the Glenarm Repowering Project (GT-5 Combined Cycle Installation) will be constructed (Figures 2 & 3).

This limited assessment consisted of collecting split soil samples during geotechnical drilling for analytical testing. The soils engineering investigation for the proposed GT-5 Combined Cycle generator was also conducted by Hydrologue, Inc. and reported separately.

2.0 DESCRIPTION OF SITE

The Site is located at the southeast corner of the intersection of South Fair Oaks Avenue and East Glenarm Street in Pasadena, California (Figure 1). The Site was first developed in the early 20th century with the existing warehouse building in its southwest corner. The Site now contains an inactive oil-and-natural-gas-fired electric generating station used by the Pasadena Water and Power Department from 1906 through 1977.

In 1906, the Pasadena Water and Power Department constructed the original steam-plant building. The facility was demolished before construction of the tank farm in 1971. The existing non-operational steam plant (i.e. the Glenarm Building) occupies the Site's northwestern corner and currently consists of two attached buildings, including an eastern building, constructed in the early 1920s, and a western building, constructed in the early 1930s. Each of the extant buildings includes boiler and turbine generator systems. Both systems in the west building remain in place but Pasadena Water and Power Department removed the systems from the east building during the 1950s. The Pasadena Water and Power Department later installed a few machine tools in the former boiler area of the east building. Some of those machine tools remain.

The topography of the Site is relatively flat. Mixed land uses surround the Site and include a commercial building, The Metropolitan Transit Authority-owned Gold Line light rail right of way (ROW) and the City of Pasadena Water and Power's Broadway Steam Plant to the east, a Southern California Edison substation and the Water and Power Department Electrical and Maintenance shop to the south, and several commercial businesses to the west. Residential areas of Pasadena and South Pasadena are within 1,000 feet of the site to the west and south respectively.

3.0 PROPOSED DEVELOPMENT

We understand that the proposed project consists of the construction of the Glenarm Repowering Project (GT-5 Combined Cycle Installation) (Figures 2 & 3).

4.0 BACKGROUND

Two environmental investigation reports were made available to us by the City of Pasadena Department of Water and Power. These reports partially cover the present Site (Figures 4 & 5):

4.1 Summary of Additional Soil Assessment Activities (Phase III) Reference 3

The report was prepared by Pacific Environmental Group and the IT Group PEG/IT and dated September 3, 1999.

The scope of PEG/IT work included drilling forty soil borings to assess subsurface soil conditions at the Site (Figures 2 & 3). Soil borings were located in areas of concern identified in PEG/IT's Phase II Report (PEG/IT, 1999b). The Phase II Report recommended further subsurface environmental assessment to better define impact to the soils in focused areas. The report also includes a risk-based review to determine whether potential restrictions to development of the Site may be warranted due to impacted soil.

The assessment was performed primarily in the central portion of the Site, but also included a few additional locations as shown in Figures 4 & 5 of the referenced report. The locations included the area near boring B-8A, at which the Phase II investigation identified a concentration of mercury. Although mercury concentrations appeared to attenuate with depth, the Phase II investigation did not define the lateral extent. The Phase II Report also suggested further investigation for volatile organic compounds (VOCs), lead, copper, and heavy hydrocarbon impact near borings B-10A through B-10F. Although lead and copper concentrations appeared to attenuate with depth, the vertical and lateral extent of the impact was not defined to regulatory action limits. Lastly, the area near borings B-12 and B-13A required further investigation for vertical and lateral definition of lead concentrations. Lead concentrations identified by the Phase II Report in this area increased with depth.

4.1.1 Subsurface Conditions

Subsurface lithologies encountered during drilling and sampling consisted primarily of sandy silt and silty sands to the total depth explored, though many borings also contained lithologies that ranged from clays to gravelly sands. Some possible hydrocarbon was observed in samples collected from the various soil borings, as noted on boring PEG/IT logs. Appendix C contains the complete PEG/IT borings logs.

The highest PID reading recorded by PEG/IT was 70.0 parts per million by volume from the sample collected from boring GP-17 at 1.5' bgs.

The geologists noted that borings GP-39A and GP-40 contained a lithology zone that appeared impacted by hydrocarbons, based on its dark gray to black color and hydrocarbon-like odor. However, analytical results indicated that no TPH existed at any of the samples above, and laboratory reporting limits and TRPH analysis determined that only a small concentration of

TRPH existed above laboratory detection limits. This black layer of silt and clay was observed at an approximate depth of 3 to 7 feet bgs and contained sharp upper and lower contacts indicative of the presence of artificial fill material. The lateral extent of this material is not known.

4.1.2 Analytical Results for Volatile Organic Compounds (VOCs)

PEG/IT analyzed the samples collected from boring GP-10 at 5-feet bgs, boring GP-15 at 5-feet bgs, and boring GP-34 at 5-feet bgs for VOCs (Figure 4). Laboratory analyses did not detect any VOCs above method detection limits in these samples.

4.1.3 Analytical Results for Polychlorinated Biphenyls (PCBs)

PEG/IT reported that laboratory analyses did not detect concentrations of PCBs above laboratory method detection limits in samples analyzed for PCBs. The samples analyzed for PCBs were GP-40 at 1.5-feet bgs, GP-4, GP-11, GP-14, GP-19, GP-39, and GP-40 at 5-feet bgs and GP-7 at 7-feet bgs (Figures 4 & 5). Table 1 of the PEG/IT report (Appendix D) summarizes PCB data, including laboratory reporting limits.

4.1.4 Analytical Results for Total Recoverable Petroleum Hydrocarbons (TRPH) and Total Petroleum Hydrocarbons (TPH) Fuel Characterization

The laboratory detected TPH above method detection limits in 17 of the 44 samples analyzed for TPH fuel characterization. The 17 samples were collected from a total of eleven borings. Sixteen samples contained carbon22 to carbon33 (oil) range hydrocarbons, two contained carbon10 to carbon22 (diesel) range hydrocarbons, and two contained carbon6 to carbon10 (gasoline) range hydrocarbons. The detectable levels of TPH in all samples ranged from 100 mg/kg to 3,810 mg/kg, with the highest concentration (oil range) found in boring GP-14 at 7-feet bgs. The next highest concentration detected in a sample other than GP-14 (9,000 ppm TRPH @ 5' depth and 3,810 ppm oil range TPH @ 7' depth, inside present Site) occurred in the sample from boring GP-15 (outside of present Site) at 1.5-feet bgs. TPH concentrations appear to attenuate laterally to the north, east, and west. With the exception of borings GP-10 (280 ppm oil range TPH @ 7' depth, inside the Site) and B-5 (from Phase II), no TPH impact to soil was observed south of boring GP-14. In general, TPH concentrations in most borings attenuate with depth (Figure 5).

The most common fuel type detected appears to be motor oil or similar heavy hydrocarbons. Based on this determination and the apparently dark stained soils at GP-39 and GP-40 for which the laboratory detected no TPH, PEG/IT, in consultation with the Water and Power Department, requested Associated Laboratory to analyze selected samples for TRPH in an effort to confirm that no petroleum hydrocarbons existed outside the normal TPH range. Those samples with high TPH levels were also found to contain higher TRPH levels. TRPH was detected in one sample from boring GP-40 at a concentration of 44 mg/kg, well below the Site clean-up level of 10,000 ppm (Figure 5). Table 2 of the PEG/IT report (Appendix D) summarizes analytical results for TPH fuel characterization and TRPH.

4.1.5 Analytical Results for Lead

PEG/IT reported total lead concentration for 83 samples collected from 34 borings. If any total lead concentrations exceeded the 50 ppm, PEG/IT directed the laboratory to perform a soluble lead analysis on that sample for STLC comparison. Additional samples were analyzed by the California Toxicity Characteristic Leaching Procedure in order to obtain preliminary data for possible waste disposal characterization.

Detected total lead concentrations exceeded 50 ppm in 23 samples. The Laboratory analyzed each of these samples for soluble lead and found that five samples contained soluble lead at a concentration that exceeded the STLC threshold and two samples contained soluble lead at the STLC threshold. The highest soluble lead concentration was found in the sample from boring GP-19 (outside present Site) at 1.5-feet bgs (36.4 mg/kg). Most other elevated levels of total lead and soluble lead also occurred in the upper 1.5-feet bgs samples. Furthermore, at most boring locations, lead levels attenuated with depth (Figures 4 & 5). Analytical results for lead are summarized in Table 3 of the PEG/IT report (Appendix D). If the excavated soil from areas where elevated soluble lead in soil sample is reported is planned to be disposed off-site, the stock pile soil samples should be tested for soluble lead prior to its disposal.

4.1.6 Analytical Results for Copper

PEG/IT reported the total copper concentrations for 48 samples collected from 20 soil borings. All samples contained some copper concentrations, but none contained total copper exceeding the TTLC threshold for copper. Moreover, none of the samples were determined to contain copper at or more than ten times the STLC threshold. Table 4 of PEG/IT report (Appendix D) summarizes copper regulatory limits and analytical results. It should be noted that the mercury concentration of soil sample collected from boring 8A was not confirmed in confirmatory soil samples collected by PEG/IT.

4.1.7 Analytical Results for Mercury

PEG/IT reported total mercury concentrations for samples collected at GP-34 through GP-37, GP-39, and GP-40 at depths of 1.5- and 5-feet bgs. Although most samples contained low levels of mercury, no samples contained detectable mercury concentrations that exceeded TTLC (20 ppm) or ten times STLC (0.2 ppm) for mercury. Table 5 of the PEG/IT repot (Appendix D) summarizes mercury regulatory limits and analytical results.

4.1.8 Analytical Results for Title 22 Metals

Four soil samples collected at depths of 1.5 and the 5 feet bgs from borings GP-39 and GP-40 were analyzed for Title 22 Metals. The 5 feet bgs samples were collected in the center of the black stained layer. Although various metal concentrations were detected in each of the above referenced soil samples, only the total lead concentration of soil samples collected at a depth of 1.5 feet from boring GP-40 exceeded 50 ppm (75.3 mg/kg). TTLC threshold concentration for lead is 1,000 ppm. All other analytes were below the TTLC and ten times the STLC levels.

Based on known analytical data from the Phase II and the Phase III performed by PEG/IT and the risk-based review performed by Gradient (subsidiary of PEG/IT), PEG/IT required no further action at this Site.

4.2 Report of Soils Investigation, Pasadena Water and Power Plant

This report was prepared by Hunter-Kennedy and Associates, Inc., for Southwest Industries and is dated July 30, 2003 (Reference 4).

Hunter-Kennedy reported that to make way for Site improvements, soil from selected areas in the Pasadena Water and Power Plants was tested and where necessary, excavated and disposed of off-Site. This operation was conducted beginning in October 2002 and continued through March 2003. The overall activities can be broadly classified into three project areas: Marley Cooling Tower foundation adjacent acid lines, duct banks and other associated structures; Burn Tank; and East-West Tanks. Only the Marley Cooling Tower foundation partially overlaps the present Site.

As a part of the removal of the Marley Cooling Tower foundation adjacent acid lines, duct banks and other associated structures by Southwest Industries, Hunter-Kennedy performed soil sampling and analytical testing for the underlying soil. The Marley Cooling Tower was located in the western portion of the "Glenarm power plant". The Hunter-Kennedy testing found that the soil beneath the Marley Cooling Tower was contaminated to a depth of 10 feet with varying degrees of petroleum related hydrocarbons and lead. Uncovered during the testing excavation was: (1) an area to the south of the tower (hereafter referred to as the "Oil Pit") which contained contaminated soil to a depth of 22 feet, and (2) a "tank ring" which appeared to be an old tank foundation at a depth of 10 feet near the south east corner of the tower. This tank ring area was contaminated to a depth of 12 feet. The soil underlying the duct banks, acid line and other associated structures generally did not contain levels of contaminants above the specified action levels for this project.

Soil underneath the Marley Cooling tower that contained varying concentration of petroleum hydrocarbons and lead was excavated to a depth of 10 feet at the southern end of the cooling tower and 5 feet at the northern end, 22 feet at the Oil Pit location, and 12 feet at the tank ring location (see figure 5). Excavated soil was placed in stockpiles and tested for profiling purposes for off-site disposal.

Sample locations were determined based upon the specified collection of one sample per 50 foot grid. A total of 25 samples were initially collected at depths of 1 and 5 feet below the surface (after the foundation was removed).

4.2.1 Cooling Tower

4.2.1.1 Initial Investigation (Figure 1a of the Hunter-Kennedy report, Appendix G)

The initial sample (PPPI) was collected ahead of the scheduled grid sampling when discolored soil was discovered after demolition of a small utility building located just southeast of the

cooling tower. This sample was analyzed for CAM metals and STLC lead. The results were below action levels.

On October 7 through October 16, 2002, soil samples were collected from 13 locations (samples A 1-1 through C 15-5) from depths of 1 and 5 feet.

At 9 locations, the laboratory analysis did not detect contaminant levels above the limits established for the project. However, at the remaining locations, petroleum hydrocarbon levels in excess of 10,000 mg/kg in three samples (A5-5, B5-5 and C5-5) and metal concentrations exceeding the STLC limit in 17 samples were detected.

4.2.1.2 Additional Investigation (Figure 1b of the Hunter-Kennedy report, Appendix G)

Based upon these results, additional samples were collected on January 15 and 20, 2003, in a 15-foot grid pattern at depths of 9 feet (wall/face samples) and 10 feet (bottom). These samples were analyzed for Petroleum hydrocarbons in the C10-20 and C20-30 ranges and soluble lead (STLC). Petroleum hydrocarbon levels detected in these samples were below the action levels. Laboratory results reported one sample with STLC levels above the action levels. A confirmation sample (LCS) collected March 3, 2003 did not find detectable levels of STLC lead.

4.2.1.3 Tank Ring (Figure 1c of the Hunter-Kennedy report, Appendix G)

As the excavation of the soil near the southeast portion of the cooling tower area was extended to a depth of 10 feet, a "tank ring" was discovered. The ring was a three-foot wide concrete ribbon, approximately 30 feet in diameter. The soil within the ring was discolored (black). The visually discolored soil was removed to a depth of 12 feet. One sample contained petroleum hydrocarbon levels above the action level. Three samples were collected at the 12-foot level and analyzed for petroleum hydrocarbons C10-20 and C20-30 and soluble lead (STLC). None of the results exceeded action levels.

4.2.1.3 New Storm Drain Trench (Figure 1c of the Hunter-Kennedy report, Appendix G)

While excavating a trench for the installation of a new storm drain under the former cooling tower location, a discolored area at an approximate depth of 12 feet was observed. Three samples were collected; two from the bottom at a depth of 12 feet and one from the wall face at a depth of 10 feet. Petroleum hydrocarbon levels in the samples were below action levels.

4.2.1.4 Conclusion

Contamination, primarily petroleum hydrocarbons or soluble lead, was detected to depths of 5 feet under the former Marley Cooling Tower (excavated 10 feet); 10 feet at the tank ring (excavated 12 feet); and 19 feet at the oil pit (excavated 22 feet). Elevated results reported in the soil below the "pipeline" were not confirmed by the follow-up tests.

Soil underlying the Burn Tank had elevated concentration of petroleum hydrocarbons and soluble lead detected to depths of 8 feet. The burn tank area was excavated to a depth of 10 feet below ground surface. Soil underneath the Marley Cooling tower that contained varying concentration of

petroleum hydrocarbons and lead was excavated to a depth of 10 feet at the southern end of the cooling tower and 5 feet at the northern end, 22 feet at the Oil Pit location, and 12 feet at the tank ring location (see figure 5). Excavated soil was properly disposed off-Site.

No chemical of concerns were detected at or above action levels in the soil underlying the East-West Tanks.

5.0 PRE-DRILLING

Prior to drilling activities, a Site visit was conducted by HI staff and Principal Geologists. The locations of the proposed borings were discussed with the City of Pasadena Project Managers and adjusted to avoid buried obstacles identified in a previous geophysical survey of the Site. Due to the existence of underground pipes and utilities, several adjustments were necessary. A Site-specific Health and Safety Plan was prepared and followed during field activities. Health and safety issues related to the Site conditions and drilling activities were discussed with the drilling crew.

6.0 FIELD EXPLORATION

Subsurface conditions were explored by drilling 10 soil borings; 3 to a depth of 60 feet below ground surface (bgs), and seven to 50-feet bgs. Soil borings were placed in the vicinity of the requested boring locations by Power Engineers, Inc. Soil borings were drilled by R & C Drilling using a drilling rig equipped with hollow-stem augers to observe and sample the materials potentially affected by the previous Site operation (Figures 2 & 3). Soil samples were collected at 5 foot intervals from each boring using six 2½-inch diameter by 1-inch long and two 2½-inch diameter by 3-inch long brass tubes mounted within a 2½-inch inside diameter Modified California split-spoon drive sampler. A Hydrologue geologist supervised drilling operations and logged all soil borings in accordance with the Unified Soil Classification System (Appendix A). Additionally, a Standard Penetration Test was performed at each sampling interval using a Standard Split Spoon Sampler. All drilling equipments were steam-cleaned prior to being used.

All sampling equipment was cleaned prior to drilling at each boring location. Following sample collection, all sampling equipment, including the brass rings, were brushed clean in a solution of non-phosphate cleanser and rinsed with tap and distilled water and then shaken to remove excess moisture.

The sampler was attached to sampling rods, lowered to the sampling depth, and then was driven 18-inches into the formation. Blow counts per last 12-inches of penetration of the sampler were recorded to evaluate the consistency of the formation. No groundwater was encountered during drilling.

After sample recovery, the ends of the lowest 3-inch long brass tube were covered with Teflon sheets and plastic caps and secured with silicon tape.

Additionally, samples planned to be analytically tested for Volatile Organic Compounds (VOCs) were prepared using the EPA SW5035 Method from the bottom sampling ring as described below. The sampling and preservation protocols use the ESS Lock N' Load 5035 Soil Syringe Sampler. The Soil Syringe Sampler is a one-time use tool which collects approximately 5 grams of soil. The soil collected from the Soil Syringe Sampler is then transferred into pre-weighed 40-mL vials with appropriate preservatives.

Method 5035 requirements for sampling and preserving soil followed as detailed below:

- VOA vial prepared with sodium bisulfate preservative (5ml of de-ionized ultrapure water and 1 gram of Sodium Bisulfate preservative) – low level volatiles. In the field, HI staff measured 5 grams of soil using a Soil Syringe Sampler and added it to the VOA vial. Since the entire sample is consumed during each test, HI used two VOA vials per soil sample.
- VOA vial prepared with methanol preservative (10 ml of methanol (MeOH)) – high level volatiles. In the field, HI staff measured 10 grams of soil using a Soil Syringe Sampler and added it to the VOA vial. Each methanol sample can be analyzed more than once; therefore, only one method VOA was needed. The methanol solution becomes the actual representation of the soil sample being submitted. Since the MeOH virtually "masks" the low-level analytes, only volatiles with concentrations exceeding 200 ppb appear when analyzed.
- Standard boring sleeve followed by preservation in the lab – both high and low level volatiles.

The soil samples were labeled with the sample identification, date and time of sampling and the HI project number, and delivered to an off-Site state certified laboratory for hazardous waste testing. Prior to use, all the tubes were washed in a non-phosphate cleanser solution rinsed with tap water and then distilled water.

For each sampling interval within the borings, the soil contained in the second 3-inch long sleeve from the tip of the sampler was used for headspace analysis to determine if volatile hydrocarbon vapors were emanating directly from the soil using a photoionization detector (PID) MiniRAE 2000 Portable VOC Monitor, calibrated against an isobutylene gas standard. Each sample was placed in an airtight Ziploc™ plastic bag. The Ziploc plastic bags were placed in the sun for approximately 5 minutes and the headspace in each bag was analyzed using a PID. The headspace readings were recorded on the boring logs (Appendix A).

The soil samples were logged on requisite chain-of-custody record forms (Appendix B) and immediately delivered to American Scientific Laboratory (ASL), a State of California Certified Hazardous Waste Testing Laboratory (Certificate # 2200). The soil samples were labeled with the sample identification, date and time of sampling and the HI project number.

7.0 EQUIPMENT DECONTAMINATION

All hollow stem augers were steam-cleaned prior to being used. Following sample collection, all sampling equipment, including the brass rings, were brushed clean in a solution of non-phosphate cleanser and rinsed with tap and distilled water and then shaken to remove excess moisture.

8.0 FIELD QAULITY ASSURANCE/QUALITY CONTROL

For field quality assurance/quality control (QA/QC) purposes, field/equipment blanks and trip blanks were prepared daily, along with the collected soil samples. The field/equipment blanks are used to demonstrate whether the sampling procedures have any positive interference on the analytical results. The field/equipment blanks were prepared by flushing the decontaminated sampling equipment with purified water and collecting the water in sample containers. The trip blanks were supplied by ASL and are used to provide a measure of the potential positive interference introduced by sample preservation, transportation, and storage. The aforementioned QA/QC blanks were handled and processed in exactly the same manner as other samples, as described above. In addition to the requested analysis, ASL analyzed QA/QC samples which consisted of the analysis of matrix spike/matrix spike duplicates, method blanks, check samples and standards. Copies of the laboratory reports are included in Appendix B.

9.0 PHYSICAL SITE LOCATION

The coordinates of the Site are approximately 118.1494° west longitude, 34.1268° north latitudes. The Site is located at an elevation of approximately 752 feet above Mean Sea Level (MSL). The local surface drainage and topographic pattern is generally to the southeast and locally to the east, with a local topographic gradient of approximately 0.01 foot/foot, toward the east (Figure 1).

10.0 GEOLOGIC SETTING

The City of Pasadena Power Plant (Site) is located along the northeastern side of the Raymond Hills and eastern side of Grace Hill at the terminus of the Alhambra Wash in the southern portion of the City of Pasadena and Raymond Basin, a structurally elevated low relief surface lying to the northwest of the prominent San Gabriel Basin. The Raymond Basin is a triangular shaped alluvial plain that abuts the steep and high San Gabriel Mountains to the north and the moderate relief San Rafael Hills to the west. The active Raymond Fault forms the south-southeast boundary and separates the Raymond and San Gabriel Basins.

The Pasadena/Altadena/Sierra Madre areas are considered seismically active, where moderate sized earthquakes occur infrequently and active and potentially active faults abound. The east-west trending San Gabriel Mountains raise more than one mile above the basin floor with the steep southerly flank of the range, representing a recessed fault scarp of the Sierra Madre fault zone. The north side of the San Gabriel Mountains is bounded by the active San Andreas Fault and represents the main boundary between the North American and Pacific tectonic plates. The Raymond fault is trending east-northeast, a branch, and closely related to the Sierra Madre Fault that separates the Raymond and San Gabriel Basins. All of these faults have ruptured historically and have produced moderate to major earthquakes.

As a result of the continued movement between the plate boundaries, major north to south compressive forces are created across the region. These have resulted in uplift of mountains and

chains of hills and depressing adjoining basins shaping a sequence of east-west trending uplands which collectively form the Transverse Ranges Physiographic Provence of Southern California. The adjacent basin floors are filled as a result of the uplands erosion and transport of sedimentary deposits. In the vicinity of the Site, alluvium of Pleistocene and Holocene age was deposited by rivers and streams flowing south from the San Gabriel Mountain and San Rafael Hills. The San Rafael Hills are characterized by small- and medium-sized rounded hills and intervening valleys.

These drainages migrated back and forth, forming broad coalescing alluvial fans. Today the Raymond Basin is filled with several hundred feet of alluvial materials. Underlying the alluvium is a thick sequence of Tertiary age sedimentary rocks and below that is basement rock composed of granitic intrusive rocks of Mesozoic age and pre-Cambrian (?) metasediments. The depth to basement rock varies from a few feet near the mountain and hill fronts to nearly 2,000 feet in the southerly portion of the basin.

A major geomorphic feature in the area is the Arroyo Seco, which extends through Pasadena down the west-central part of the area and veers southwesterly near the Pasadena/South Pasadena city boundary. The Arroyo Seco is a steep-walled, flat-floored ravine about 500 to 1,000 feet wide and 50 feet deep. The arroyo widens into a relatively flat plain in South Pasadena. This change in relief is related to the Raymond Fault scarp, which crosses the area on the southern side of Raymond Hill. This scarp is a result of vertical fault displacement. Relief across the scarp is about 40 or 50 feet, but has been highly modified by urban development.

The San Gabriel Valley, which encompasses the southeastern side of Raymond Basin, is essentially a flat, gently south-sloping surface consisting of ancient (Pleistocene age) alluvial fans, flood plain, and basin fill alluvium. Elevations in the northern part of the Valley are in the 800- to 900-foot range, whereas in the south, elevations are in the 400- to 500-foot range. The flatness of the San Gabriel Valley surface is interrupted by several small hills and knolls which are outliers of the Repetto and San Rafael Hills. The largest of these hills is Raymond Hill, which is about 90 feet high. A smaller knoll just northwest of Raymond Hill is called Grace Hill. The other knolls are not named and are relatively subtle features that go largely unnoticed by the general public. Although subtle, these small knolls are important for understanding the geology of the region because they are bedrock exposures that reveal information regarding the surrounding subsurface geology.

11.0 STRATIGRAPHY

The majority of rocks in the area consist of Tertiary age (16 million years old) marine sedimentary rocks of the Topanga Formation. It is important to recognize that the geologic profile in Figure 9 is idealized and simplified to represent the entire zone. The south of the area (Figure 6) consists primarily of rock formations, whereas the east, west and north sides of the area have thick alluvial deposits over the rock formations.

Quaternary-age alluvium occurs at the Site proximity to a depth of approximately 200 feet (190 feet at R-09Z3B3), and at the south side of the Pasadena Power Plant where it is much thinner and on the order of 0 to 50 feet (43 feet at R-09-Z3B6). Alluvium at the proximity of the Site consists

of clay, silt, and sand with a major component of gravel and cobbles and some boulders, all composed of igneous and metamorphic rocks.

The principal formation in the southernmost portion of area (Figure 7) is the Fernando Formation which consists of soft and weak massive claystone and siltstone. The Fernando Formation overlies the Puente Formation in the southern part of the area (Figure 7). The contact is sharp and possibly unconformable (Dibblee, 1992).

The sedimentary rock at the proximity of the Site is composed of the Topanga Formation and includes a wide variety of rock types ranging from coarse-grained rocks such as breccia, conglomerate, and sandstone to fine-grained sandstone and siltstone with minor claystone (mudstone). The part of the Topanga Formation north of the Raymond Fault is predominantly sandstone, conglomerate, and breccia. The Topanga Formation also has intrusive volcanic rocks. For example, a 10-foot-thick zone of hard volcanic rock was encountered in a previous Caltrans study within boring EMI-2, immediately south of the Raymond Fault.

The bedrock northern side of the Site, north of the San Rafael Fault, consists of the Cretaceous age (approximately 120 to 160 million years ago) basement complex that is generally mapped in exposures of the San Rafael Hills as Wilson Diorite or Quartz Diorite (Dibblee, 1989c; Lamar, 1970).

12.0 GROUNDWATER CONDITIONS WITHIN RAYMOND BASIN

The Raymond Basin and San Gabriel Basin, to the southeast, have been extensively utilized for groundwater resources. Water wells drilled in both basins have produced good aquifer data for the groundwater depth and flow direction. Groundwater is resupplied to the Raymond Basin from surface runoff in the San Gabriel Mountains. The Raymond Fault to the south forms a very effective groundwater barrier causing groundwater to cascade over the fault and fall about 200 feet.

The groundwater surface elevation ranges from about 1,400-feet near the mountain front in the north to 450-feet near the Raymond Fault. In the past, springs and small ponds have formed to the south of the Raymond Fault scarp. The groundwater in the basin is unconfined and has a southeast gradient of 0.02 to 0.06 -foot per foot. Perched groundwater was not encountered to the depth explored at the Site (60 feet bgs). Reported highest groundwater depth at the Site proximity was about 50 feet bgs. Reported groundwater depth by the Caltrans consultant on the south side of the Site (south of San Rafael Fault in boring R-09-Z3B6) was 51.2 and on the north side of the Site was 136 feet (north of San Rafael Fault in boring R-09Z3B3). Both borings were converted to pizometers after drilling.

13.0 TECTONIC SETTING

Tectonic processes (faulting and earthquakes) are very active in the Site region. Figures 6 to 9 show the Site location relative to known active and potentially active faults. Obviously, the closer

a site is to an active fault, the greater potential there is for surface rupture and high earthquake ground motions. The Site does not lie close to any known active fault capable of surface fault rupture. However, the queried and buried trace of the San Rafael Fault is shown to cross or skirt the extreme corner of Jacob Parking Lot, east of Old Power Plant Building (Figures 6 to 9). It should be noted that in Figure 6 the fault is shown to cross through the Pasadena Power Plant entering from the west and exiting from the southeast corner along the Alhambra Wash. The nomenclature Eagle Rock or San Rafael faults were kept identical to their referenced sources in the figures 6 to 8.

The faults that trend mostly to the east-west are those associated with the Transverse Ranges. They produce mostly reverse (thrust) movement along north dipping planes which trend along southerly facing upland flanks. The active thrusts in the region include the Sierra Madre, Cucamonga, Raymond, and Santa Monica-Hollywood Faults. Another type of thrust fault is a blind thrust. These faults also are associated with the same process that elevated the Transverse Ranges, but the fault has remained buried and undetectable unless it produces an earthquake. The Raymond Fault, projecting along the south side of the Raymond Basin, at one time, may have been a blind thrust but because of continued activity it ruptured the ground surface.

The dominant fault system in the region is associated with the San Andreas Fault Zone. The system moves in a right lateral northwest trending direction with locally some vertical movement. The San Jacinto, Whittier-Elsinore, Newport-Inglewood, Palos Verdes and Mojave Desert Faults are coupled with the San Andreas (plate boundary) system. All of these faults have ruptured historically and produced moderate to major sized earthquakes.

14.0 STRUCTURAL GEOLOGY

As shown in Figure 9, the geologic strata are deformed into a series of folds and faults. Most of the folds and faults are continuations of geologic structures in the Santa Monica Mountains and the Elysian Hills to the southwest. These structures trend southeasterly through the Repetto Hills and continue below the flat-lying Quaternary alluvium of the San Gabriel Valley. The major folds are the Elysian Park Anticline and the South Pasadena Anticline.

The folding shown in Figure 9 is generalized and simplified. In reality, there are numerous small-scale folds within the larger fold trends. Frequent changes in bedding orientation due both to folding and faulting should be expected at depth.

Many of the faults are intra-formational features, meaning that the faults offset rocks of the same type. However, some of the faults could comprise highly fractured or clayey gouge zones.

15.0 LOCAL AND REGIONAL FAULTING

The potentially active Sierra Madre Fault Zone is over 60-miles long and is located just about 5.6 miles to the north of the Site. The fault displays dominantly reverse (vertical) movement and forms a very irregular and deeply incised scarp which, in places, may be several hundred feet

high. The fault zone strikes roughly east-west and locally dips northward at 18 to 70 degrees beneath the San Gabriel Mountains. Locally, at the foot of the range, the fault has been mapped most notably with basement rock thrust southward over older alluvium. A potentially active fault is one that has ruptured in the last two million years, but no evidence has been found to suggest rupture in the last 10,000-years. This infers that the fault has a relatively long recurrence interval.

The Sierra Madre Fault, in the Pasadena, Altadena and Sierra Madre areas, has not been placed into an active category or an Alquist-Priolo Earthquake Fault Zone as designated by the California Division of Mines and Geology. The potential for direct surface fault rupture through the subject Site is judged to be nil based on available geologic and fault related technical data. The upper bound (moment magnitude) earthquake assigned to the Sierra Madre Fault is M6.7 and the calculated slip rate is 3.0 mm per year. The fault is assigned to a Type B category. The entire Raymond Basin lies in Seismic Zone 4. Because of the proximity of this potentially active fault, it may produce significant ground motion effects should it rupture in the area closest to the Site and produce a major earthquake.

The faults of most interest to the proposed Power Plant project are the active faults that might result in ground rupture and displacement during an earthquake, and faults that might generate strong shaking of project facilities. The faults of most interest to the project are the Raymond Fault, the San Rafael Fault, and the Eagle Rock Fault.

The faults of greatest significance to the project are described in detail below. The locations of these faults are shown in Figures 6 to 8, and in the representative geologic profiles (Figures 9). These faults represent earthquake shaking hazards, but only the Raymond and Alhambra Wash faults located outside of the Site are identified as Alquist-Priolo Earthquake Fault Zones (APEQFZ), which implies a surface rupture potential. Such a designation indicates the fault is well known and its location is well defined. Other potentially active faults may not be identified as APEQFZ because their locations are not well defined and/or they have not generated earthquakes in historical times. The City of Pasadena Safety Element (City of Pasadena, 2003) has designated a "fault hazard management zone" for the Eagle Rock Fault, which means that geological studies are required for determining the potential for fault rupture before development occurs within the zone.

The active Raymond Fault Trace strikes east-northeast, 1.0 mile south of the Site, along the south boundary of the Raymond Basin. The fault is 12 to 15.5 miles long depending upon which interpretation is accepted, dips to the north beneath the basin at generally a high angle, and has produced lateral and vertical displacements. A well-developed scarp to 100-feet high along with sag ponds, offset drainages, back tilted surfaces, springs, a groundwater barrier and pressure ridges suggest its surface rupture is relatively young. Carbon dating gave movement within the last 2,500-years. The fault has been assigned to a Type B Category with an upper bound (moment) magnitude earthquake of 6.5, and a slip rate of 0.1 to 0.4 mm per year.

The State of California (CGS) has established an APEQFZ along the Raymond Fault from the San Gabriel Mountains in the east to near the intersection of Avenue 50 and York Boulevard in the west. The Raymond Fault extends southwesterly from the Sierra Madre Fault Zone at the base of the San Gabriel Mountains through the communities of Monrovia, Arcadia, San Marino, and

Pasadena to the Raymond Hill area of South Pasadena, where the Raymond Fault trends more westerly through the communities of South Pasadena, Highland Park, and possibly into Los Angeles. The fault forms a gentle arc, convex toward the south across the alluvial deposits of the San Gabriel Valley. The fault is best expressed in the San Marino to South Pasadena area, where if forms a prominent escarpment up to about 150 feet high.

A prominent linear gravity anomaly extending easterly from the southern margin of the Santa Monica Mountains, under the Los Angeles River plain, and into the Repetto Hills indicates that the Hollywood fault may extend easterly into the Repetto Hills, and has led to the interpretation by some that the Hollywood and Raymond Faults may be interconnected. Others (Dolan, Reference 15) have postulated that the Raymond Fault is directly connected with the Hollywood Fault and other faults within the southern frontal fault system of the Transverse Ranges. The westerly continuation of the Raymond Fault into the Los Angeles River floodplain is uncertain. For the purposes of this study, it is assumed that the Raymond and Hollywood Faults are independent features.

The most recent major rupture on the Raymond Fault occurred in the Holocene time, about 1,000 to 2,000 years ago (Crook et al., 1987; Weaver and Dolan, 2000, Reference 15). The largest earthquake within the project area in historical times was the 1988 Pasadena Earthquake with a magnitude (ML) of 5.0; this shock was interpreted by Jones et al. (1990) to have occurred on the Raymond Fault.

Currently, most geoscientists consider the Raymond Fault to be a left-lateral reverse-oblique fault that dips steeply (approximately 80 degrees) to the north. Geological trenching studies across the fault scarp indicate average rates of fault slip between 0.1 and 0.4 millimeters per year (mm/yr). More recently, the rate of slip has been estimated to be about 1.5 mm/yr and the recurrence interval at 3,300 years (Dolan et al., 2000; Cao et al., 2003; Weaver and Dolan, 2000, Reference 15). The maximum earthquake estimated by the CGS is in the range of M_w= 6.0 to 7.0.

The nature of potential surface displacements on the Raymond Fault is poorly known. Due to the lack of earthquake history on the Raymond Fault, seismic design for the fault must be based on empirical fault/earthquake relationships, based on a length of 12 miles, a down-dip width of 10 miles, and average slip of 1.6 to 3.3 feet. A maximum earthquake of Mw=6.7 is estimated.

Eagle Rock and San Rafael Faults

The Eagle Rock and San Rafael Faults, in the Pasadena area, have not been placed into an active category or APEQFZ Fault Zone as designated by the California Division of Mines and Geology. Existing geological maps (Lamar, 1970; Dibblee, 1989; Yerkes and Campbell, 2005; and City of Pasadena, 2002) show different locations for the Eagle Rock and San Rafael Faults. The principal difference is that Lamar's (1970) map shows the San Rafael and Eagle Rock Faults as separate features. The San Rafael Fault extends southeasterly from within the San Rafael Hills to the north edge of Grace Hill, Raymond Hill and the smaller associated knolls, essentially along the same trace as Dibblee's Eagle Rock Fault. At the eastern end Lamar splits the fault into two splays or branches; one extends through the top of Raymond Hill (south of the Pasadena Power Plant) and the other is a dotted line (that is, a subsurface fault) trending more easterly, along East Glenarm

Street, past Arroyo Parkway and into the hills north of the main trace of the Raymond Fault. Lamar maps the Eagle Rock Fault to the south of the San Rafael Fault within the knolls and projecting south of Raymond Hill. The differences between the fault mapping are not really significant from an earthquake hazard perspective, but the differences might be important for the Pasadena Power Plant projects, in that if there is only one fault (as indicated by Dibblee), the fault crosses the Power Plant, while in the case of two separate faults (as indicated by Lamar) it may be located outside of the Site. Borehole R-09-Z3B3 excavated during Caltrans study (Reference 16) encountered a significant zone of fault gouge believed to be the San Rafael Fault. The Eagle Rock and San Rafael Faults do not extend across the Raymond Fault.

Both the Eagle Rock and San Rafael Faults are considered potentially active faults, as defined above. According to the Caltrans Seismic Design Criteria (2009) fault database, the Eagle Rock Fault is estimated as having a maximum earthquake magnitude of 6.8.

Although the San Rafael Fault is not well documented, the approximate magnitude of its maximum earthquake can be estimated using empirical relationships on earthquake magnitude and fault length. According to these empirical relationships, the maximum magnitude could be about 6.0.

The so-called Eagle Rock/San Rafael Faults (San Rafael fault is the northern branch of the Eagle Rock fault at the proximity of Pasadena Power Plant, by those researchers who believes that Eagle Rock fault bifurcate at the proximity of the Pasadena Power Plant) have been discussed by numerous geoscientists over the past few decades and are shown on several geological maps, notably Lamar (1970), Crook et al. (1987), and Dibblee (1989), as well as several others (e.g. California Division of Mines and Geology, 1978). All of these investigations except CDMG (1978) were regional studies and did not really focus on the Eagle Rock/San Rafael Faults. Consequently, none of these maps show the faults in the same location. However, the CDMG (1978) categorically states that no evidence of Holocene activity has been found in any investigation. Based on the CDMG (1978) and Caltrans/Metropolitan Transportation Agency findings and on our own investigation, as discussed below, we believe that the fault is not active.

In this study the Eagle Rock and San Rafael Faults are considered as two discrete faults as shown by Lamar (1970); the southern fault is the Eagle Rock Fault, extending from the Eagle Rock area, crossing Arroyo Seco, and into the small hills and knolls west of Raymond Hill (Figure 8). The northern fault is the San Rafael Fault; this fault is basically parallel to the Eagle Rock Fault and similarly passes through Arroyo Seco, but extends to the north side of the Raymond and Grace Hills, at the proximity of the City of the Pasadena Power Plant.

Lamar shows the San Rafael Fault bifurcating near Raymond Hill with one branch cutting through the rocks at the top of Raymond Hill and the other branch under the alluvium north of the hill extending towards Blair and Allendale schools. Although in the Caltrans/Metropolitan Transportation Agency the southern branch is shown on their geological maps included in the final 710 tunnel report, they could not find any evidence of such a fault on aerial photographs or during field geological mapping or drilling.

In addition to the CDMG (1978) fault evaluation report, the Caltrans/Metropolitan Transportation Agency investigation (Reference 15), Wilson Geosciences (Diaz-Yourman and Associates, 2007, Reference 22), are investigations that treated the Eagle Rock-San Rafael Faults as their primary focus.

The only location in the area where the fault can be identified is in Arroyo Seco where the fault extends under the La Loma Bridge. The recent investigation by Wilson Geosciences (WGI) excavated a trench on the west side of Arroyo Seco and found faulting within the Tertiary-age Topanga Formation rocks. The fault was entirely within Tertiary-age rocks and did not displace the overlying Quaternary alluvium. Although the faults in their trench exposure may not represent the main branch of the fault, the location is consistent with the change in rock type contact from igneous rocks on the north to the Tertiary-age Topanga Formation on the south. The trench exposure, in conjunction with boreholes and seismic refraction data, locates the fault location quite closely to the eastern end of the bridge. This location is slightly north of the location on Lamar's map and has a slightly more easterly trend than the Lamar or Dibblee maps.

The Caltrans/Metropolitan Transportation Agency drilled several boreholes in the area. Three of the holes revealed important information relative to the San Rafael Fault (R-09-Z3B3, R09-Z3B6, and R-06EM3). The boring R09-Z3B6 is located on State Street just south of the railway and near the Pasadena Power Plant and borings R-09-Z3B3 and R06EM3 are located about 5,000 feet west of the Pasadena Power Plant along Pasadena Avenue (Figure 7).

Boring R-06EM3 was drilled in the park along Pasadena Avenue north of Arlington Drive. This boring was drilled to a depth of 201 feet and encountered alluvium to a 50 feet depth below ground surface (bgs) and Topanga Formation from 50 feet to the bottom of the hole. There was no indication of faulting; therefore the San Rafael Fault must be north of the boring. In addition, there was no indication of a southern branch as shown by Lamar.

Boring R-09-Z3B3 was drilled about 800 feet to the north of R-06EM3 in the grassy median just south of Bellefontaine Street (Reference 16). This boring was drilled to a depth of 275 feet and encountered old alluvium (Pleistocene age) to 185.5 feet bgs, and light-gray clay fault gouge from 185.5 to the bottom of the hole. This clay consisted of intensely sheared, altered, pulverized, highly plastic clay and sandy clay. Reportedly, petrographic thin-section analysis of included pebbles indicated an origin from dioritic igneous rock. The apparent great thickness of gouge (i.e. 90 feet) is interpreted by the Caltrans/Metropolitan Transportation Agency to be due to the borehole extending down a steeply dipping fault. Geometric calculations indicate about an 80 degree northerly dip; the true thickness of the zone is probably more on the order of 20 to 40 feet. In any event, this gouge places the surface projection of the fault quite close to the intersection of Hurlbut Street and Pasadena Avenue (Reference 16).

The third boring, R09-Z3B6, was on State Street just south of the railway tracks, just northeast of Raymond Hill and just west of the power plant (Reference 16). This boring extended to a depth of 326 feet bgs and encountered about 15 feet of alluvium overlying Topanga sandstone and conglomerate. This boring suggests that there is no north-dipping fault through the top of Raymond Hill as shown by Lamar and Dibblee. Furthermore, Caltrans/Metropolitan

Transportation Agency believes that the lack of any apparent faulting indicates that the northern splay of Lamar's fault must be north of the boring (within the City of Pasadena Power Plant).

A seismic-reflection line was run along Raymond Avenue from Glenarm Street to the north (Reference 16). The seismic-reflection line did not reveal any major faults, indicating that any faulting is south of Glenarm Street. Projecting the San Rafael Fault to the southeast based on these 3 borings and the seismic-reflection line places the fault directly through the Jacob Parking Lot. Groundwater was reported at depths of 51.5 and 136 feet in borings R-09-Z3B6 and R-09Z3B3 located at south and north of the San Rafael Fault respectively. A drop of 32.8 feet in groundwater elevations in the above borings is interpreted to be related to the San Rafael Fault. The lack of groundwater in boring JP-1, located at northeast corner of the Jacob Parking Lot and drilled to 60 feet below ground surface and existence of the saturated soil encountered in borings JP-2 and B-1 at depth of 50 feet below ground surface may suggest that the San Rafael Fault is located between borings JP-1 and JP-2. Further investigation is needed to confirm or refute this interpretation.

Although Hydrologue believes the San Rafael Fault may cross the Jacob Parking Lot, we recognize that the location may be somewhat imprecise. It appears to be located outside of the proposed Repowering Project GT-5 Combined Cycle. Reportedly Caltrans/Metropolitan Transportation Agency aerial-photograph analysis and geological mapping did not find any evidence of Holocene activity on the San Rafael Fault. As mapped, the fault trend crosses within Pleistocene-age alluvial deposits. The Pleistocene age is well established by numerous carbon 14 dates (Crook et al., 1987). In support of the Pleistocene age, Caltrans boreholes found weathered, oxidized alluvium with crumbly clasts and multiple pedogenic soil horizons.

Crook et al. (1987) indicate two ages of alluvium along the San Rafael Fault trend; these are less recent alluvium Qal_2 and older alluvium Qal_3 at the Site proximity. Reportedly, Caltrans/Metropolitan Transportation Agency analysis of vintage Fairchild aerial photographs (late 1920s to 1950s) did not reveal any evidence of topographic fault scarps along the trace of the San Rafael Fault in either less recent or the older Holocene alluvium indicating that the fault has not been active in latest Quaternary time. The only surficial indication of a fault is the crude alignment of the widely spaced knolls and hills (i.e. Grace Hill, Raymond Hill, etc). This type of geomorphology is typical of what geologists call a fault-line scarp. A fault-line scarp is a scarp that represents the eroded remnant of an ancient fault. Such a feature is consistent with a Pleistocene age of latest displacement on the San Rafael Fault.

Reportedly, according to the borehole data adjacent to Blair and Allendale schools, near-surface stratigraphic relationships, revealed in the shallow geotechnical borings, indicate lack of Holocene activity on the San Rafael Fault (Reference 20). These borings indicate a black, clayey soil similar to one we observed during grading operations related to the construction of GT1 and GT2 within the Pasadena Power Plant, overlie the Pleistocene alluvium (this layer was not observed during our recent investigations, References 1 & 2). This black soil is widespread throughout the area and is characteristic of a well-developed organic soil horizon on the Pleistocene alluvium. Although there are no carbon dates available for this soil, the thickness alone indicates a substantial age, perhaps several thousand years. The presence of carbonate nodules in the material supports advanced age. However, these clayey horizons are typically

"cumulative" soil horizons that are difficult to date precisely. The consistent thickness, and consistent depth of this unit across the area indicates tectonic stability, and that there has not been any Holocene fault displacement at the Site.

In conclusion, based on the above, Hydrologue believes the present data indicate that the San Rafael Fault may pass through the Jacob Parking Lot, but also it has not been active in Holocene time.

16.0 SOIL CONDITION

Fill

Man-made fill was encountered to a depth of approximately 5 to 15 feet below ground surface (bgs) in the exploratory borings. The man-made fill consists of dark brown to brown clayey, silty sand and fine to coarse gravelly sand in moist and moderately compact conditions. Deeper man-made fill may be present in unexplored areas of the Site.

Natural Ground

Subsurface lithology encountered during drilling and sampling consisted primarily of sandy silt and silty sands to the total depth explored, though many borings also contained lithology that ranged from clayey to gravelly sands. Some black, clayey soil was observed in samples collected from the various soil borings, as noted on boring logs. This black soil is widespread throughout the area and is characteristic of a well-developed organic soil horizon on the Pleistocene alluvium. Appendix A contains the complete borings logs for the current phase of work.

The Site is underlain by stream channel deposits of gravel, sand and silt (Qg) and alluvial fan outwash from major canyon grades northward into Q_a. The Site appears to be within the northern terminus of the Alhambra Wash. The Qg deposits underlying the Alhambra Wash intersect a concealed portion of the Eagle Rock Fault. According to Figure 10, the north side of the Site is covered with Holocene young Alluvial Fan Deposits, Qyf1, while the southeast of the Raymond Hills is covered with Pleistocene Alluvial Fan Deposits, Qof4gs. The contact between the two units at the proximity of the Site is not shown. Raymond Hill and Grace Hill are mapped as pre-Quaternary bedrock.

Almost adjacent to the east and west sides of the Site is alluvium Q_{of} consisting of older dissected surfacial sediments alluvial fans from the San Gabriel Mountains, according to the Geologic Map of the Pasadena Quadrangle by Thomas W. Dibblee, Jr. dated 1989 (Figure 6).

At the Site, beneath the man-made fill, brown sandy silt, gravelly sand, and silty sand in moist and moderately dense to dense conditions were encountered.

Site Groundwater

Groundwater was not encountered at the Site to the depth explored (60 feet bgs). Based on the Los Angeles County Department of Public Works (LACDPW), the closest active well near the Site is Well No. 4057H (personal communication with Miguel Osorio of LACDPW, December 17, 2009), located two blocks northeast of the Site at the intersection of Ohio Street and South Euclid Avenue. The depth to groundwater was measured at approximately 120.7 feet bgs on May 10, 2004. Ground surface elevation at this well is about 750 feet above mean sea level (MSL).

The closest inactive well near the Site is Well No. 4056C, located near the railroad tracks at the intersection of Thomas Guide Grid Lines 6 and 7 (just south of Fillmore Street). The depth to water was last measured at approximately 164.3 feet bgs on October 25, 1974. The ground surface elevation at this well is about 757.8 feet MSL.

A groundwater well was discovered beneath a concrete block and slab during the demolition activities at the vicinity of the gas turbine generators GT1 and GT2 at the Pasadena Power Plant. The demolition contractor excavated the perimeter of the well to approximately 15 feet below ground surface using a backhoe. A 12-inch steel conductor casing and a 2-inch diameter steel inner pipe was observed. The gap between the inner pipe and outer casing was filled with soil but the inner pipe casing was found open and the depth to water was measured by the contractor using a measuring tape and found to be about 85 feet below ground surface (bgs) with at least 5 feet of water. This is consistent with the depth to water reported by the LACDPW measured on May 16, 2002 from the nearby Well No. 4057H.

17.0 LABORATORY ANALYSIS

The collected soil samples were logged on requisite chain-of-custody record forms and delivered to American Scientific Laboratory (ASL), a State of California certified hazardous waste testing laboratory (Certificate # 2200), at the end of each day of field work. The selected samples were analytically tested for Semi-Volatile Organic Compounds (SVOCs) using EPA Method 8270C, Volatile Organic Compounds (VOCs) using EPA Method 8260B, Polychlorinated Biphenyls (PCBs) using EPA Method 8082, Total Lead Concentration using Method SW 6010B, total Hexavalent Chromium using Method SW 7196, Total Petroleum Hydrocarbons (TPH) Carbon Chain using EPA Method 8015M, and Total Recoverable Petroleum Hydrocarbons (TRPH) EPA Method 418.1. No soil sample was tested for soluble lead or Hexavalent Chromium concentrations for the purpose of their comparison with their respective STLC. However, it is recommended to test all stock pile soils for soluble lead prior to their off-site disposal.

The soil samples collected at the surface were analyzed for Polychlorinated Biphenyls (PCBs), lead, and hexavalent chromium,) using EPA Methods 8082, 6010B, and 7196 respectively.

The soil samples collected at a depth of 5, 10 and 15 feet below ground surface were analyzed for Semi-Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs) and Total Petroleum Hydrocarbons (TPH) carbon chain using EPA Methods 8270C, 8260B and modified 8015.

All collected soil samples from the surface to a depth of 25 feet bgs were analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) using EPA Method 418.1.

In addition to the requested analysis, ASL analyzed QA/QC samples which consisted of the analysis of matrix spike/matrix spike duplicates, method blanks, check samples and standards. Copies of the laboratory reports are included in Appendix B.

18.0 DISCUSSION

Table 1 through 7 summarizes the analytical testing results for soil samples collected and analytically tested during this investigation at the subject Site.

Table 1: Concentrations of Lead Detected in shallow Soil Samples milligrams/kilogram (mg/kg)

Sample I.D.	Total Lead Concentration	Site Cleanup level ppm	ASL Laboratory Report No.
BH-1@S	17	750	50219
BH-1@5-6.5'	2.53	750	50219
BH-1@9.5-11'	1.27	750	50219
BH-1@15-16.5	0.553	750	50219
BH-2@S	56.7	750	50196
BH-2@5-6.5'	36.4	750	50196
BH-3@S	36.1	750	50219
BH-3@5'	30.6	750	50219
BH-3@10-11.5'	122	750	50219
BH-3@15-16.5'	4.6	750	50223
BH-4@S	33.4	750	50209
BH-4@5-6.5'	28	750	50209
BH-4@10-11.5	24.7	750	50209
BH-4@15-16.5'	8.85	750	50209
BH-5@S	31.8	750	50177
BH-5@5'	5.66	750	50177
BH-5@9.5-11'	1.77	750	50177
BH-5@15.5-16.25'	1.31	750	50177
BH-6@S	47.9	750	50223
BH-6@5-6.5'	543	750	50223
BH-6@10-11.5'	1.87	750	50223
BH-6@15-16.5'	1.64	750	50223
BH-7@S	105	750	50223
BH-7@5-6.5'	662	750	50223
BH-7@10-11.5'	27.9	750	50223
BH-7@15-16.5'	5.28	750	50223
BH-8@S	58.1	750	50177
BH-8@4.5-6'	16.9	750	50177
BH-8@9-10.5'	2.08	750	50177
BH-8@15-16.5'	1.3	750	50177
BH-9@S	15.8	750	50196
BH-9@4.5-6'	334	750	50196
BH-9@9-10.5'	1.38	750	50196
BH-9@9.5-11'	1.79	750	50209
BH-9@15.5-17'	1.82	750	50209
BH-9@15-16.5	1.91	750	50196
BH-10@S	215	750	50219
BH-10@5-6.5'	198	750	50219
BH-10@9.5-11'	2.04	750	50219
BH-10@14-15.5	1.64	750	50219

ND = Not Detected
Clean-up level for total lead concentration, previously established, for this area is 750 mg/Kg,

Table 2: Detected Hexavalent Chromium using Ion Chromatography in Soil Samples, milligrams/kilogram (mg/kg)

Sample	Chromium (VI) mg/kg	Site Cleanup level ppm	ASL REPORT NO
BH-1@5-6.5'	0.51	37	50219
BH-8@S	0.75	37	50177
BH-9@4.5-6'	1.08	37	50196
BH-10@S	2.22	37	50219
BH-10@5-6.5'	0.52	37	50219
California's Human-Exposure Based Screening Number for Residential sites mg/Kg	17		
California's Human-Exposure Based Screening Number for Commercial/Industrial sites mg/Kg	37		
US EPA's Preliminary Remediation Goal for Residential site mg/Kg	30		

Table 3: Detected Total Recoverable Petroleum Hydrocarbons (TRPH) Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TRPH mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@S	109.00	10,000	50219
BH-1@5-6.5'	206.00	10,000	50219
BH-2@5-6.5"	66.00	10,000	50196
BH-3@S	744.00	10,000	50219
BH-3@5'	196.00	10,000	50219
BH-3@10-11.5'	11.20	10,000	50219
BH-4@S	1,220.00	10,000	50209
BH-4@5-6.5	83.20	10,000	50209
BH-4@10-11.5'	140.00	10,000	50209
BH-4@15-16.5'	2,060.00	10,000	50209
BH-5@S	624.00	10,000	50177
BH-6@S	640.00	10,000	50223
BH-6@5-6.5'	120.00	10,000	50223
BH-7@S	896.00	10,000	50223
BH-7@5-6.5'	60.80	10,000	50223
BH-7@10-11.5'	64.00	10,000	50223
BH-8@S	2,690.00	10,000	50177
BH-9@S	276.00	10,000	50196
BH-9@4.5-6'	108.00	10,000	50196
BH-9@9.5-11'	70.80	10,000	50209
BH-9@20-21.5"	24.00	10,000	50209
BH-10@S	868.00	10,000	50219
BH-10@5-6.5'	928.00	10,000	50219
Previously Established Site Clean-up Level by CH2MHILL mg/Kg	10,000		

Table 4: Detected TPH DROs (Diesel Range) Organics Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TPH DROs mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@5-6.5'	29.4	2000	50219
BH-2@5-6.5'	47.7	2000	50196
BH-4@S	30.4	2000	50209
BH-4@15-16.5'	416	2000	50209
BH-5@S	238	2000	50177
BH-8@S	714	2000	50177
BH-9@4.5-6'	41.6	2000	50196
BH-9@9.5-11'	12.1	2000	50209
BH-10@S	100	2000	50219
BH-10@5-6.5'	82.4	2000	50219
Soil Screening level for* Residential sites in mg/kg	110(HQ = 0.2)-540 (HQ= 1)		
Soil Screening level for* Industrial sites in mg/kg	450(HQ = 0.2)-2200(HQ= 1)		

*** Environmental Screening Level "ESL" Tables (reference 27)**
HQ: hazard quotient/Hazard Index

Table 5: Detected TPH OROs (Oil Range) Organics Concentrations in Soil Samples, milligrams/kilogram (mg/kg)

Sample	TPH OROs mg/kg	Site Cleanup level ppm	ASL REPORT NO.
BH-1@5-6.5'	87	10,000	50219
BH-3@5'	76.8	10,000	50219
BH-3@S	177	10,000	50219
BH-4@S	107	10,000	50209
BH-4@5-6.5'	51.8	10,000	50209
BH-4@10-11.5'	87.4	10,000	50209
BH-4@15-16.5'	840	10,000	50209
BH-5@S	323	10,000	50177
BH-7@S	229	10,000	50223
BH-8@S	406	10,000	50177
BH-9@S	57.4	10,000	50196
BH-10@S	123	10,000	50219
BH-10@5-6.5'	176	10,000	50219
Soil Screening level for* Residential sites in mg/kg	370 (HQ = 0.2)-1800 (HQ= 1)		
Soil Screening level for* Industrial sites in mg/kg	3700(HQ = 0.2)-18000 (HQ= 1)		

*** Environmental Screening Level "ESL" Tables (reference 27)**
HQ: hazard quotient/Hazard Index

The middle distillates category TPH-DROs includes diesel fuel, kerosene, Stoddard solvent, home heating fuel, jet fuel and similar petroleum mixtures. Residual fuels TPH-ORO include heavy petroleum products such as No. 6 fuel oil (Bunker C), lubricating oils, oil and grease, waste oil and asphalts.

Table 6: Detected Volatile Organic Compounds (VOCs) Concentrations in Soil Samples, micrograms/kilogram (µg/kg)

Sample I. D.	VOCs I.D,	VOCs Concentrations ug/Kg	Site Cleanup level ug/kg	ASL REPORT NO.	Soil Screening level* for industrial sites in ug/kg
BH-3@ 10-11.5'	Bromobenzene	2.26	9,000	50219	9200 (PRG)**
BH-4@15-16.5'	Bromobenzene	19.5	9,000	50209	
	Ethylbenzene	2.00	3,000	50209	3,300
	o-Xylene	2.72	2,000	50209	2300 (total Xylenes)
	m&p Xylenes	5.50	2,000	50209	2300 (total Xylenes)
BH-9@ 9-10.5	Benzene	2.08	40	50196	44

*** Environmental Screening Level "ESL" Tables (reference 27)**
** California Department of Toxic Substances Control (DTSC) Preliminary Remedial Goal

Table 7: Detected Semi-Volatile Organic Compounds (SVOCs) Concentrations in Soil Samples, micrograms/kilogram (µg/kg)

SVOCs I.D.	BH-2@5-6.5' ug/Kg	BH-9@4.5-6' ug/Kg	Site Cleanup level ug/kg	ASL REPORT NO.	Soil* Screening level for industrial sites in ug/kg
Benz(a)anthracene	1,340	1,710	12,000	50196	12,000
Benzo(a)pyrene	948	**1,500**	1,600		1,500
Benzo(b)fluoranthene	1,250	2,230	15,000		15,000
Benzo(k)fluoranthene	478	1,400	27,000		27,000
Chrysene	1,440	2,260	23,000		23,000
Flouranthene	1,130	4,610	60,000		60,000
Phenanthrene	ND	2,100	11,000		11,000
Pyrene	1,410	4,230	85,000		85,000

*** Environmental Screening Level "ESL" Tables (reference 27)**

LEAD

Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total lead using EPA Method 6010 B. Lead was detected in all soil samples. Detected total lead concentrations vary from 0.553 to 662 mg/Kg. None of the total lead concentrations exceeds 750 mg/Kg, the clean-up level previously established for this area by Hunter-Kennedy and Associates (Reference 4).

It should be noted that total lead concentrations of three soil samples exceeded 250 mg/Kg (BH-6 @ 5-6.5', BH-7 @5-6.5' and BH-9 @4.5-6'). It should also be noted that 1,400 ppm of lead was reported for the soil sample collected at 1.5' bgs at the GP-32 location, and the extent of shallow soil contaminated with lead is defined by the lead concentration of soil samples reported for GP-31, and GP-33. Also the extent of lead-impacted soil in BH-7 is defined by lead concentrations reported for confirmation soil samples A1, B1 and C1 (Figure 5). The extent of lead impacted soil at the proximity of BH-9 is determined by the reported lead concentration of GP17 (268 @1.5' and 10.8 @ 5'ppm), GP-21(428 @ 1.5' ppm and ND @ 5'), GP22, and GP25 soil samples. In addition to these three samples, the total lead concentration of soil samples BH-2 at surface and BH-10 @ 5-6.5' exceed 50 ppm (10 times the STLC threshold for lead).

Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above mentioned locations is planned for off-Site disposal, then the excavated soil should be stock piled and a WET test should be made on stock pile soil samples to determine the soluble lead concentration of the stock piled soil for soil disposal purposes.

Chromium VI

Forty soil samples collected from the surface and depths of 5, 10 and 15 feet below ground surface were tested for total Chromium VI using Method SW 7196. Chromium VI concentrations were detected in only 5 soil samples. The detected concentrations vary from 0.51 mg/kg in BH-1@5-6' to 2.22 mg/kg in BH-10 at the surface. None of the detected Chromium VI concentrations exceed Chromium VI STLC threshold, California's Human-Exposure Based Screening Number for Residential or Commercial/Industrial sites or DTSC Preliminary Remedial Goal for Chromium VI and recommended site clean-up level for chromium VI and no further action is necessary.

Total Recoverable Petroleum Hydrocarbons TRPH

Sixty soil samples collected from the surface, 5, 10, 15, 20 and 25 feet below ground surface were tested for Total Recoverable Petroleum Hydrocarbons TRPH using EPA Method 418.1. TRPH concentrations were detected in 23 soil samples (Table 3). The detected TRPH concentrations vary from 11.20 to 2,690 mg/kg. Detected TRPH concentrations of only three soil samples exceed 1,000 mg/kg (BH-4 @ S (1,220 mg/kg), BH-4 @ 15-16.5' (2,060 mg/kg), and BH-8 @ surface (2,690 mg/kg)).

None of the detected TRPH concentrations exceed its previously established clean-up levels for the area (References 3 & 4).

We understand that a TRPH cleanup level of 10,000 ppm was previously proposed by CH2MHILL for the City of Pasadena Power Plant and is considered acceptable by the Pasadena Fire Department, which is the regulatory oversight agency for the Site. Based on the above-mentioned analytical results, TRPH concentrations do not exceed the CH2MHILL proposed action level.

The above-mentioned TRPH concentrations are considered non-problematic based on comparison with the ESL tables for deep soil screening levels for industrial soil (when groundwater is the drinking water source). The reported concentrations are well below the soil screening level for industrial and commercial land uses.

If the soil at the vicinity of the locations where TRPH concentrations exceed 1000 ppm is planned for off-Site disposal then the excavated soil should be stock piled and should be analytically tested for TPH and VOCs using EPA Method 8015 M and 8260B or per soil disposal facility requirements. The horizontal extent of TRPH-impacted soil that potentially will be disposed off-site is not defined.

TPH DROs and TPH OROs

Forty soil samples collected from the surface, 5, 10 and 15 feet below ground surface were tested for TPH DROs and TPH OROs using EPA Method 8015M. TPH-DROs Extractable Range Organics C_{10}- C_{28}, TPH-OROs Heavy Extractable Range Organics TPH C_{28+} . Detected TPH DROs and TPH-OROs are shown in Tables 4 and 5, respectively.

TPH-DROs were detected in only 10 soil samples. The detected concentration varies from 12.1 mg/kg in BH-9@9.5-11' to 714 mg/kg in BH-8 at surface. TPH-OROs were detected in only 13 soil samples. The detected concentration varies from 12.1 mg/kg in BH-9@9.5-11' to 714 mg/kg in BH-8 at the surface. TPH-OROs were detected in only 13 soil samples. The detected concentration varies from 87 mg/kg in BH-1@ 5-6.5' to 840 mg/kg in BH-4@15-16.5. The detected TPH-DROs and TPH-OROs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses and no further action is required.

Volatile Organic Compounds (VOCs)

Thirty soil samples collected from 5, 10 and 15 feet below ground surface were tested for Volatile Organic Compounds using EPA Method 8260B. Benzene was detected at 2.08 ug/kg only in soil sample BH-9@9-10.5'. Bromobenzene was detected at 2.26 and 19.5 ug/kg in soil samples BH-3@10-11. and BH-4@15-16.5', respectively. Ethylebenzene, toluene, o-Xylene and m&pXylenes were detected in soil sample BH-4@15-16.' at concentrations of 2.00, 19.40, 2.72, and 5.50 ug/kg respectively. The above-mentioned VOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses.

Semi Volatile Organic Compounds (SVOCs)

Thirty soil samples collected from 5, 10 and 15 feet below ground surface were tested for Semi Volatile Organic Compounds SVOCs using EPA Method 8270C. SVOCs were detected in only two soil samples: BH-2@5-6.5' and BH-9@4.5-6. Concentrations of Benzo(a)anthracene from 1,340 to 1,710 ug/kg, Benzo(a)pyrene 948 to 1,500 ug/kg, Benzo(b)fluoranthene 1,250 to 2,230 ug/kg, Benzo(k)fluoranthene 478 to 1,400 ug/kg, Chrysene 1,440 to 2,260 ug/kg, Flouranthene 1,130 to 4,610 ug/kg, Phenanthrene at from ND to 2,100 ug/kg and Pyrene 1,410 to 4,230 ug/kg. The above-mentioned SVOCs concentrations are considered non-problematic based on comparison with the deep soil screening levels for industrial sites (when groundwater is the drinking water source) of the San Francisco Water Quality Control Board. The reported concentrations are well below the soil screening level for industrial and commercial land uses except for Benzo(a)pyrene concentration of BH-9@4.5-6' which is at 1,500 ug/kg and is equal to screening level of SFWQCB.

PCBs

Ten soil samples collected from the surface were tested for PCBs using EPA Method 8082. No PCBs concentration was detected in any soil samples analytically tested for PCBs except for Aroclor-1254 (PCB-1254) at 78 ug/kg in soil sample BH-6@ surface.

The above-mentioned PCB concentration is considered non problematic based on comparison with DTSC Preliminary Remedial Goal (PRGs) for industrial sites. The reported PCB concentration is well below the soil screening level for industrial and commercial land uses.

TRIP AND EQUIPMENT QA/QC

No concentrations of analytes were detected in Trip Blank and Equipment Blank samples (Appendix B).

19.0 CONCLUSIONS

Based on the above-discussed data, Hydrologue recommends no further action, except for the removal of the shallow soils in the proximity of GP-32. For off-Site disposal of shallow soils in the proximity of soil boring GP-32, we recommend additional testing on the soil stockpile samples for the purpose of soil profiling for off-Site disposal.

Shallow soil contamination at the proximity of GP32 (total lead concentration of 1,400 ppm at 1.5 feet bgs) should be excavated and disposed of off-Site. The lateral extent of the remedial excavation may extend to GP-31, GP-33, and BH-7. The vertical extent of remedial excavation is anticipated to be less than 5 feet. In addition, if the soil at the vicinity of the above mentioned locations is planned for off-Site disposal, then the excavated soil should be stock piled and a WET test should be made on stock pile soil samples to determine the soluble lead concentration of the stock piled soil for soil disposal purposes.

20.0 REFERENCES

1. LIMITED PHASE II ENVIRONMENTAL INVESTIGATION , Proposed 65 MW Combined Cycle – Repowering Project, City of Pasadena Power Plant, 72 East Glenarm Street, Pasadena, CA 91105, Hydrologue Report No. 3626-00-02, dated January 28, 2010
2. LIMITED PHASE II ENVIRONMENTAL INVESTIGATION , Proposed Operation Building Center, 72 East Glenarm Street, Pasadena, CA 91105, Hydrologue Report No. 3626-01-02, dated February 2, 2010
3. Summary of Additional Soil Assessment Activities (Phase III), Glenarm Steam Plant Property, City of Pasadena Water and Power Department, 72 East Glenarm Street, Pasadena, California, by Pacific Environmental Group/ The IT Group, Inc. Report No. 640-001.1B, dated September 3, 1999
4. Report of Soil Investigation, Pasadena Water and Power Plant, by Hunter-Kennedy and Associates, Inc., dated July 30, 2003
5. Phase II Environmental Site Assessment, Proposed Water Treatment Facility, 130 Wallis Street, Pasadena, California, Hydrologue Draft Report No. 2540-01, dated December 16, 2002.
6. Phase II Environmental Site Assessment for ASTs, 130 Wallis Street, Pasadena, California, Hydrologue Report No. 2435, dated July 18, 2002.
7. Phase II Environmental Site Assessment for Generator Turbine, Northeast Corner of Fair Oaks Avenue and State Street, Pasadena, California, Hydrologue Report No. 2391, dated July 17, 2002.
8. Phase II Environmental Site Assessment Proposed GT-1 and GT-2 SCR and Exhaust Stacks, City of Pasadena Power Plant-72 East Glenarm Street, Pasadena, California, Hydrologue Report No. 2555-01, dated January 30, 2003.
9. Soils Engineering Investigation, Proposed Gas Turbine Generators, Broadway and Glenarm Power Plant, Pasadena, California, Hydrologue report No. 2391-00, dated April 3, 2002.
10. Soils Engineering Investigation, Proposed 65 MW Combined Cycle - Repowering Project, Pasadena Power Plant, Pasadena, California, 72 East Glenarm Street, Pasadena, CA 91105, Hydrologue report No. 3826-00-01, dated January 28, 2010.
11. Soils Engineering Investigation, Proposed Compressor, Cooler and Above Ground Storage Tank, 130 Wallis Street Power Plant, Pasadena, California, Hydrologue Report No. 2435-00, dated July 18, 2002.
12. Foundation Investigation Proposed Turbine Generators at Glenarm Plant Fair Oaks and Glenarm, Pasadena, California Converse Davis and Associates Project No. 73-026-A dated February 12, 1973.
13. Foundation Investigation Proposed Fuel Storage Tank Relocation Glenarm Steam Plant Fair Oaks Avenue and Glenarm Street, Pasadena, California Converse Davis and Associates Project No. 73-191-A dated October 23, 1973.

14. Soils Engineering Investigation, Proposes Water Treatment and Water Storage Tank, 130 Wallis Street Pasadena Power Plant, Hydrologue Report No. 2540-00, dated December 10, 2002.
15. Draft Geotechnical Summary Report SR-710 Tunnel Technical study, Los Angeles County, California, Report No. EA-07-187900, Prepared by CH2MHILL, dated October 2009.
16. Geotechnical Report for the Route 7 Freeway Corridor, from Route 10 to 210 In and Near the Cities of Los Angeles, South Pasadena, Pasadena and Alhambra, Report No. 625.732, Prepared by Materials and Environmental Investigation Section of the Engineering Branch, District 7, California Department of Transportation, dated January 1974.
17. Preliminary Geologic Hazards Evaluation for Pasadena Unified School District, San Rafael, Elementary School, 1090 Nithsdale Road, Pasadena, California, 91105, Hydrologue Report No. 3866-01, dated September 2, 2009.
18. Geotechnical Investigation, Proposed New Classroom Buildings, Blair Middle school, SEC of South Marengo Avenue and Allendale Road, Pasadena, California, report prepared by Geotechnical Professionals Inc., dated March 31, 2009.
19. Response to Engineering Geology and Seismology Review, Blair IB Magnet School, 1200 South Marengo Avenue, Pasadena, California, prepared by Geotechnical Professionals, Inc., dated November 23, 2009.
20. Eagle Rock-San Rafael Fault, report prepared by Schell Geological Consulting CO., dated November 19, 2009.
21. Earthquake Hazards Associated with the Verdugo-Eagle Rock and Benedict Canyon Fault Zones, Los Angeles County, California, DMG open file report 80-10.
22. Preliminary Engineering Geology Investigation of the La Loma Bridge Site, City of Pasadena, California prepared by Wilson Geosciences Inc. Altadena, California 91001-2117, dated November 2004.
23. Quaternary Geology and Seismic Hazard of the Sierra Madre and Associated Faults, Western San Gabriel Mountain, California by R. Crook, Jr. et al, dated December 1978.
24. USGS Professional Paper 1339.
25. California Division of Mine & Geology, Geology of Southern Half of the Azusa Quadrangle, D.M. Morton 1973.
26. Blake, T.F., 2002, EQSEARCH, Computer Program for Estimation Prediction of Peak Horizontal Acceleration from California Earthquake Catalogs, Unpublished Private Programs, Fault and Earthquake data base updated 1999.
27. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, by California Regional Water Quality Control Board, San Francisco Bay Region, Interim Final – November 2007 (revised May 2008)

21.0 LIMITATIONS

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by environmental consultants practicing in this or similar localities. The findings and conclusions presented herein are based primarily upon the analyses of test results from the soil samples during this study. This report has been prepared exclusively for the City of Pasadena Water and Power (CLIENT) and other authorized parties for the subject Site at a specific point in time, and hence it DOES NOT contain sufficient information for other parties or other uses (with the exception of jurisdictional regulatory agency(s). CLIENT shall be the sole beneficiary of this report, and no third party shall be an intended beneficiary unless so stated in writing. No other third party shall have the right to rely on HI's opinions rendered in connection with this report without HI's written consent. This report is also for the use and review of the jurisdictional regulatory agency(s). This report shall not create any rights or benefits to parties other than CLIENT, HI and other expressly named parties. The conclusions and recommendations included in this report are based on information contained or referenced herein, and our best judgment. No other warranty, expressed or implied, is made as to the professional advice contained in this report. No right or interest in the contract associated with this report may be assigned by either HI or CLIENT without the written permission of the other party, and any attempted assignment shall be wholly void and totally ineffective for all purposes. No delegation of any duty owed by either HI or CLIENT may be made without the written permission of the other party. This report is prepared subject to the terms and conditions in the contract related to this report and which was expressly negotiated, agreed to and acknowledged by CLIENT.

All work has been conducted in accordance with generally accepted practices in the fields of environmental engineering, geology, and hydrogeology that exist in this or similar localities at this time. No other warranty, either expressed or implied, is made. The fact that HI finds no recognized environmental conditions after performing the work described herein does not constitute a warranty by HI that this property is free of contamination. HI's opinion about the condition of this Site does not constitute a warranty of any kind. It is impossible to guarantee that any property is free from contamination without testing every square inch of the property for every conceivable hazardous substance, which would obviously be prohibitively expensive. Due to the inherent limits of time and cost, some uncertainty about Site conditions will always remain.

REVIEWED	SUBMITTED	APPROVED
James E. Valentine	Mitsuyi Hino	Arthur A. Krieger 3/31/83
		ARTHUR A. KRIEGER DATE
		DIRECTOR OF PUBLIC WORKS
		REGISTERED CIVIL ENGINEER NO. 11257

APPROVED BY:
LOS ANGELES COUNTY SANITATION DISTRICT
W.E. GARRISON CHIEF ENGINEER
Stanley J. Garrison 3/9/83
FOR OFFICE ENGINEER DATE

STATE OF CALIFORNIA }
County of Los Angeles } ss
City of Pasadena

I, PAMELA S. SWIFT, City Clerk of the City of Pasadena, do hereby certify that the PLAN upon which this certificate appears is the PLAN referred to in CONTRACT No. 11,591 of said City.
IN WITNESS WHEREOF, I have hereunto set my hand and affixed the corporate seal of the City of Pasadena.

P. S. Swift 10/27/83
CITY CLERK DATE

CITY OF PASADENA

PUBLIC WORKS DEPARTMENT

IMPROVEMENT OF FAIR OAKS AVENUE

S/o California Boulevard to S/o State Street

FEDERAL AID URBAN PROJECT
M-L510(5)

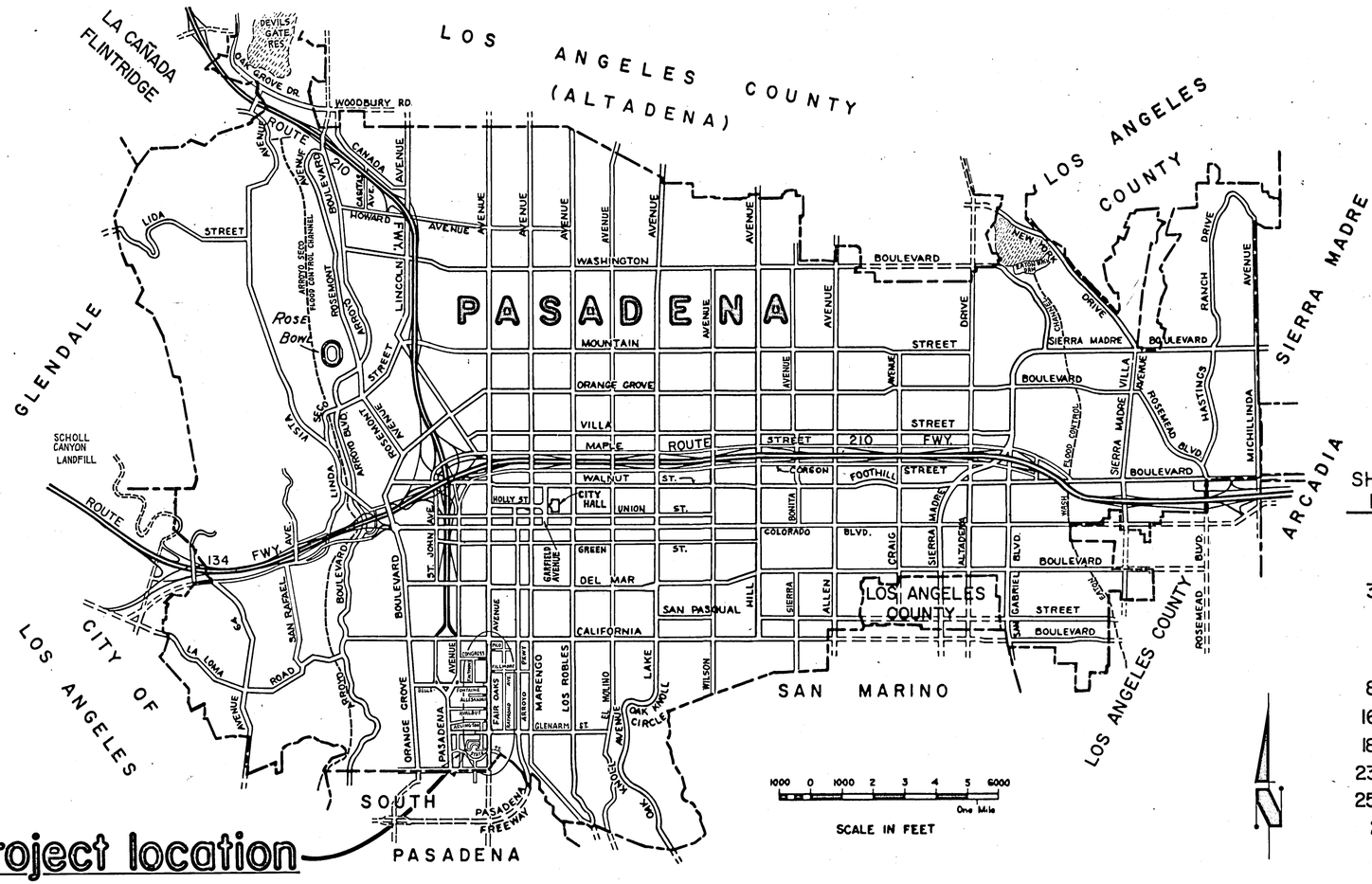
CONSTRUCTION LEGEND

1. P C C CURB & GUTTER PER S-406
2. P C C CURB ONLY PER S-406
3. P C C GUTTER ONLY PER S-406
4. 3 1/2" P C C SIDEWALK
5. P C C DRIVE APRON PER S-403A
6. P C C PAVEMENT PER S-409
7. ASPHALT CONCRETE PAVEMENT
8.
9. AGGREGATE BASE MATERIAL
10. SEAL COAT
11. ROOF DRAIN
12. 8" PCC CROSS GUTTER AND SPANDREL AREA
13. 8" PCC ALLEY APRON

○—8 ABOVE THE LINE REFERS TO TYPE OF STANDARD OR THICKNESS OF SURFACE MATERIAL IN INCHES.

○—DETAIL "A", 6 BELOW THE LINE REFERS TO DETAIL OR THICKNESS OF BASE MATERIAL IN INCHES.

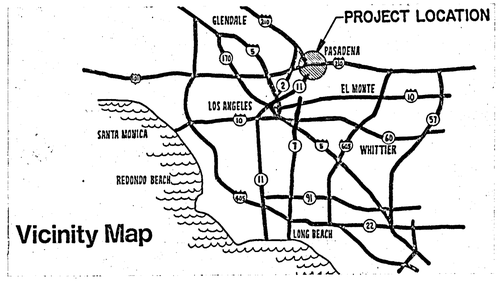
- EXISTING CURB
- EXISTING GUTTER
- EXISTING CURB & GUTTER
- EXISTING WALK
- MANHOLE
- VALVE
- WELL OR VAULT
- TEST HOLE
- FIRE HYDRANT
- METER BOX
- EXISTING POST TOP LIGHT
- EXISTING MAST ARM LIGHT
- EXISTING TRAFFIC SIGNAL WITH BACKPLATE
- EXISTING SIGNAL CONTROL BOX
- POLE
- POLE ANCHOR
- DRAIN PIPE
- SIGN
- R R CROSSING POST
- FENCE
- HEDGE
- SHRUB
- TREE
- PALM
- SPRINKLER HEAD
- WALLS: CONCRETE
- STONE
- BRICK
- BUILDING
- RELOCATE UTILITY, SEE DRAINAGE PLANS



Project location

GENERAL NOTES

1. ALL WORK TO BE DONE IN ACCORDANCE WITH THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION," 1982 EDITION, INCLUDING ANY SUPPLEMENTS, AND THE "SPECIFICATIONS FOR THE IMPROVEMENT OF FAIR OAKS AVENUE FROM S/O CALIFORNIA BOULEVARD TO S/O STATE STREET IN THE CITY OF PASADENA."



INDEX OF SHEETS

SHEET NO.	TITLE
1	TITLE SHEET
2	TYPICAL STREET CROSS SECTIONS & DETAILS
3-6	EXISTING UTILITIES & TOPOGRAPHY
7	STREET PLAN & PROFILE, TYPICAL CROSS SECTION, EXISTING UTILITIES & TOPOGRAPHY - GLENARM STREET
8-15	STREET PLAN & PROFILE
16-17	SANITARY SEWER PLAN & PROFILE
18-22	DRAINAGE PLAN & PROFILE (M.T.D. 1014)
23-24	DRAINAGE DETAILS, LOG OF BORING (M.T.D. 1014)
25-26	CHANNELIZATION
27	TRAFFIC SIGNALS & STREET LIGHTING - DETAILS

NO CONNECTION FOR THE DISPOSAL OF INDUSTRIAL WASTES SHALL BE MADE TO SEWERS SHOWN ON THESE DRAWINGS UNTIL A PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE HAS BEEN ISSUED BY THE SANITATION DISTRICTS FOR SAID CONNECTION.

BEFORE BREAKING INTO OR CONSTRUCTION ON A COUNTY SANITATION DISTRICT SEWER AND PRIOR TO FINAL ACCEPTANCE OF THE PROJECT, SANITATION DISTRICT INSPECTOR SHALL BE NOTIFIED BY PHONE - 962-8605, 638-1162 SO THAT REQUIRED INSPECTION CAN BE MADE.

M.T.D. 1014

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X	2/27/84	AS BUILT	J.G.	R.W.C.	J.A.C.

DRAWN BY GEORGE MARTINEZ - RUDY G. ORDONEZ
CHECKED BY DAVE RINEARSON
DESIGNED BY J.T.LLOYD

CITY OF PASADENA - PUBLIC WORKS DEPARTMENT

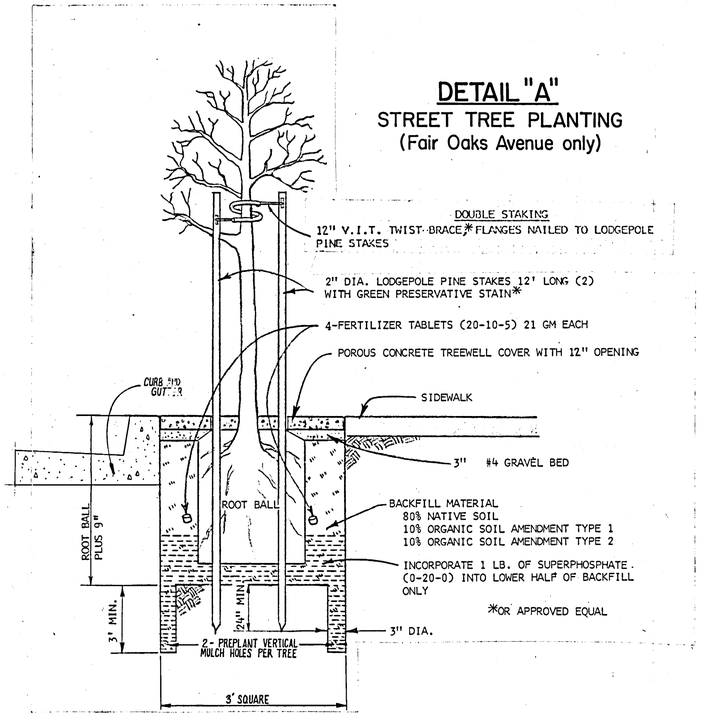
PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 1 OF 27

LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716

CONSTRUCTION COMPLETED _____ — PROJECT NUMBER 530

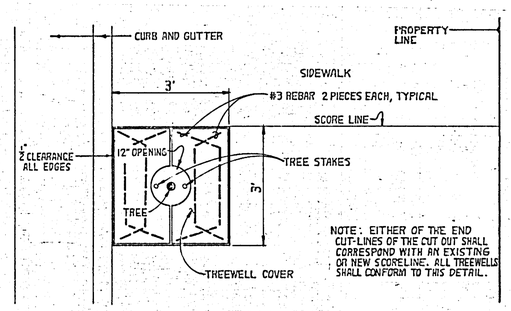
REVIEWED James E. Valentine

SUBMITTED Mitsuyi Kira

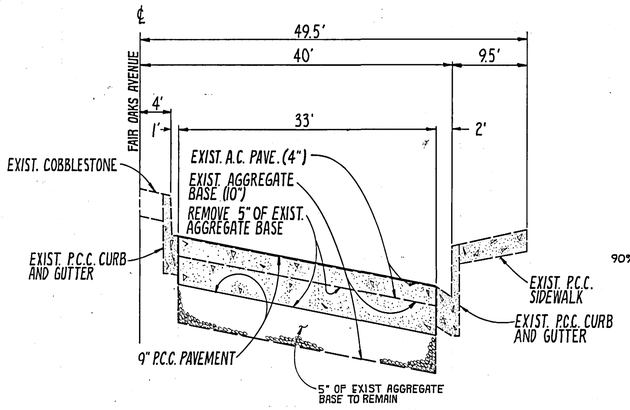


DETAIL "A"
STREET TREE PLANTING
(Fair Oaks Avenue only)

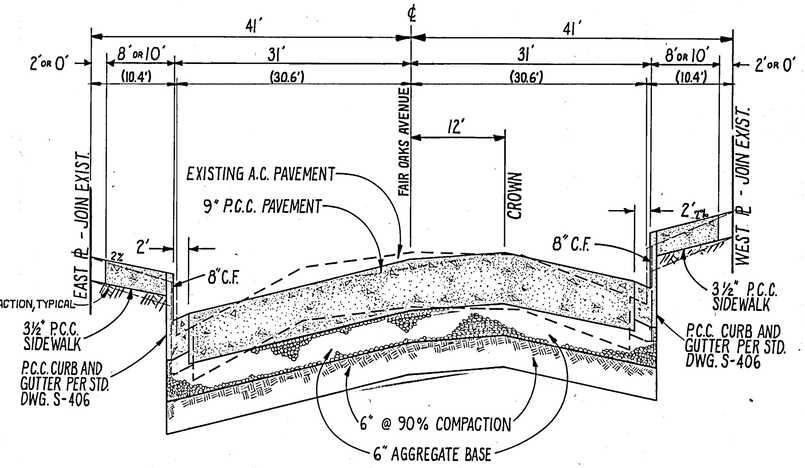
TREE PLANTING DETAIL



TREE WELL CUT OUT DETAIL

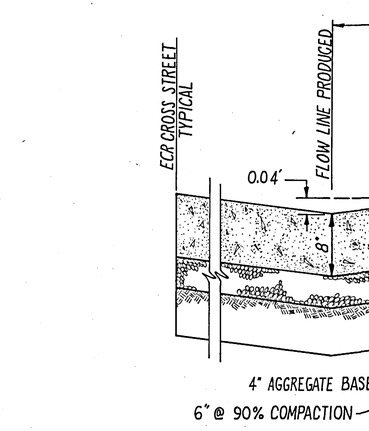


TYPICAL HALF CROSS SECTION
STA. 72+75 — BRIDGE

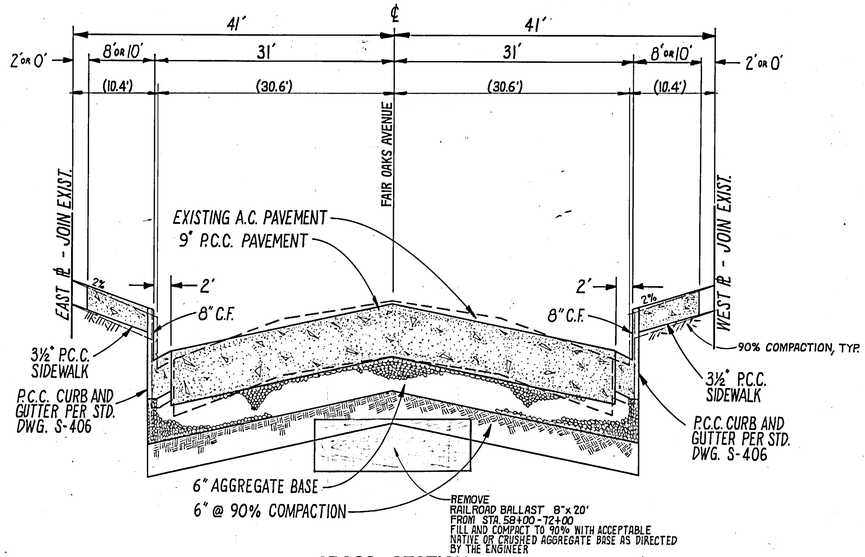


CROSS SECTION
STA. 39+06 — STA. 41+75

NOTE:
Refer to Section 10-12.03 of the Specifications. Should the new P.C.C. pavement require "grinding", then the net thickness of the remaining P.C.C. pavement must be 9" in thickness. All P.C.C. pavement less than 9" in thickness shall be replaced.



DETAIL "B"
TYPICAL SECTION - CROSS GUTTER & SPANDREL AREA



CROSS SECTION
STA. 42+98 — STA. 72+77

TYPICAL SECTIONS AND DETAILS

PROJECT ENGINEER John A. Cafarella	DRAWN BY GEORGE MARTINEZ	REVISIONS	CITY OF PASADENA - PUBLIC WORKS DEPARTMENT
DATE 3/25/83	CHECKED BY DAVE RINEARSON	MARK / DATE / DESCRIPTION / BY / CHKD. / APPROVED	PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 2 of 27
LANDSCAPE ARCHITECT Ray Ellen Montgomery	DESIGNED BY J.T.LLOYD		LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716
NO. 1319 DATE 3/25/83		X AS BUILT	SCALE: —— WORK ORDER NO. 530
FIELD BOOK NO. 1834-L			

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED: James E. Valentine

SUBMITTED: Mitsuji Kira

MATCH LINE 56+50 — SEE SHEET 4

MATCH LINE 62+00

MATCH LINE 62+00 — SEE SHEET 6

MATCH LINE 67+50

MATCH LINE 0+75 W — SEE SHEET 7

#888 — A.C. PAVEMENT — STREET LIGHT ST. LT. PULL BOX — 3" ROOF DRAIN ELIMINATED — 2-4" ROOF DRAIN — 6" ROOF DRAIN ELIMINATED — WATER VALVE FIRE HYDRANT — ST. LT. PULL BOX — CONC. BLOCK WALL

SEE DETAIL "C" SHEET 27

ST. LT. PULL BOX STREET LIGHT — 4" ROOF DRAIN — A.C. PARKING LOT — 30' COMM. DRIVE — 4" ROOF DRAIN — ST. LT. PULL BOX

#990 — 4" ROOF DRAIN — 4" BRASS PISC W/SLOT 4" WIDE TILE CAPPED STUCCO WALL BIN NEXT — 11.4' TILE CAPPED STEPS — ST. LT. PULL BOX STREET LIGHT CONC. CURB PLANTER — 2" ROOF DRAIN — STREET LIGHT PULL BOX — 4" ROOF DRAIN — 6.6' CONC. WALK — A.C. PARKING LOT — 24.7' COMM. DRIVE — 3-4" ROOF DRAIN

SPRINKLERS — 2"DLC — 6"PEM GAS, 2'WE — 20"H GAS, 15'WE — 6-4"F POWER, 21.5'WE — 4"M GAS, 24'WE — 12"CI WATER, 27'WE — TO BE ABANDONED

STA 57+49.29 0+00 W — TO BE ABANDONED — 57 — 30.6' — 82' — 58 — 59 — 60 — 61 — 62

FAIR OAKS AVENUE

8-6"+2-3"ABS POWER, 39'WE — 6-6"+2-3"F POWER, 36'EW — 5 P.P. TEL., 28.5'EW — 10" VIT SEWER, 24'EW — 6 DU TEL., 16.5'EW — 12"CI WATER, 4'EW — 2"GAS, 2'EW — SLOPED CONC. — JUNIPERS — ASSORT PLANTS / SHRUBS

REMOVE ABANDONED STREET LIGHT BASE — SEE DETAIL "B" SHEET 27 — 10.4' — 30.6' — 10.4'

#909 — METAL SIGN — 4" ROOF DRAIN — WATER METER — 2 STEPS — 3" ROOF DRAIN — ST. LT. PULL BOX — ST. LIGHT — GROUND COVER

HURLBUT ST. — 8" VIT SEWER — 4"M GAS, 23'SN — 4"SP TEL, 21'NS — 6"CI WATER, 23'NS — 4-5"P TEL, 21'NS — 1"PLD TEL, 7'NS — 15' — 15' — 15' — 15' — 60' — GRADING LIMIT

1 DU TEL., 19'NS — 16"M GAS, 19'NS (TO BE ABANDONED)

#939 — #953 — #955 — #965 — #975

STREET LIGHT — FIRE HYDRANT WATER VALVE — 6.5' CHAIN LINK FENCE — 1"M GAS (TO BE ABANDONED) — A.C. PARKING LOT — DEAD MAN - RELOCATE "BY OTHERS" — 22" TREE — 41.5' COMM. DRIVE — 4" ROOF DRAIN — 2 STEPS & BLDG. ENTRANCE — WATER METER — 4" ROOF DRAIN — PLANTERS — GRASS LAWN — WATER METER — 7.4' DRIVE — IRRIGATION CONTROL BOX — ST. LT. PULL BOX STREET LIGHT WATER METER — GRASS LAWN — 4" ROOF DRAIN GAS METER — WATER METER — 23.2' DRIVE — WATER METER — BLDG. ENTRANCE — 5' A.C. WALK — COLORED RC ENTRANCE — 12' COMM. DRIVE — 4" ROOF DRAIN GRATE — STREET LIGHT ST. LT. PULL BOX — 8' CHAIN LINK FENCE — 18.5' COMM. DRIVE — 4" ROOF DRAIN

13 DU TEL., 25'SN — 8"CI WATER, 22'SN — 12"GAS, 20'SN — 12" VIT SEWER, 29'SN — 8-3½" MTP, 7'NS — 6-5"P/C POWER, 4'NS — 60' — 10' — 20' — 20' — 10' — SEE DETAIL "G" SHEET 27

#1012 — #1044 — #1050 — GAS STATION

A.C. PARKING LOT — 0.6' HIGH CONC. CURB PLANTER — 22.2' COMM. DRIVE — ST. LT. PULL BOX — SEE DETAIL "C" SHEET 27 — R.R. TRACK BUMPER — 10.4' — 30.6' — 82'

A.C. PARKING LOT — GAS VALVE — 28.4 COMM. DRIVE — ST. LT. PULL BOX — 4" ROOF DRAIN — 2' HIGH SLUMPSTONE WALL — SLOPING CONC. — 6"PEM GAS, 2'WE — 2"DLC

A.C. PARKING LOT — 25' COMM. DRIVE — 4" ROOF DRAIN — STREET LIGHT ST. LT. PULL BOX WATER METER — 10' CONC. WALK AIR VENT — ST. LT. PULL BOX 4" ROOF DRAIN — 28.9' COMM. DRIVE — ST. LT. PULL BOX — WATER METER — CONC. PUMP BAY — CONC. SWALE — 29.8' COMM. DRIVE — F.H., WV & T.S. — 0.5' HIGH CONC. CURB — ST. LT. PULL BOX STREET LIGHT, TRAFFIC SIGNAL 2 LIGHTS, SIGN, ASSORT. PLANTS — ROOF DRAIN TO STORM DRAIN — 7.5'N — 10' GAS, 18'SN — 12"CI WATER, 19'5"N — GRADING LIMIT — ST. — 6-4½"F POWER — RELOCATE CONDUIT, SEE SHT. 27 — 0.2' HIGH CONC. CURB — ST. LT. PULL BOX TRAFFIC SIGNAL — T.S. CONTROLLER — TRAFFIC SIGNAL ST. LIGHT T.S. PULL BOX — STONE WALK — GRASS LAWN

20"H GAS, 15'WE — 6-4"F POWER, 21.5'WE — 4"M GAS, 24'WE — 12"CI WATER, 29'WE — TO BE ABANDONED — SEE DETAIL "B" SHEET 27 — STA 66+59.82 0+00 W — 63 — 64 — 65 — 66 — 67

FAIR OAKS AVENUE

SEE SHEET 18 FOR REMOVALS — 8 DU TEL., 29.5'EW — 10" VIT SEWER, 26'EW — 2"M GAS, 18'EW — TO BE ABANDONED — GAS TO BE ABANDONED — 2"PEM GAS, 2'EW — 12"CI WATER, 4'EW — SEE DETAIL "H" SHEET 27 — 22" PALM - REMOVE — TO BE ABANDONED — ST. LT. PULL BOX - TO BE ABANDONED SEE SHT. 27 — WATER METER — TRAFFIC SIGNAL — DEAD MAN - RELOCATE "BY OTHERS" — PP #13812 MP — AC PARKING LOT — 41.5' COMM. DRIVE

#995 — 18" TREE — WATER METER — STEPPING STONES — CROSSED BOX — ST. LT. — 7.6' BLDG. ENTRANCE

ARLINGTON DR. — 6"M GAS, 23'SN — 8" VIT SEWER — 6" WATER — 23'NS — 15' — 15' — 15' — 15' — 60' — GRADING LIMIT

WATER VALVE FIRE HYDRANT — PLANTERS — ST. LT. PULL BOX 4" ROOF DRAIN — 1¼"M GAS., 6'NS (TO BE ABANDONED) — 3-3½" + 1-3" F POWER — STREET LIGHT ST. LT. PULL BOX — #1017 — 3' CONC. WALK — WATER METER — #1029 — ROOF DRAIN — GAS METER — WATER METER — 5.5' ENTRANCE — #1035 — #1039 — 4" ROOF DRAIN — STREET LIGHT ST. LT. PULL BOX — 3' WALK — 3' HIGH FOOTING — 31.6' COMM. DRIVE — AUTO SHOP AND GAS STATION — #1055 — CONC. WALL 6' HIGH — WATER METER — T.S. PULL BOX TRAFFIC SIGNAL — TRAFFIC SIGNAL ST. LT. PULL BOX 2'x3' CONC. SIGN PEDESTAL — TO BE ABANDONED — GLENARM — RELOCATE - BY OTHERS — FIRE HYDRANT ST. LT. PULL BOX STREET LIGHT, TRAFFIC SIGNAL — CONC. SLAB (MULTI-COLOR)

EXIST. UTILITIES & TOPOGRAPHY

PROJECT ENGINEER	John A. Cafarella
DATE	3/25/83
LANDSCAPE ARCHITECT	
NO. ____ DATE ____	
FIELD BOOK NO.	1834-L
DRAWN BY	GEORGE MARTINEZ - RUDY G. ORDONEZ
CHECKED BY	DAVE RINEARSON
DESIGNED BY	J.T. LLOYD

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X	10/26/83	AS BUILT	G.P.		

CITY OF PASADENA - PUBLIC WORKS DEPARTMENT

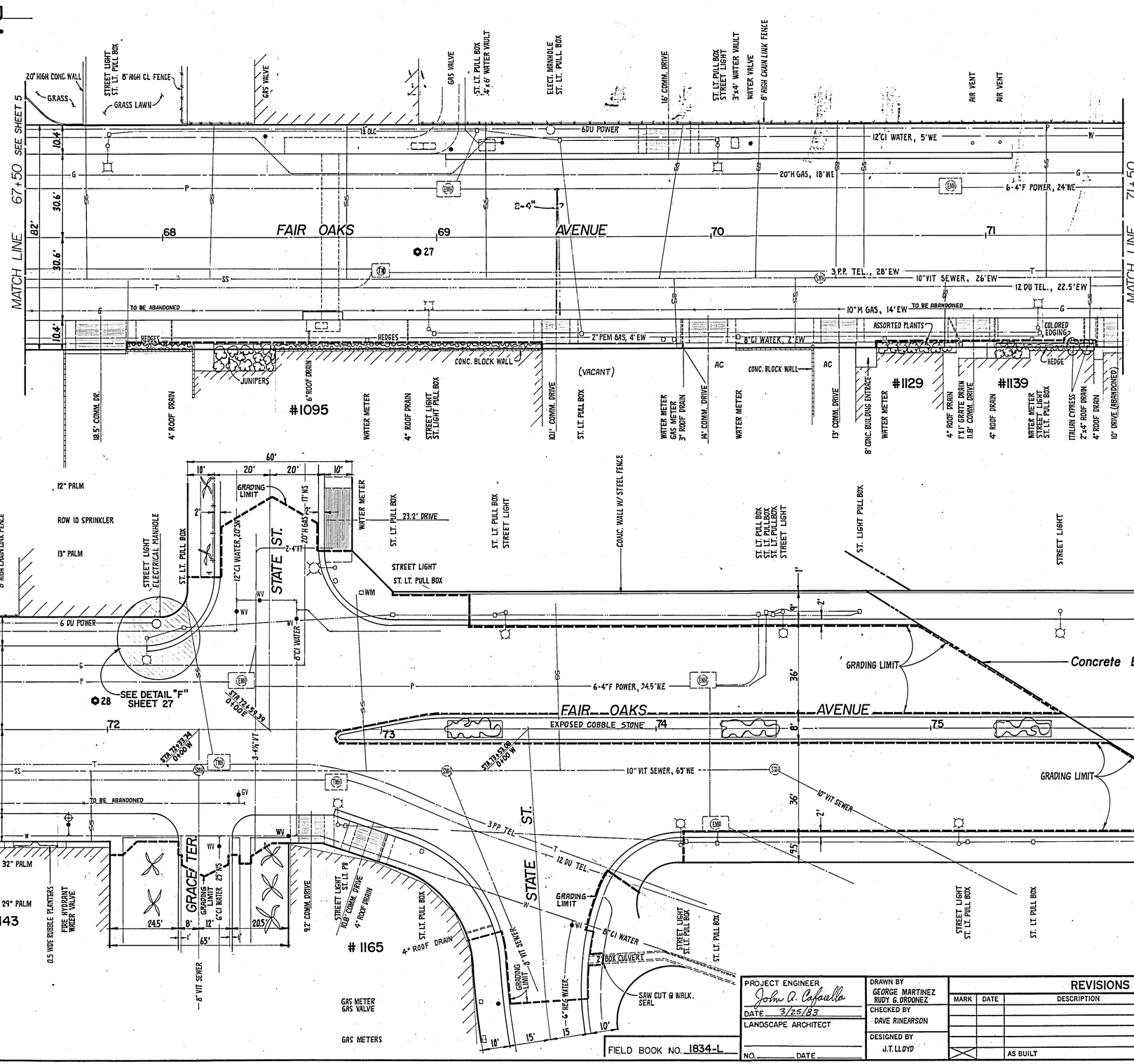
PROJECT: IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 5 of 27

LIMITS: S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716

SCALE: 1" = 20' — WORK ORDER NO. 530

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED	SUBMITTED
James E. Valentine	Mitsuyo Hino



EXISTING UTILITIES & TOPOGRAPHY

PROJECT ENGINEER John A. Cafaella DATE 3/25/83 LANDSCAPE ARCHITECT NO. ____ DATE ____	DRAWN BY GEORGE MARTINEZ, RUDY G. ORDONEZ CHECKED BY DAVE RINEARSON DESIGNED BY J.T. LLOYD	FIELD BOOK NO. 1834-L

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X		AS BUILT			

CITY OF PASADENA-PUBLIC WORKS DEPARTMENT

PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 6 of 27

LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716

SCALE: 1" = 20' — WORK ORDER NO. 530

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED: James E. Valentine

SUBMITTED: Mitsuyo Hino

BENCHMARK: RAMSET W. CURB FAIR OAKS AVE. 8' S/o S. ℄ GLENARM ST.
ELEV. = 750.04'

PROFILE
SCALE: HORIZ. 1" = 20'
VERT. 1" = 2'

753 / 752 grade lines

52.98 TC — 8" CURB FACE — 0.984% — PROPOSED E. TC — 51.75 TC — 8" CURB FACE — 0.600% — PROPOSED E. TC — CB # 3, W=29', D#4 — STA. 65+95.40 BCR

PROPOSED CROWN ℄ — 53.01 — 0.752% — STA. 62+00 — 52.80 TC — 8" CURB FACE — 0.572% — PROPOSED W. TC — STA. 62+40.19 BCR — 52.02 OE

℄ CB # 3, W=10', D#4 — 52.57 TC — 51.90 FL — 18' — ℄ ARLINGTON DRIVE — STA. 62+70.40 — 51.91 OE — 51.87 FL — 18' — 51.75 OE — 51.71 FL — 52.19 TC — 51.52 FL — STA. 63+00.19 BCR — 51.64 OE — PROPOSED OUTER EDGE — STA. 63+25 — 52.07 — 0.600% — PROPOSED CROWN ℄ — EXISTING ℄ — 0.600% — PROPOSED W. TC — 8" CURB FACE — 0.600% — 50.45 — STA. 65+95.40 BCR — 50.13 TC — 49.46 FL — ℄ CB # 3, W=10', D#4 — STA. 66+04.86 BCR

PROPOSED E. OUTER EDGE PROD. — 49.68 — ℄ GLENARM ST. (EAST) STA. 66+40.45 — 49.40 — STA. 66+85.40 — PROPOSED E. TC — 8" CURB FACE — 0.600% — 49.59 TC — 48.92 FL — PROPOSED CROWN ℄ — 0.600% — 50.11 — STA. 66+22.45 — ℄ GLENARM ST. (WEST) STA. 66+39.67 — 49.82 — STA. 66+58.45 — STA. 67+00 — 49.87 — PROPOSED W. TC — 8" CURB FACE — 0.600% — 49.85 — 66+24.78 — 49.72 — 66+54.77 — 50.36 TC — 49.69 FL — 50.00 TC — 49.33 FL — PROPOSED W. OUTER EDGE PROD. — STA. 66+74.85 BCR

60' — 10' — 20' — 20' — 10' — 0+77.97 E. — 40th — Variable — 2' — 9/6 — 7 — SDMH — WV — 0+56.04 E ECR — ST. — 0+55.97 E — MODIFIED CB # 3 SEE SHEET 18 — (49.80 TC) (49.14 FL) ECR — 49.59 TC — 48.92 FL — BCR

ECR (49.96 TC) (49.32 FL) — 49.96 TC, 49.21 FL — 49.96 TC, 49.21 FL — 49.96 TC, 49.21 FL — 50.13 TC — 49.46 FL — BCR — 8' — 7.5'

RECONSTRUCT CB DECK SEE SHT. 18 #23 — 49.68 — 49.40 — EMH — WV — S-414 TYP. — 4 — STA. 65+95.40 BCR — STA. 66+85.40 BCR — STA. 66+60.45 ℄ GLENARM — 9/6 — TREE WELL 67+17 — I — 67+50

62+00 — 63+00 — 64+00 — 65+00 — 66+00 — 67+00

TREE WELL 62+00 — 24" COMM. DRIVE 62+36.9 — TREE WELL 62+82 — HO VALVE — 29' COMM. DRIVE 63+21.3 — 4" ROOF DRAIN 63+59.5 — TREE WELL 63+66 — 26' COMM. DRIVE 64+01.7 — 4" ROOF DRAIN 64+22.1 — TREE WELL 64+52 — ELECT. VAULT AIR VENT 64+61.2 — 4" ROOF DRAIN 64+67.6 — ELIMINATED — 29' COMM. DRIVE 64+88.7 — TREE WELL 65+16 — RECONSTRUCT CB DECK SEE SHT. 18 — 23' COMM. DRIVE (4.5° X ON NORTH) — 10' — 2' — 31' — EMH — WV

MATCH LINE — SEE SHEET 12 — 62+00 — STA. 62+70.40 0°00'W — 63 — CROWN — 64 — FAIR OAKS AVENUE S 0°32'24"E — 65 — CROWN — 66 — 67 — SEE SHEET 14 — MATCH LINE — 67+50

℄ CB # 3, W=10' SEE SHT. 19 — SDMH — BCR 62+40.19 — S-414 TYP. — SMH — 2 TYP — BCR 63+00.19 — 4" ROOF DRAIN 63+07.4 — TREE WELL 63+20 — RELOCATE TREE WELL 63+65 — TREE WELL 64+02 — 4" ROOF DRAIN 64+13.7 — 4" ROOF DRAIN 64+30.0 — TREE WELL 64+61 — 4" ROOF DRAIN 64+95.3 — TMH — 22' COMM. DRIVE 64+46.5 — 65+30 — TREE WELL 65+75.1 — ℄ CB # 3 W=10' SEE SHT. 18 — 2 TYP. — 49.85 — 49.72 — 38.4' COMM. DRIVE 67+26.65

0+46.14 W ECR — A — TREE WELL 62+10 — CB # 3, W=10', K=19' SEE SHT. 19 — 52.57 TC — 51.90 FL — BCR — ECR — 52.45 TC — 51.77 FL — 3' — JOIN — 3' — 15 — 15 — 15 — 15' — 60' — ARLINGTON DRIVE

ECR 0+45.86 — B — CB # 3 W=14' K=4' SEE SHEET 19 — 52.19 TC — 51.52 FL — BCR — 52.07 TC — 51.40 FL — ECR — EXIST 24' COM. DR.

55.07 — 0+48.87 W ECR — D — BCR — STA. 66+04.86 BCR — 50.29 TC — 49.62 FL — FOR RETURN ELEV. SEE SHEET 7 — 49.79 FL — 49.79 FL — ECR — CB # 2 SEE SHT. 20

53.13 — 0+49.13 W — ECR — F — CB # 2 SEE SHT. 20 — 70.4 — STA. 66+79.85 BCR — 50.00 TC — 49.33 FL — BCR — 50.13 TC — 49.46 FL — ECR

MATCH LINE 0+75 W. SEE SHT. 7 — GLENARM

(A) CURB DATA
Δ = 90° 15' 45"
R = 15'
T = 15.07'
L = 23.63'

(B) CURB DATA
Δ = 89° 44' 15"
R = 15'
T = 14.93'
L = 23.49'

(C) CURB DATA
Δ = 90° 03' 21"
R = 25'
T = 25.02'
L = 39.29'

(C) ℞ DATA
R = 10'

(D) CURB DATA
Δ = 89° 47' 00"
R = 25'
T = 17.93'
L = 28.21'

(E) CURB DATA
Δ = 89° 56' 39"
R = 25'
T = 24.98'
L = 39.25'

(E) ℞ DATA
R = 23'

(F) CURB DATA
Δ = 90° 13' 00"
R = 18.22'
T = 18.07'
L = 28.34'

PROJECT ENGINEER: John A. Capsella
DATE: 3/25/83
LANDSCAPE ARCHITECT
NO. ____ DATE ____

DRAWN BY: RUDY G. ORDONEZ
CHECKED BY: DAVE RINEARSON
DESIGNED BY: J.T. LLOYD

FIELD BOOK NO. 1834-L

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X	11/1/85	AS BUILT	G.P.		

PLAN & PROFILE

CITY OF PASADENA - PUBLIC WORKS DEPARTMENT

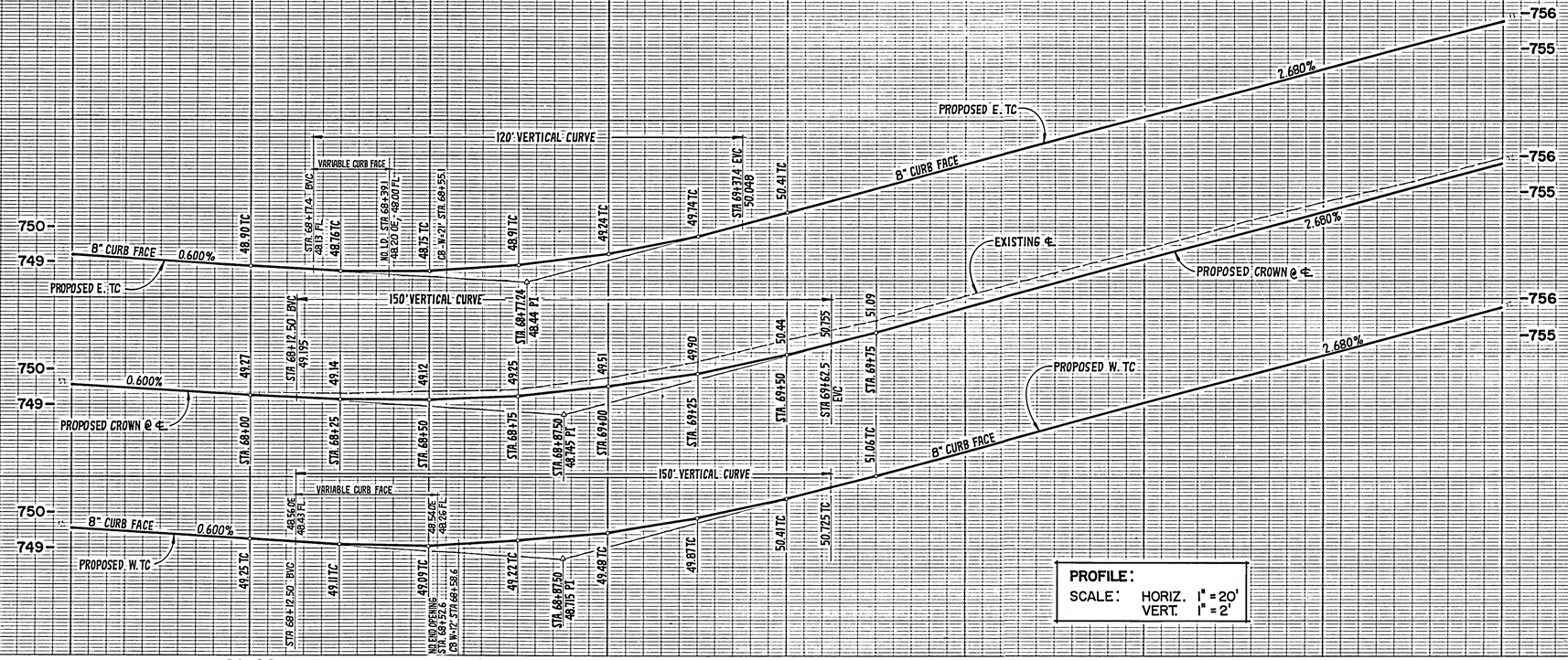
PROJECT: IMPROVEMENT OF FAIR OAKS AVENUE
LIMITS: S/o CALIFORNIA BOULEVARD TO S/o STATE STREET
SCALE: 1" = 20'
WORK ORDER NO. 530
SHEET 13 of 27
DWG. NO. 3716

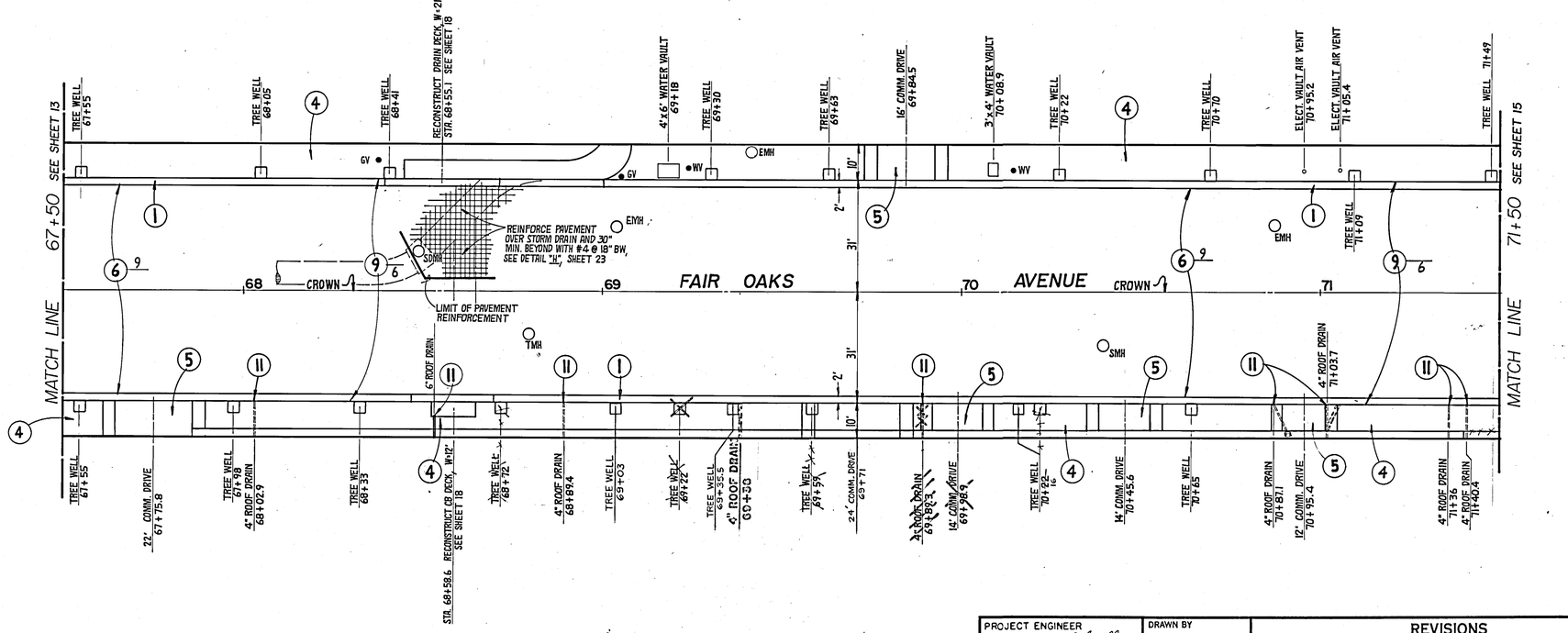
PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED: James E. Valentine

SUBMITTED: Mitsugi Kira

BENCHMARK: BOLT 1' S/o S. END C.R. SW. COR. FAIR OAKS AVE. & GRACE TER.
ELEV. = 758.47'





PLAN & PROFILE

PROJECT ENGINEER: John A. Caporella, DATE 3/25/83	DRAWN BY: RUDY G. ORDONEZ	REVISIONS	CITY OF PASADENA-PUBLIC WORKS DEPARTMENT
LANDSCAPE ARCHITECT: NO. ____ DATE ____	CHECKED BY: DAVE RINEARSON	MARK / DATE / DESCRIPTION / BY / CHKD. / APPROVED	PROJECT: IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 14 of 27
FIELD BOOK NO. 1834-L	DESIGNED BY: J.T. LLOYD	11/1/88 AS BUILT — G.P.	LIMITS: S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716
			SCALE: 1" = 20' — WORK ORDER NO. 530

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED: James E. Valentine

SUBMITTED: Mitsugi Hino

BENCHMARK: BOLT 1' S/o S. END C.R. S.W. COR. FAIR OAKS AVE. & GRACE TERRACE
ELEV. = 758.47'

PROFILE
SCALE: HORIZ. 1" = 20'
VERT. 1" = 2'

PROPOSED E. TC
2.680%
8" CURB FACE
PROPOSED OUTER EDGE PROD.
JOIN EXISTING EAST OUTER EDGE
JOIN EXISTING ISLAND OUTER EDGES
JOIN EXISTING WEST OUTER EDGE
EXIST. ℄
2.680%
PROPOSED CROWN @ ℄
PROPOSED W. OUTER EDGE PROD.
PROPOSED W. TC
2.680%
8" CURB FACE
8" CF
2.530%
PROPOSED W. OUTER EDGE (PROD.) (SEE PLAN FOR ELEVATIONS)
8" CURB FACE
BCR STA. 73+04.33
BCR STA. 72+14.34
BCR STA. 74+09.31
BCR STA. 72+11.05
BCR STA. 72+61.05
STA. 72+59.39 ℄ CURB STATE ST. (E)
STA. 72+41.37
STA. 72+71.36
STA. 72+73
STA. 72+26.94
STA. 72+33.74
STA. 72+44.94
℄ GRACE TERRACE
℄ NOSE
72+00
73+00
74+00
75+00
76+00
77+00
756
755

(A) CURB DATA
Δ = 90° 03' 00"
R = 25'
T = 25.02'
L = 39.29'

(B) CURB DATA
Δ = 89° 57' 00"
R = 25'
T = 24.98'
L = 39.25'

(C) CURB DATA
Δ = 89° 36' 40"
R = 15'
T = 14.90'
L = 23.46'

(D) CURB DATA
Δ = 90° 23' 20"
R = 15'
T = 15.10'
L = 23.66'

(E) CURB DATA
Δ = 18° 37' 33"
R = 50'
T = 8.20'
L = 16.28'

(F) CURB DATA
Δ = 35° 11' 48"
R = 50'
T = 15.86'
L = 30.71'

(G) CURB DATA
Δ = 32° 39' 16"
R = 50'
T = 14.65'
L = 28.50'

(H) CURB DATA
Δ = 29° 14' 33"
R = 100'
T = 26.09'
L = 51.04'

(I) CURB DATA
Δ = 70° 37' 22"
R = 30'
T = 21.25'
L = 36.98'

STATE ST.
GRACE TER.
MATCH LINE
SEE SHEET 14
71+50
REVISED
CROWN
EXIST 5
TYP
JOIN
EMH
SMH
TMH
GV
WV
TREE WELL 71+89
TREE WELL 73+21
TREE WELL 73+31
SAWCUT TREE WELL 73+71
SAWCUT TREE WELL 74+22
SAWCUT TREE WELL 74+70
SAWCUT TREE WELL 74+49
SAWCUT TREE WELL 74+86
SAWCUT TREE WELL 75+34
SAWCUT TREE WELL 75+88
SAWCUT TREE WELL 76+42 ELIMINATED
Concrete Bridge
3/4" EXPANSION JOINT PER DETAIL "A", STD. DRWG. S-409
4" ROOF DRAIN
STA. 0+863 W.
STA. 1+00 W JOIN
FIELD BOOK NO. 1834-L

NOTE: ADDITIONAL TREE WELLS SHALL BE SAWCUT AND TREES PLANTED AT THE FOLLOWING LOCATIONS:

FAIR OAKS AVE. EAST SIDE – STA. 77+38
STA. 77+78

FAIR OAKS AVE. WEST SIDE – STA. 78+08
STA. 78+43

PROJECT ENGINEER: John A. Cafarella
DATE: 3/25/83
LANDSCAPE ARCHITECT
NO. DATE

DRAWN BY: RUDY G. ORDONEZ
CHECKED BY: DAVE RINEARSON
DESIGNED BY: J.T. LLOYD

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
		AS BUILT			

CITY OF PASADENA-PUBLIC WORKS DEPARTMENT

PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 15 of 27

LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716

SCALE: 1" = 20' — WORK ORDER NO. 530

PLAN & PROFILE

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED: James E. Valentine

SUBMITTED: Mitsuaki Hino

BENCHMARK: BOLT E. CURB FAIR OAKS AVE. ℄ PROD. HURLBUT ST.
ELEV. = 776.54'

760
755
750

EXISTING A.C. PAVEMENT
PROPOSED P.C.C. PAVEMENT
6"CI. WATER
4"M GAS
4"P POWER
REMOVE EXIST. M.H.
CONSTRUCT M.H.
12" GAS
TEL. MANHOLE
S=0.0112
REMOVE EXIST. 8" V.C.P.
748.80 EXIST. 8" V.C.P.
748.57 EXIST. 10" V.C.P.
748.72 NEW 10" V.C.P.
(748.64 EXIST. 8" V.C.P.)
226.9'-10" V.C.P.

11+00 10+00 9+00 8+00

PROFILE
SCALE: HORIZ. 1" = 20'
VERT. 1" = 2'

FAIR OAKS AVENUE
GLENARM ST.
(STA. 66+40.45)
(STA. 66+39.67)
EXIST. 12" V.C.P.
(742.26)
STA. 0+00
(742.37)
15'
NEW 10" V.C.P.
EXIST. 10" V.C.P.
742.48
NEW MANHOLE
742.75
STRAIGHT GRADE
NEW 8" V.C.P.

INVERT DETAIL
NO SCALE

MATCH LINE 11+00 SEE SHEET 17

STA. 10+66± (STA. 55+74±)
STA. 10+14± (STA. 56+26±)
STA. 9+45± (STA. 56+95±)
STA. 8+92± (STA. 57+50±)
STA. 10+95± (STA. 55+45±)
STA. 10+51± (STA. 55+89±)
STA. 10+04± (STA. 56+36±)
STA. 9+62± (STA. 56+78±)

2'-0 LC
6" PEM GAS, 2' WE
20"H GAS, 15' WE
6-4"F POWER, 21.5' WE
12"CI WATER, 27' WE
TO BE ABANDONED
OFFSET JOINT 2'± N/o M.H. - REPLACE W/10" V.C.P. REMOVE AND CONSTRUCT MANHOLE APPROX. 8' DEEP
8-6"+2-3" ABS POWER, 35' EW
5 PP TEL., 28.5' EW
BROKEN PIPE - REPLACE 8'± W/10" VCP
CONSTRUCT MANHOLE
6-6"+2-3"F POWER, 14' EW
6 PU TEL., 7' EW
12"CI WATER, 4' EW
6" V.C.P.
6" C.I.
6" VCP
6" PEM GAS, 7' SN
1 PU TEL., 19' NS
16"M GAS, 19' NS (TO BE ABANDONED)
HURLBUT ST.
4"M GAS, 23' SN
8" VIT. SEWER
6"CI WATER, 23' NS
4"SF TELEPHONE
1" PLD TEL., 7' NS
ARLINGTON DR.
4" LAT
STA. 5+77±
STA. 2+75± (STA. 63+64±)
STA. 2+64± (STA. 63+75±)
STA. 3+59 (STA. 62+70)
STA. 2+83 (STA. 63+46)
STA. 5+72± (STA. 60+84)
OFFSET JOINTS - REMOVE M.H. AND REPLACE 14± W/10" VCP, APPROX. 7' DEEP
0+61 W
3+51 W
REPLACE 5'± W/ 8" VCP APPROX. 7' DEEP
SEE SHEET 19 FOR PROPOSED STORM DRAIN

(56) (57) FAIR OAKS (58) 10 9 8

(65) AVENUE (66) (67)
BROKEN PIPE - REPLACE 2'± W/10" VCP
STA. 1+41 (STA. 64+98) APPROX. 7' DEEP
8 PU TEL., 29.5' EW
2"M GAS, 18' EW
CRACKED PIPE - REPLACE 10'± W/10" VCP ENCASE
10" VIT SEWER, 26' EW
STA. 1+40± (STA. 65+00±)
SEE SHEET 18 FOR PROPOSED STORM DRAIN
STA. 0+00
STA. 0+00 W
STA. 0+00 E
STA. 0+00 (STA. 66+39.67)
STA. 1+46.50 (STA. 66+40.45)
REMOVE EXIST. MANHOLE
CONSTRUCT MANHOLE
SEE INVERT DETAIL ABOVE.
APPROX. 8' DEEP
SAG IN LINE - REPLACE 35'± W/ 8" VCP
TO BE ABANDONED

12" VIT SEWER, 29' SN
13 PU TEL., 25' SN
8" CI WATER, 22' SN
12" GAS, 20' SN
10" GAS, 18' SN
6-4¼" V.T. POWER, 7' SN
30" VCP
(TO BE ABANDONED)
(TO BE ABANDONED)
12" CI WATER, 19.5' NS
8-3½" MTD POWER, 7' NS
6-5" PVC POWER, 4' NS
BROKEN PIPE - REPLACE 5'± W/12" VCP (STA 0+65E) APPROX. 7' DEEP
6-4"F POWER, 21.5' WE
12" CI WATER, 29' WE
6-4¼" V.T. POWER, 4' SN
TEL., 12' SN
12"M GAS, 15' SN
8" VIT SEWER, 25' SN
(TO BE ABANDONED)
8" CI WATER, 21' NS
8 PU POWER, 12.5' NS
POWER, 2' NS
GLENARM ST.
6' 12' 17' 17' 8'
50'

10' 20' 20' 10'
6.0'

SANITARY SEWER

PRINTED ON DIETERICH-POST CLEARPRINT

PROJECT ENGINEER	John A. Caparella
DATE	3/25/83
LANDSCAPE ARCHITECT	
NO.	DATE
DRAWN BY	GEORGE MARTINEZ
CHECKED BY	J.T. LLOYD
DESIGNED BY	J.T. LLOYD

FIELD BOOK NO. 1834-L

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X		AS BUILT			

CITY OF PASADENA - PUBLIC WORKS DEPARTMENT

PROJECT: IMPROVEMENT OF FAIR OAKS AVENUE
LIMITS: S/o CALIFORNIA BOULEVARD TO S/o STATE STREET
SCALE: 1" = 20'
WORK ORDER NO. 530
SHEET 16 of 27
DWG. NO. 3716

REVIEWED: James E. Valentine

SUBMITTED: Mitsugi Hino

Q_{10}=102.8 cfs

Q_{50}=158 cfs ±

Q_{10}=101.8cfs

Q_{10} = 91.0 cfs

Q_{10} = 60.9 cfs

Q_{10} = 59.5 cfs

TRANSITION STRUCTURE #1
MH #3

MANHOLE #4

SEWER MANHOLE

EXISTING A.C. PAVEMENT

PROPOSED PCC PAVEMENT

HGL

WS

750

745

740

(743.43)

(743.40)

(743.75) JOIN

S=0.002

EXIST 25'x6' RCB
743.83
743.85

S=0.00781

EXIST. 10" VIT SEWER

STA 01+42.95

STA 01+89 BEGIN PIPE

STA 0+92.83

PROTECT 12" CI WATER
PROTECT 20" HP GAS
SEE DETAIL "F", SHT. 23

6-4" P POWER

3.25'x 6'

3'x6'

SINGLE BOX CULVERT PER CALTRAN STD. DWG. D80
USE: 6' SPAN, 4' HEIGHT, 10' COVER, d BARS, 6' SPAN/<2' COVER, "V" INVERT

NOT TO BE MAINTAINED BY LACFCD

SEWER H.C. ABANDON AND SEAL

SEWER H.C. ABANDON AND SEAL

SEAL AND ABANDON LATERAL

SEWER H.C.

STA. 2+49

STA. 2+57

160'-43"x 68" ELLIPTICAL RCP 1350D

5 DU TELEPHONE

PROTECT 10" VIT SEWER
15 DU TEL

4 DU (VAC) POWER

STA. 2+92

8 DU POWER

PROTECT 12" WATER

8" CI WATER
(TO BE ABANDONED)
12" GAS
1 DU TEL
8 DU POWER

744.91

743.73

STA 3+50
JS #2

S=0.0035

2" IP TEL

EXISTING AC PAVEMENT

SEWER MANHOLE

HGL

EXIST. 10" VIT SEWER

4 DU TELEPHONE

SEWER H.C.

2 DU POWER

SEWER H.C.

SEWER H.C.

6"C.I. SEWER H.C.

SEWER H.C.

750

745

740

343'-34"x 53" ELLIPTICAL RCP 2000D

BENCHMARK: RAMSET W. CURB FAIR OAKS AVE. 8' S/o S. Pl. GLENARM ST.
ELEV. = 750.04'

PROFILE
SCALE: HORIZ. 1" = 20'
VERT. 1" = 2'

0+00 1+00 2+00 3+00 4+00 5+00 6+00

SEE SHEET 20

LINE B

1ST

RECONSTRUCT CB #3 DECK W=12' AND CONSTRUCT LD #4 PER DETAIL "G", SHEET 23
NOT TO BE MAINTAINED BY LACFCD
MANHOLE COVER PER PASADENA STANDARD S-112

MH #4 A=18" B=30" C=35" D1=34"x53" D2=43"x68"

8" CI WATER, 2' EW

10" M GAS, 14' EW TO BE ABANDONED

12 DU TEL, 22.5' EW

10" VIT SEWER, 26' EW

8 DU TEL, 29.5' EW

6-4"P POWER 24' WE

20" H GAS 18' WE

12" CI WATER, 5' WE

69 68 FAIR OAKS AVENUE 67 66 65 64

LINE A

CB #3 W=10' LD#4
4-18" RCP

REMOVE EXISTING CATCH BASIN #3, W=30'

DH-3
TO BE ABANDONED

JS #2 A=54" B=18"
C=2.3', D=34"x53"

LINE A

TO BE ABANDONED

REMOVE EXIST. 30" CMP

EXTEND EXISTING 30" RCP AND CONSTRUCT NEW END WALL

30" RCP

CLOSE EXIST. OPENING

INSTALL MANHOLES AND STEPS
MANHOLE COVERS PER PASADENA S-112

RECONSTRUCT DECK PER DETAIL "E", SHT. 23

PROTECT GAS LINE & WATER LINE SEE DETAIL "D", SHT. 23

NOT TO BE MAINTAINED BY LACFCD

DETAIL "G"
DETAIL "F"
DETAIL "E"
21' OPENING
2-2022 LD#4
TRANSITION STRUCTURE #1 W/ MH#3
2' DIA. SHAFT
DETAIL "H"

SEE SHEET 23 FOR DETAILS

(A)(B)(C) STORM DRAIN & DATA
Δ = 45° 00' 00"
R = 22.5'
T = 9.32'
L = 17.67'

(D) STORM DRAIN & DATA
Δ = 53° 19' 03"
R = 22.5'
T = 11.29'
L = 20.94'

(E) STORM DRAIN & DATA
Δ = 8° 19' 03"
R = 22.5'
T = 1.64'
L = 3.27'

(F) STORM DRAIN & DATA
Δ = 28° 56' 54"
R = 22.5'
T = 5.81'
L = 11.37'

(G) STORM DRAIN & DATA
Δ = 30° 22' 50"
R = 22.5'
T = 6.11'
L = 11.93'

(H) STORM DRAIN & DATA
Δ = 14° 06' 44"
R = 28.62'
T = 3.54'
L = 7.05'

(I) STORM DRAIN & DATA
Δ = 18° 00' 00"
R = 22.5'
T = 3.56'
L = 7.07'

MODIFIED CB #3, W=10', V=3.3'
LD #4, K=1.5', L=85' (MODIFY TO CLEAR POWER)
12"-18" RCP INCLUDING COLLAR, NO STEPS
NOT TO BE MAINTAINED BY LACFCD
MANHOLE COVER PER PASADENA STD. S-112

JS #2

42" RCP STORM DRAIN 22.75'NS
12" CI WATER, 19.5' NS
8-3" MTD, POWER, 7'NS
6-5" PVC, POWER, 4'NS

GLENARM

STA 1+60.81 (0+60.81 W)

STA 1+49.44 (0+49.92 W)

STA 1+22.11

STA 1+17.15

STA 1+14.03

STA 1+08.93

STA 1+04.48

STA 0+91.45

STA 0+86.05

STA 2+30.39 (67+06.22)

STA 2+57.73

STA 2+46.06

STA 2+57

STA 2+49

STA 3+45.15

STA 3+40.83

3+03.61

(66+49.09) 23.41

(66+45.92) 31.76

(66+40.86)

(66+29.67)

(66+18.10) 26.4

(66+04.65) 26

(66+71.90)

(66+19.31)

1.59'

21.5'

30" RCP

30" CMP

30" RCP

4

2'

STA 1+00.52

STA 0+87.69

STA 01+42.65 (68+81.56) 34.24

(68+67.65) 21.65

(68+51.59)

(68+35.68)

STA 01+60.12

1½ 0.C.

10' 20' 20' 10'

67.2'

RECONSTRUCT DECK CB #3 W=28' (EXIST. W=30') PER DETAIL "C" SHT. 23. LD #4, K=4.3'
NOT TO BE MAINTAINED BY LACFCD
MANHOLE COVER PER PASADENA STD. S-112

GASOLINE STATION YARD DRAIN

RECONSTRUCT MANHOLE DECK PER PASADENA STANDARD DRAWING S-105 AND S-302 (5R)
NOT TO BE MAINTAINED BY LACFCD

PROPOSED CURB WILL BE SETBACK 0.4'. SEE SHEETS 8 THRU 15 FOR DETAILS.

6+00 SEE SHEET 19 MATCH LINE

NOTES:
1. ALL STANDARD STRUCTURE THICKNESSES AND REINFORCEMENT SHALL BE BASED ON THE LARGEST DIMENSION OF ELLIPTICAL PIPE.
2. BEDDING FOR ALL R.C.P. SHALL BE PER LACFCD 2-D177.
3. SEE SHEET 23 FOR STORM DRAIN LATERAL PROFILES.
4. SEE SHEET 16 FOR SEWER WORK.
5. ALL DRAINAGE CONSTRUCTION PER LACFCD STD. DWGS. UNLESS OTHERWISE NOTED.

DRAINAGE M.T.D. 1014

PROJECT ENGINEER: John A. Caparella
DATE: 3/25/83
LANDSCAPE ARCHITECT
NO. ____ DATE ____

FIELD BOOK NO. 1834-L

DRAWN BY: GEORGE MARTINEZ - RUDY G. ORDONEZ
CHECKED BY: J.T. LLOYD
DESIGNED BY: J.T. LLOYD

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X	8/27/84	AS BUILT	J.G.	R.W.G.	J.A.C.

CITY OF PASADENA - PUBLIC WORKS DEPARTMENT

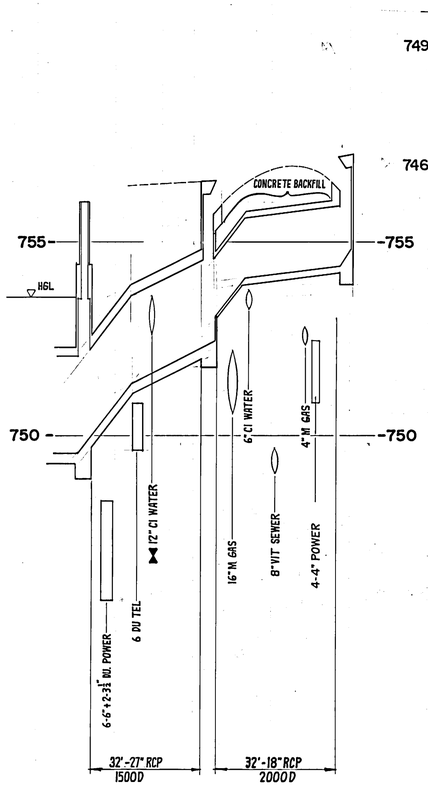
PROJECT: IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 18 of 27

LIMITS: S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716

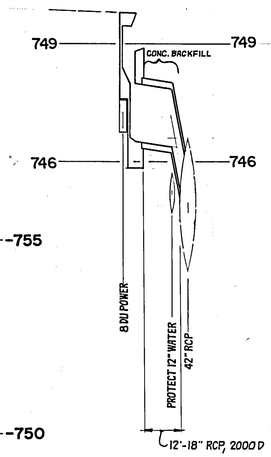
SCALE: 1" = 20' — WORK ORDER NO. 530

PRINTED ON DIETERICH-POST CLEARPRINT

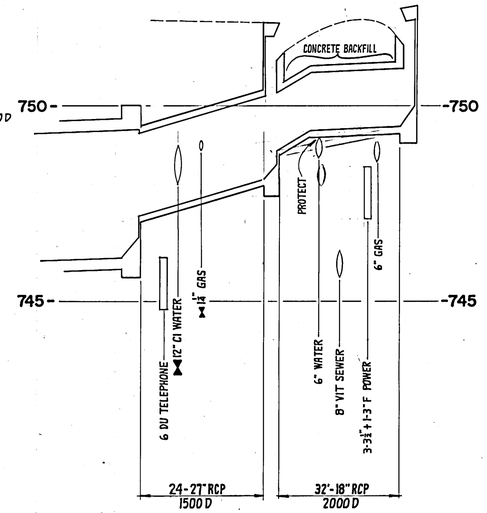
REVIEWED	SUBMITTED
James E. Valentine	Mitsuge Hino



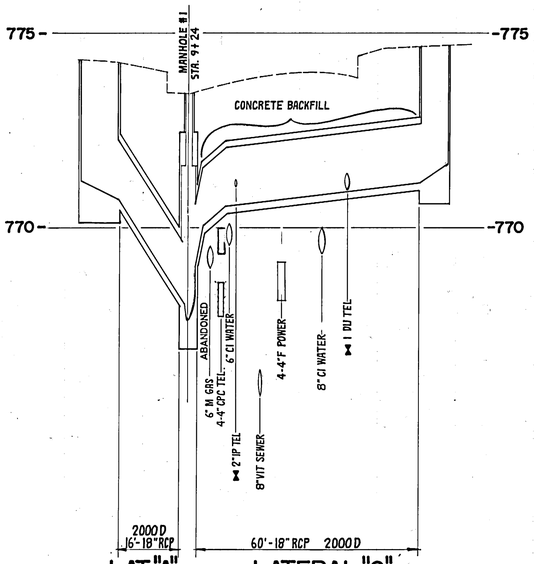
LATERAL "K"
(Hurlbut Street)
See Sheet 19



LATERAL "N"
(Glenarm Street)
See Sheet 18

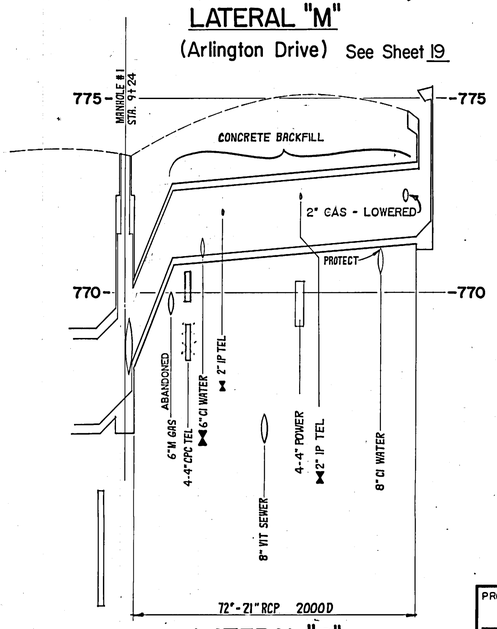


LATERAL "M"
(Arlington Drive) See Sheet 19

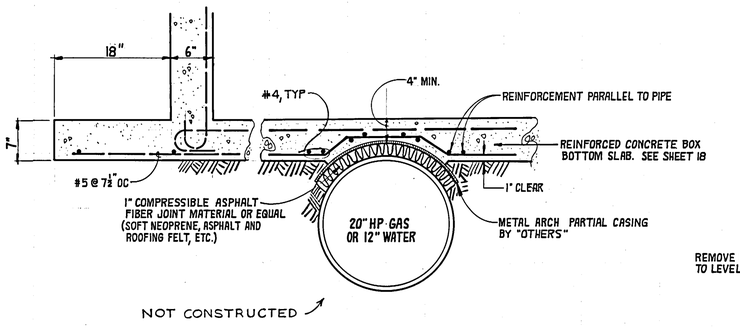


LAT. "A"

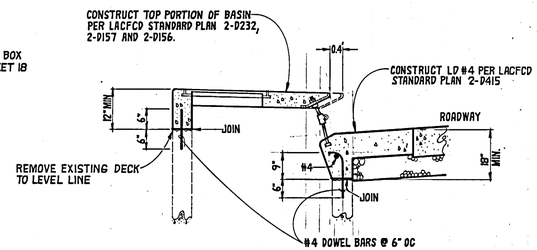
LATERAL "C"
(Congress Street) See Sheet 22



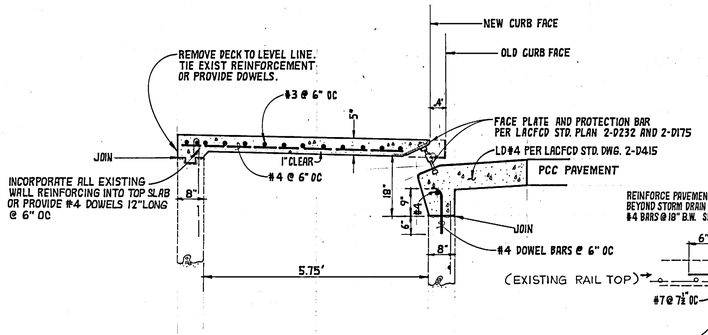
LATERAL "B"
(Congress Street) See Sheet 22



DETAIL "D"
UTILITY LINE PROTECTION DETAIL

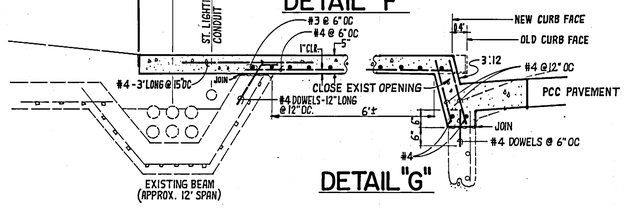


DETAIL "C"
RECONSTRUCTION OF CATCH BASIN DECK AND LOCAL DEPRESSION

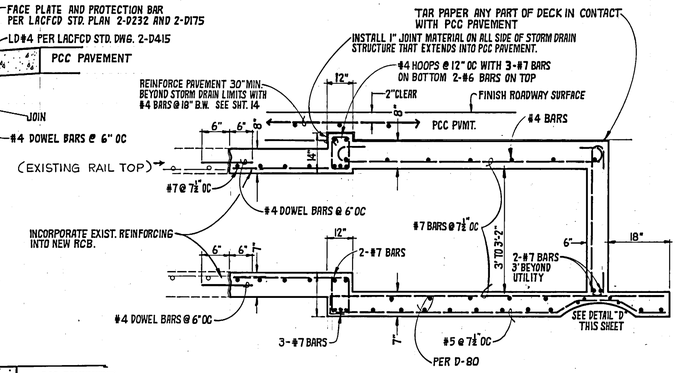


DETAIL "E"

DETAIL "F"



DETAIL "G"



DETAIL "H"

DRAINAGE M.T.D. 1014

PROJECT ENGINEER John A. Cafarella	DRAWN BY RUDY ORDONEZ	REVISIONS	CITY OF PASADENA-PUBLIC WORKS DEPARTMENT
DATE 3/25/83	CHECKED BY J.T. LLOYD	MARK / DATE / DESCRIPTION / BY / CHKD. / APPROVED	PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 23 of 27
LANDSCAPE ARCHITECT	DESIGNED BY J.T. LLOYD	8/27/87 AS BUILT — R.G. / J.T.L. / J.A.C.	LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET — DWG. NO. 3716
NO. DATE			SCALE: 1" = 20' — WORK ORDER NO. 530
FIELD BOOK NO. 1834-L			

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED	SUBMITTED
James E. Valentine	Mitsugi Hino

LOG OF DRILL HOLE

DRILLED May 6, 1982 WITH Rotary Bucket
DIAMETER OF DRILL HOLE IN INCHES 18
LOGGED BY EWF

DH-1
STA. 45+50

SURFACE ELEVATION IN FEET 771 DATUM

GEOLOGICAL CLASSIFICATION DESCRIPTION	ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLES	ENGINEERING CLASSIFICATION AND DESCRIPTION	TEST DATA M — D — 0 (RC)
FILL	770				8-inches asphalt surfacing.	
					SILTY SAND (SM), yellow-brown, moist, medium dense, fine to coarse grained.	
		5			SANDY CLAY (CL), light gray, moist, medium firm, stiff, plastic.	
ALLUVIUM	765				CLAYEY SAND (SC), yellow-brown, moist, medium dense, fine to coarse.	
Invert		10			SILTY SAND (SM), orange-brown, moist, dense, 10% gravel and cobbles to 5 inches.	
		15			Bottom of drill hole at 9 feet. No water; no caving. Drill hole backfilled, tamped, and patched with asphalt.	
		20				
		25				
		30				
		35				

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

LOG OF DRILL HOLE

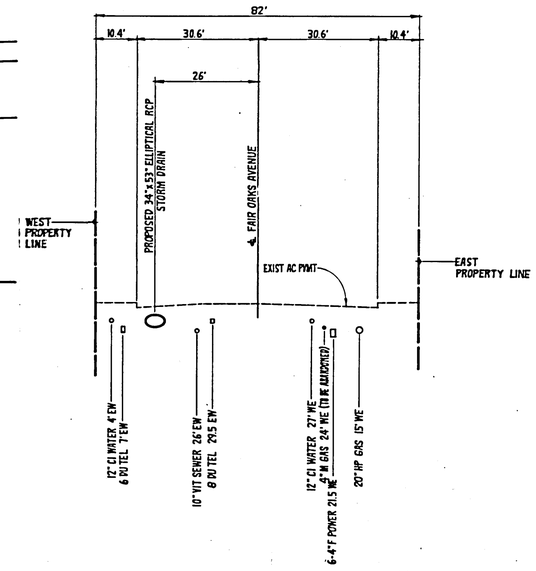
DRILLED May 6, 1982 WITH Rotary Bucket
DIAMETER OF DRILL HOLE IN INCHES 18
LOGGED BY EWF

DH-2
STA. 60+00

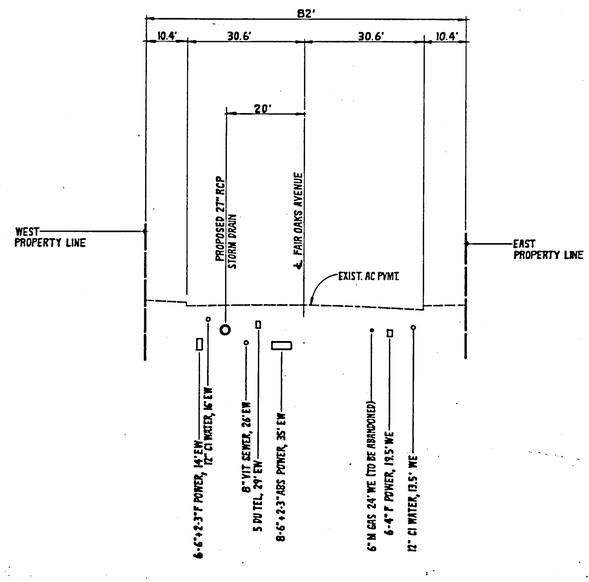
SURFACE ELEVATION IN FEET 754 DATUM

GEOLOGICAL CLASSIFICATION DESCRIPTION	ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLES	ENGINEERING CLASSIFICATION AND DESCRIPTION	TEST DATA M — D — 0 (RC)
FILL					8 inches asphalt surfacing.	
					SILTY SAND (SM), yellow-brown, moist, medium firm, fine to coarse.	
	750	5			SANDY CLAY (CL), dark brown, moist, medium firm, plastic.	
ALLUVIUM					CLAYEY SAND (SC), gray, moist, medium dense.	
Invert					SAND (SP) with gravel, and cobbles to 12 inches diameter, orange-brown, moist, dense, fine to coarse grained. Layers of silty sand at 10½ feet.	
	745	10				
		15			Bottom of drill hole at 11 feet. No water; moderate caving 5 to 11 feet. Drill hole backfilled and tamped and patched with asphalt.	
		20				
		25				
		30				
		35				

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL



CROSS SECTION
Glenarm St. to Arlington Dr.



CROSS SECTION
Bellefontaine St. to Congress St.

LOG OF DRILL HOLE

DRILLED May 6, 1982 WITH Rotary Bucket
DIAMETER OF DRILL HOLE IN INCHES 18
LOGGED BY EWF

DH-3
STA. 65+40

SURFACE ELEVATION IN FEET 751 DATUM

GEOLOGICAL CLASSIFICATION DESCRIPTION	ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLES	ENGINEERING CLASSIFICATION AND DESCRIPTION	TEST DATA M — D — 0 (RC)
FILL	750				8 inches asphalt surfacing.	
					SILTY SAND (SM), yellow-brown, moist, medium dense.	
ALLUVIUM		5			SANDY CLAY (CL), dark brown, moist, medium firm.	
Invert	745				SAND (SP) with gravel and cobbles, light gray turning yellow-brown at 4 feet, moist, dense, fine to coarse grained, cobbles to 8 ins. Layer of clayey silt with fine sand at 9 to 10½ feet, orange-brown.	
		10				
	740				Bottom of drill hole at 11 feet. No water; no caving. Drill hole backfilled, tamped, and patched with asphalt.	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

LEGEND TO LOGS

GEOLOGICAL CLASSIFICATION DESCRIPTION — CONVENTIONAL TERMINOLOGY

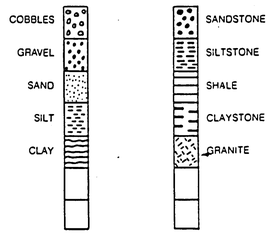
ENGINEERING CLASSIFICATION AND DESCRIPTION — SOIL - UNIFIED SOIL CLASSIFICATION SYSTEM WITH LETTER SYMBOL IN PARENTHESIS. ROCK - CONVENTIONAL TERMINOLOGY WITH (R) FOR ROCK

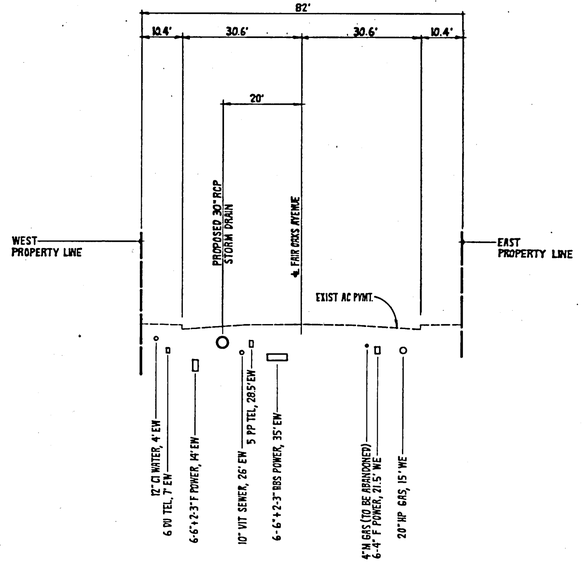
SYMBOLS
- WATER LEVEL
- WATER SEEPAGE
- HEAVY CAVING
- LIGHT CAVING
- SAMPLES AND CORES
  - UNDISTURBED
  - DISTURBED
  - UNSUCCESSFUL SAMPLING ATTEMPT
  - CORING RUN
  - P - PUSH
  - BLOW COUNT FOR 12 INCH SAMPLER PENETRATION (O.D. = 32 INCHES, 12 INCH DROP)
  - 7 — 2650 LBS. (DRIVING WEIGHTS)

GEOLOGIC STRUCTURE
- STRIKE AND DIP
  - B N.75 W 50 S (B = BEDDING)
  - CN 15E 75W (C = CONTACT)
  - J N 45W 85E (J = JOINT)
  - S N30E 45W (S = SHEAR)
  - F N 15E 20W (F = FOLIATION)
- (3)
- (6)
- (4)
- (5)

TEST DATA M — D — 0 (RC)
- MOISTURE CONTENT — PERCENT OF DRY WEIGHT. "S" INDICATES COMPLETE SATURATION
- DRY DENSITY — POUNDS PER CUBIC FOOT
- OTHER TESTS PERFORMED
  - DS = DIRECT SHEAR TEST
  - UC = UNCONFINED COMPRESSION TEST
  - TC = TRIAXIAL COMPRESSION TEST
  - CN = CONSOLIDATION TEST
  - EX = EXPANSION TEST
  - CP = COMPACTION TEST
  - GS = GRAIN SIZE DETERMINATION
  - PM = PERMEABILITY TEST
  - SE = SAND EQUIVALENT DETERMINATION
  - AL (45/10 = ATTERBERG LIMITS (LIQUID LIMIT/PLASTICITY INDEX)
- RELATIVE COMPACTION — PERCENT OF MAXIMUM DRY DENSITY OBTAINED BY LABORATORY COMPACTION TEST ON REPRESENTATIVE SAMPLE

SYMBOLS FOR EARTH MATERIALS





CROSS SECTION
Arlington Dr. to Hurlbut St.

M.T.D. 1014

LOG OF BORINGS DRAINAGE

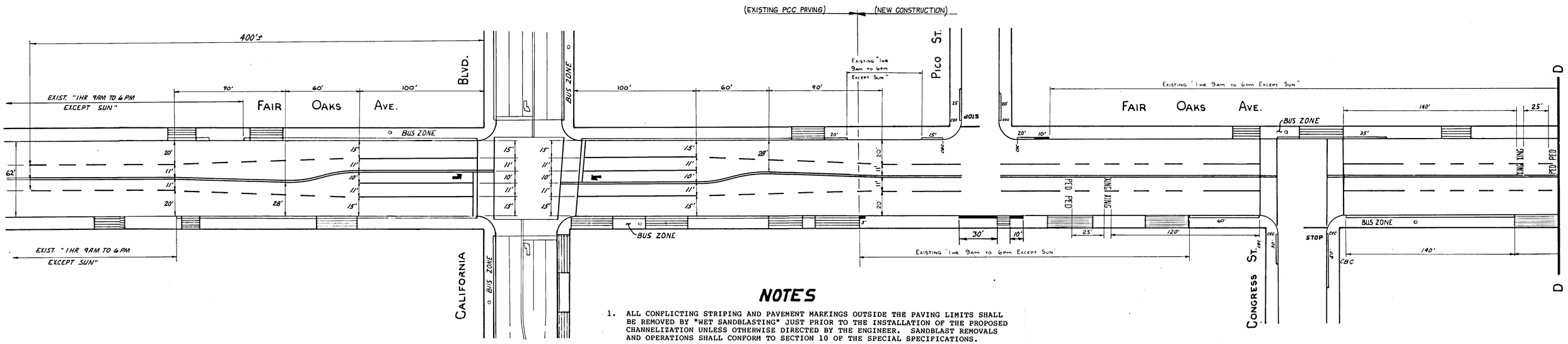
PROJECT ENGINEER	DRAWN BY	REVISIONS						CITY OF PASADENA-PUBLIC WORKS DEPARTMENT	
John A. Cafarella	RUDY G. ORDONEZ	MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED	PROJECT IMPROVEMENT OF FAIR OAKS AVENUE	SHEET 24 of 27
DATE 3/25/83	CHECKED BY J.T.LLOYD							LIMITS S/o CALIFORNIA BOULEVARD TO S/o STATE STREET	DWG. NO. 3716
LANDSCAPE ARCHITECT	DESIGNED BY J.T. LLOYD	X	8/27/83	AS BUILT	R.G.	J.T.L.	J.A.C.	SCALE: —— WORK ORDER NO. 530	
NO. DATE									

FIELD BOOK NO. 1834-L

PRINTED ON DIETERICH-POST CLEARPRINT

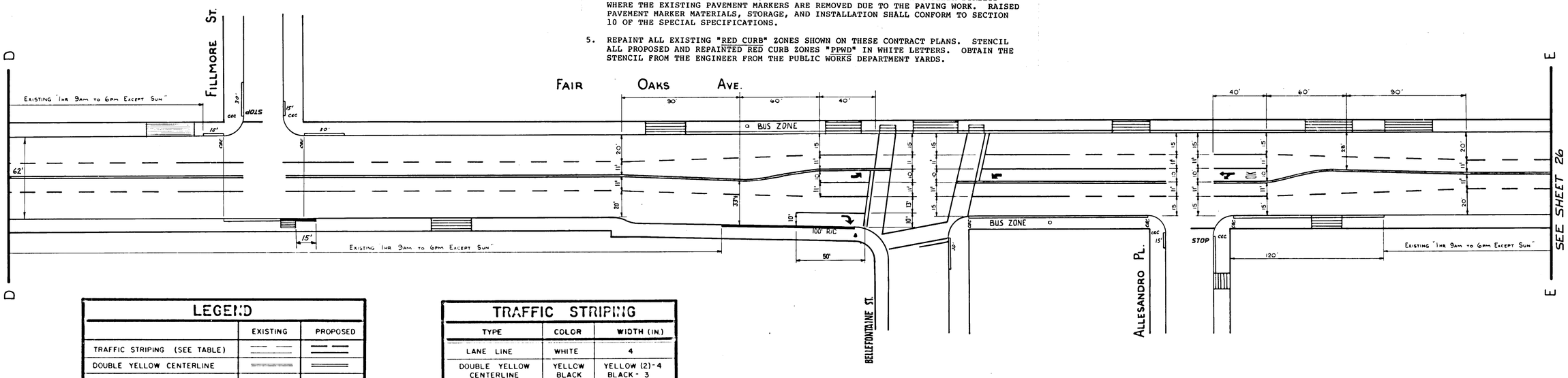
REVIEWED

SUBMITTED



NOTES

1. ALL CONFLICTING STRIPING AND PAVEMENT MARKINGS OUTSIDE THE PAVING LIMITS SHALL BE REMOVED BY "WET SANDBLASTING" JUST PRIOR TO THE INSTALLATION OF THE PROPOSED CHANNELIZATION UNLESS OTHERWISE DIRECTED BY THE ENGINEER. SANDBLAST REMOVALS AND OPERATIONS SHALL CONFORM TO SECTION 10 OF THE SPECIAL SPECIFICATIONS.
2. THE INSTALLATION OF ALL PROPOSED STRIPING, PAVEMENT MARKINGS, AND PAINTED CURB ZONES SHALL CONFORM TO THE CONTRACT PLANS, SPECIFICATIONS, AND STANDARD DRAWINGS T-366, T-367, T-393, T-395, T-397, T-398 AND T-335.
3. BEFORE THE PERMANENT STRIPING IS INSTALLED, THE ENGINEER SHALL APPROVE THE LAY-OUT ("CAT-TRACKING").
4. RAISED PAVEMENT MARKERS SHALL BE INSTALLED ON ALL PROPOSED STRIPING (LANE LINES, BARRIER STRIPES, CENTER LINES) ON FAIR OAKS AVENUE AND ON ALL OTHER STREETS WHERE THE EXISTING PAVEMENT MARKERS ARE REMOVED DUE TO THE PAVING WORK. RAISED PAVEMENT MARKER MATERIALS, STORAGE, AND INSTALLATION SHALL CONFORM TO SECTION 10 OF THE SPECIAL SPECIFICATIONS.
5. REPAINT ALL EXISTING "RED CURB" ZONES SHOWN ON THESE CONTRACT PLANS. STENCIL ALL PROPOSED AND REPAINTED RED CURB ZONES "PPWD" IN WHITE LETTERS. OBTAIN THE STENCIL FROM THE ENGINEER FROM THE PUBLIC WORKS DEPARTMENT YARDS.



LEGEND

	EXISTING	PROPOSED
TRAFFIC STRIPING (SEE TABLE)		
DOUBLE YELLOW CENTERLINE		
RED CURB		
LEFT / RIGHT TURN LEGEND		
SIGN		
FIRE HYDRANT		

TRAFFIC STRIPING

TYPE	COLOR	WIDTH (IN.)
LANE LINE	WHITE	4
DOUBLE YELLOW CENTERLINE	YELLOW BLACK	YELLOW (2)-4 BLACK - 3
BARRIER STRIPE	WHITE	8
LIMIT LINE	WHITE	12
CROSSWALK	WHITE	12

PROJECT ENGINEER
Ivan J. Lahaye
DATE 3/25/87
LANDSCAPE ARCHITECT
NO. _____ DATE _____

FIELD BOOK NO. NONE

DRAWN BY J. WOOD, D. LEDYARD
CHECKED BY J. CAFARELLA
DESIGNED BY J. CAFARELLA, J. WOOD

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
A	2-7-86	LOCAL WIDENING INSTALL R-TURN BAY	SAF		
		AS BUILT			

CHANNELIZATION

CITY OF PASADENA-PUBLIC WORKS DEPARTMENT

PROJECT IMPROVEMENT OF FAIR OAKS AVENUE

LIMITS S/o CALIFORNIA BLVD. TO S/o STATE ST.

SCALE: 1" = 40'

WORK ORDER NO. 530

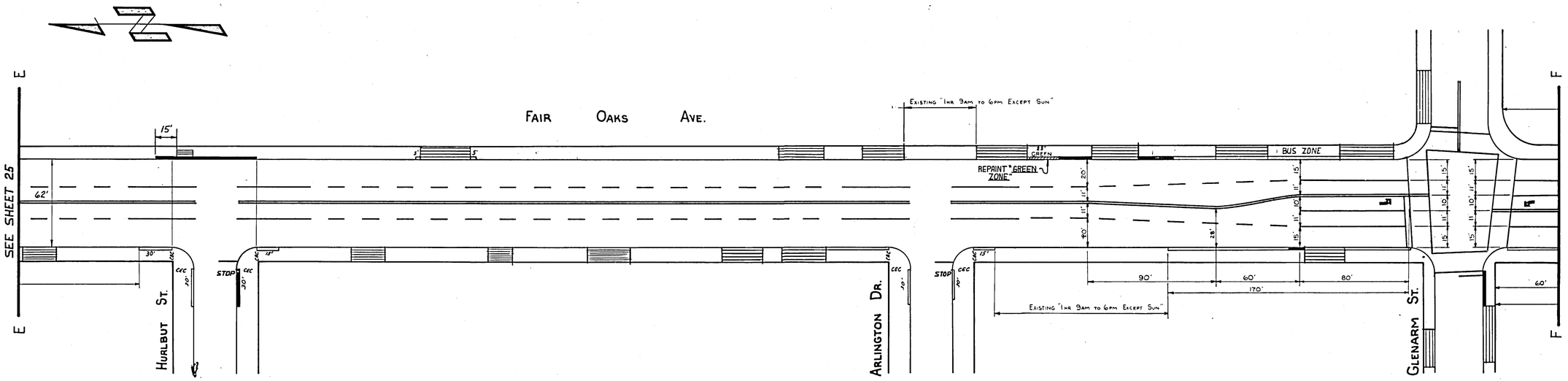
SHEET 25 of 27

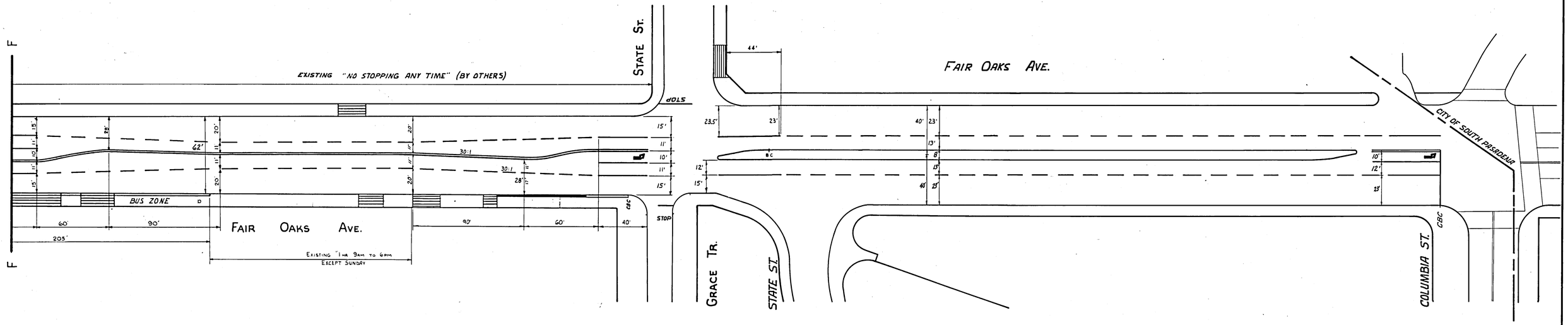
DWG. NO. 3716

PRINTED ON DIETERICH-POST CLEARPRINT

REVIEWED

SUBMITTED





CHANNELIZATION

PROJECT ENGINEER
Evan J Lahart
DATE 9/25/80

LANDSCAPE ARCHITECT
NO. DATE

DRAWN BY J. WOOD, D. LEDYARD
CHECKED BY J. CAFARELLA
DESIGNED BY J. CAFARELLA, J. WOOD

FIELD BOOK NO. NONE

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X		AS BUILT			

CITY OF PASADENA-PUBLIC WORKS DEPARTMENT

PROJECT IMPROVEMENT OF FAIR OAKS AVENUE — SHEET 26 of 27

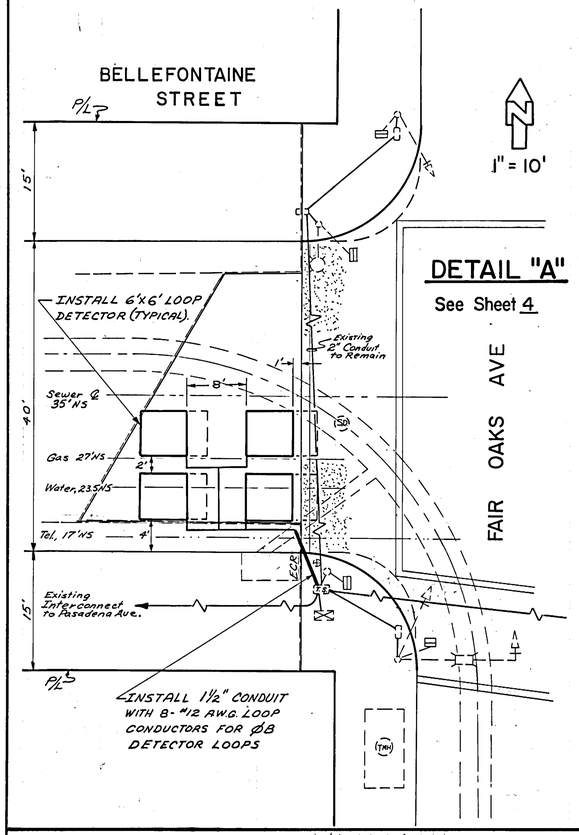
LIMITS S/O CALIFORNIA BLVD TO S/O STATE ST.

SCALE: 1" = 40' — WORK ORDER NO. 530 — DWG. NO. 3716

PRINTED ON DIETZGEN-POST CLEARPRINT

REVIEWED

SUBMITTED

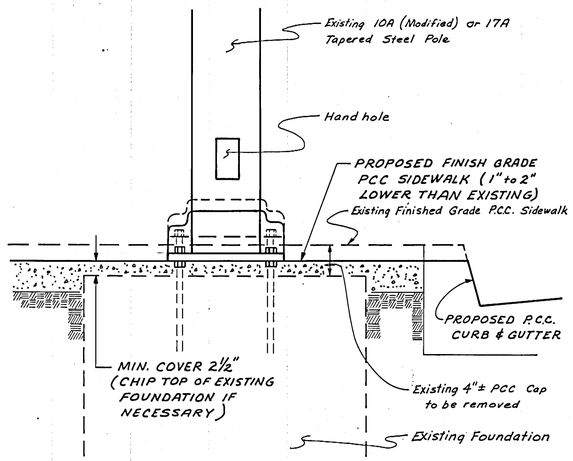


DETAIL "A"

See Sheet 4

DETAIL "B"

NO SCALE



ADJUSTMENT OF STREET LIGHT/TRAFFIC SIGNAL STANDARDS

(PROPOSED FINISH SIDEWALK GRADE LOWER THAN EXISTING)

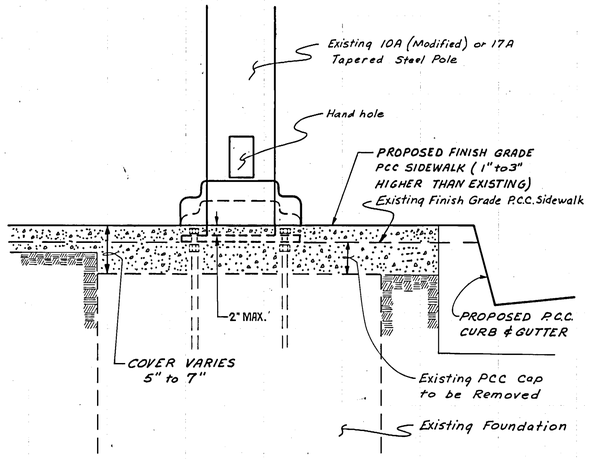
Locations:

1. Westside Fair Oaks Ave. - Sta. 59+78.5
2. Eastside Fair Oaks Ave. - Sta. 46+32.8
3. " - Sta. 66+00.2

See Sheets 4 & 5

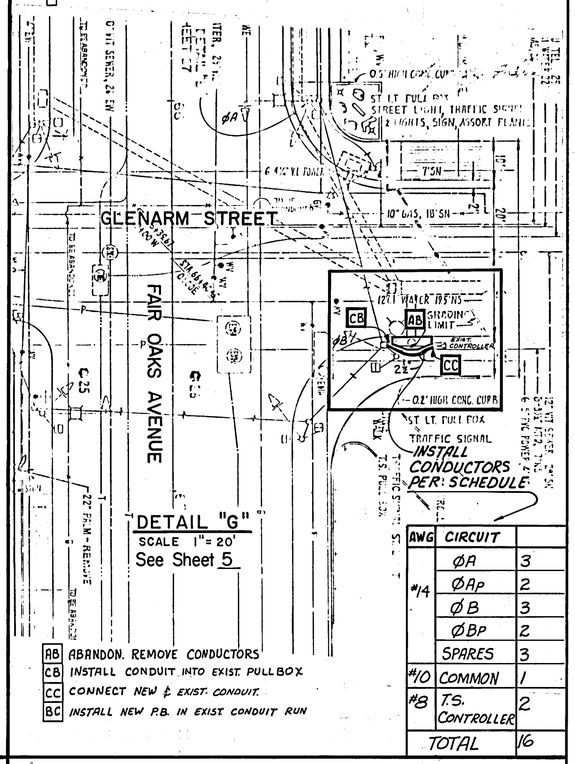
DETAIL "C"

NO SCALE



SIDEWALK PAVING AT STREET LIGHT STANDARDS

(PROPOSED FINISH SIDEWALK GRADE HIGHER THAN EXISTING)



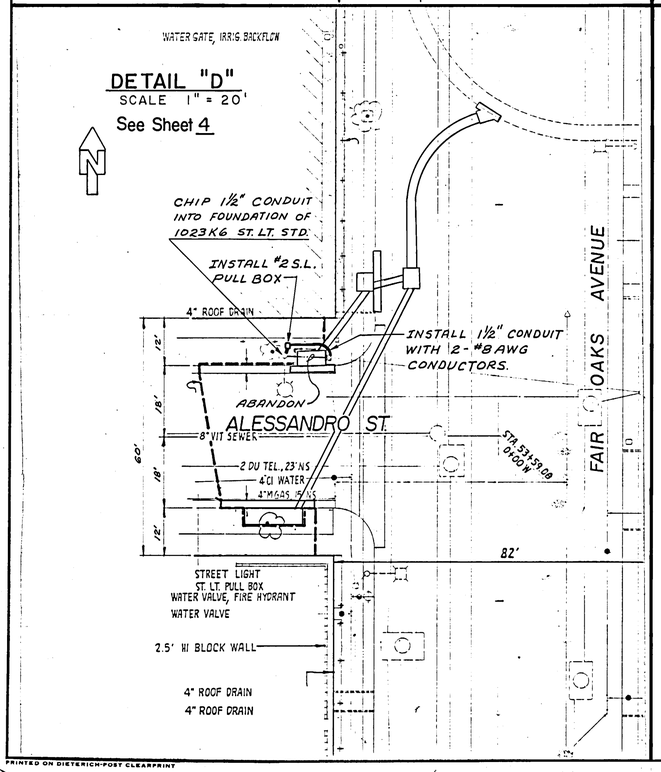
DETAIL "G"

SCALE 1" = 20'

See Sheet 5

AB	ABANDON. REMOVE CONDUCTORS
CB	INSTALL CONDUIT INTO EXIST. PULL BOX
CC	CONNECT NEW & EXIST. CONDUIT.
BC	INSTALL NEW P.B. IN EXIST CONDUIT RUN

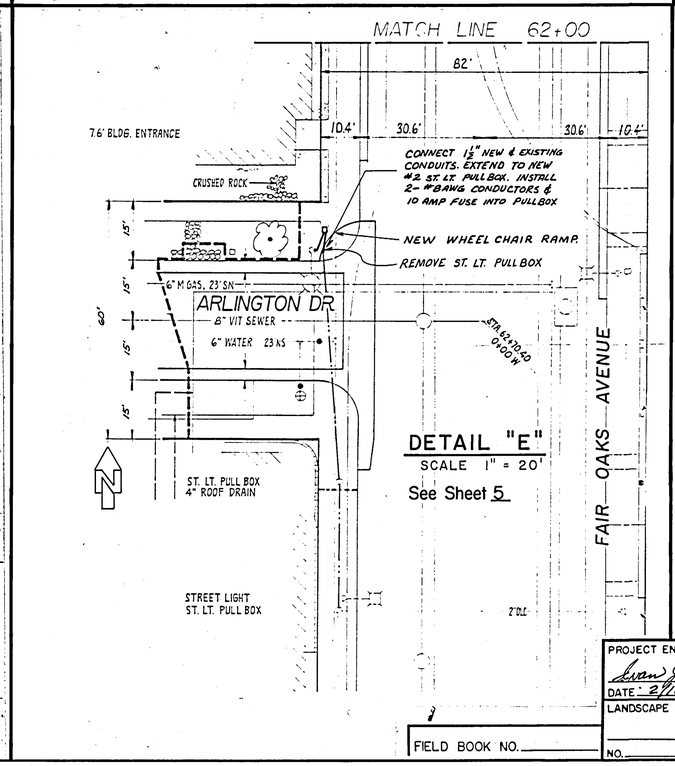
AWG	CIRCUIT	
#14	ØA	3
	ØAp	2
	ØB	3
	ØBP	2
	SPARES	3
#10	COMMON	1
#8	T.S. CONTROLLER	2
	TOTAL	16



DETAIL "D"

SCALE 1" = 20'

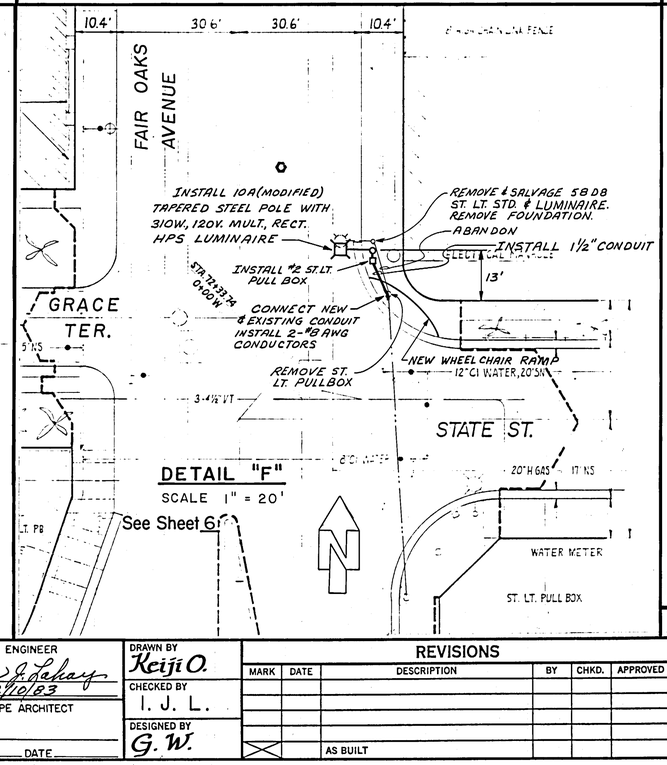
See Sheet 4



DETAIL "E"

SCALE 1" = 20'

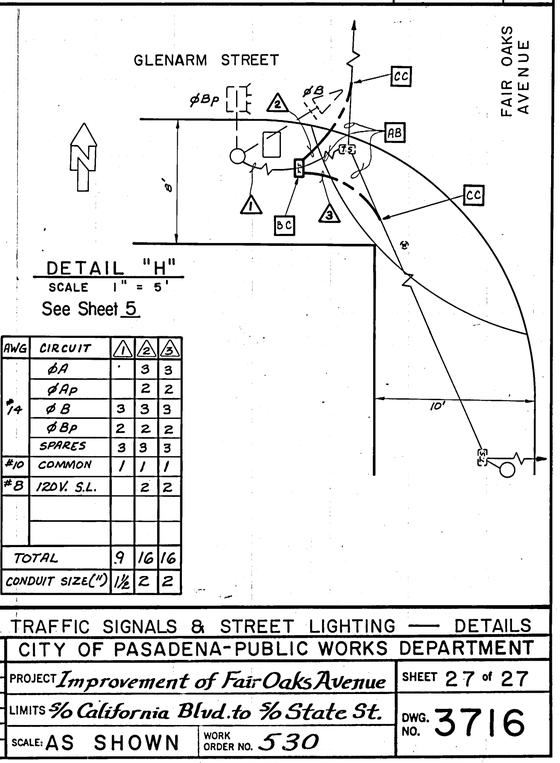
See Sheet 5



DETAIL "F"

SCALE 1" = 20'

See Sheet 6



DETAIL "H"

SCALE 1" = 5'

See Sheet 5

AWG	CIRCUIT	1	2	3
#14	ØA		3	3
	ØAp		2	2
	ØB	3	3	3
	ØBp	2	2	2
	SPARES	3	3	3
#10	COMMON	1	1	1
#8	120V. S.L.		2	2
	TOTAL	9	16	16
	CONDUIT SIZE(")	1½	2	2

PROJECT ENGINEER: Evan J. Lahay
DATE: 2/10/83
LANDSCAPE ARCHITECT
NO. ____ DATE ____

DRAWN BY: Keiji O.
CHECKED BY: I. J. L.
DESIGNED BY: G. W.

FIELD BOOK NO. ____

REVISIONS					
MARK	DATE	DESCRIPTION	BY	CHKD.	APPROVED
X		AS BUILT			

TRAFFIC SIGNALS & STREET LIGHTING — DETAILS

CITY OF PASADENA-PUBLIC WORKS DEPARTMENT

PROJECT Improvement of Fair Oaks Avenue

LIMITS % California Blvd. to % State St.

SCALE: AS SHOWN

WORK ORDER NO. 530

SHEET 27 of 27

DWG. NO. 3716

PRINTED ON DIETERICH-POST CLEARPRINT

FOR CONTINUATION SEE DRAWING 8-2-1005

GLENARM ST.

DISPATCHING CENTER

GLENARM BASELINE NO.

EDMONDSON BASELINE

RAYMOND BASE LINE

GLENARM BASE LINE SOUTH

ST. DEPT. DWG. 1762A
BOLT W. CURR F.O.
B.M. 750.26

SO. E. GLENARM ST. 0+2.87

SEE 2-2-519 FOR GAS AND WATER

GLENARM STEAM PLANT

WATER FOUNTAIN

TRANSFORMER

GAS ENCLOSURE

WASH RM.

G.T. FUEL TANK NO. 1

G.T. FUEL TANK NO. 2

NO. 8 F.O. TANK

LOAD CENTER

PIPE TRENCH

CONC. SLAB

CONC. SUMP

FUEL OIL TRANSFER LINE

J.S. BLVD.

FUEL OIL STORAGE (UNDERGROUND)

BROADWAY

FRWY

SOFTENERS

STORM DRAIN

PROPANE TANK

WATER TANKS

DEMINERALIZER

GATE

R.O. UNIT

QUONSET HOUSES

MARLEY NO. 3 COOLING TOWER (OLD BRAUN)

FAIR OAKS AVE.

WALLIS ST.

PASADENA

42" ϕ STEEL CASING

M.H.

TEST HOLE NO. 1

TEST HOLE NO. 2

STORM DRAIN

B-1 DIST. WATER TK.

B-2 DIST. WATER TK.

40,000 BBL. F.O. TANK

MAINTENANCE BLDG.

BROADWAY STEAM PLANT

SEE DRAWING 8-2-1182

B-1

B-2

B-3

12" F.O. LINE
8-2-1210
8-2-1211

STORAGE AREA

WAREHOUSE
(FORMERLY PACIFIC ELEC. BLDG.)

GAS ENCLOSURE

48" R.C.P. ST. DRAIN

12" R.C.P. DRAIN

51" RC STORM DRAIN

FUEL OIL PUMP STATION

20,000 BBL. F.O. TK.

20,000 BBL. F.O. TK.

16" SEWER

ELEC. SHOP

STATE ST.

N. 6 STATE ST. 5+72.10

20" H.P. GAS LINE

8" S.T. PIPE

NOTES:

1. FAIR OAKS AVE. STATION (0+00) = STREET ENGINEERING DEPT. STATION (66+20.30)
2. FOR GRADES SEE DRAWING 8-2-2248

FOR CONTINUATION SEE DRAWING 8-2-1006

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN			
DRAWN	L. JONES	3-29-73	
CHECKED			
CIVIL			
ELECT.			
MECH.			DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED _____ ENGR. DATE _____

APPROVED _____ CHIEF ENGR. DATE _____

BROADWAY & GLENARM STEAM PLANTS

GENERAL LOCATION PLAN

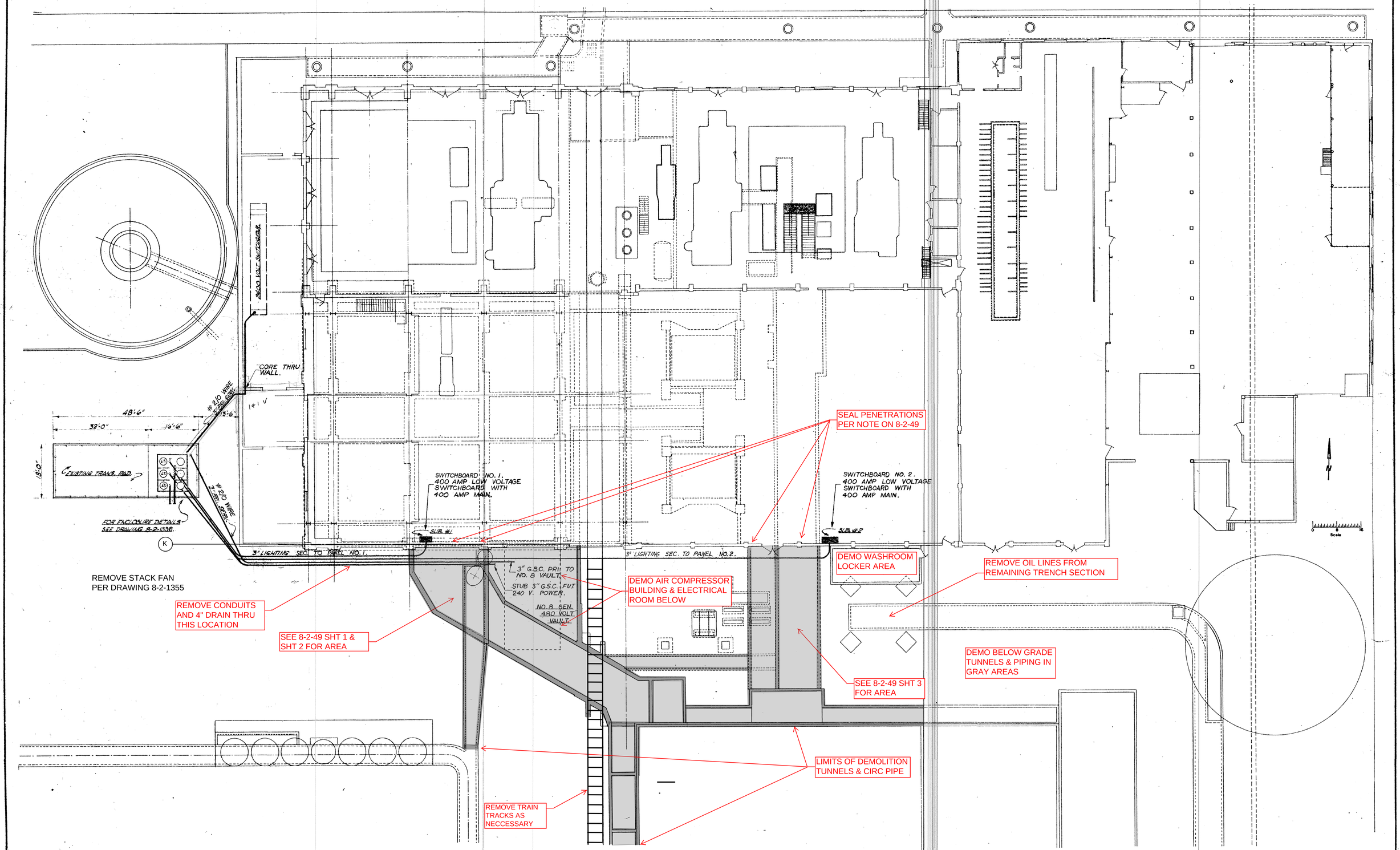
EJO NUMBER 071-03-51 | FILE

SCALE 1" = 40'-0" | PAGE

DRAWING NUMBER 8-2-1002

SHEET NUMBER 2

11/72 DIETERICH-POST 21128 .003 FILM



ENGINEERING FILE	1
SUPV. ELEC. CONSTR.	3

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO
	7						14							
	6						13							
	5						12							
	4						11							
	3						10							
	2						9							
	1						8							

DRFTSMN	A. CARIFFE	7-23-58
CHECKED	J.K. GEDDES	1-2-58
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED ENGR. DATE
APPROVED GEN. MGR. DATE

GLENARM STEAM PLANT ELECTRICAL LAYOUT STATION SERVICE PLOT - PLAN

AUTH. NUMBER	
ENG. W.O.	
PRINT FILE	SCALE SHOWN
DRAWING NUMBER	8-2-1337

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

DEMO 1

2400 VOLT SWITCHGEAR

CORE THRU WALL.

#2/0 WIRE 3" CONDUIT

1#1 V

48'-6"

32'-0"

16'-6"

8'-6"

18'-0"

EXISTING TRANS. PAD

FOR ENCLOSURE DETAILS SEE DRAWING 8-2-1336.

SWITCHBOARD NO. 1.
400 AMP LOW VOLTAGE
SWITCHBOARD WITH
400 AMP MAIN.

SUB. #1

3" LIGHTING SEC. TO PANEL NO. 1.

3" G.S.C. PRI. TO NO. 8 VAULT.

STUB 3" G.S.C. FVT. 240 V. POWER.

NO. 8 GEN. 480 VOLT VAULT

SWITCHBOARD NO. 2.
400 AMP LOW VOLTAGE
SWITCHBOARD WITH
400 AMP MAIN.

SUB #2

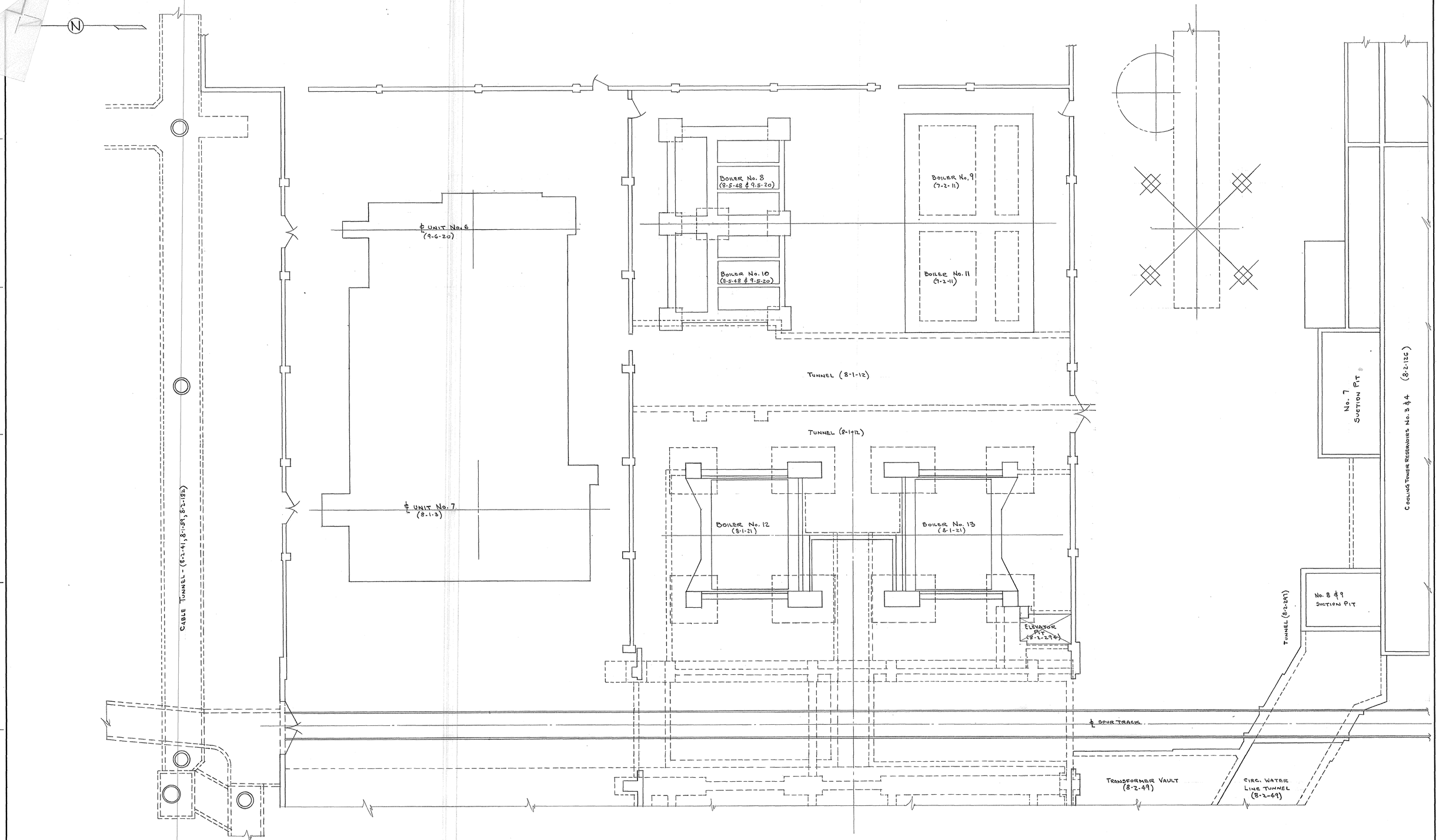
3" LIGHTING SEC. TO PANEL NO. 2.

N

Scale 0 8 16

1" = .073'

| | | |



DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	NAT MILLER	3-27-58
DRAWN		
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED _____ ENGR. DATE _____

APPROVED _____ GEN. MGR. DATE _____

GLENARM STEAM PLANT

GENERAL ARRANGEMENT OF EXISTING STRUCTURES AND FOUNDATIONS

AUTH.	E. J. O.	ACCT.
464	4161	311

PRINT FILE — SCALE 1/8" = 1'-0"

DRAWING NUMBER 8-2-1341

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT 500-10-56

E-W BASE L.

N.P.

25'-0 (DWGS. 7-2-134 & 7-2-140)

FIRING AISLE

(DISTILLED WATER)

30" CAISSON

30" GRAVEL FILL

16" FUEL GAS

8" SOOT-WATER

8" S.B. WATER

CIRCULATING TUNNEL & 2-49

MULTICLONE DUST COLL. TYPE 9-190-10 SIZE 12 447004 EMPTY WT. = 44,000#

8 WF 17 DIAG. BCG.

GW 15.5

3'-4½ TO W.P.

9'-9

15 LC 33.9

13'-5½

10'-3

9-7 6/6 C's

23'-8½

ABANDONED STORM DRAIN 1-7-62 FILE 1895 S OF SR GLENARM

PLAN
¼" = 1'-0

L's G×4×G×1'-11

13/16" HOLES

PLAN

ELEVATION
1" = 1'-0

6"ø - 1'-10 A.B. × 1'-3 & NUTS. 12 REQ'D. BY CONC. CONTRACTOR.

+18'-9"

W.P.

17'-11½

8 WF 31

GROUT

+1'-3½

750.11 = 0'-0

REMOVE STACK FOOTING TO 6'-0" BELOW GRADE. ABANDON LOWER PORTION IN PLACE

Dwg. 8-2-452

8'-0" ø WAS OCTAGON

MECH. COMPACTED BACKFILL

30" ø

8 - #4 #3 TIES @ 12

3" CLEAR

CIRCULATING TUNNEL WALL

17'-0

2'-0 1/2

734.11

ELEVATION

- 20'-5

TOP OF BASE ℄ = +1'-3

+1'-1

(-) 4'-5

CUT & WELD FLANGE

8 WF 17

8'-4½

8'-1⅞

6 - #5 BARS. SULPHUR ø IN ROOF SLAB

#3 TIES @ 12

SIDE ELEV.
¼" = 1'-0

℄ 6"ø × 0'-11

55'-2

17'-6

TYP.

½" ø HOLE ON ℄

TOP OF BASE ℄ = +1'-3

TOP OF CONC. = +1'-1"

GROUT

LEVELG. ℄

BASE ℄

4" PROJ.

1'-0

2 - 1¼" ø A.B. × 3'-0 & NUTS, 4" THRD. 8 REQ'D IN 1⅝" ø HOLES

1 - ℄ 10 × ⅜ × 0'-10

1 - ℄ 10 × ¼ × 0'-10

TYP. COL. BASE
½" = 1'-0

+22'-0

SEE DET. A

6" SCH. 40 PIPE

SEE DET B

+1'-1

#3 @ 12

6 - #5

1'-5

STANCHION FTG.
½" = 1'-0

13'-6 ø

8'-6

2'-5⅞

3'-6¼

2'-5⅞

6" ø

79"

ø B.C.

SEE DETAIL

3/3

12

KEY BOLT
LOCATE AS SHOWN. BOLTS TO BE SET PER TEMPLATE FURNISHED BY CONC. CONTRACTOR. TEMPATE TO BE MARKED FOR KEY BOLT.

PLAN

24 - 1½" ANCH. B. × 6'-0 LG. W. 3 STD. & 1 JAM NUTS EA. 20" THRD. & 4" SLEEVE. 6" LONG. BY CONC. CONTR.

2 STD. NUTS

1 STD. & 1 JAM NUT

+1'-0

1'-7 PROJ.

GROUT

LEVEL. CONTR.

10'-0

1'-6

10 - #4 TIES @ 18

4 - #6 U-BARS 90° HOOKS TYP.

6"

2½" CL.

#3 @ 9 E.W.

#6 @ 9 E.W.

ELEVATION
⅜" = 1'-0

+22'-0

GW 15.5 × 7'-0

4" SCH. 40 PIPE

2'-0

6" STD. PIPE

⅜ PL.

DETAIL A

4" PROJ.

+1'-1

2 - 1⅛ × 1'-3 A.B. & NUTS BY CONC. CONT.

ELEVATION

1 - ℄ 8 × 4 × 1'-3

1 - ℄ 8 × 4 × 1'-3

⅜

2 SLOTS 1⅝ × 2"

8

4

4

10½

1'-3

DETAIL B
½" = 1'-0

18"ø SUMP

+1'-0

OMIT BELL

6" V.C. PIPE

SLOPE TO DRAIN

SUMP DET.
1" = 1'-0

4 - ℄ 4 × 4'-0 @ +0'-9" BOTH CORNERS.

STACK

CORNER REINFORCING

60" ø

18"ø

10'-0

#3 GRAVEL

4'-0

DRAIN DET.
⅜" = 1'-0

ALL ANCH. BOLTS BY CONCRETE CONT. RACTOR.
ALL GROUT & STEEL ABOVE ROUGH CONCRETE BY STEEL CONTRACTOR.
¾" MACH. BOLTS IN 13/16 HOLES EXCEPT AS NOTED.
SHOP DETAILS TO BE SUBMITTED FOR APPROVAL BEFORE STARTING FABRICATION.

PACAL GEN. CONTRACTOR

NO	DATE	REVISIONS	BY	CHKD	APVD
1	11-1-56	REV. TO CONFORM TO FIELD	JHN		

DISTRIBUTION

REFERENCE DRAWINGS	FILE NO
SIRC. LINE TUNNEL & TRANSF. VAULT	8-2-49
SOOTBLOWING STACK	8-2-1354

DESIGN	J.H. NORMAN	9-26-56
DRAWN		
CHECKED		
CIVIL	J.H. Norman	9-26-56
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED _____ ENGR. DATE 11-5-56.

APPROVED _____ GEN. MGR. DATE 11-5-56

GLENARM STEAM PLANT

SOOTBLOWING STACK & PRECIPITATOR SUPPORT FOUNDATIONS

AUTH. NUMBER	300
ENG. W.O.	3022/312
PRINT FILE	SCALE NOTED
DRAWING NUMBER	8-2-1355

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

DEMO 5

N

E-W BASE L.

N.P.

25'-0 (DWGS. 7-2-134 & 7-2-140)

8'-6

16'5-2

13'-8

(-)17'-0 (-)17'-6 (-)17'-6 (-)18-4 (-)19-2 (-)20-0

3-4⅞ 1-4½ 1-0¾ 2-8⅜ 2'-0

30" GRAVEL PIT

(DISTILLED WATER

30" CAISSON

EW 15.5

3'-4½ TO W.P.

9'-9

16" FUEL GAS

8" SOOT WATER

8" STEAM

8" WATER

8 WF 17 DIAG. BCG.

MULTICYONE DUST COLL. TYPE 9-190-10 SIZE 12 447004 EMPTY WT. 44,700#

15 I 33.9

8'-1¼

8'-1¼

15 I 33.9

8 WF 17 DIAG. BCG.

(-) 20'-5

CIRCULATING TUNNEL & 2-49

6'-0 8'-7 8'-1'

30" CAISSON

9'-9

15 I 33.9

4 9-7 6/16 C's 4

13'-5½

10'-3

23'-8½

ABANDONED STORM DRAIN 1-7-62 FILE 1895 S OF SR GLENARM

PLAN

¼" = 1'-0

FIRING AISLE

14'-3½

15'-0

55'-2

17'-6

TYP.

⅝" ø HOLE ON ℄

TOP OF BASE ℗ +1'-3

TOP OF CONC. +1'-1"

GROUT 4" LEVELG. ℗ 2" BASE ℗

1'-0

1 PROJ.

2-1¼" ø A.B. x 3'-0 ℄ NUTS, 4" THRD. & REQ'D 1⅝" ø HOLES

1-℗ 10 x ⅜ x 0'-10

1-℗ 10 x ¼ x 0'-10

TYP. COL. BASE

½" = 1'-0

CUT & WELD FLANGE

8 WF 17

8 WF 31

8'-4½

8'-1⅛

8'-4½

+1'-1

+22'-0

SEE DET. A

8" SCH. 40 PIPE

SEE DET B

+1'-1

#3 @ 12

6-#5

1'-5

STANCHION FTG.

½" = 1'-0

SIDE ELEV.

¼" = 1'-0

TOP OF BASE ℗ +1'-3

6-#5 BARS. SULPHUR 8" IN ROOF SLAB

#3 TIES @ 12

13'-6 ø

8'-6

2'-5⅞ 3'-6¼ 2'-5⅞

ø B.C.

79"

SEE DETAIL 3⅜ 12

KEY BOLT
LOCATE AS SHOWN. BOLTS TO BE SET PER TEMPLATE FURNISHED BY CONC. CONTRACTOR. TEMPATE TO BE MARKED FOR KEY BOLT.

PLAN

18" ø SUMP

+1'-0

OMIT BELL

6" V.C. PIPE

SLOPE TO DRAIN

SUMP DET.

1" = 1'-0

4-#4 x 4'-0 @ +0'-9" BOTH CORNERS.

STACK

CORNER REINFORCING

24-1½" ANCH. B. x 6'-0 LG. W. 3 STD. & 1 JAM NUTS EA., 20" THRD. #4" SLEEVE. 6" LONG. BY CONC. CONTR.

2 STD. NUTS

1 STD. & 1 JAM NUT

+1'-0

1'-7 PROJ.

GROUT

CONC.

10-#4 TIES @ 18

4-#6 U-BARS 90° HOOKS TYP.

2'-0"

1'-6

2'-2" CL.

#3 @ 9 E.W.

#6 @ 9 E.W.

ELEVATION

⅜" = 1'-0

+22'-0

GW 15.5 x 7'-0

4 SCH. 40 PIPE

4 STD. PIPE

2'-0

⅝ ø x 0'-8

DETAIL A

1'-7 PROJ.

+1'-1

GROUT 1" LEVEL. 4" BASE ℗ 2"

2-1⅛ x 1'-3 A.B. & NUTS BY CONC. CONT.

ELEVATION

1-℗ ⅝ x 4'-10 x 1'-3

1-℗ ⅝ x 4'-10 x 1'-3

⅝ ø

2 SLOTS 1⅝ x 2"

8"

4"

2½"

10½"

1'-3

DETAIL B

½" = 1'-0

60" ø

18" ø

10'-0

#3 GRAVEL

4'-0

DRAIN DET.

⅜" = 1'-0

PLAN

1 PROJ.

2'-0

1'-0

6" W.P.

6-1" ø A.B. x 1'-3 & NUTS. 12 REQ'D. BY CONC. CONTRACTOR.

ELEVATION

1" = 1'-0

+18'-9"

W.P.

17'-1½

8 WF 31

8 WF 31

+1'-1

TOP OF BASE ℗ +1'-3

GROUT 3"

+1'-3½

750.11 = 0'-0

DWG. 8-2-432

(-) 3'-4

(-) 8-7⅞

(-) 8-8⅜

8'-6" ø WAS OCTAGON ⚠

MECH. COMPACTED BACKFILL

17'-0

2'-0 1'-0½

734.11

30" ø

8-#4 #3 TIES @ 12 3" CLEAR

CIRCULATING TUNNEL WALL

(-) 4'-5

6'

ELEVATION

- 20'-5

ALL ANCH. BOLTS BY CONCRETE CONTRACTOR.
ALL GROUT & STEEL ABOVE ROUGH CONCRETE BY STEEL CONTRACTOR.
¾" MACH. BOLTS IN 13/16 HOLES EXCEPT AS NOTED.
SHOP DETAILS TO BE SUBMITTED FOR APPROVAL BEFORE STARTING FABRICATION.

PACAL GEN. CONTRACTOR

NO	DATE	REVISIONS	BY	CHKD	APVD
1	11-1-56	REV. TO CONFORM TO FIELD	JHN		

DISTRIBUTION

REFERENCE DRAWINGS: CIRC. LINE TUNNEL & TRANSF. VAULT 8-2-49; SOOTBLOWING STACK 8-2-1354

FILE NO

DESIGN	J.H. NORMAN	9-26-56
DRAWN		
CHECKED		
CIVIL	J.H. Norman	9-26-56
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED _____ ENGR. DATE 11-5-56.

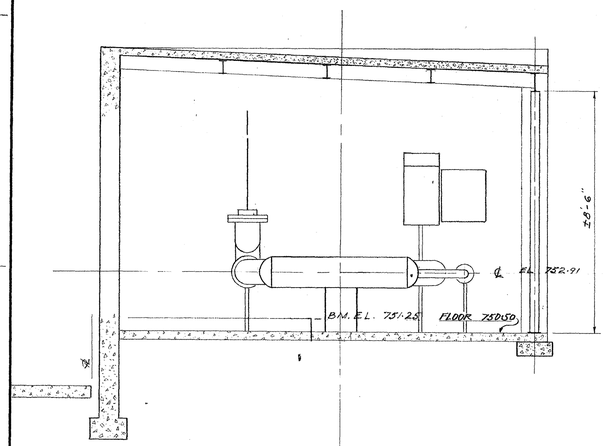
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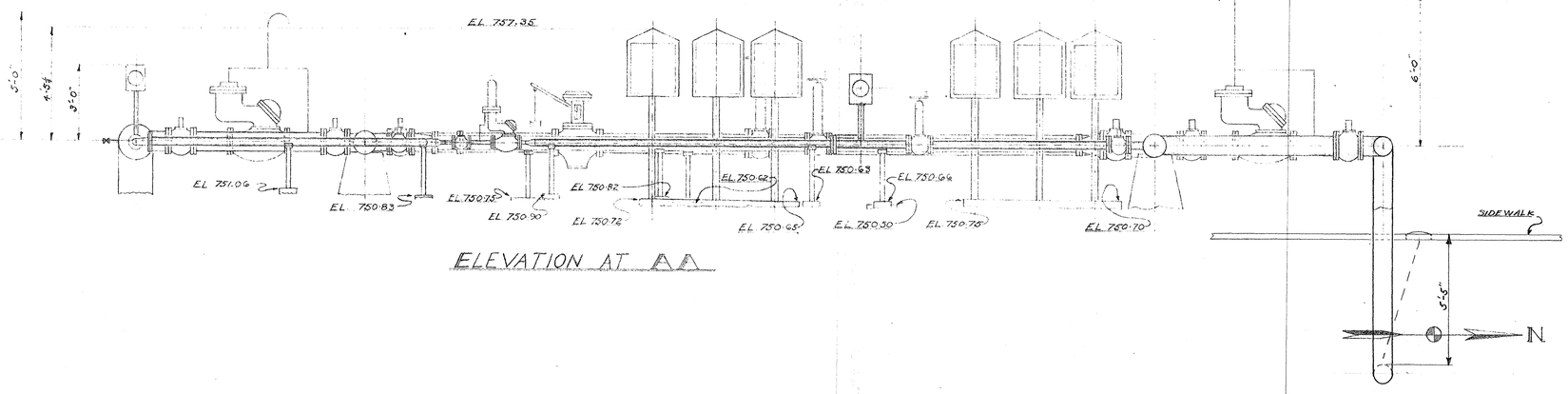
GLENARM STEAM PLANT

SOOTBLOWING STACK & PRECIPITATOR SUPPORT FOUNDATIONS

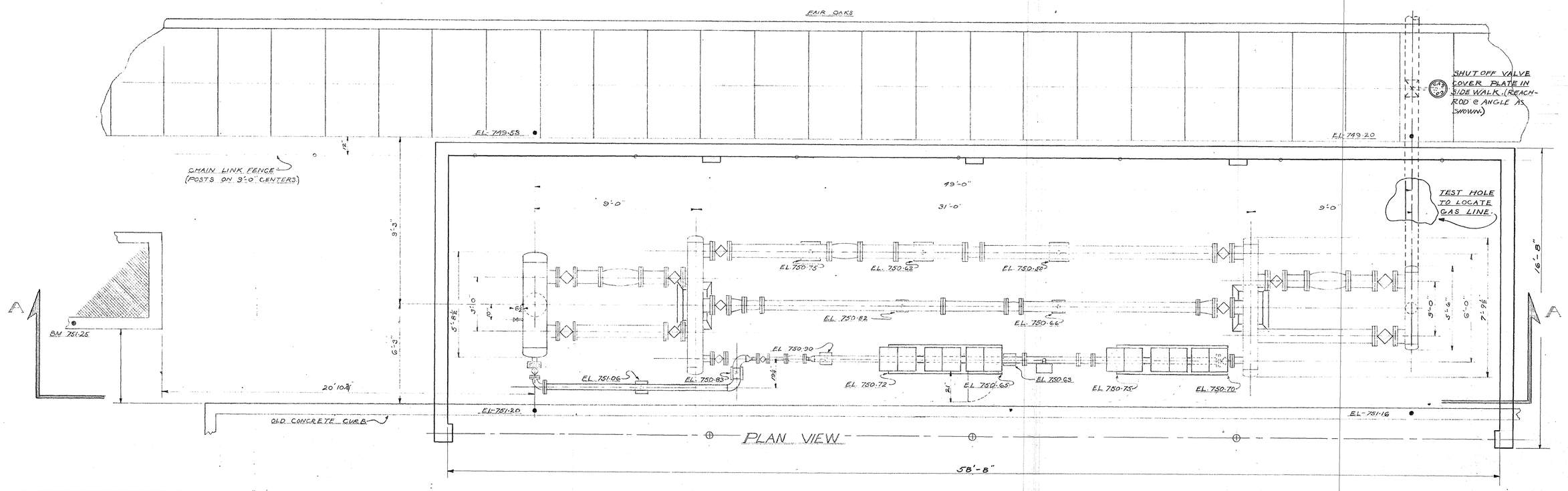
AUTH. NUMBER	300
ENG. W.O.	3022/312
PRINT FILE	SCALE NOTED
DRAWING NUMBER	8-2-1355

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT





ELEVATION AT E E



PLAN VIEW

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS

FILE NO

DESIGN		
DRAWN	CHARLSON	11-25-60
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.

CITY OF PASADENA

APPROVED _____ ENGR. DATE _____

APPROVED _____ GEN. MGR. DATE _____

GLENARM STEAM PLANT

SOUTHERN CALIFORNIA GAS CO

PIPING ARRANGEMENT

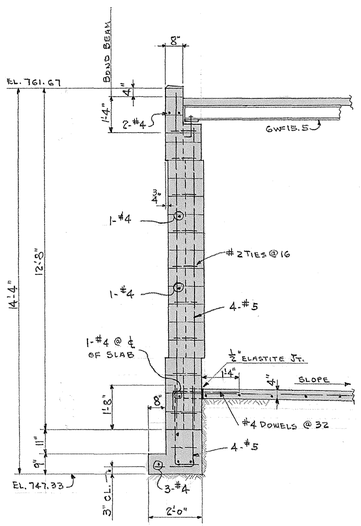
AUTH.	E. J. O.	ACCT.

PRINT FILE

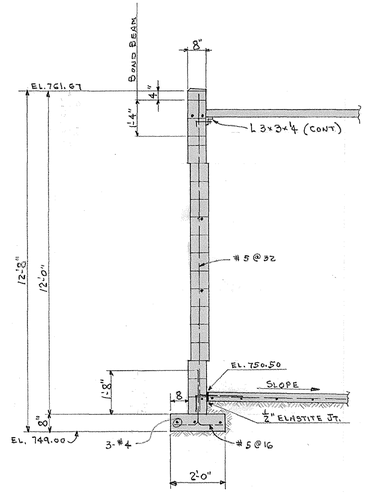
SCALE 3/8" = 1'-0"

DRAWING NUMBER 8-2-1477

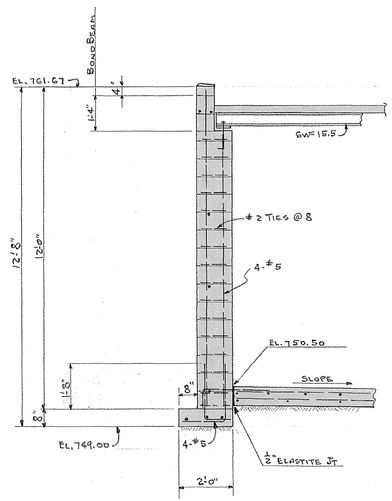
PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT



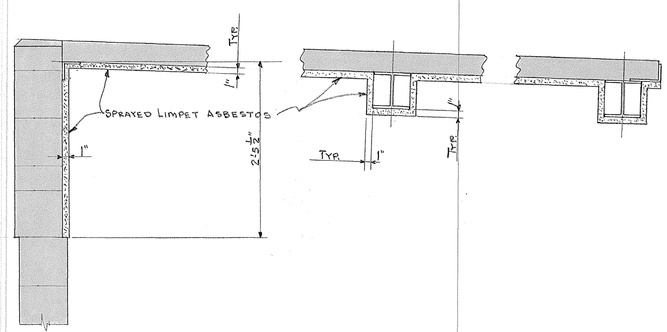
SECTION H-H (8-2-1666)
3/8" = 1'0"



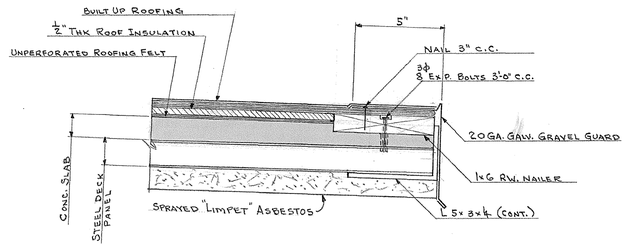
SECTION J-J (8-2-1666)
3/8" = 1'0"



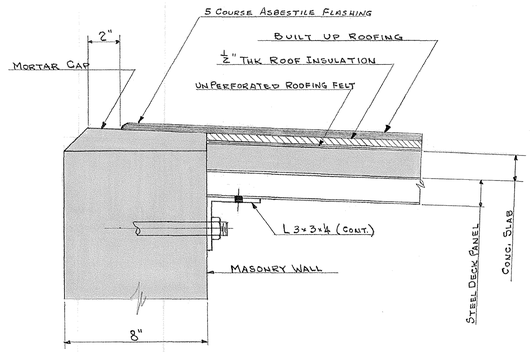
SECTION K-K (8-2-1666)
3/8" = 1'0"



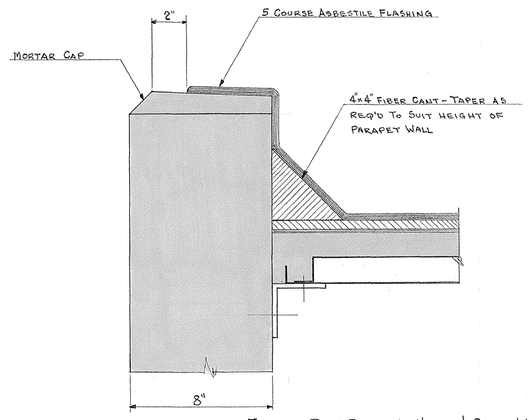
TYPICAL DETAILES FOR SPRAYED "LIMPET" ASBESTOS
1" = 1'0"



TYPICAL DETAIL AT EDGE OF ROOF
3" = 1'0"



TYPICAL ROOF DETAIL AT WEST WALL
3" = 1'0"



TYPICAL ROOF DETAIL AT NORTH & SOUTH WALLS
3" = 1'0"

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS	FILE NO
SPEC. LD-62-2	
PAVING & YARD DETAILS	8-2-1670
ELEVATIONS & DETAILS	8-2-1668
ROOF PLAN	8-2-1667
FOUNDATION PLAN	8-2-1666

DESIGN	H.H. LEWIS	
DRAWN	NAT MILLER	1-26-62
CHECKED	[illegible]	2-15-62
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 2-26-62
APPROVED [illegible] GEN. MGR. DATE 2-26-62

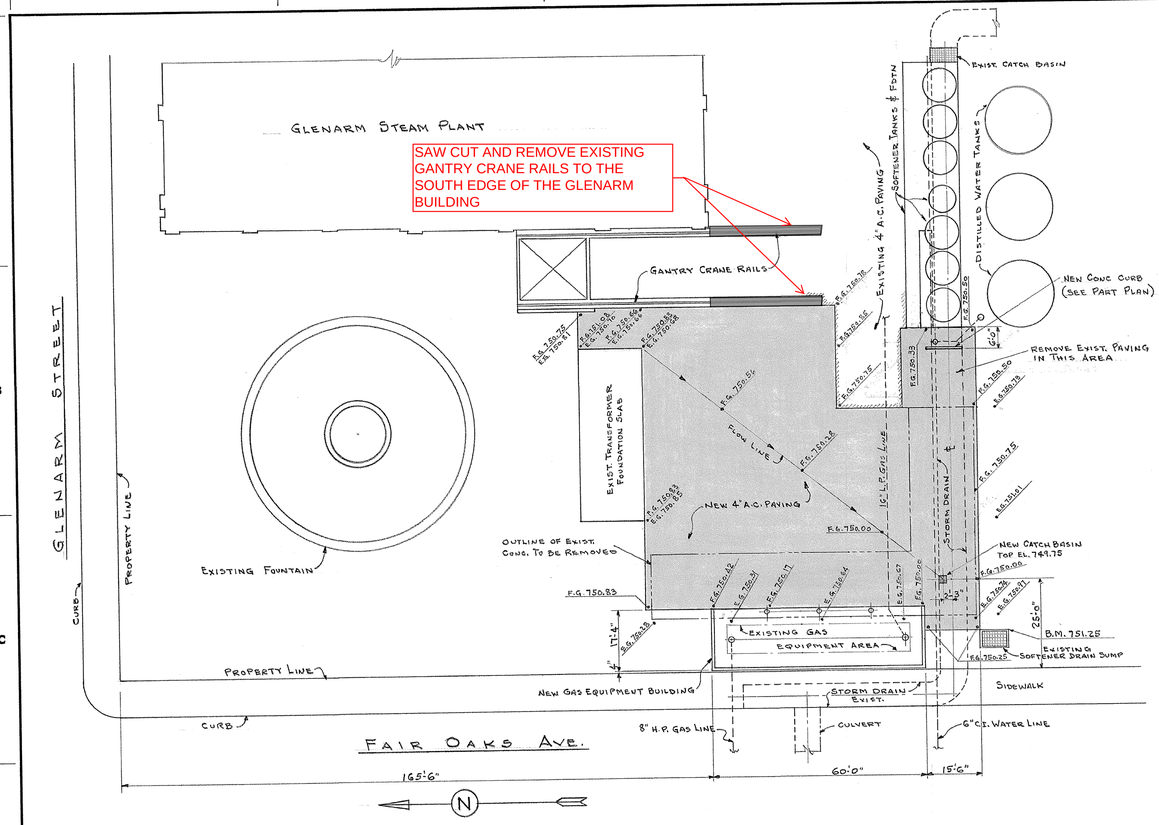
GLENARM STEAM PLANT
GAS EQUIPMENT BUILDING
MISCELLANEOUS
SECTIONS & DETAILS

AUTH.	E. J. O.	ACCT.
G29	9008	A
PRINT FILE	SCALE	
	AS NOTED	
DRAWING NUMBER		
8-2-1669		

CIVIL ENGINEER HAROLD H. LEWIS NO. 5773

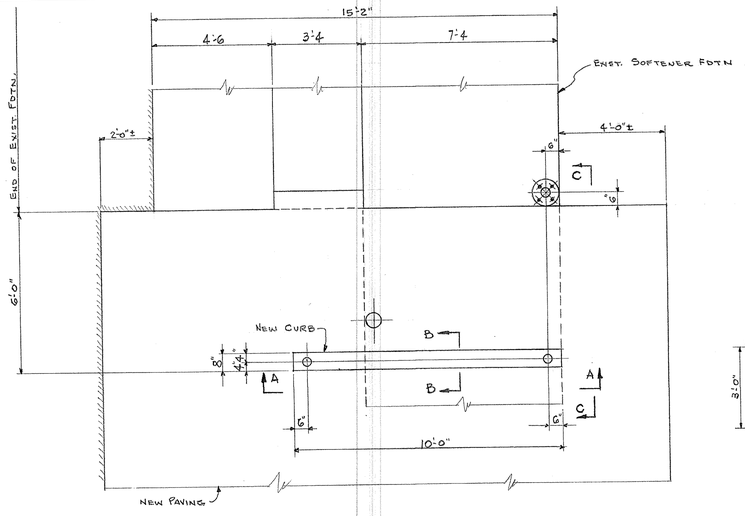
PRINTED ON 1000M CLEARPRINT

SAW CUT AND REMOVE EXISTING GANTRY CRANE RAILS TO THE SOUTH EDGE OF THE GLENARM BUILDING

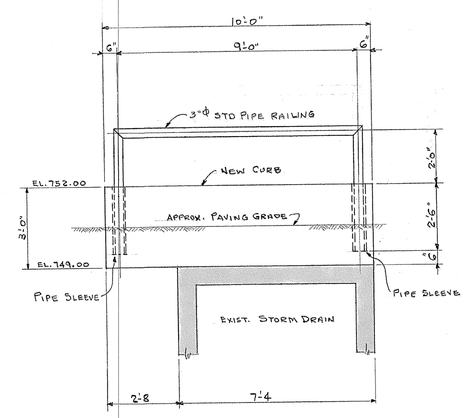


NOTE:-
SHADED AREA INDICATES NEW PAVING - 4" A.C.

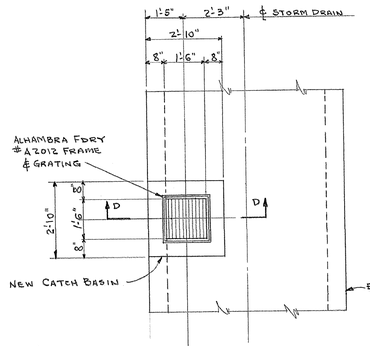
PLOT PLAN
1" = 20'



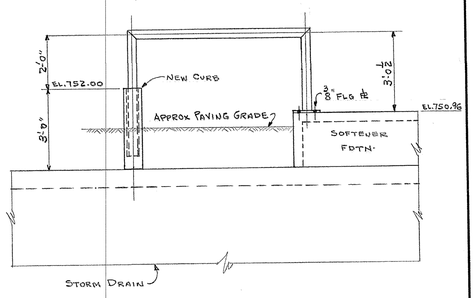
PART PLAN AT SOFTENER FDTN
3/8" = 1'-0"



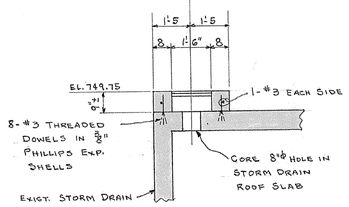
SECT. A-A
3/8" = 1'-0"



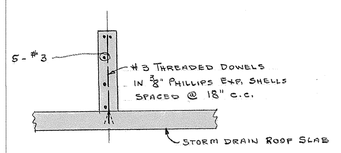
PLAN OF CATCH BASIN
3/8" = 1'-0"



SECT. C-C
3/8" = 1'-0"



SECT. D-D
3/8" = 1'-0"



SECT. B-B
3/8" = 1'-0"

HAROLD H. LEWIS
REGISTERED CIVIL ENGINEER
NO. 5773

NOTE:-
SHADED AREA INDICATES NEW PAVING - 4" A.C.

NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

SPEC. LD-62-2

REFERENCE DRAWINGS	FILE NO
MISC. SECTIONS & DETAILS	8-2-1669
ELEVATIONS & DETAILS	8-2-1668
ROOF FRAMING PLAN	8-2-1667
FOUNDATION & FLOOR PLAN	8-2-1666

DESIGN	NAT MILLER	2-6-62
DRAWN	NAT MILLER	2-6-62
CHECKED		2-15-62
CIVIL		
ELECT.		
MECH.		DATE

DISTRIBUTION
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MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED _____ ENGR. DATE 2-26-62
APPROVED _____ GEN. MGR. DATE 2-26-62

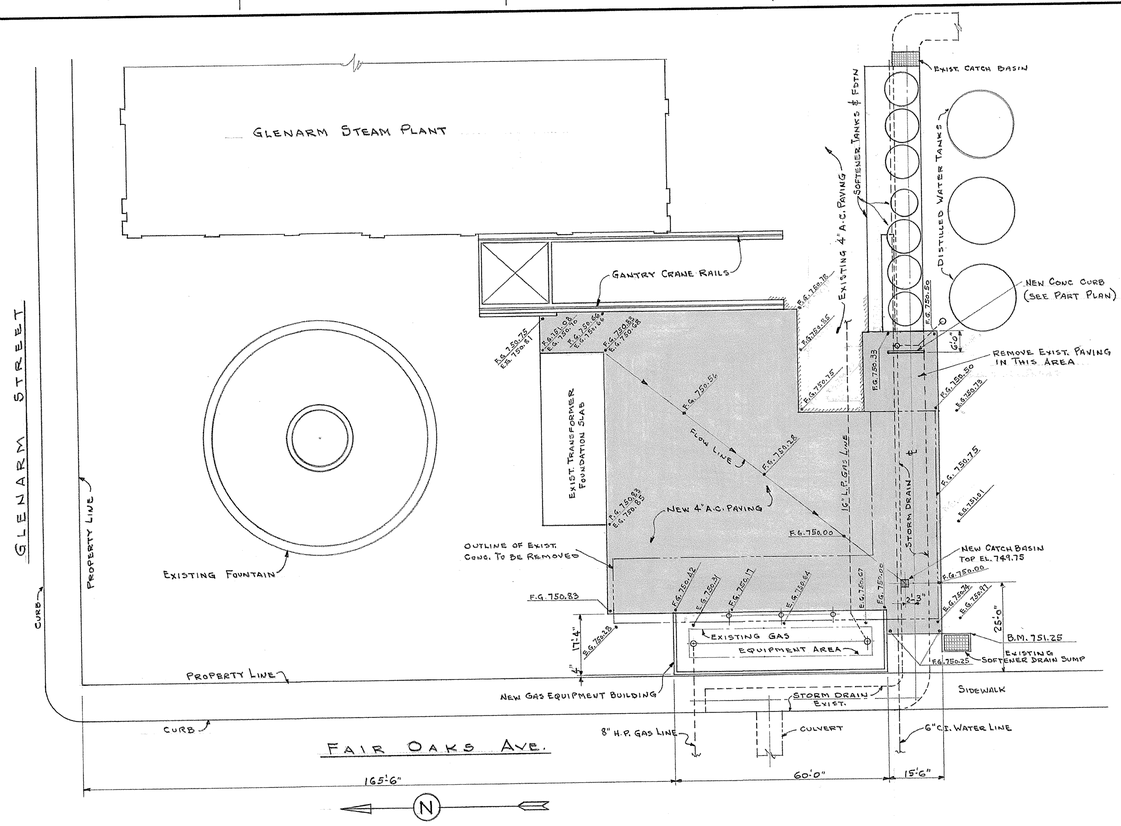
GLENARM STEAM PLANT
GAS EQUIPMENT BUILDING
PLOT PLAN
PAVING & YARD DETAILS

AUTH.	E. J. O.	ACCT.
629	9008	A

PRINT FILE | SCALE: As Noted

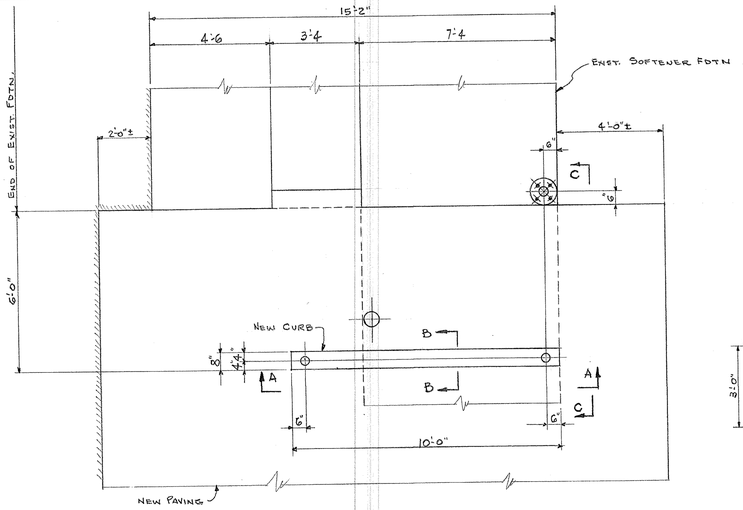
DRAWING NUMBER
8-2-1670

DEMO 6

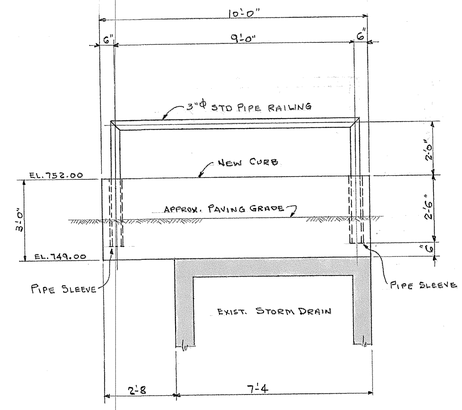


NOTE:-
SHADED AREA INDICATES NEW PAVING - 4" A.C.

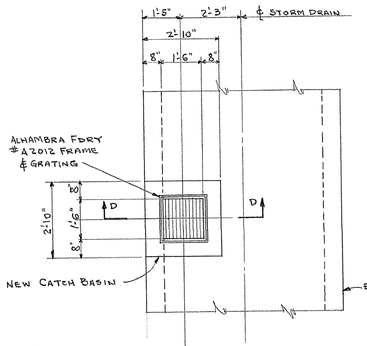
PLOT PLAN
1" = 20'



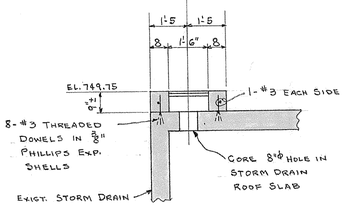
PART PLAN AT SOFTENER FDTN
3/8" = 1'-0"



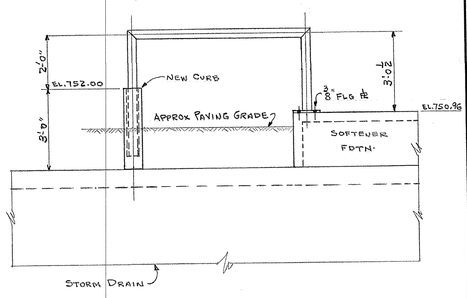
SECT. A-A
3/8" = 1'-0"



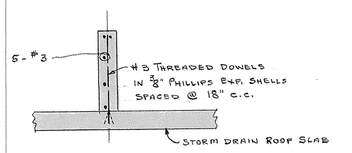
PLAN OF CATCH BASIN
3/8" = 1'-0"



SECT. D-D
3/8" = 1'-0"



SECT. C-C
3/8" = 1'-0"



SECT. B-B
3/8" = 1'-0"

HAROLD H. LEWIS
NO. 5773

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
PRINTED ON 1000H CLEARPRINT						

NO	DATE	REVISIONS	BY	CHKD	APVD

SPEC. LD-62-2

REFERENCE DRAWINGS	FILE NO
MISC. SECTIONS & DETAILS	8-2-1669
ELEVATIONS & DETAILS	8-2-1668
ROOF FRAMING PLAN	8-2-1667
FOUNDATION & FLOOR PLAN	8-2-1666

DESIGN	NAT MILLER	2-6-62
DRAWN	NAT MILLER	2-6-62
CHECKED		2-15-62
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED _____ ENGR. DATE 2-26-62
APPROVED _____ GEN. MGR. DATE 2-26-62

GLENARM STEAM PLANT
GAS EQUIPMENT BUILDING
PLOT PLAN
PAVING & YARD DETAILS

AUTH.	E. J. O.	ACCT.
629	9008	A
PRINT FILE	SCALE	
	As Noted	
DRAWING NUMBER		
8-2-1670		

GLENARM STEAM PLANT SPUR TRACK

10" W.I. DR. PIPE

1+87.00

1+64.33

1+62.00

1+44.90 (ABANDONED) LINES

1+37.00

1+21.00

1+12.00

0+87.00

0+62.00

0+58.00

0+37.00

0+22.00

0+12.00

0+00.

℄ CATCH BASIN

℄ DRIVEWAY

DRIVEWAY (8-2-2375)

14" PIPE GUARD RAIL (8-2-2380)

CONCRETE STRUCTURE (SEE DWG. 8-2-2372)

END OF TELEPHONE CONDUIT

END OF PARAPET WALL

2" WATER SERVICE SEE 8-2-2373

STEEL STAIR-SEE (8-2-2380)

CONC. STAIR (8-2-2375)

4'-6" GATE

SIDEWALK DRAIN BOX

CATCH BASIN (8-2-2378)

CHAIN LINK FENCE

FORM TROWEL WITH A.C. PAVING

RETAINING WALL TOP EL. 753.85

1½" GALV. STL. COND. FOR TELEPHONE. 2'-0 BELOW SIDEWALK GRADE

STREET

STATE

EAST

EDGE OF BERM

CATCH BASIN (8-2-2378) TOP GRATING 755.25

SEE NOTE No. 3

SIDEWALK DRAIN BOX

CONC. FENCE CURB (8-2-2377)

GUY WIRE

24' SINGLE LEAF GATE

NEW 4" C.I. SOIL PIPE SEWER LAT.

2" WATER SERVICE SEE 8-2-2373

EXTEND 1" WATER SERVICE FROM EXIST. HOSE BIB

PLANTER (EXIST.) WALL 8-2-2377

1" WATER SERVICE

PLANTER AREA 8-2-2377

(EXIST.) FENCE & FENCE CURB (8-2-2377)

SEWER LAT.

REMOVE & REPLACE DRIVE APRON & 2½' OF CURB

(REMOVE) DRIVEWAY

DRIVE

SOUTH FAIR OAKS AVE.

LDUF-G1-5

NORTH

NEW PAVING — EXISTING PAVING — NEW VALLEY — EXISTING VALLEY

758.00 — 757.00

SEC. E-E ⚠4

SCALE HORIZ. 1"=10' VERT. 1"=1'

TOP PARAPET WALL

4" — 2" — 1½" — 4 BOLTS ¼" Ø PHILLIPS E.V.P. SHELLS

TYPICAL LINE POST CONN. (N.I.C.)

10' MAX SPACING

6' FENCE — 2'-0" — TOP PARAPET WALL

TYPICAL ELEVATION (N.I.C.)

3" MIN. — WELD POST TO STRAP — ¼" DENT STRAP

PLAN

4 — 2½ — 4 BOLTS ¼" Ø PHILLIPS E.V.P. SHELLS

ELEV.

TYPICAL CORNER POST CONN.

TYPICAL FENCE DETAILS AT SOUTH END OF EXIST. CONC. STRUCTURE (N.I.C.)

8" — 762.53 — B-#4 — #4@18" — #6@6 — C#4 — #4@12 — 4'-4" — 2-4" TILE WEEPHOLES @4'-0" c.c. — 757.53 — 3'-6"

SEC. D-D ⚠4

RETAINING WALL AT SOUTH END OF PLANTER AREA.

NOTES

1. ELEVATIONS SHOWN HAVE BEEN DETERMINED FROM BENCH MARK - BOLT IN WEST CURB OF FAIR OAKS AVE. S/S LINE OF GRACE TERRACE ELEV. 758.52
2. ELEVATIONS USED AT INCINERATOR, BWAY STEAM PLANT, & GLENARM STEAM PLANT HAVE BEEN DETERMINED FROM OTHER BENCH MARKS & SHALL NOT BE USED WITH THIS DWG.
3. DOT & DASH OUTLINE INDICATES LOCATION & SHAPE OF BLDG WHICH HAS BEEN REMOVED. WALLS & FOOTINGS BELOW GRADE STILL REMAIN.
4. ⚠4 DRIVEWAYS, SIDEWALKS, CURBS & GUTTERS SHALL CONFORM TO ENGRG-STREET DEPT. SPEC. NO. 31 & DWG. NO. 5403A.
5. ⚠5 4" A.C. PAVING IS TO BE 2 COURSE, 2½" BASE & 1½" SURFACE.
6. ⚠6 SALVAGED FENCE SHALL REMAIN THE PROPERTY OF THE LIGHT DEPT.

LEGEND

E.G. = EXISTING GRADES
F.G. = FINISH GRADES = TOP OF 4" A.C.
P.G. = PRELIMINARY GRADES (SEE DWG. NO. 8-2-2375)
S.G. = SUBGRADES = BOTT. OF 4" A.C.
T.W. = TOP OF WALL
S.W. = SIDEWALK GRADES @ PROPERTY LINE
C = TOP OF CURB GRADES
F.L. = FLOW LINE GRADES
F.F. = FINISHED FLOOR ELEVATION
⚠1⚠2⚠3 (760) EXISTING CONTOUR
⚠1⚠2⚠3 —760— FINISHED CONTOUR
⚠1⚠2⚠3 ////// REPAVING - THICKNESS VARIES

HAROLD H. LEWIS NO. 5773

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	⚠4	10-16-61	PLANTER WALL, FENCE CURB & PAVING ADDT'NS.	C.G.W.	BDS.	
	⚠3	12-1-60	MINOR REVISIONS TO BRING DWG UP TO DATE.	N.M.		
	⚠2	9-21-60	CHANGED LOCATION OF SOIL PIPE IN BASEMENT ADDED TELEPHONE CONDUIT & WATER SERVICE TO DWG.	N.M.		
	⚠1	7-15-60	ADDED FENCE DETAILS	N.M.		

REFERENCE DRAWINGS	FILE NO
STRUCTURAL DWGS	8-2-2371-80
ELECTRICAL SHOP-MEZZ FL.-PLAN & DTLS	8-2-2370
ELECTRICAL SHOP-PLAN & DETAILS	8-2-2369
FIELD BOOK 17 PAGE 58 (DEDUCT -217 FROM ELEVATIONS SHOWN)	

DESIGN	NAT MILLER	1-18-60
DRAWN	NAT MILLER	1-18-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 6-21-60

APPROVED [illegible] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

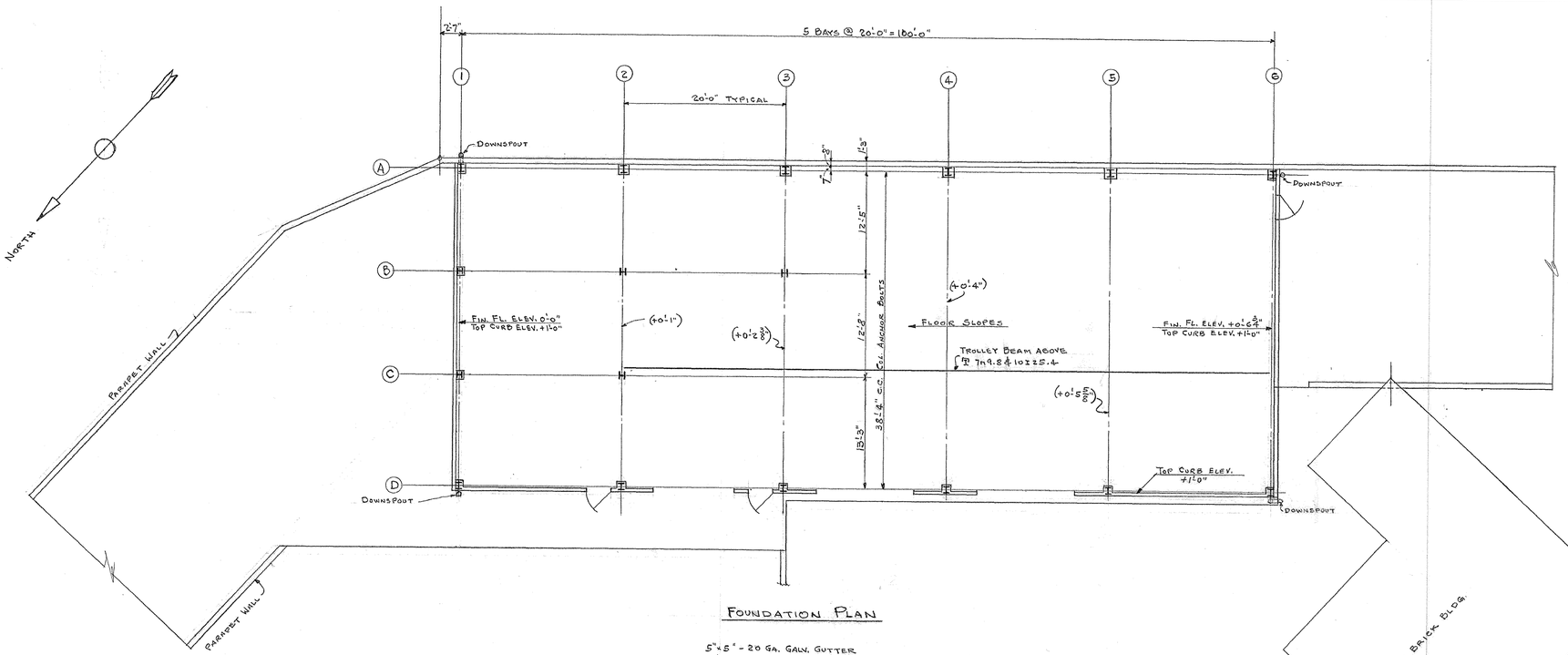
ELECTRICAL SHOP PLOT PLAN

AUTH.	E. J. O.	ACCT.
525	6793	371

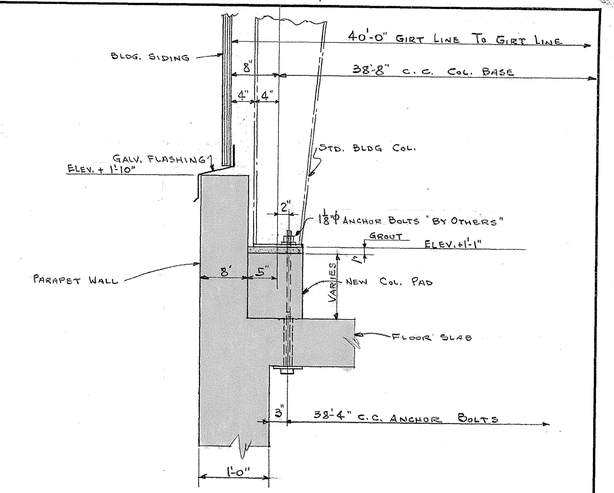
PRINT FILE — SCALE 1" = 10'

DRAWING NUMBER 8-2-2368

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

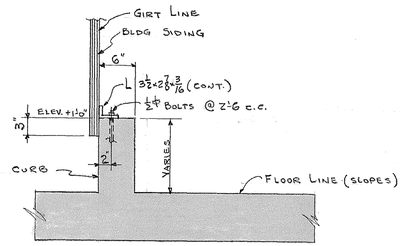


FOUNDATION PLAN



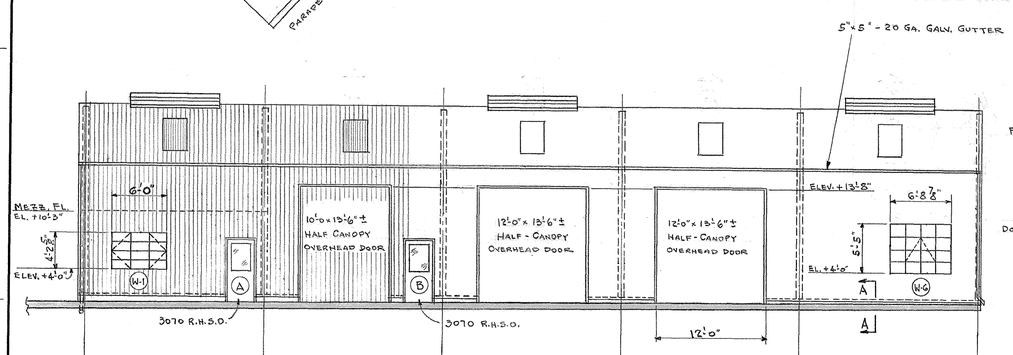
SECTION B-B

1" = 1'-0"



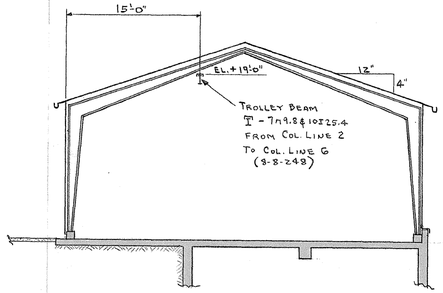
SECTION A-A

1" = 1'-0"



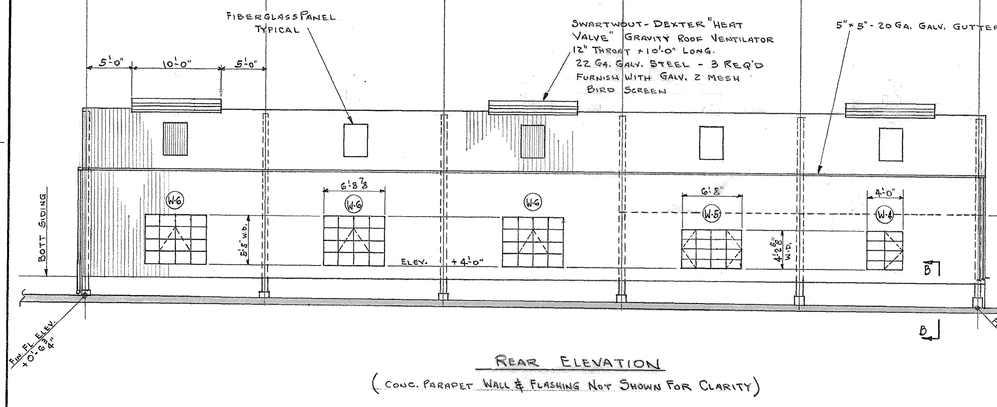
FRONT ELEVATION

RIGHT ELEVATION



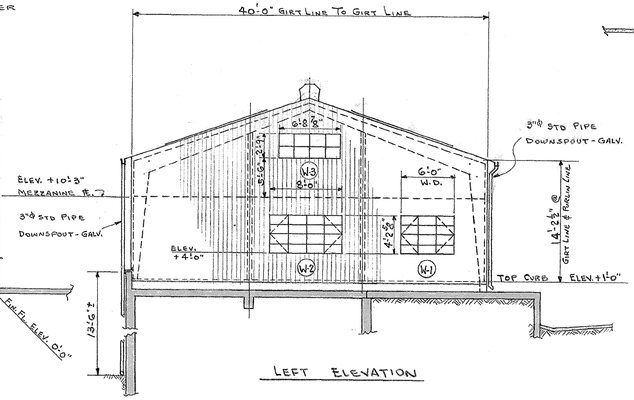
TYPICAL CROSS SECTION

(LOOKING N.E.)



REAR ELEVATION

(CONC. PARAPET WALL & FLASHING NOT SHOWN FOR CLARITY)



LEFT ELEVATION

HAROLD H. LEWIS
REGISTERED CIVIL ENGINEER
NO. 5723

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	3	12-8-60	ADDED TROLLEY BM & MINOR REVISIONS	N.M.		
	2	2-15-60	MISC. REVISIONS	N.M.		
	1	1-4-60	REVISED FDTN PLAN, EAST ELEV, SECT. B-B	N.M.		

NO	DATE	REVISIONS	BY	CHKD	APVD

L.D. 59-16
MECH. FLOOR PLAN & DETAILS
REFERENCE DRAWINGS
8-2-2370
FILE NO

DESIGN	JOHN H. NORMAN	11-19-59
DRAWN	NAT MILLER	11-19-59
CHECKED	J. H. LEWIS	11-24-59
CIVIL	J. H. LEWIS	11-24-59
ELECT.		
MECH.		

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED ____ ENGR. DATE 11-24-59
APPROVED J.M. Goodrich GEN. MGR. DATE 11-24-59

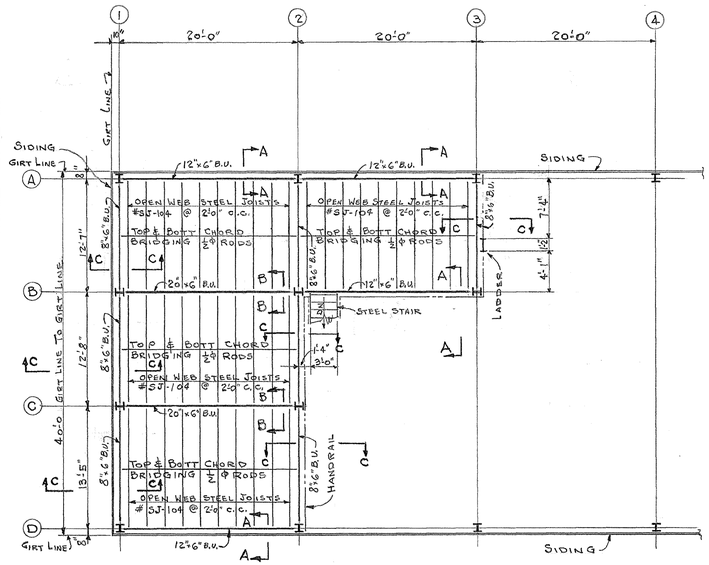
GLENARM STEAM PLANT

ELECTRICAL SHOP PLAN AND ELEVATIONS

AUTH.	E. J. O.	ACCT.
	6793	371
PRINT FILE	SCALE	
	1/8" & 1" = 1'-0"	

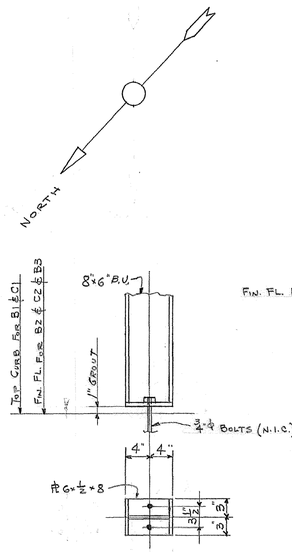
DRAWING NUMBER 8-2-2369

PASADENA BLUEPRINT CO. PRINTED ON 100OH CLEARPRINT



PLAN OF MEZZANINE FLOOR FRAMING

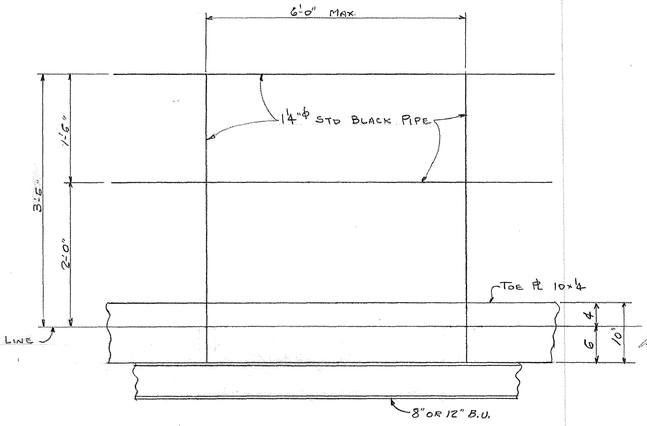
⅛" = 1'-0"



FOR COLS B1·B2·C1·C2·B3

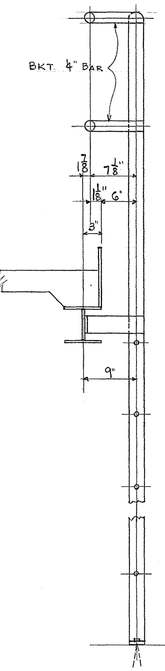
TYPICAL COL. BASE DETAIL

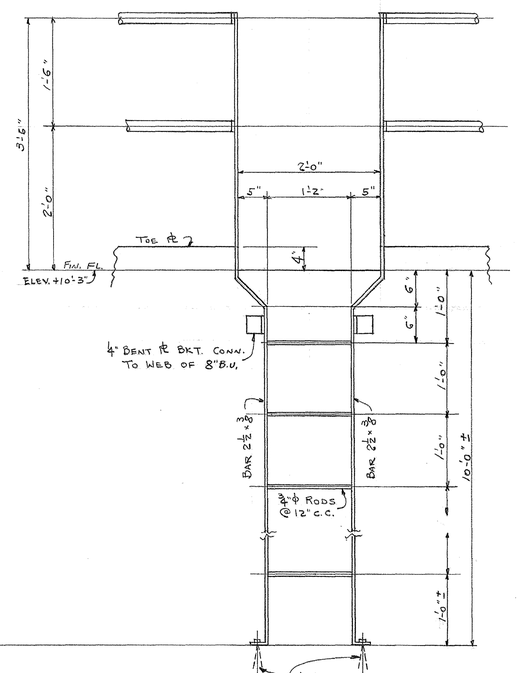
1" = 1'-0"



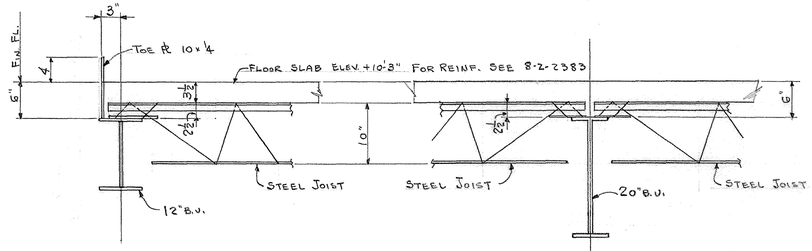
TYPICAL HANDRAILING

NO SCALE





DETAIL OF LADDER

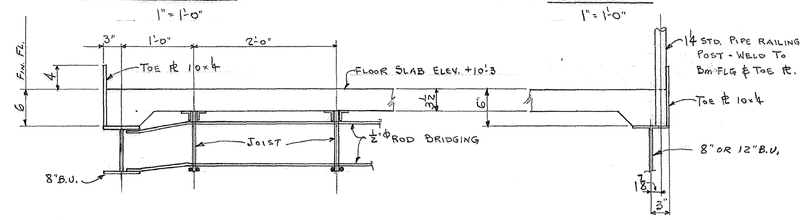


SECT. A-A

1" = 1'-0"

SECT. B-B

1" = 1'-0"



SECT. C-C

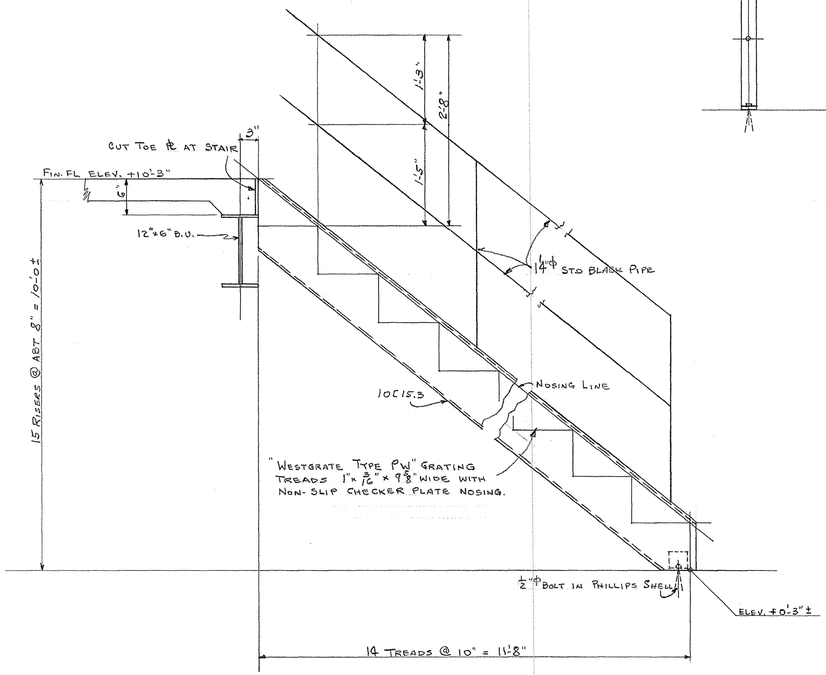
1" = 1'-0"

HANDRAIL POST SLEEVE

1" = 1'-0"

COLUMN LOADS	
COL.	LD.
D1, D2	13ᴷ
C1, C2	24ᴷ
A1, A3, B3	12ᴷ
A2, B1	23ᴷ
B2	35ᴷ

NOTE:- ABOVE LOADS ARE DUE TO MEZZ. FLOOR.



DETAIL OF STAIR

MEZZ. D.L = 25 P.P. D.L = 100 #/SF

MEZZ. L.L = 125 PSF. P.P. LL = 125

COL. NO.	MEZZ. LD.	DL+LL	CRANE	WIND	GOV. TOT
A 1	12	6·01		1·57	18.0 ᴷ
A 2	23	6·01		1·57	29.0 ᴷ
A 3	12	6·01	2·33	1·57	20 ⅓ ᴷ
A 4		6·01	2·33	1·57	8 ⅓ ᴷ
A 5		6·01	2·33	1·57	8 ⅓ ᴷ
D 1	13	6·01		1·57	19.0 ᴷ
D 2	13	6·01		1·57	19.0 ᴷ
D 3		6·01	3·97	1·57	10.0 ᴷ
D 4		6·01	3·97	1·57	10.0 ᴷ
D 5		6·01	3·97	1·57	10.0 ᴷ

REGISTERED CIVIL ENGINEER HAROLD H. LEWIS NO. 5723 STATE OF CALIFORNIA

NO	DATE	REVISIONS	BY	CHKD	APVD
3	9-21-60	CHANGED STAIR LOCATION	N.M.		
2	2-15-60	GEN. REVISIONS	N.M.		
1	1-4-60	REVISED PLAN	N.M.		

DISTRIBUTION

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS: LD 59-16; PLAN & ELEVATIONS 8-2-2369

FILE NO

DESIGN	JOHN H. NORMAN	11-19-59
DRAWN	NAT MILLER	11-19-59
CHECKED	J.H. Norman	11-24-59
CIVIL	H.H. Lewis	11-24-59
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.

CITY OF PASADENA

APPROVED ENGR. — DATE 11-24-59

APPROVED GEN. MGR. — DATE 11-29-59

GLENARM STEAM PLANT

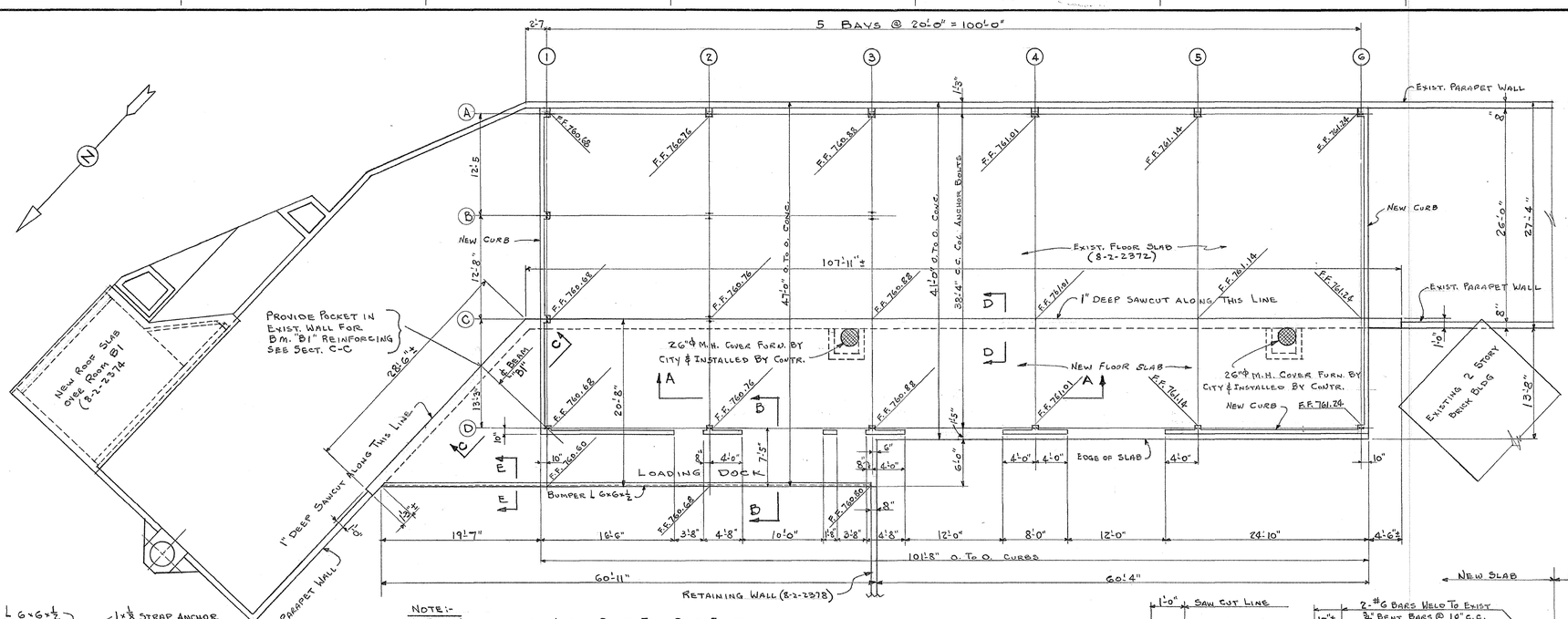
ELECTRICAL SHOP MEZZANINE FLOOR PLAN & DETAILS

AUTH.	E. J. O.	ACCT.
	6793	371

PRINT FILE — SCALE: AS NOTED

DRAWING NUMBER 8-2-2370

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

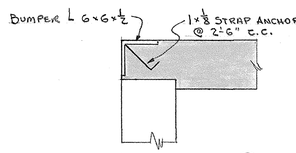


FLOOR PLAN

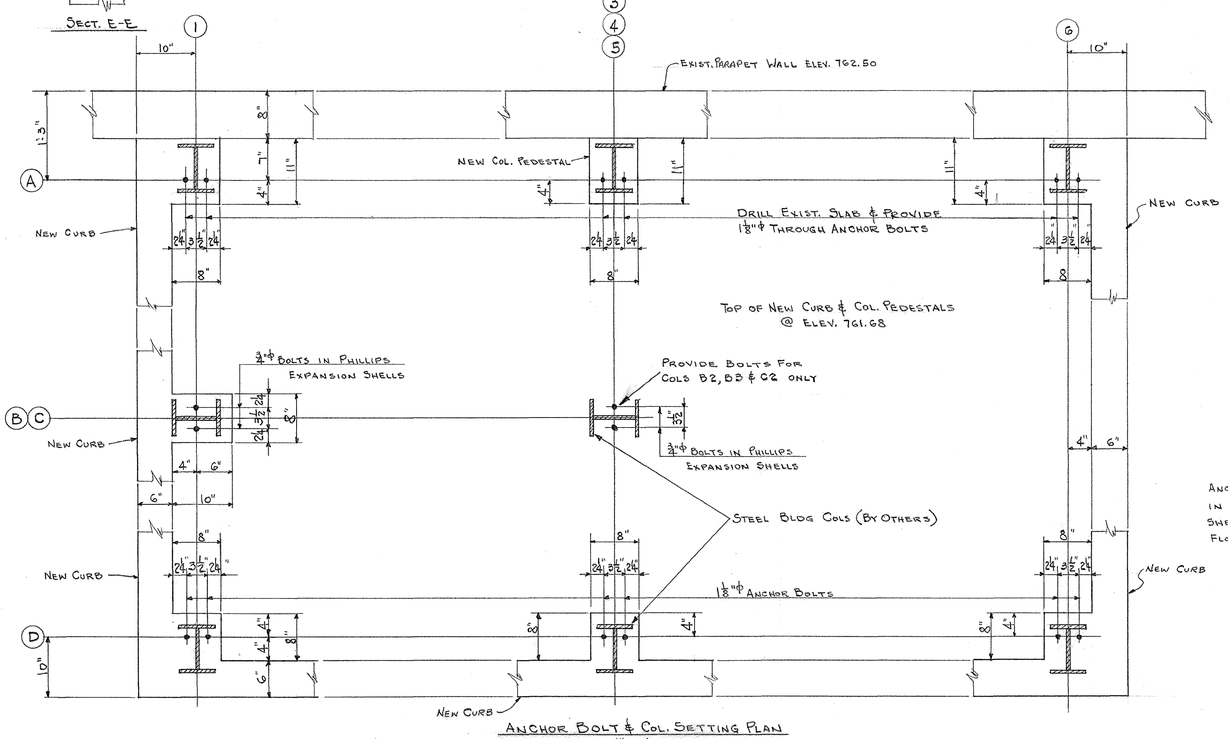
1/8" = 1'-0"

NOTE:-

1. FOR LOCATION OF ANCHOR BOLTS FOR DOOR JAMBS & SIDING BASE & SEE "PASCOE STEEL CORP." ANCHOR BOLT SETTING DWG. # F-1
2. MARK NEW FLOOR SLAB WITH JOINTER AT ALL COL. LINES JOINTER MARKS SHALL BE AT LEAST 3/8" DEEP.

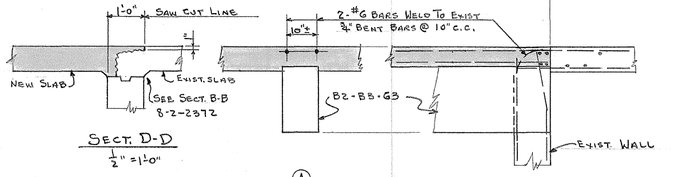


SECT. E-E



ANCHOR BOLT & COL. SETTING PLAN

1" = 1'-0"

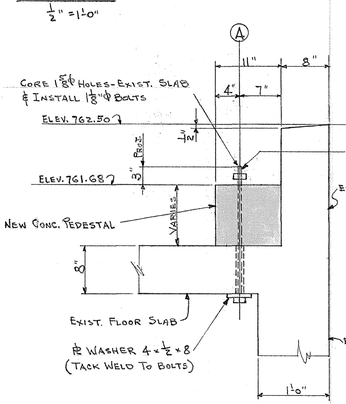


SECT. D-D

1/2" = 1'-0"

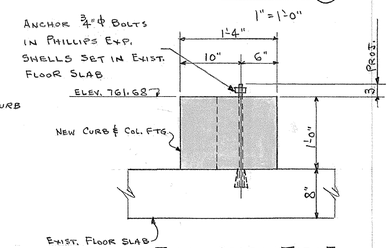
TYPICAL SLAB REINFORCING AT BEAM & GIRDER POCKET

1/2" = 1'-0"

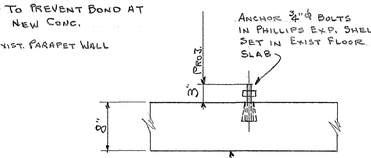


TYPICAL SECTION THRU COL. FTG AT COL. LINE (A)

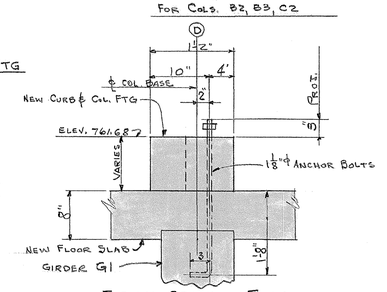
1" = 1'-0"



TYPICAL SECTION THRU FTG FOR COLS. B1 & C1

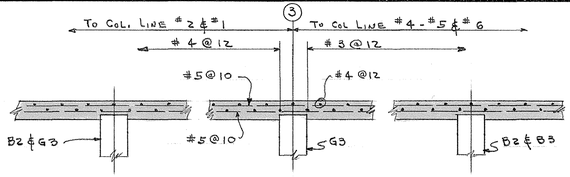


ANCHOR BOLT SETTING FOR COLS. B2, B3, C2



TYPICAL SECTION THRU COL. FTG. AT COL. LINE (D)

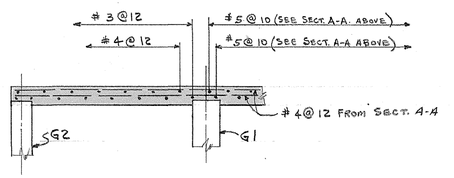
1" = 1'-0"



SECTION A-A

TYPICAL SLAB REINFORCING BETWEEN COL. LINES "C & D" & COL. LINES "#1 THRU #6"

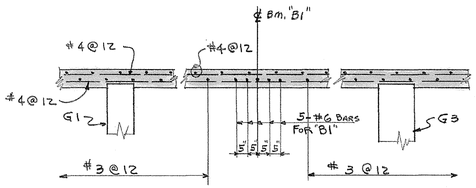
3/8" = 1'-0



SECTION B-B

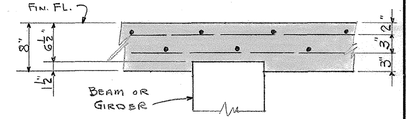
SLAB REINFORCEMENT GIRDERS G1 & G2

3/8" = 1'-0"



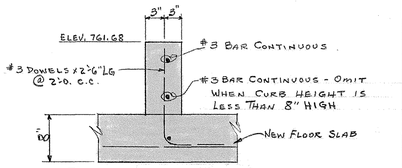
SECTION C-C.

3/8" = 1'-0"

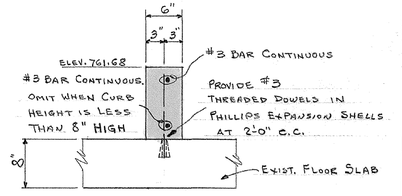


TYPICAL SECTION THRU SLAB

1" = 1'-0"



TYPICAL SECTION THRU CURB ON NEW FLOOR SLAB



TYPICAL SECTION THRU CURB ON EXIST. FLOOR SLAB

HAROLD H. LEWIS NO. 5773

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	NAT MILLER	2-5-60
DRAWN	NAT MILLER	2-5-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.

CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 6-21-60

APPROVED [illegible] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

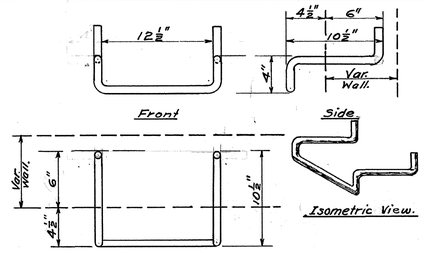
ELECTRICAL SHOP
FLOOR PLAN
ANCHOR BOLT SETTING PLAN

AUTH.	E. J. O.	ACCT.
	6793	A

PRINT FILE — SCALE: AS NOTED

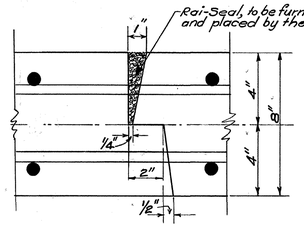
DRAWING NUMBER 8-2-2371

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEANPRINT

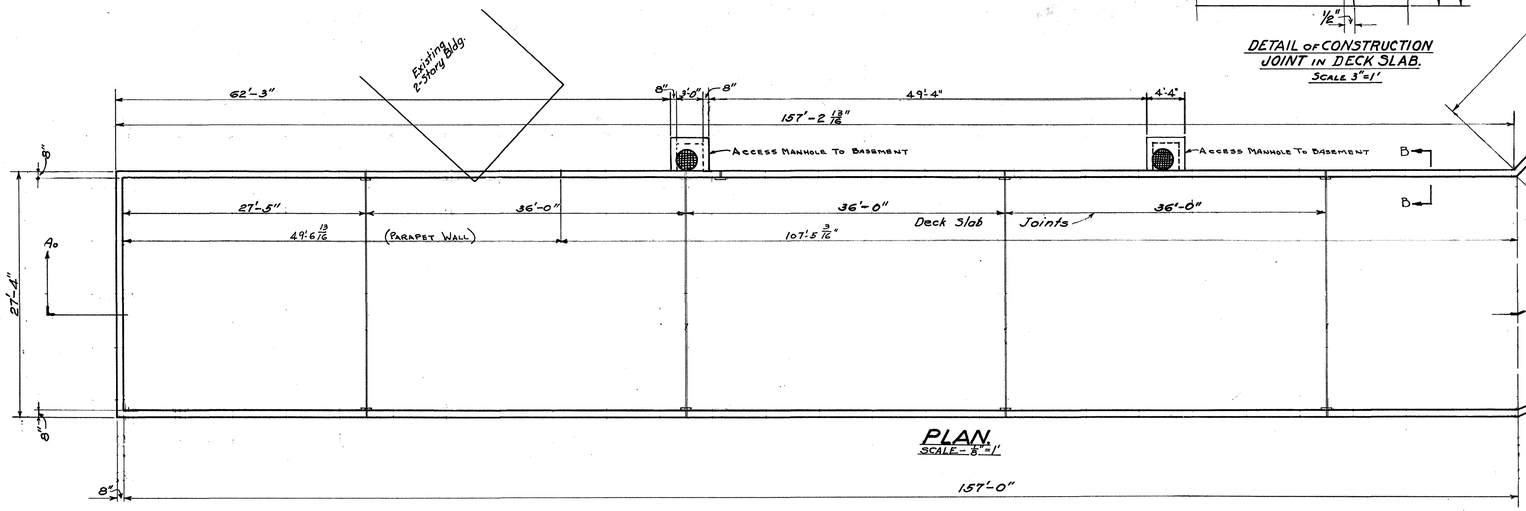


DETAIL of LADDER STEPS.
SCALE: 1½"=1'

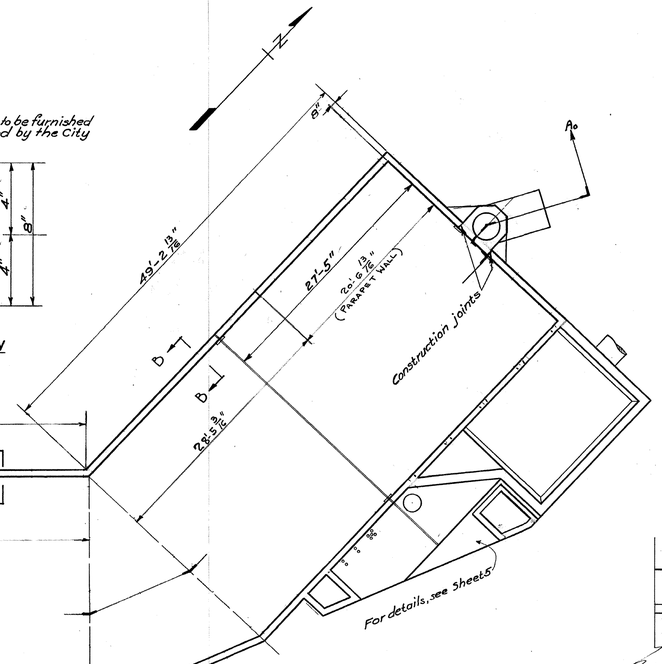
FURNISHED BY CITY, PLACED BY CONTRACTOR.

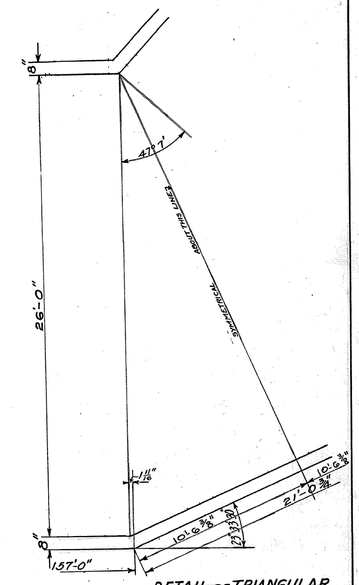


DETAIL of CONSTRUCTION JOINT IN DECK SLAB.
SCALE 3"=1'

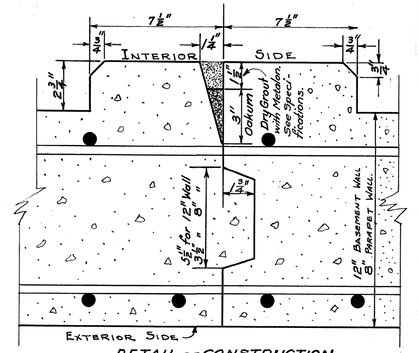


PLAN.
SCALE - 8"=1'

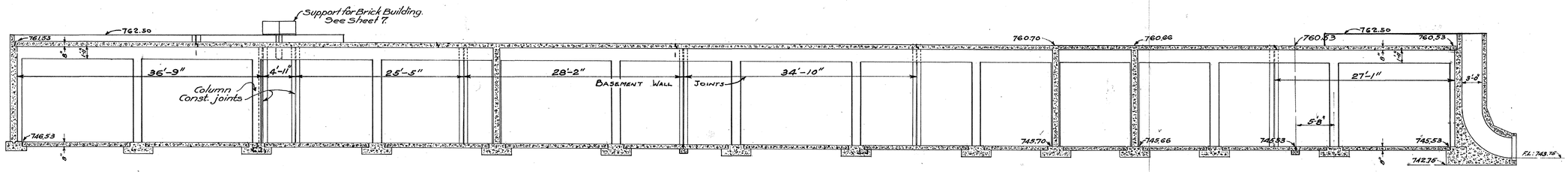




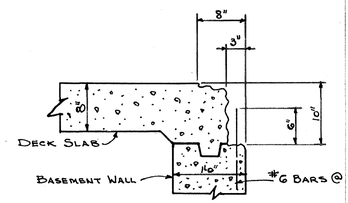
DETAIL of TRIANGULAR PORTION of DECK.
SCALE ½"=1'



DETAIL of CONSTRUCTION JOINT IN BASEMENT & PARAPET WALLS
SCALE 3"=1'



SECTION A_0-A_0
SCALE ⅛"=1'



SECTION B-B
SCALE 1"=1'-0"

No.	Revisions	By	Date
1	Revised Dwg., Title, & Number (See Dwg 8-2-328)	N.M.	3-3-60

NOTE: For Dwg Showing Structure Before The Revision See Dwg No. 8-2-328

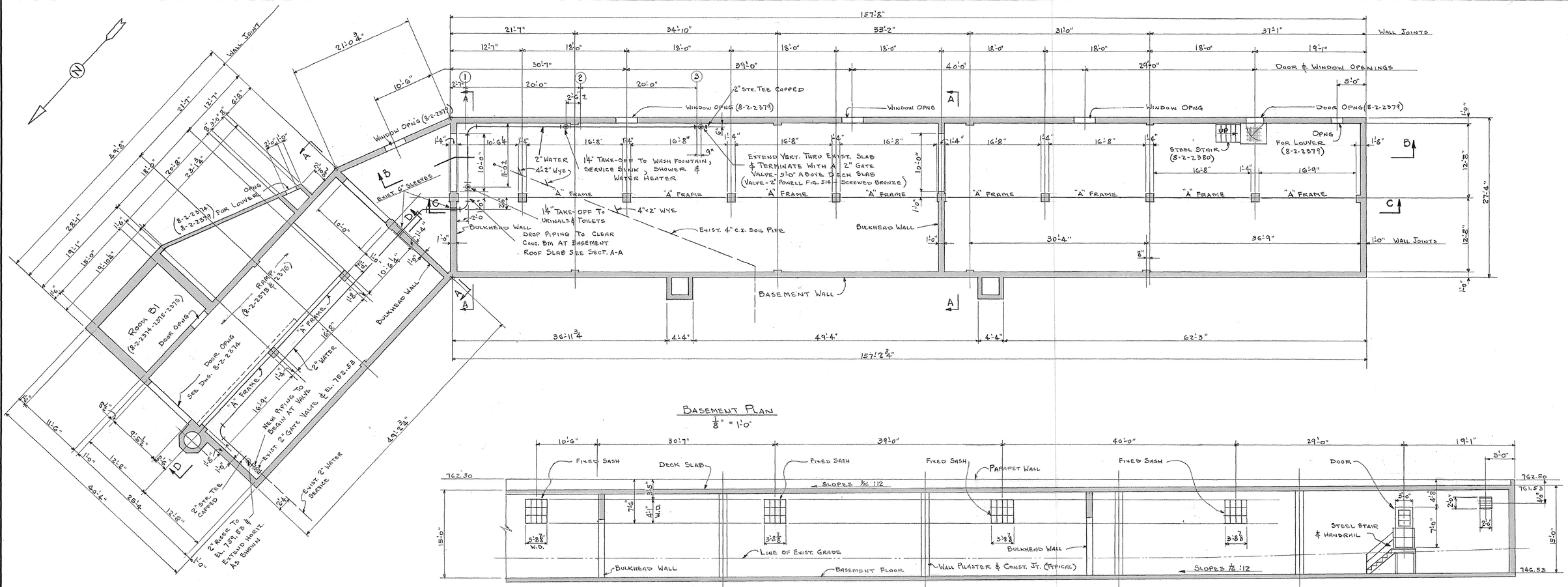
MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

GLENARM STEAM PLANT
ELECTRICAL SHOP
PARTIAL DECK PLAN & LONGITUDINAL SECT.

Approved O.H. Hedrick, Mech. Engr. Date
W.F. Gaut, Gen. Supr. Date 6-5-62

		Date
Drawn	J.B.N.	
Traced	J.B.N.	
Checked		
Corrected		
Changed	Harold Adams R.E. No. 5713 - 6-5-62	

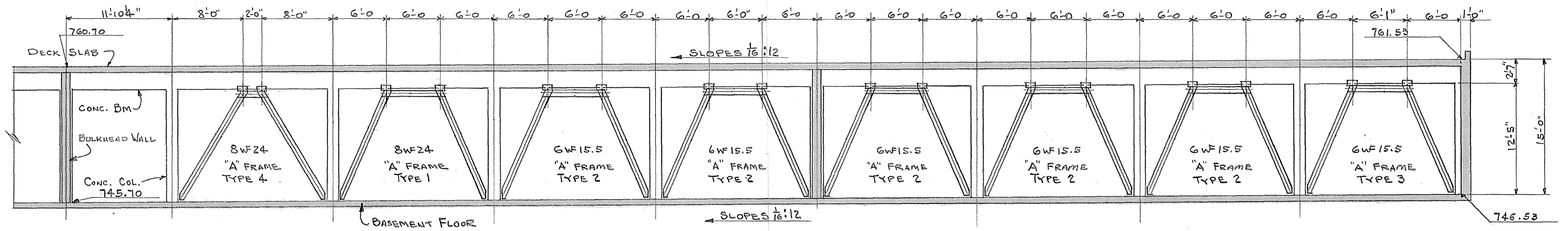
Scale	Drwg. No.	File No.
As Shown	8-2-2372	



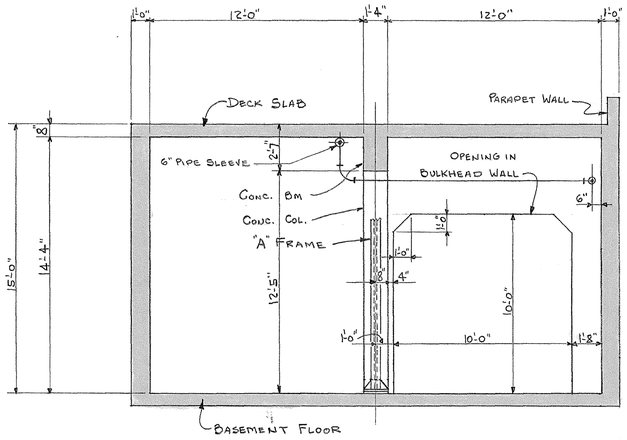
BASEMENT PLAN

$\frac{1}{8}$" = 1'-0"

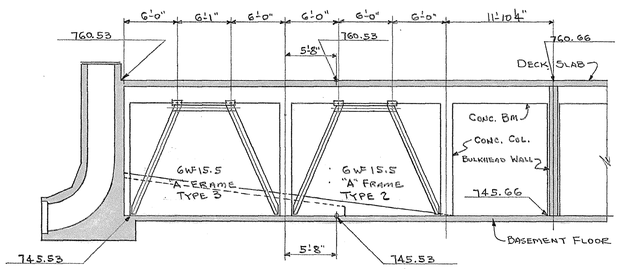
SECTION B-B ($\frac{1}{8}$"=1'-0")



SECTION C-C ($\frac{1}{8}$"=1'-0")



SECTION A-A



SECTION D-D ($\frac{1}{8}$"=1'-0")

NOTE:-
FOR "A" FRAME DETAIL
SEE DWG. 8-2-2379

HAROLD H. LEWIS NO. 5773

NO	DATE	REVISIONS	BY	CHKD	APVD
2	2-17-60	MISC. REV - DELETED "NEW"	BHH		
1	9-21-60	ADDED WATER SERVICE & 6" C.I. SOIL PIPE	N.M.		

DISTRIBUTION

DESIGN	H.H. LEWIS	
DRAWN	NAT MILLER	6-6-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [signature] ENGR. DATE 6-21-60

APPROVED [signature] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

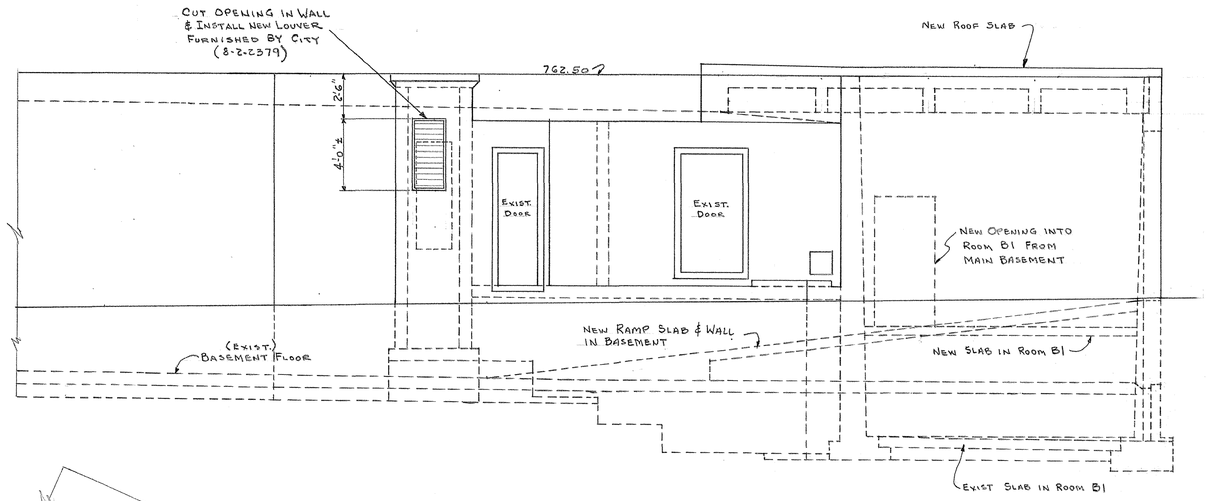
ELECTRICAL SHOP
BASEMENT PLAN
SECTIONS & DETAILS

AUTH.	E. J. O.	ACCT.
525	6793	371

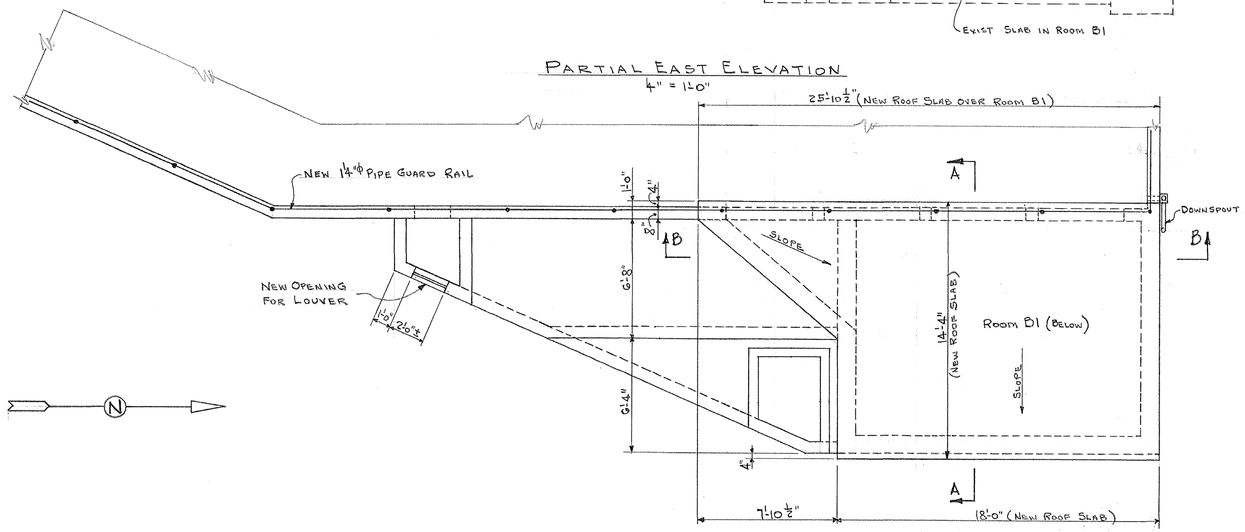
PRINT FILE | SCALE: AS NOTED

DRAWING NUMBER 8-2-2373

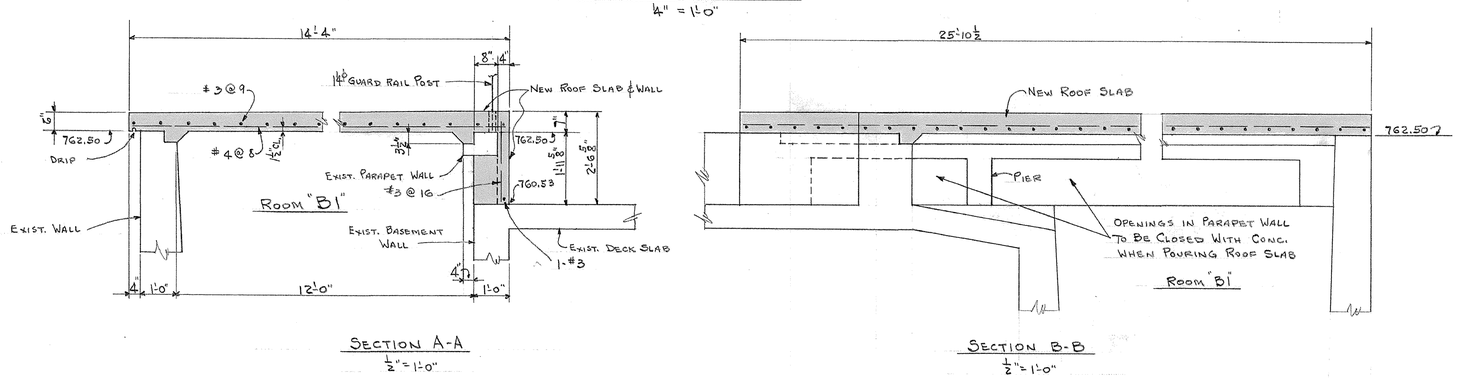
PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT



PARTIAL EAST ELEVATION
4" = 1'-0"

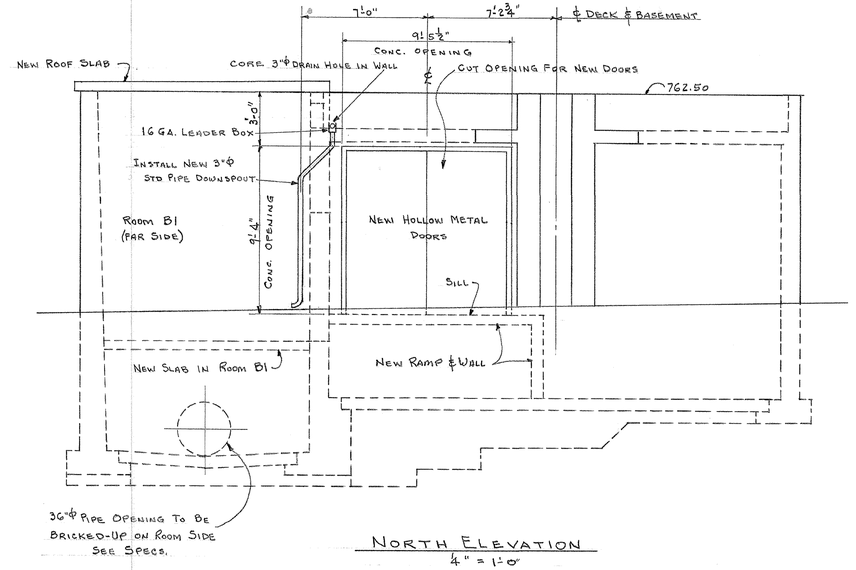


PARTIAL DECK PLAN
¼" = 1'-0"



SECTION A-A
½" = 1'-0"

SECTION B-B
½" = 1'-0"



NORTH ELEVATION
¼" = 1'-0"

HAROLD H. LEWIS No. 5773 REGISTERED CIVIL ENGINEER

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS

FILE NO

DESIGN	NAT MILLER	
DRAWN	NAT MILLER	5-26-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [signature] ENGR. DATE 6-21-60

APPROVED [signature] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

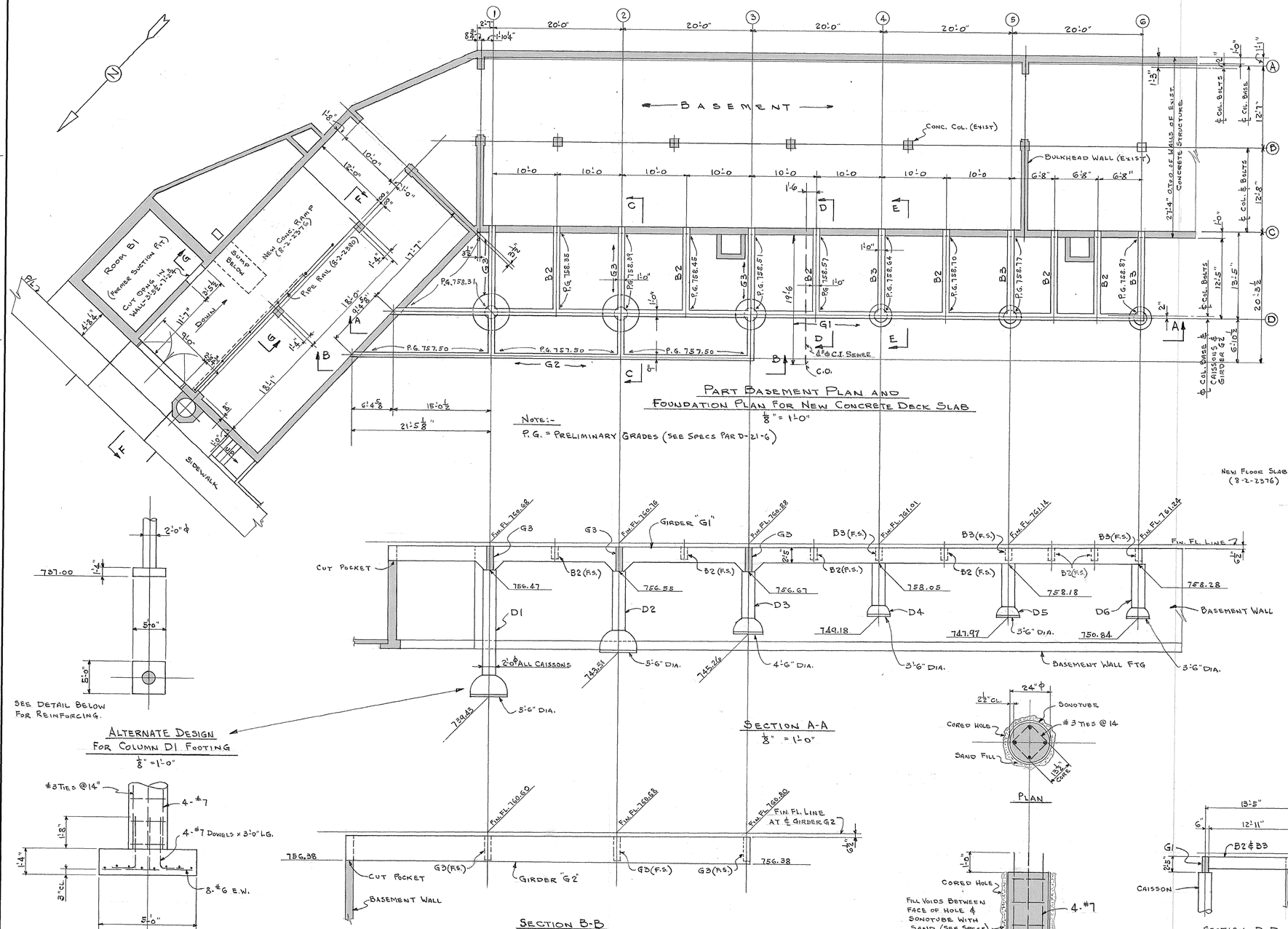
ELECTRICAL SHOP
NORTH & PARTIAL EAST ELEVATIONS & ROOF SLAB OVER ROOM "B1"

AUTH.	E. J. O.	ACCT.
525	6793	371

PRINT FILE | SCALE: AS NOTED

DRAWING NUMBER 8-2-2374

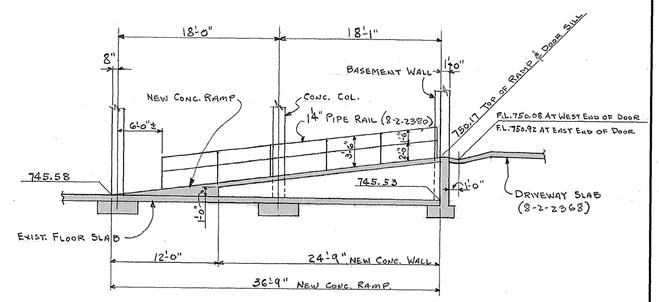
PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT



Part Basement Plan and Foundation Plan For New Concrete Deck Slab

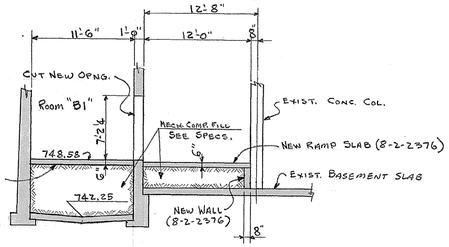
1/8" = 1'-0"

Note:-
P.G. = Preliminary Grades (See Specs Par D-21-6)



Section F-F

1/8" = 1'-0"



Section G-G

1/8" = 1'-0"

Section A-A

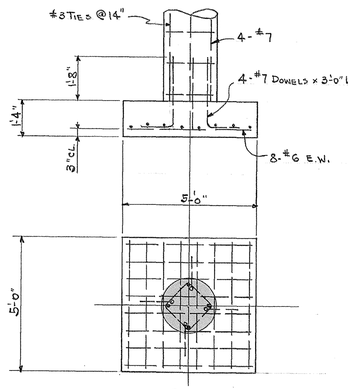
1/8" = 1'-0"

Alternate Design For Column D1 Footing

1/8" = 1'-0"

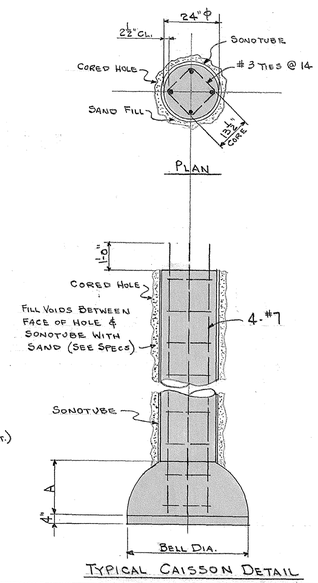
Section B-B

1/8" = 1'-0"

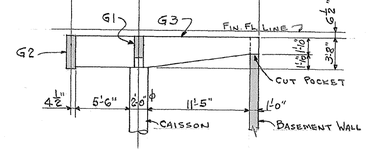


Plan
Reinforcing For D1 (Alt.)

Caisson Schedule		
MK	Bell Dia.	A
D1	5'-6"	3'-1" (See Alt.)
D2	5'-6"	3'-1"
D3	4'-6"	2'-2"
D4	3'-6"	1'-4"
D5	3'-6"	1'-4"
D6	3'-6"	1'-4"

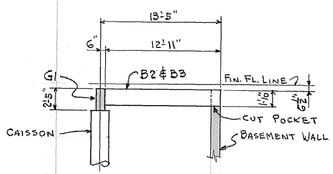


Typical Caisson Detail



Section C-C

1/8" = 1'-0"



Section D-D
Section E-E

1/8" = 1'-0"

Note:-
1. For Dimensions & Reinforcing of Beams & Girders See Dwg. 8-2-2376
2. For Details of Deck Slab See Dwg. 8-2-2371

HAROLD H. LEWIS No. 5773

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	1	2-17-69	Misc Field Changes	BHH		

REFERENCE DRAWINGS — FILE NO

DESIGN	Nat Miller	5-18-60
DRAWN	Nat Miller	5-18-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 6-21-60
APPROVED [illegible] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

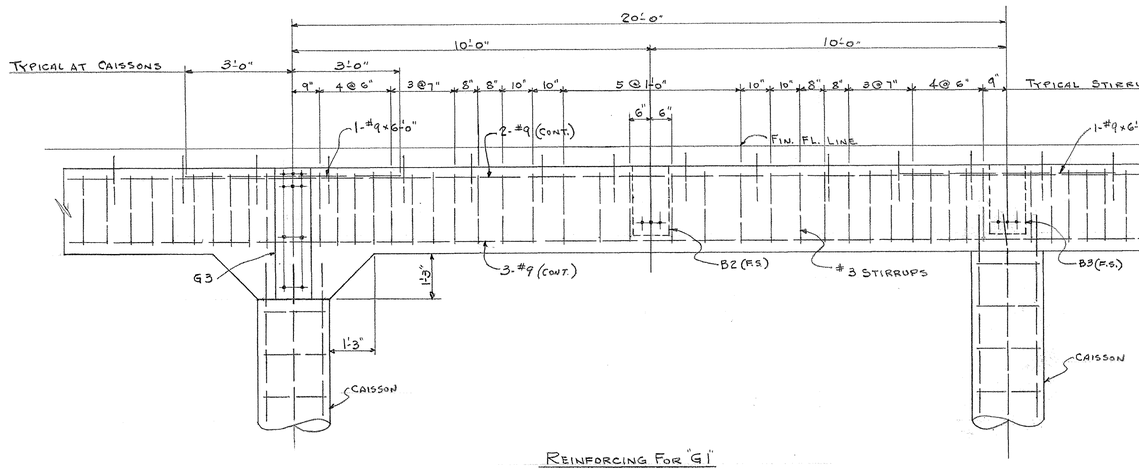
ELECTRICAL SHOP
- FOUNDATION PLAN FOR NEW DECK SLAB -
- BASEMENT RAMP & ROOM B1 FLOOR SLAB -

AUTH.	E.J.O.	ACCT.
525	6793	371

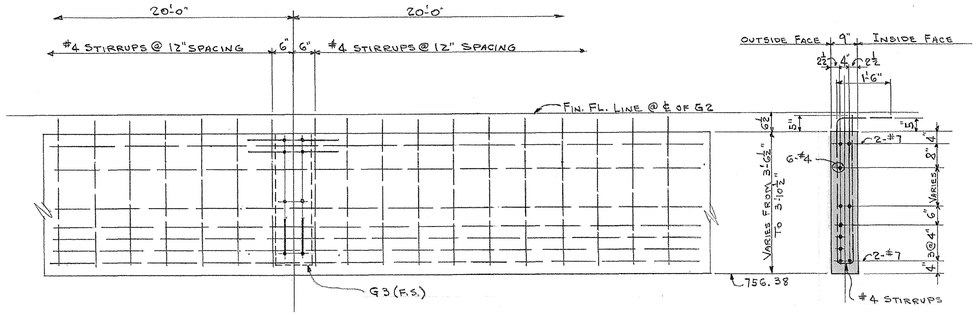
PRINT FILE — SCALE: As Noted

DRAWING NUMBER: 8-2-2375

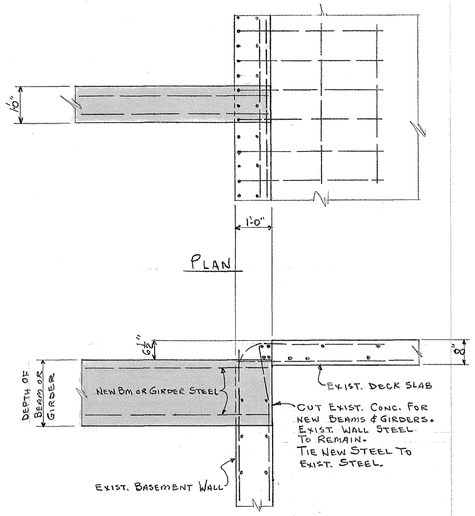
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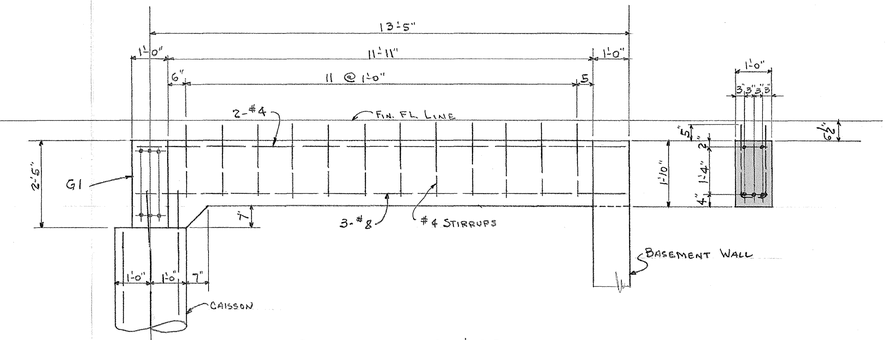
REINFORCING FOR "G1"
½" = 1'-0"



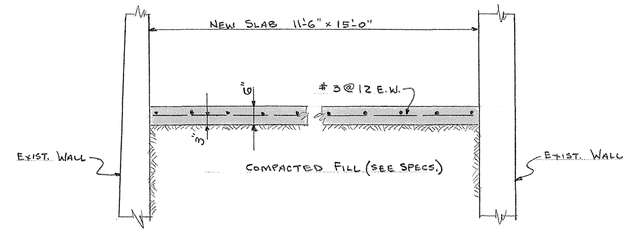
REINFORCING FOR "G2"
½" = 1'-0"



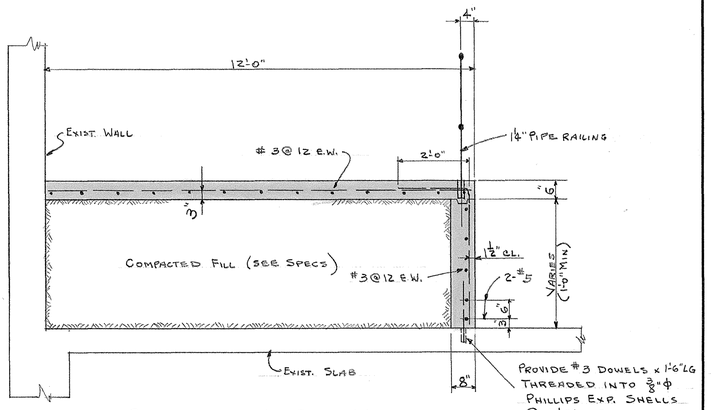
TYPICAL POCKET FOR BMS & GIRDERS
½" = 1'-0"



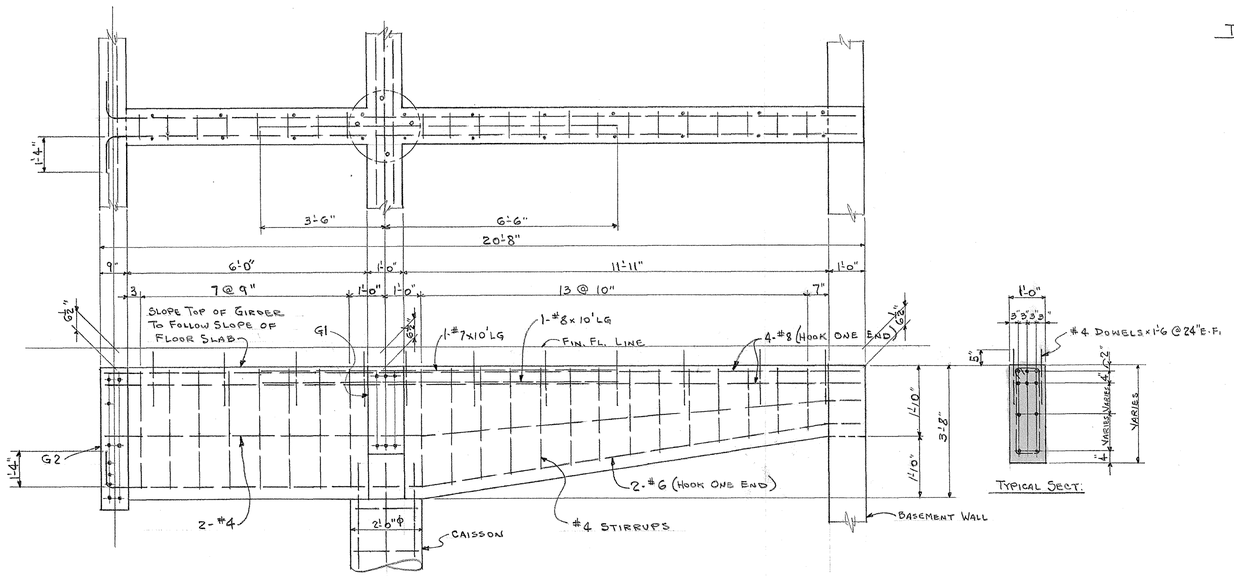
REINFORCING FOR B2 & B3
½" = 1'-0"



REINFORCING IN NEW FLOOR SLAB
IN BASEMENT ROOM "B1"
½" = 1'-0"



REINFORCING IN NEW RAMP & WALL
IN BASEMENT
½" = 1'-0"



REINFORCING FOR G3
½" = 1'-0"

HAROLD H. LEWIS
NO. 5775

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	H. H. LEWIS	5-24-60
DRAWN	NAT MILLER	5-24-60
CHECKED	[illegible]	6-21-60
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED [signature] ENGR. DATE 6-21-60
APPROVED [signature] GEN. MGR. DATE 6-22-60

GLENARM STEAM PLANT

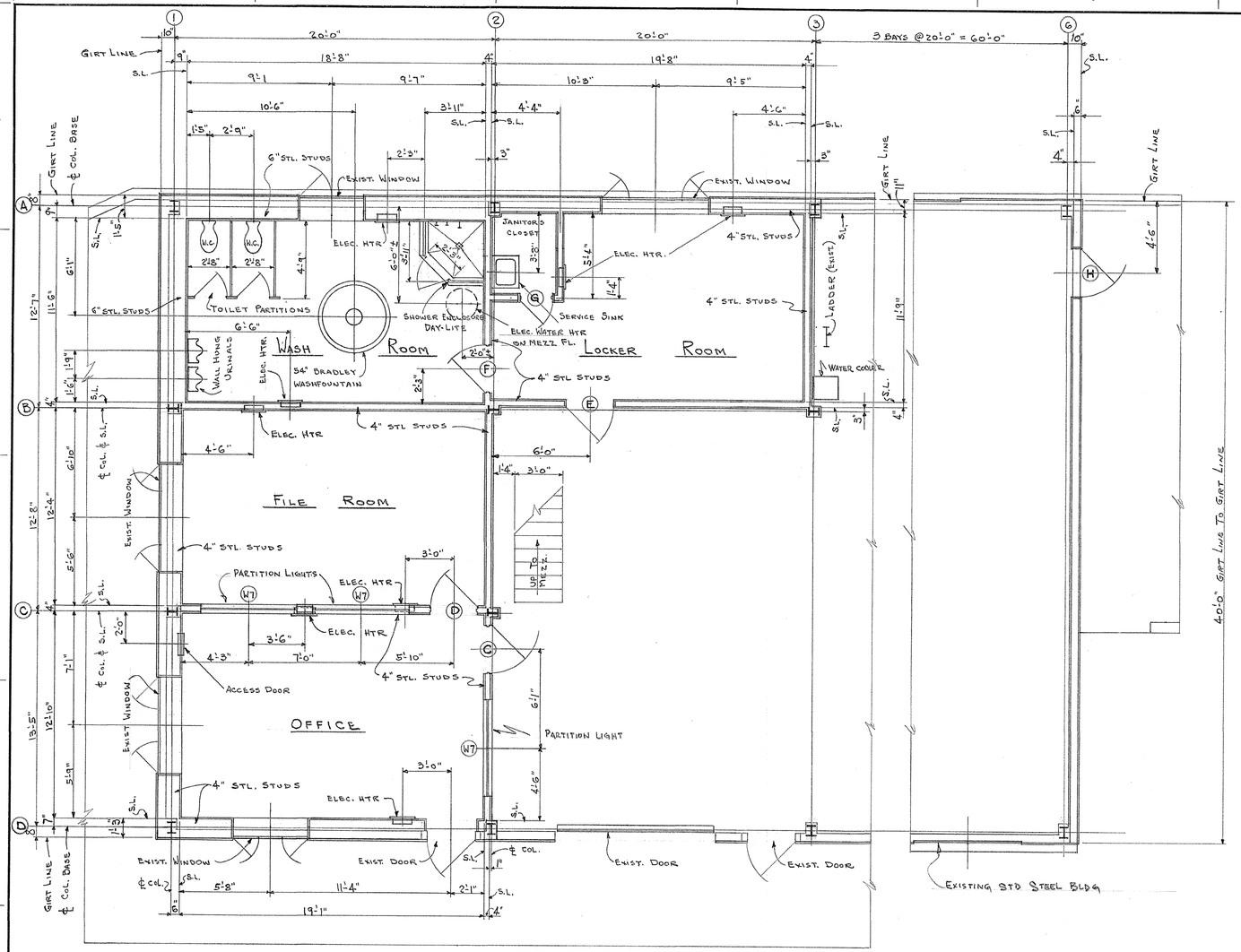
ELECTRICAL SHOP
REINFORCING DETAILS FOR BEAMS, GIRDERS, FLOOR SLAB & RAMP

AUTH.	E. J. O.	ACCT.
525	6793	371

PRINT FILE | SCALE: AS NOTED

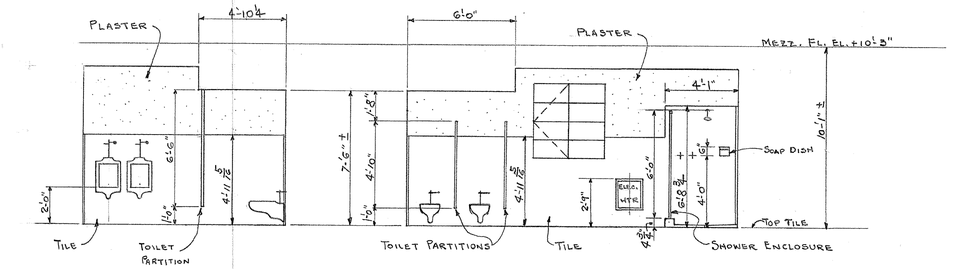
DRAWING NUMBER 8-2-2376

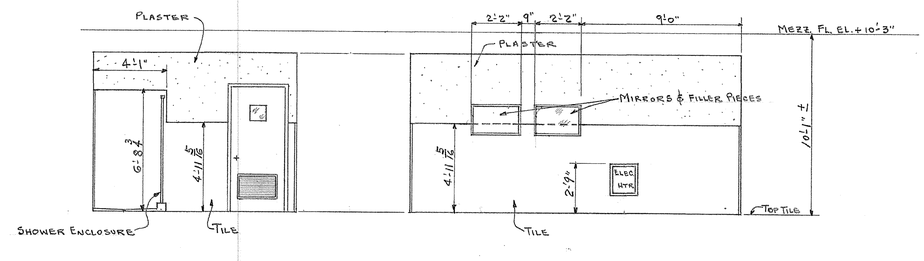
PASADENA BLUEPRINT CO. PRINTED ON 100OH CLEARPRINT



PART FLOOR PLAN

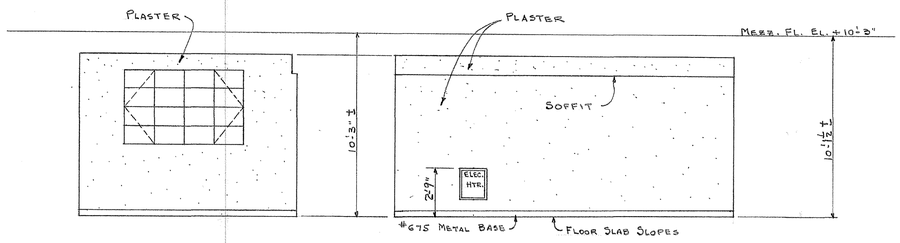
4" = 1'-0"

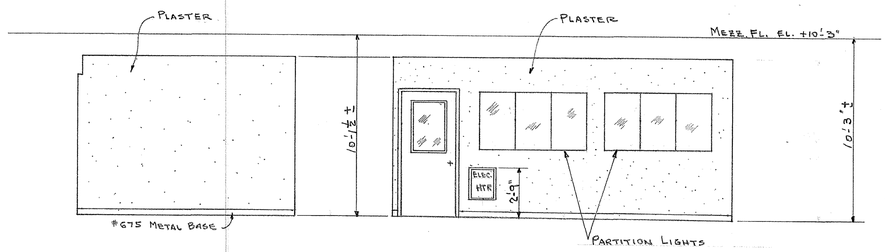




WASH ROOM WALL ELEVATIONS

4" = 1'-0"





FILE ROOM WALL ELEVATIONS

4" = 1'-0"

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	1	2-17-69	MISC FIELD CHANGES	BHH		

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

DESIGN	NAT MILLER	8-29-60
DRAWN	NAT MILLER	8-29-60
CHECKED		
CIVIL		
ELECT.		
MECH.		

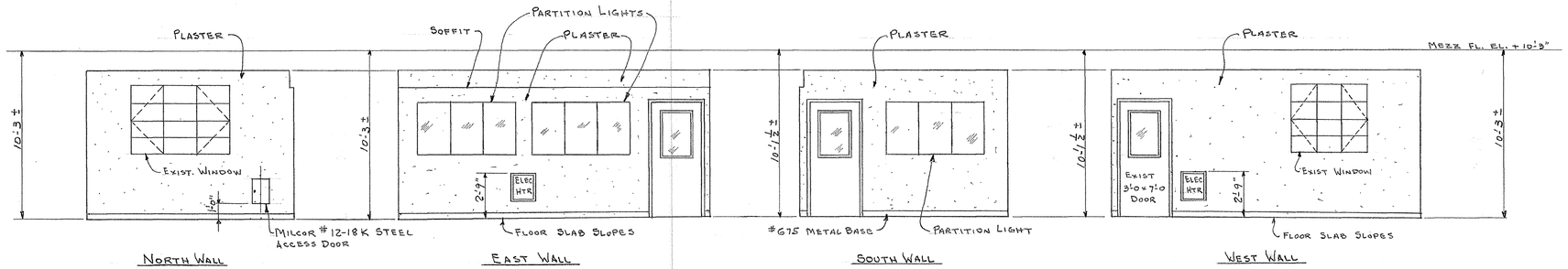
MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED ENGR. — DATE 9-16-60
APPROVED GEN. MGR. — DATE 9-20-60

GLENARM STEAM PLANT

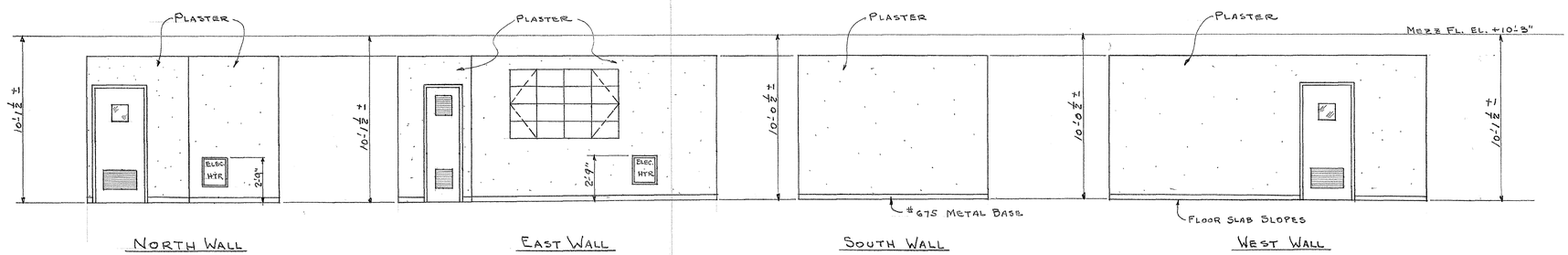
ELECTRICAL SHOP
ARCHITECTURAL FLOOR PLAN
& ROOM ELEVATIONS

AUTH.	E. J. O.	ACCT.
525	6793	371
PRINT FILE	SCALE	
	AS NOTED	
DRAWING NUMBER		
8-2-2381		



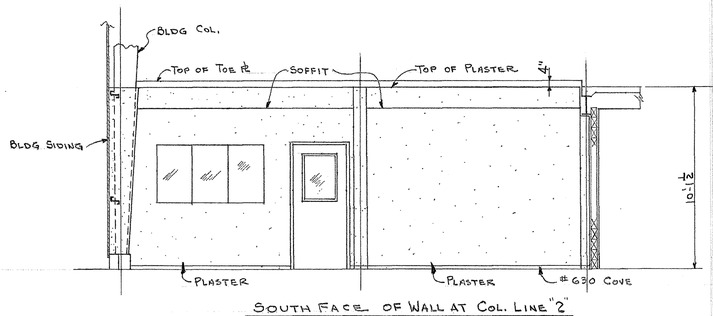
OFFICE WALL ELEVATIONS

4" = 1'-0"



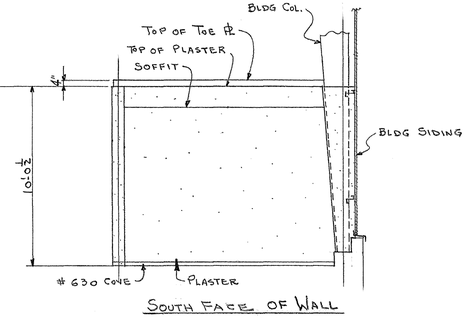
LOCKER ROOM ELEVATIONS

4" = 1'-0"



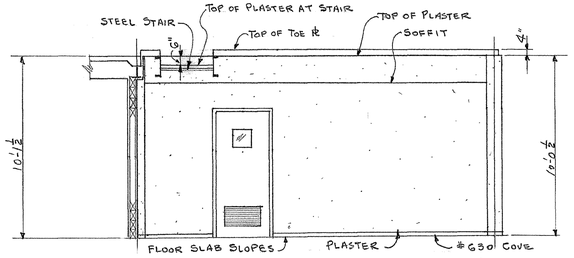
SOUTH FACE OF WALL AT COL. LINE "2"

4"=1'-0"



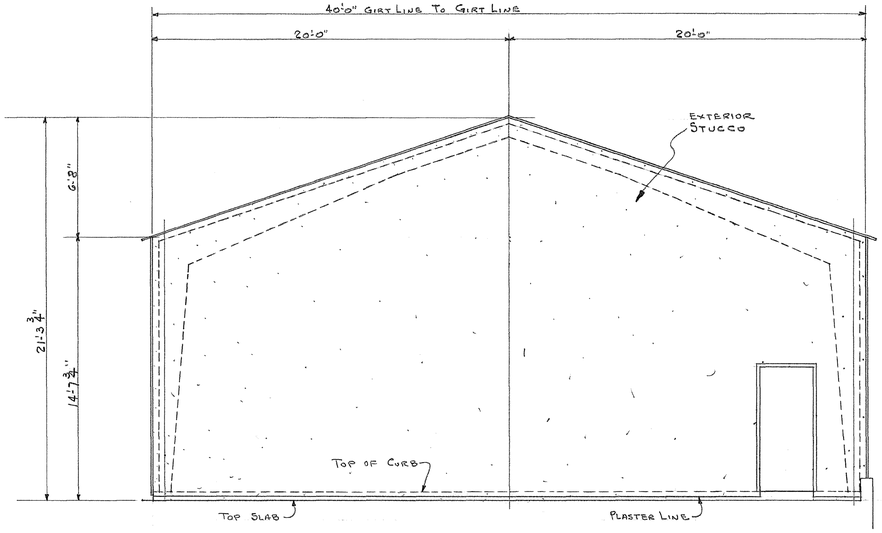
SOUTH FACE OF WALL AT COL. LINE "3"

4" = 1'-0"



WEST FACE OF WALL AT COL. LINE "B"

4" = 1'-0"



BLDG SOUTH WALL EXTERIOR ELEVATION

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	NAT MILLER	9-12-60
DRAWN	NAT MILLER	9-12-60
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.

CITY OF PASADENA

APPROVED _____ ENGR. DATE 9-16-60

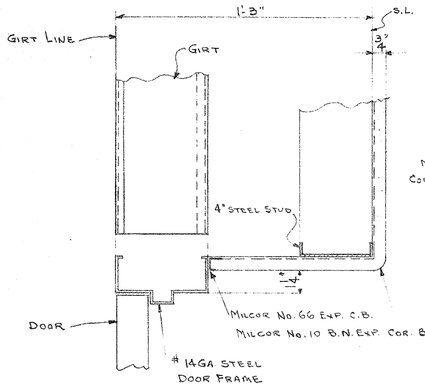
APPROVED _____ GEN. MGR. DATE 9-20-60

GLENARM STEAM PLANT

ELECTRICAL SHOP ARCHITECTURAL ROOM ELEVATIONS

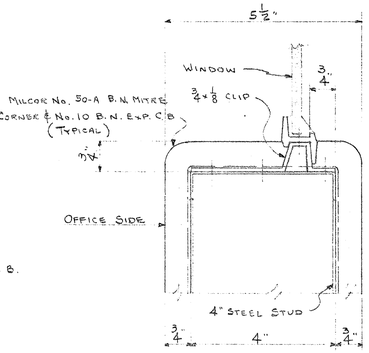
AUTH.	E. J. O.	ACCT.
525	6793	371
PRINT FILE	SCALE	
	As Noted	
DRAWING NUMBER		
8-2-2382		

PASADENA BLUEPRINT CO. PRINTED ON 100OH CLEARPRINT



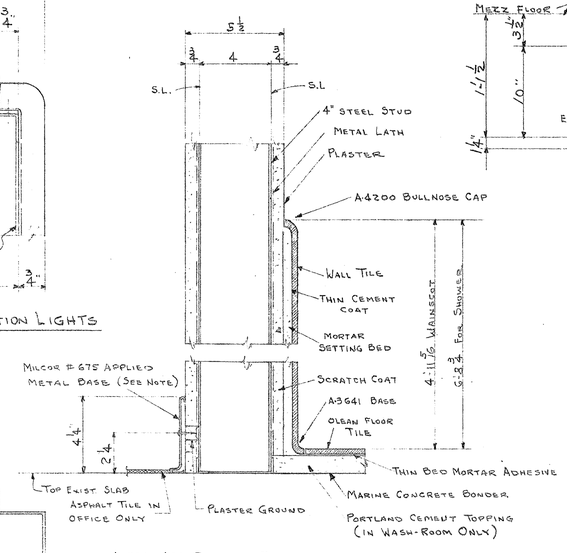
DETAIL AT EXTERIOR OFFICE DOOR

1/4" = 1"

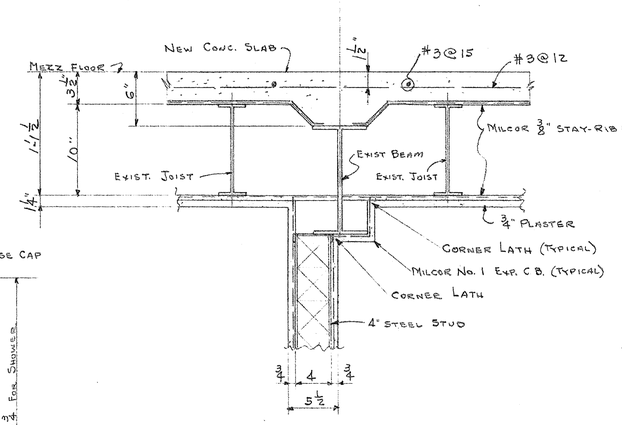


DETAIL AT PARTITION LIGHTS

1/2" = 1"

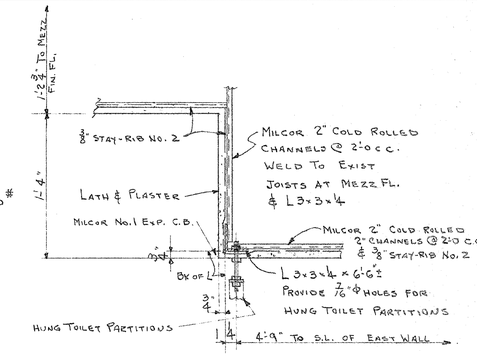


NOTE:- USE FRICTION FIT FITTING # 675-A & #675-B WITH BASE # 675



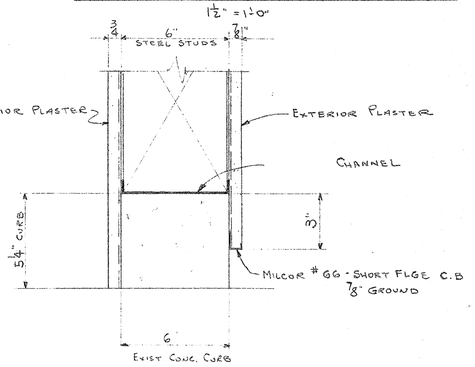
TYPICAL DETAIL AT CEILING, WALL & SOFFIT

1 1/2" = 1'-0"



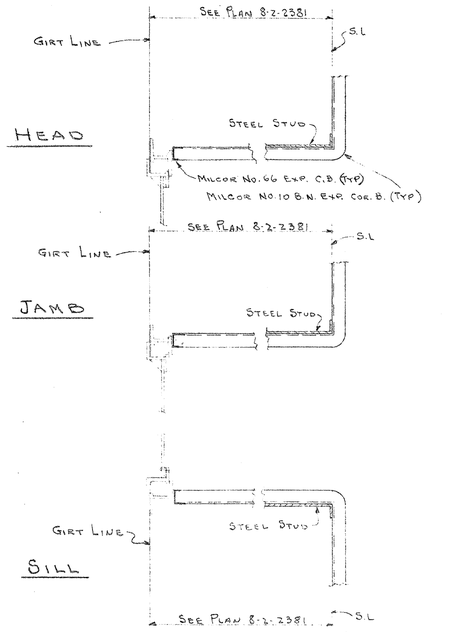
SUSPENDED CEILING AT TOILET PARTITIONS

1 1/2" = 1'-0"



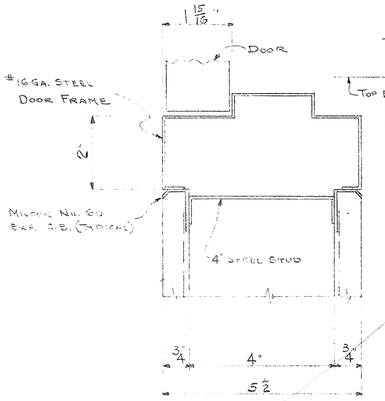
DETAIL SECTION THRU CURB & SOUTH WALL

3" = 1'-0"



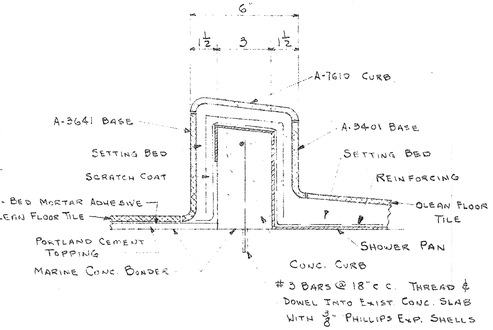
DETAILS AT EXTERIOR CASEMENT WINDOWS

4" = 1"



DETAIL AT INTERIOR DOORS

1/2" = 1"



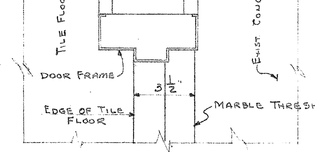
DETAIL OF SHOWER CURB

4" = 1"

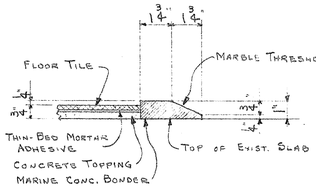
NOTE:-
FLOOR IN WASH-ROOM SHALL BE ADHESIVE SET EXCEPT FOR SHOWER FLOOR WHICH SHALL BE CEMENT SET

DETAIL OF WALL SECTION

4" = 1"



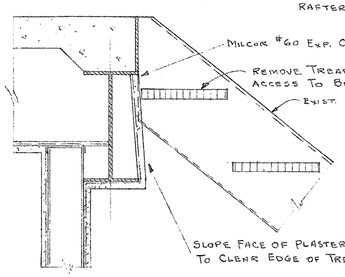
PLAN



SECTION

DETAIL OF MARBLE THRESHOLD

4" = 1'

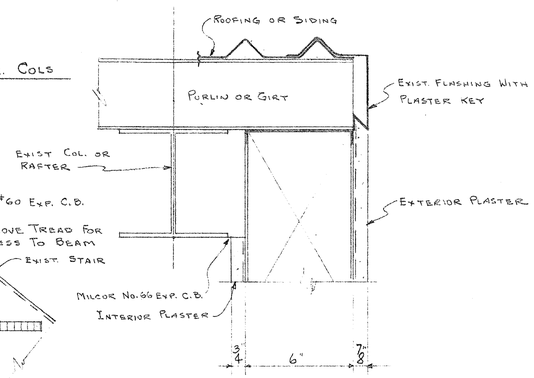


PLASTER DETAIL AT STAIR

1 1/2" = 1'-0"

DETAIL AT MEZZ. COLS

1 1/2" = 1'-0"



TYPICAL SECTION THRU SOUTH WALL

3" = 1'-0"

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	NAT MILLER	9-20-60
DRAWN	NAT MILLER	9-20-60
CHECKED		
CIVIL		
ELECT		
MECH		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED ENGR. DATE
APPROVED GEN. MGR. DATE

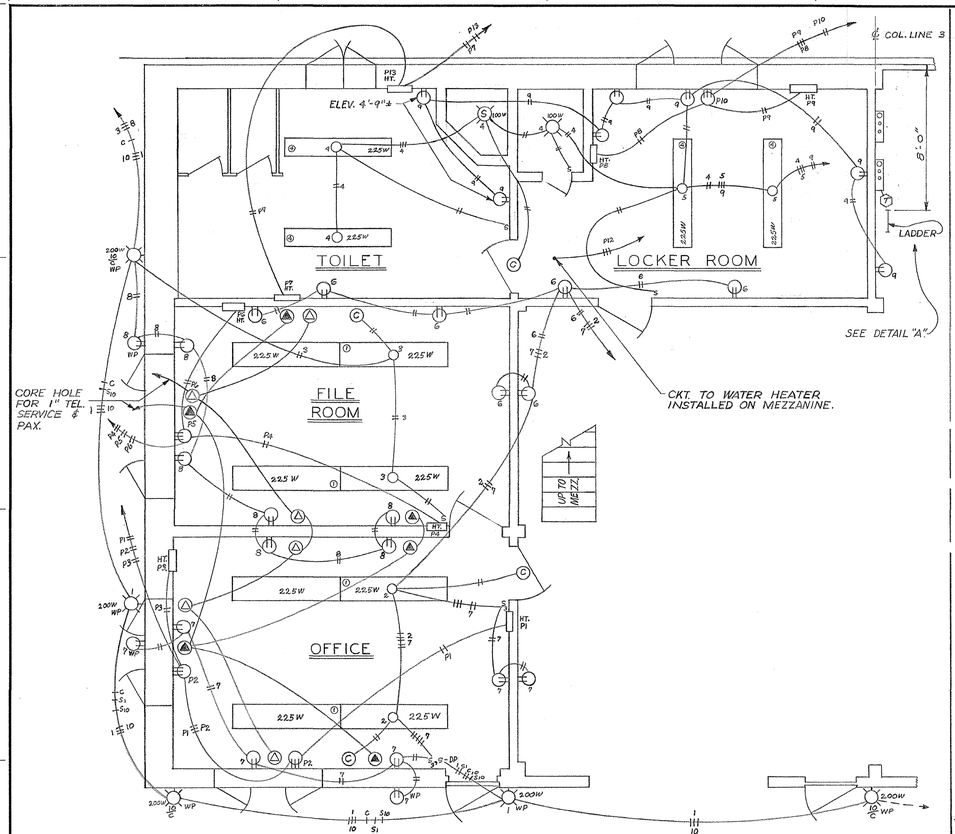
GLENARM STEAM PLANT

ELECTRICAL SHOP MISCELLANEOUS ARCHITECTURAL DETAILS

AUTH.	E. J. O.	ACCT.
525	6793	371
PRINT FILE	SCALE	
	AS NOTED	
DRAWING NUMBER		
8-2-2383		

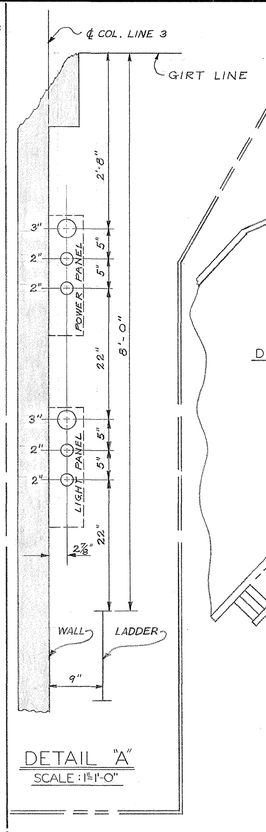
PASADENA BLUEPRINT CO. PRINTED ON 100GH CLEARPRINT

SEP 22 1960



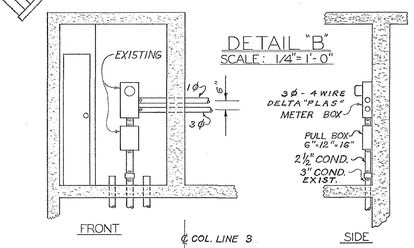
DETAIL OFFICE & LOCKER ROOM AREA

SCALE: 1/4" = 1'-0"



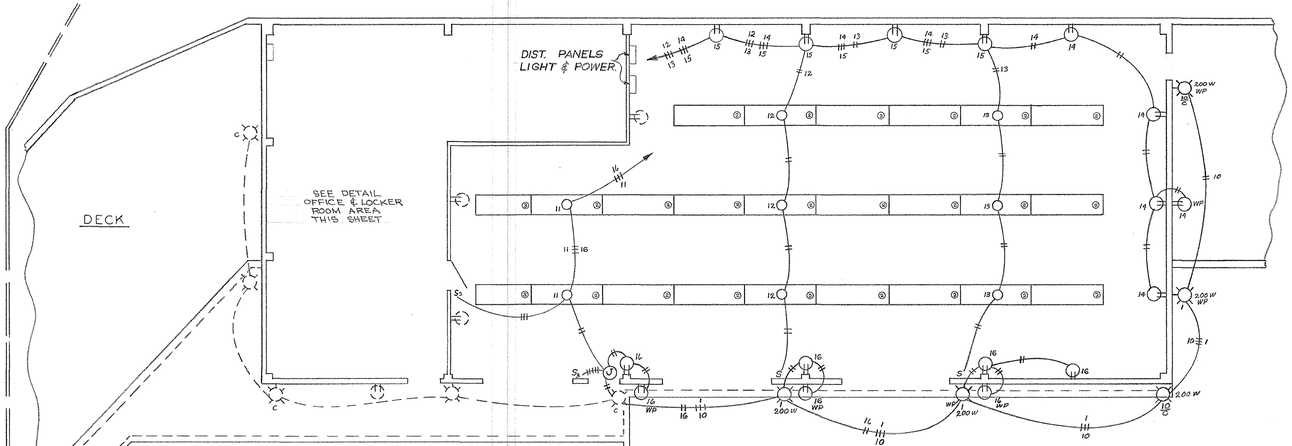
DETAIL "A"

SCALE: 1½"=1'-0"



DETAIL "B"

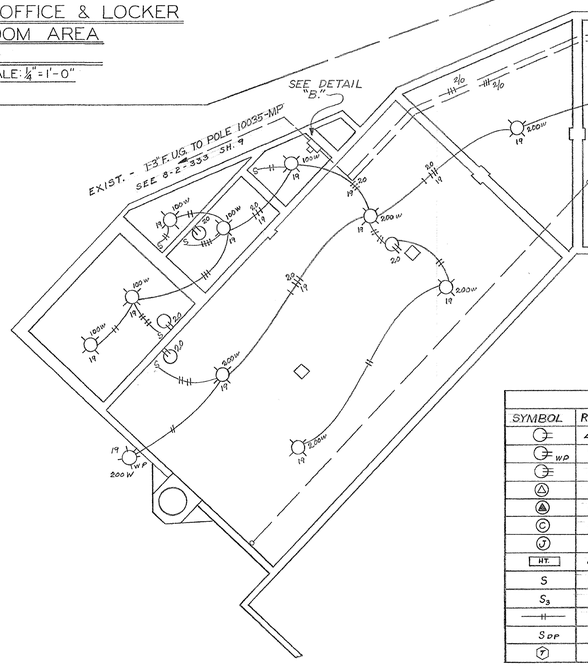
SCALE: 1/4" = 1'-0"

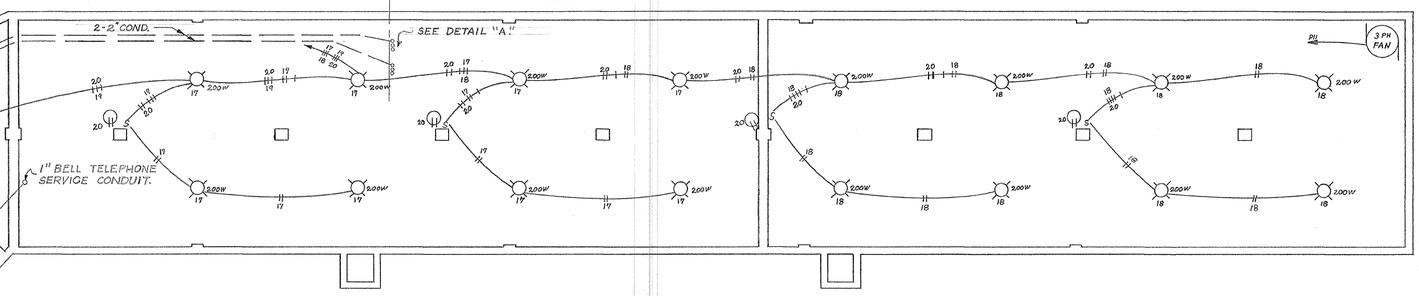


FIRST LEVEL LIGHTING

SHOP

SCALE: ⅛" = 1'-0"





BASEMENT LIGHTING

SCALE: ⅛" = 1'-0"

LIGHTING PANEL

SQ-D NQO - 30 - 3AB 100A. MAIN

POLES	AMPS	CIRCUIT	WATTS	CIRCUIT	WATTS	LIGHTS	PLUGS	OTHERS	LOCATION
1	20	1	1000			5			OUTSIDE LIGHTS
1	20			2	900	4			OFFICE LIGHTING
1	20	3	900			4			FILE ROOM LIGHTING
1	20			4	750	4			TOILET RM. LIGHTING
1	20	5	450			2			LOCKER RM. LIGHTING
1	20			6	1260		7		LOCKER, TOILET, & FILE RM. PLUGS
1	20	7	1260				7		OFFICE PLUGS
1	20			8	1260		7		OFFICE & FILE RM. PLUGS
1	20	9	900				7		TOILET & LOCKER RM. PLUGS
1	20			10	1000	5			OUTSIDE LIGHTING ON CLOCK .
1	20	11	1032			6			WAREHOUSE LIGHTING
1	20			12	1548	9			WAREHOUSE LIGHTING
1	20	13	1548			9			WAREHOUSE LIGHTING
1	20			14	900	5			WAREHOUSE PLUGS
1	20	15	1260			4			WAREHOUSE PLUGS
1	20			16	1260		7		INSIDE & OUTSIDE WAREHOUSE PLUGS
1	20	17	1600			8			BASEMENT LIGHTS
1	20			18	1600	8			BASEMENT LIGHTS
1	20	19	1500			10			BASEMENT LIGHTS
1	20			20	1440		8		BASEMENT PLUGS
2	70	21						1	TEST BREAKER
1				22					SPARE
1		23							SPARE
1				24					SPARE
1		25							SPARE
1				26					SPARE
1		27							SPARE
TOTAL			11,459		11,913				

TOTAL CONN. LOAD 23,493 WATTS, 98 AMPS @ 120/240V.

LEGEND

SYMBOL	REQ'D	DESCRIPTION
⊖	45	GROUNDING TYPE DUPLEX OUTLET, HUBBELL CAT. #5262-I, COVER 9910I.
⊖ WP	7	COMB. HUBBELL CAT. NO. 5215 GND. OUTLET & PLATE IN FSA CONDULET
⊖	4	POLARIZED RECP. 220V. 20AMP HUBBELL CAT. # 6810-I-G, COVER 99091.
△	6	PAX TELEPHONE OUTLET - PLATE BRYANT CAT. # 92181
▲	6	BELL TELEPHONE OUTLET - PLATE BRYANT CAT. # 92181
C	4	WALL CLOCK - G.E. TELECHRON & HANGER OUTLET CAT. # GE4212-2
J	1	JUNCTION BOX - APPLETON OR STEEL CITY CAT. # 72171-3⅛, COVER 72CI
HT.	8	HEATERS - THERMADOR ELEC. HEATER 4500W. CAT. # NW-452A.
S	15	SINGLE POLE T-RATED SW. IVORY, BRYANT CAT. #5861-I.
S_3	4	3-WAY T-RATED SW. IVORY, BRYANT CAT. #5863-I.
—		BRANCH CIRCUIT - CONDUIT IN WALLS & CEILING.
Sop	1	DOUBLE POLE T-RATED SW. IVORY, HUBBELL 9806.
T	1	AEMCO AUTOMATIC TIME SW. MODEL 230

FIXTURE SCHEDULE

SYMBOL	REQ'D	DESCRIPTION
225 O O	4	SUNBEAM 3 LAMP SLIMLINE CAT. NO. HPCX-1043-144(2)TW.
192 O O	22	SUNBEAM 2 LAMP SLIMLINE CAT. NO. 302-9GSL
143 O O	2	SUNBEAM 2 LAMP SLIMLINE CAT. NO. 302-72.SL
225 O O	4	SUNBEAM 3 LAMP SLIMLINE CAT. NO. 303-72.SL
WP C H	11	HOLOPHANE OUTDOOR UNIT CAT. NO. 420 & NO. 0230 BOX
	27	BRYANT PORCELAIN RECEPTACLE CAT. NO. 851.
S	1	MARCO "EECO" SHOWER LIGHT CAT. NO. ECJR6ISA.

GENERAL NOTES

1- NO CONDUIT TO BE EXPOSED ON OUTSIDE OF BUILDING
2- ALL WIRES TO BE #12 TW 600 VOLT UNLESS OTHERWISE NOTED.
3- LIGHTS AND REC. ON OUTSIDE OF BUILDING TO BE MOUNTED WITH GALVANIZED BOLTS.
4- HOLES THROUGH SIDING TO BE CUT WITH ROTORY CUTTERS

POWER PANEL

SQ-D NQO 30 - 4AB 100A. 240V. 3ϕ

CKT	LOCATION	WATTS	AMP	POLE	H.P.	ϕ
P1	OFFICE - HEATER	4500	30	2P		B_C
P2	OFFICE - 2 PLUGS - AIR COND.		20	2P	2	A_B
P3	OFFICE - HEATER	4500	30	2P		C_A
P4	FILE ROOM - HEATER	4500	30	2P		B_C
P5	FILE ROOM - PLUG - AIR COND.		20	2P	2	C_A
P6	FILE ROOM - HEATER	4500	30	2P		C_A
P7	TOILET - HEATER	4500	30	2P		A_B
P8	LOCKER ROOM - HEATER	4500	30	2P		B_C
P9	LOCKER ROOM - HEATER	4500	30	2P		C_A
P10	LOCKER ROOM - PLUG - AIR COND.		20	2P	2	A_B
P11	BASEMENT - BLOWER		15	3P	2.3	
P12	WATER HEATER	8000	40	2P		I
P13	TOILET - HEATER	4500	30	2P		B_C
P14	SPACE					
P15	SPACE					
	TOTAL	44000			8	

TOTAL H.P. = 60 H.P.

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS	FILE NO
PLOT PLAN	8-2-2368
PLAN & ELEV.	8-2-2369
MEZZANINE FLOOR	8-2-2370

DESIGN	J.K.G./H.M.	6-1-60
DRAWN	H.MONTGOMERY	6-10-60
CHECKED	J.K. GEDDES	6-21-60
CIVIL		
ELECT.	J.T. BRODIE	9-15-60
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED — ENGR. — DATE 9-15-60
APPROVED — GEN. MGR. — DATE 9-15-60

ELECTRICAL CONSTRUCTION SHOP
4 E. STATE ST.
ELECTRICAL LAYOUT

AUTH.	E. J. O.	ACCT.
	7995	371
PRINT FILE	SCALE	NOTED
DRAWING NUMBER	8-2-2384	

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT

N

10'Cl. OVERFLOW TO COOLING TOWER RECIRCUIT.

6 FT. CHAINLINK FENCE

48 - Coroneaster

Prunus persica HELEN BORCHERS

7 - Brunfelsia

23 - Hydrangea - BLUE

6 - Camellia - SELECTED

6 - Azalea

Existing grass to be removed

21 - Juniper - PFITZER

INTERPLANT IN SEASON WITH LOBELIA (OR VERBENA) AND WITH PANSY GIANT MIXED 4 DOZ. EACH.

Cupressus sempervirens - PYRAMIDAL

3 - Juniperus horizontalis - (SAVIN)

FENCE RELOCATION

FOUNTAIN

NOTE - INSTALL SHRUBBERY SPRAYS IN BEDS SURROUNDING FOUNTAIN.

ADJUST SPRINKLER SYSTEM FOR LAWN AND INSTALL HYDRANTS AS NECESSARY

LAWN

REMOVE ALL SOD AND DIRT TO 6" DEPTH AND REPLACE GOOD LOAM SOIL. ADD STEER MANURE, NITRO-HUMUS AND BONEMEAL AND WORK INTO SOIL. SEED, AND MULCH WITH 2" PEAT MOSS. APPLY 2½ LB. AMMONIUM PHOSPHATE 16-20 AFTER FIRST MOWING AND AT 60-DAY INTERVALS THEREAFTER.

REMOVE 3 EUGENIA

5 - Camellia - SELECT

6 - Azalea

Existing grass in this area to be removed

3 - Jun. horizontalis

Cupressus

21 - Juniper - PFITZER

MULCH 3" LAYER PEAT MOSS 3' DIAM. EACH PLANT

FLOOR LEVEL 750.11

Magnolia

Liquidambar

AXIS OF FOUNTAIN

FAIR OAKS AVE.

GLENARM ST.

FENCE RELOCATION

MANHOLE

REMOVE: 3 EUGENIA
5 PITTOSPORUM TOBIRA

2 Camellia to remain

Ajuga

Magnolia

Liquidambar

SIDEWALK

THOROUGHLY RENOVATE ALL SOIL AREAS TO MINIMUM 4" DEPTH & ADD FERTILIZER, 5 SACKS/1000 SQ. FT. OF STEER MANURE AND WORK INTO SOIL AND RECOMPACT. USE ½ PEAT MOSS FOR CAMELLIA, AZALEA & BRUNFELSIA. MULCH 3" LAYER PEAT MOSS 3' DIAMETER EACH PLANT.

16 Camellias
27 Azalias

BUILDING

TRANSFORMER AREA

SCALE 1" = 10'-0"

NOTE - THIS DETAIL IS NOT AT SAME SCALE AS REST OF SHEET BUT IS AT SCALE OF DR. 2-2-500.

PLAN

BUILDING

2 x 4 R.W. FRAME

JOIN FRAME WITH 3½" LAG SCREWS

1½" SCREWS

1 x 2 R.W. 12" o.c.

3/16" x 2½" BOLT FRAME TO SUPPORTS

PAINT 2 COATS TO MATCH BUILDING

FACE ELEVATION

GROUND

2½ x 1½ x 3/16 ANGLE SUPPORTS

CURB & WALK

CONC. BASE 8" ϕ x 24"

Ⓐ ESPALIER FRAME

½" = 12" SEE DWG. 2-2-500

TWO TO BE FURNISHED AND SET FOR PYRUS AS SHOWN

GLENARM ST.

PLANTING PLAN

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

"AERATING FOUNTAIN"
for Nos. 7 & 8 GENERATOR AIR COOLERS
"PLOT PLAN"

APPROVED
E. E. Bellamy ELECT. ENGR.
DATE 9-2-38
APPROVED
[illegible] MGR.
DATE 9-2-38

		DATE
DRAWN	N.H. Hamit	7-25-38
TRACED	"	
CHECKED		
CORRECTED		
CHANGES		

SCALE 1" = 10'-0"

DRWG. NO. 30-T-SHEET 1

FILE NO. 8-2-800

SOUTH WALL OF GLENARM BUILDING

CIRC PIPE DAYLIGHTS

REMOVE SWITCHGEAR XFMRS & DEMO AREA, BACKFILL

IN RED AREAS SEAL PIPE & DOOR PENETRATION THU WALL BY DOWELING, ADDING BENTONITE WATER STOP, FORMING & PLACING REINFORCED STRUCTURAL CONCRETE (APPROX. 22'-0" X 8'0"X1'-6" THICK)

BENEATH ROAD DEMO CONCRETE WALL TO AT LEAST 8'-0", FILL WITH TWO SACK FLOWABLE FILL, BACKFILL TO GRADE

BOTTOM OF TUNNEL -20'-6" FROM GRADE

DEMO PIPE TO THIS LOCATION

DEMO 2 8-2-49

Existing Suction Pit

No 4 RESERVOIR

See Sheet No 5

Sections M, N, O, P, Q, & R detailed on Sheet No 2

SECTION D-D

SECTION C-C

SECTION A-A

SECTION B-B
See Longitudinal Section Sheet 2

DETAIL AT G-G
SCALE 1/4"=1'0"

SECTION AT F-F

TYPICAL DETAIL OF BUTTRESS.
SCALE 1/4"=1'0"

PLAN AT BEAM POCKETS.

DETAIL - TYPICAL METHOD OF CONSTRUCTION.
SCALE 1/4"=1'0"

DETAIL SECTION E-E
SCALE 1/4"=1'0"

BEAM & COLUMN SCHEDULE.

Beam No.	Section	Length Approx.	Elev. Top of Beam	Depth of Beam	Carried by Col. No.	Section of Col.	Elev. Top of Col.	Elev. Bot. of Lean-to	Length of Col.	Size of Col. Lean-to	Size of Stirrup No. & Spacing
1	C-18-41	23'3"	-4'0"	18"	1	6"H-25	-6'2"	-18'11"	12'9"	18"12"1	1/0"x 3/8
2-3	"	13'6"	"	"	2	"	"	"	"	"	"
4	"	12'6"	"	"	3	6"H-35	"	-16'9"	10'7"	16"16"1½	"
5-6	C-18-61	20'6"	"	"	3	"	"	"	"	"	"
7-8	C-18-41	16'0"	-4'1⅜	"	4	6"H-32	-5'7⅜	-18'11"	13'2⅜	14"14"1	"
9	C-18-25	14'0"	-3'7⅜	12"	5	6" " 25	-4'7⅜	-18'4⅜	13'9⅜	10"10"1	"
10	"	"	-3'1"	"	6	"	-4'1"	-15'9⅜	11'7⅜	12"12"1	"
11	"	"	-2'6⅞	"	7	"	-3'6⅞	-17'4"	13'9⅜	10"10"1	"
12	"	"	-2'0⅜	"	8	"	-3'0⅜	-16'9⅜	"	"	"
13	"	"	-1'6"	"	9	"	-2'6"	-14'1⅞	11'7⅛	12"12"1	"
14	C-16-62	17'6"	-0'7"	18"	10	8"H-35	-2'1"	-15'11½	13'10¼	16"16"1⅛	10"11"3/8
15	"	"	"	"	11	"	"	-15'6⅛	13'5⅛	"	"
16	C-16-30	9'6"	-0'7"	14"	12	8"H-25	-1'9"	-12'8"	11'3"	12"12"1	6"10"3/8
17	"	9'0"	"	"	—						"
18	"	15'6"	"	"	12	6"H-25	-1'9"	-12'8"	11'3"	12"12"1	"
19	12"I 31#	8'6"	-7'7"	12"	"	"	"	"	"	"	"
20	C-18-41	25'6"	-0'3"	18"	14	"	-1'9"	-10'10"	9'1"	"	"
21	"	"	"	"	15	"	"	"	"	"	"
22	"	13'6"	"	"							
23	"	8'0"	-0'7"	"	13	8"H-35	-2'1"	-10'10"	8'9"	16"16"1⅛	
24	C-18-61	11'9"	"	"	"	"	"	"	"		
6-1	12"I 31#	7'0"	-11'6"	12"	3	6"H-32					
10-1	"	"	-10'1"	"	6	6"H-25					
10-2	10"I 25#	"	-9'7"	10"	"	"					
13-1	12"I 31#	"	-8'6"	12"	9	"					
13-2	10"I 25#	"	-8'0"	10"	"	"					

See McClintic-Marshall Drwgs. for structural steel details.

All ⅞ Vents Hooked

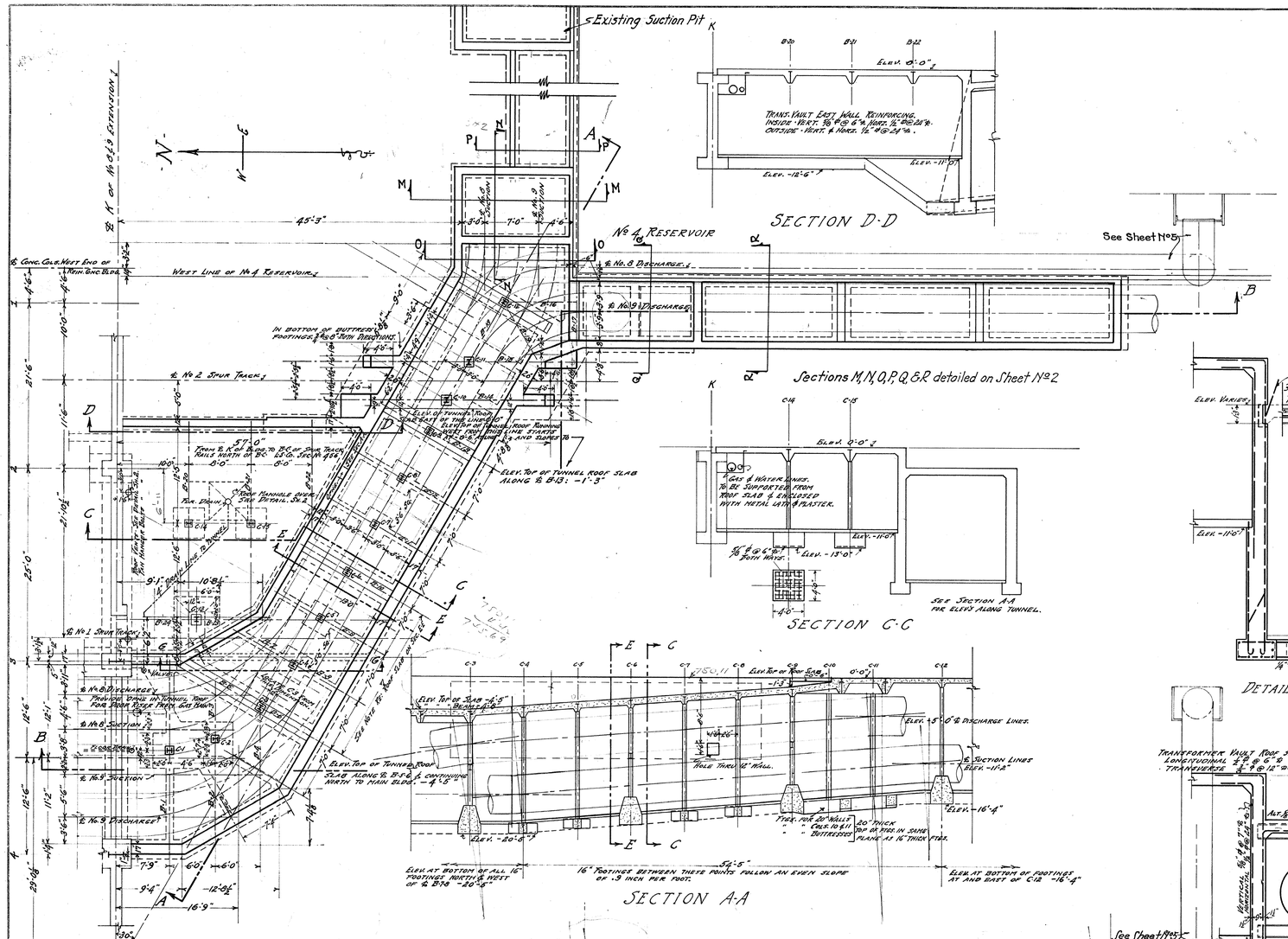
All col. ftgs. except C-10 & C-11 to have bars spaced as shown in this detail, total number of bars depends on size of ftg.

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

CIRCULATING LINE TUNNEL & TRANSFORMER VAULT.

APPROVED		DRAWN	AHLEWIS	DATE 2-26-31
		TRACED	"	2-6-31
Elect. Engr.		CHECKED		
Mech. Engr.		CORRECTED		
		CHANGES		
Gen. Mgr.				

SCALE 1/8 & 1/4" | DRWG. NO. 27-J | FILE NO. SHEET 1 OF 5 SHEETS.



Beam & Column Schedule.

Beam No.	Section	Length Approx.	Elev. Top of Beam	Depth of Beam	Carried by Col. No.	Section of Col.	Elev. Top of Col.	Elev. Bot. of Ler. Pt.	Length of Col.	Size of Col. Ctr. to Ctr.	Size of Bars Ring No. & Pitch
1	C-18-41	23'-3"	-4'-8	18"	1	6"-H-25	-6'-2"	-10'-11"	12'-9"	18"-18"-1	10-¾
2-3	"	19'-6"	"	"	2	"	"	"	"	"	"
4	"	13'-6"	"	"	3	6"-H-35	"	-16'-9"	10'-7"	18"-16"-1½	"
5-6	C-18-69	20'-6"	"	"	3	"	"	"	"	"	"
7-8	C-18-42	16'-0"	-4'-1⅞"	"	4	8"-H-32	-5'-7⅞"	-18'-11"	13'-3⅜"	16"-16"-1"	"
9	C-18-25	14'-0"	-3'-7⅜"	12"	5	6" "25	-4'-7⅜"	-18'-4⅝"	13'-9⅜"	10"-10"-1"	"
10	"	"	-3'-1"	"	6	"	-4'-1"	-15'-9⅝"	11'-7⅜"	12"-12"-1"	"
11	"	"	-2'-6⅛"	"	7	"	-3'-6⅝"	-14'-1¼"	13'-9⅜"	10"-10"-1"	"
12	"	"	-2'-0⅛"	"	8	"	-3'-0¾"	-16'-9⅜"	"	"	"
13	"	"	-1'-6"	"	9	"	-2'-6"	-14'-1¼"	11'-7⅛"	12"-12"-1"	"
14	C-18-52	17'-6"	-0'-7"	18"	10	8"-H-35	-2'-1"	-15'-11½"	13'-10¼"	18"-16"-1½	10-11"-⅞
15	"	"	"	"	11	"	"	-15'-6⅛"	13'-5⅛"	"	"
16	C-18-39	9'-6"	-0'-7"	14"	12	8"-H-25	-1'-9"	-12'-8"	11'-3"	12"-12"-1	6-10-⅞
17	"	9'-0"	"	"	—						"
18	"	15'-6"	"	"	12	6"-H-25	-1'-9"	-12'-8"	11'-3"	12"-12"-1	"
19	12"-I-31#	8'-6"	-7'-7"	12"	"	"	"	"	"	"	"
20	C-18-43	25'-6"	-0'-3"	16"	14	"	-1'-9"	-10'-10"	9'-1"	"	"
21	"	"	"	"	15	"	"	"	"	"	"
22	"	13'-6"	"	"							
23	"	8'-0"	-0'-7"	"	13	8"-H-35	-2'-1"	-10'-10"	8'-9"	16"-16"-1½	
24	C-18-69	11'-0"	"	"	"	"	"	"	"		
6-1	12"-I-31#	7'-0"	-11'-6"	12"	3	8"-H-32					
10-1	"	"	-10'-1"	"	6	6"-H-25					
10-2	10"-I-25#	"	-9'-7"	10"	"	"					
13-1	12"-I-31#	"	-9'-6"	12"	9	"					
13-2	10"-I-25#	"	-8'-0"	10"	"	"					

See McClintic-Marshall Drawgs. for structural steel details.

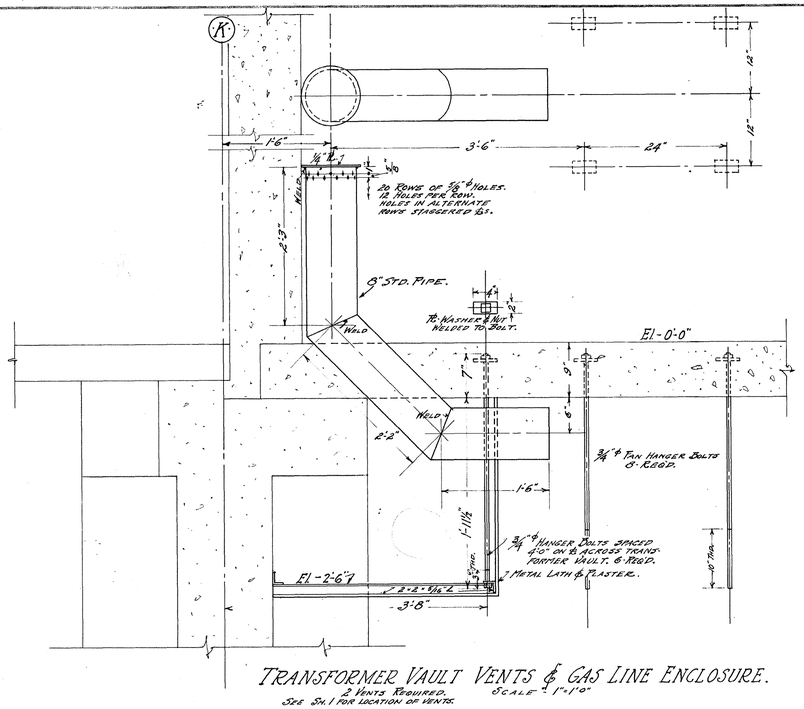
MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

CIRCULATING LINE TUNNEL & TRANSFORMER VAULT.

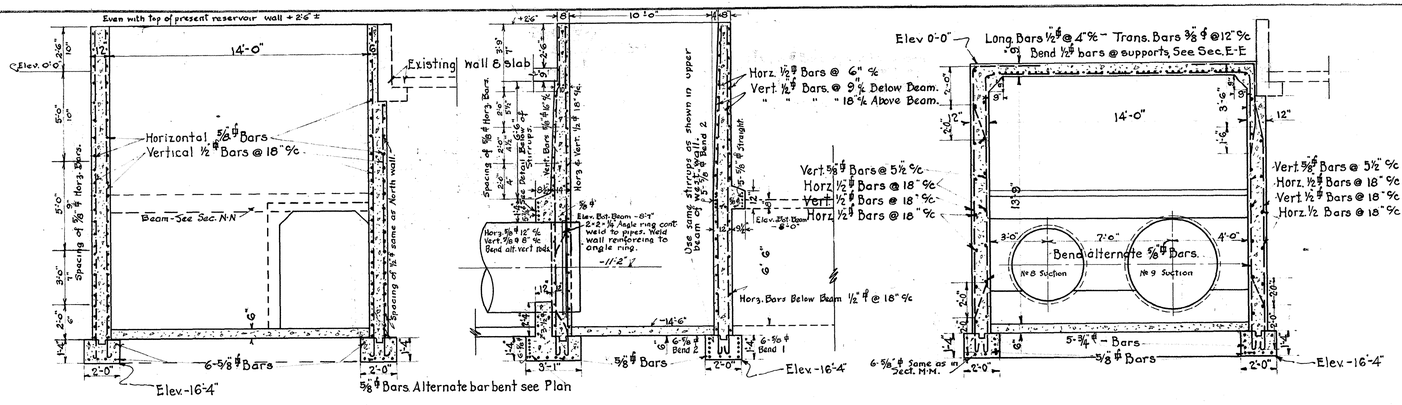
APPROVED		DRAWN	H.H.LEWIS	DATE 1-30-31
		TRACED	"	2-6-31
ELECT. ENGR.		CHECKED		
MECH. ENGR.		CORRECTED		
		CHANGES		
GEN. MGR.				

SCALE 1/8 & 1/4" | DRWG. NO. 27-J. SHEET 1 OF 5 SHEETS. | FILE NO.

8-2-49

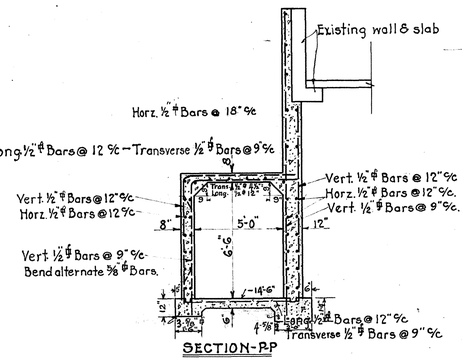


TRANSFORMER VAULT VENTS & GAS LINE ENCLOSURE.
2 Vents Required. See Sht. 1 for Location of Vents. Scale 1"=1'-0"

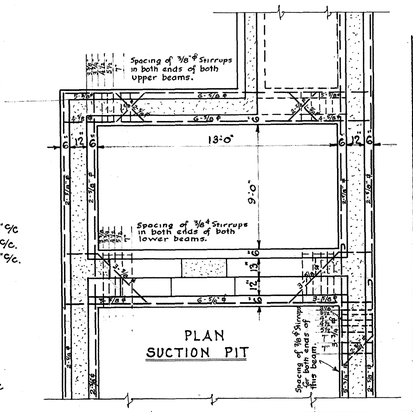


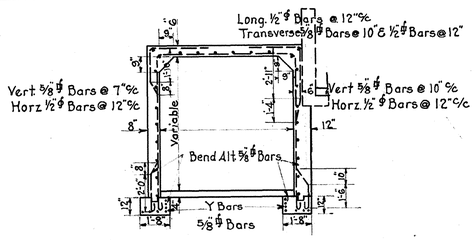
SECTION M-M. SECTION N-N SECTION O-O

Notes: Clear distance between reinforcing and forms shall be not less than 1" in 8" or less of concrete. ϕ 1½" in more than 8" of concrete. Bent bars shall be bent at one quarter of the distance between centers of supports.

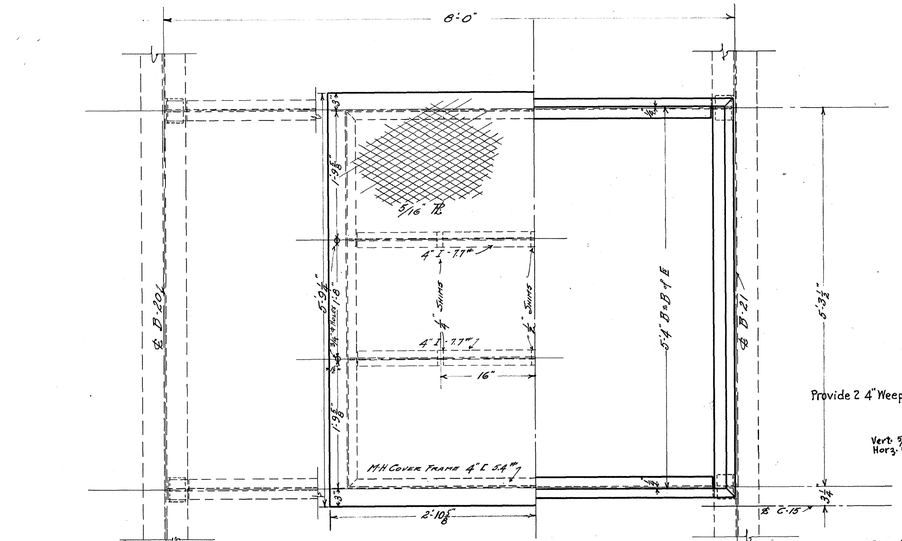


SECTION R-R



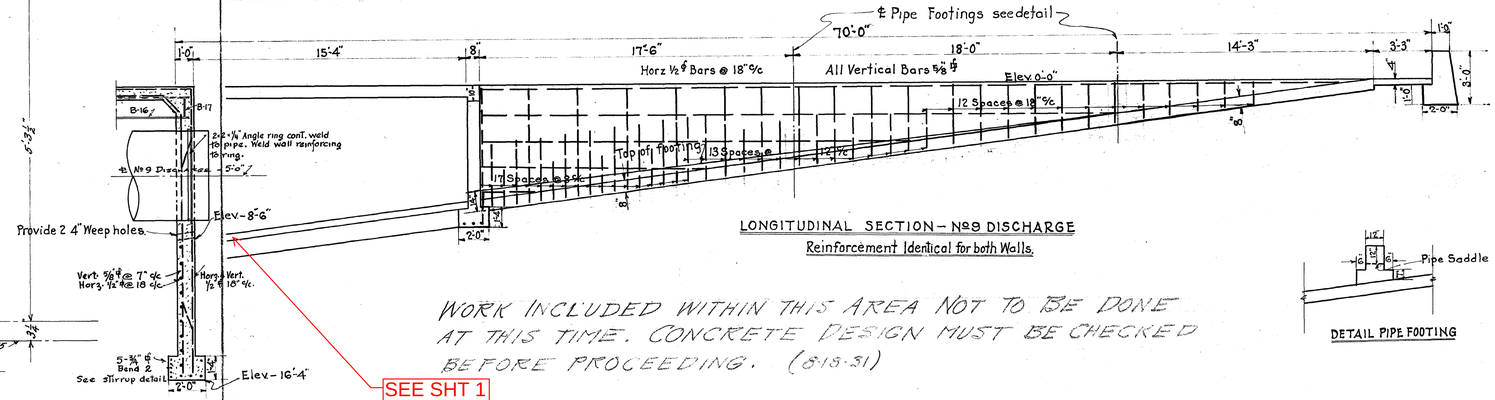


SECTION Q-Q



HALF PLAN OF COVER. HALF PLAN OF M.H.

SECTION THRU MANHOLE & COVER.
Scale 1"=1'-0"



LONGITUDINAL SECTION - No 8 DISCHARGE
Reinforcement Identical for both Walls.

DETAIL PIPE FOOTING

WORK INCLUDED WITHIN THIS AREA NOT TO BE DONE AT THIS TIME. CONCRETE DESIGN MUST BE CHECKED BEFORE PROCEEDING. (8-15-31)

SEE SHT 1

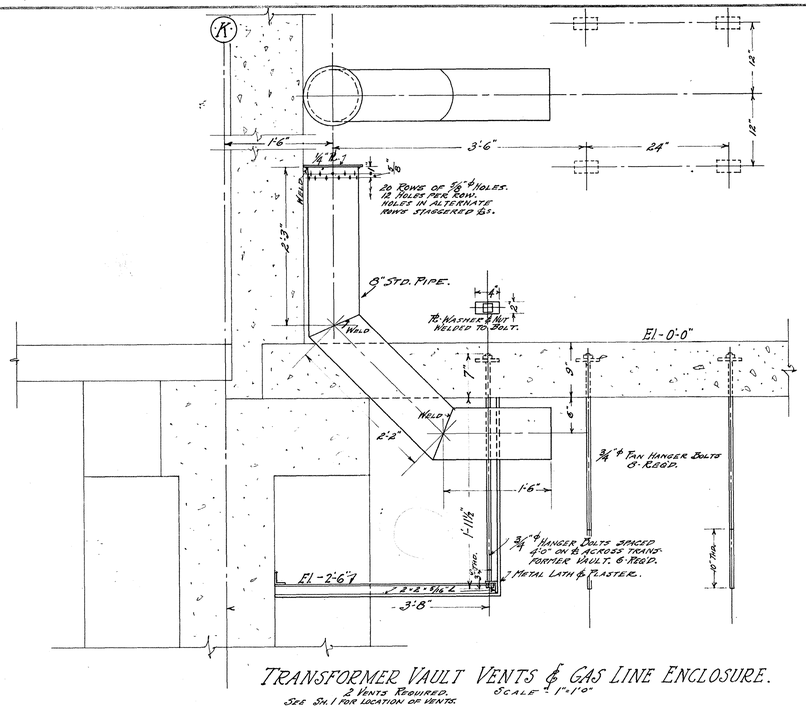
MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

CIRCULATING LINE TUNNEL & TRANSFORMER VAULT.

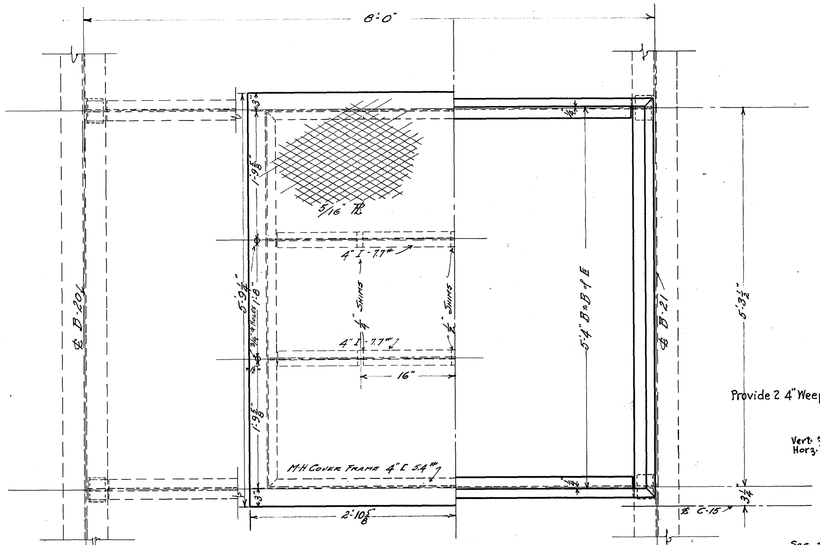
APPROVED			
	DRAWN	HHL - RS-B-	DATE
ELECT. ENGR.	TRACED	" "	
	CHECKED		
MECH. ENGR.	CORRECTED	HHL	8-14-31.
	CHANGES		
GEN. MGR.			

SCALE | DRWG. NO. 27-J SHEET 2 OF 5 SHEETS | FILE NO.

DEMO 3 8-2-49

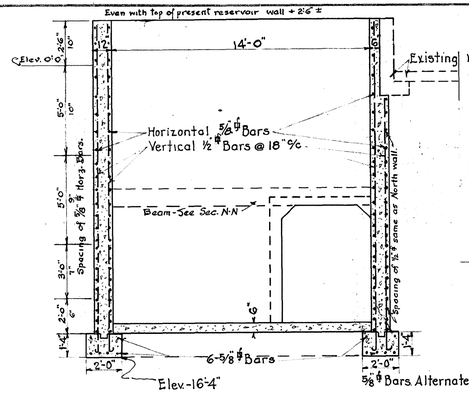


TRANSFORMER VAULT VENTS & GAS LINE ENCLOSURE.
2 Vents Required. See Sh. 1 for Location of Vents. Scale 1"-1'-0"

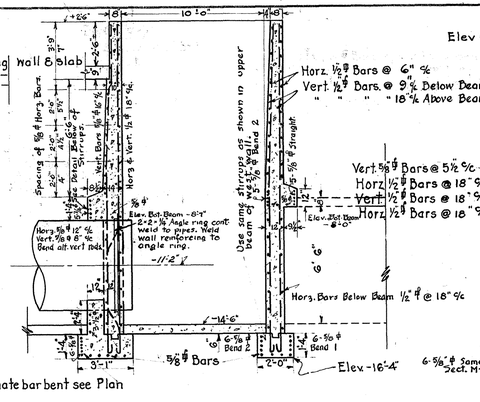


HALF PLAN OF COVER. HALF PLAN OF M·H.

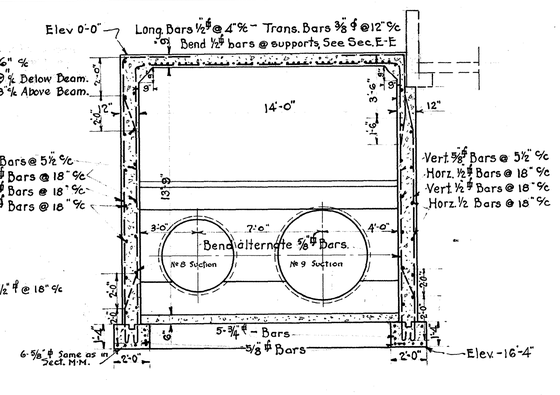
SECTION THRU MANHOLE & COVER.
Scale 1"-1'-0"



SECTION M-M.

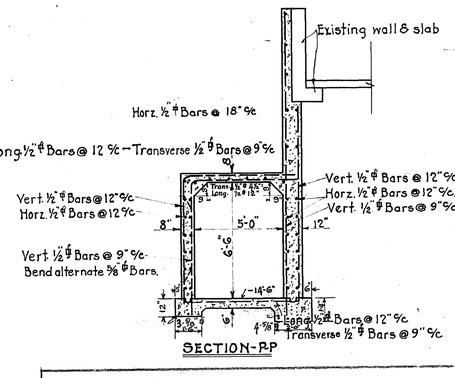


SECTION N-N

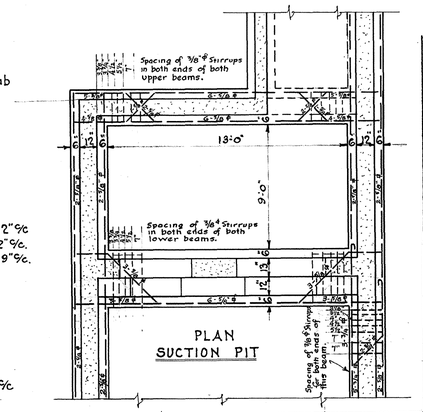


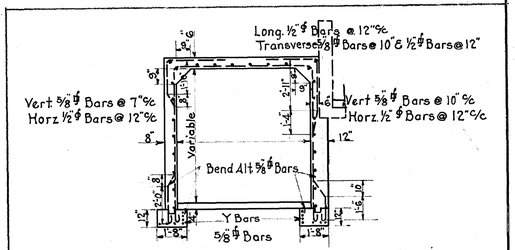
SECTION O-O

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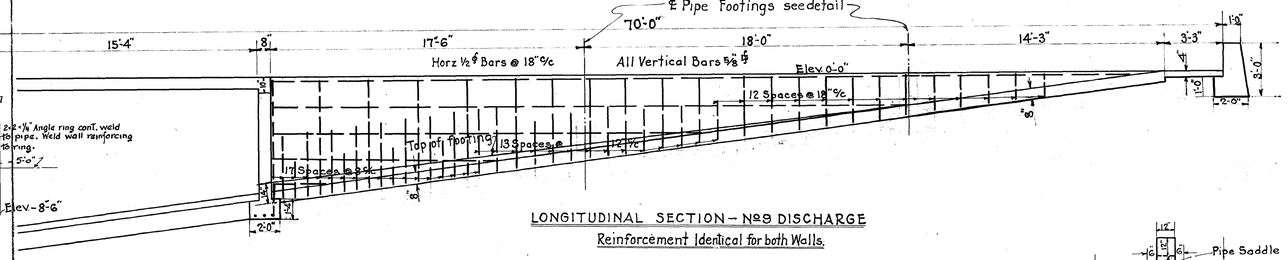


SECTION P-P



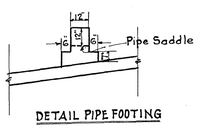


SECTION Q-Q

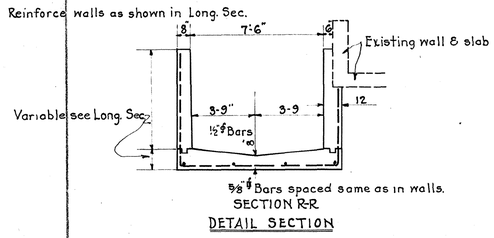


LONGITUDINAL SECTION - No 8 DISCHARGE
Reinforcement Identical for both Walls.

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DETAIL PIPE FOOTING



MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

CIRCULATING LINE TUNNEL & TRANSFORMER VAULT.

APPROVED				DATE
	DRAWN	HHL - RS-B-		
ELECT. ENGR.	TRACED	"	"	
	CHECKED			
MECH. ENGR.	CORRECTED	HHL		8-14-31.
	CHANGES			
GEN. MGR.				

SCALE | DRWG. NO. 27-J SHEET 20 OF 55 SHEETS | FILE NO.

8-2-49

SOUTH BUILDING COLUMN LINE REMOVE TUNNELS & PIPE COMPLETELY TO LIMITS SHOWN ON 8-2-1337

SEAL PIPE PENETRATION COMPLETELY PER NOTE OF SHT 1

#17 BOILER

#16 BOILER

℄ FIRING AISLE

NOTE: CUT NEW OPENING

SEE 8-2-706 DIST. WATER PUMPS

℄ Circulating Line Tunnel. ℄ Flash Tank

20"B.I.@ 56" Removable. See Detail K

20"B.I.@ 56" Grouted into pockets in place

Length of Beams & Lts.

Pipe in place

Field weld

℄ No 9 Discharge

℄ No 9 Suction

℄ No 8 Suction

℄ No 8 Discharge

Oil Heater

6WF15.5 See Det. N

4 L 5.4

PLAN
Scale ¼"=1'

Elev. Floor -10'-6"

Elev. Top of I beams -10'-9"

Elev. top 20"B.I. -10'-7¾"

℄ FLASH TANK-EL.-15'0"

℄ Circulating Lines -15'-3"

Elev. ℄ Pipes -15'-3"

Elev. Top of finished footing -16'-3"

Elev. ℄ Suction Lines -30'-3"

Elev. -32'-5" See Drwg. No. 26-T-Sh. 3

Elev. bottom of strut checked in field -12'-7" @ center, -12'-6" @ ends.

2-12"Ls @ 20.7 - Rivet to Col.

1½"x ¼" Lattice

Lead in bolts for anchorage to strut.

Frame to be fabricated in shop. Use 8"x2"x⅝" Ls ⌐ and ⅜" R. Cope out top and bottom Ls as shown.

Bottom of Ls -8'-8" below strut.

Top rough concrete - 8'-10½"

Stub out 4-¾"ϕ bars to be welded to Ls.

Varies

DETAIL-R-
Scale ½"=1'

Stub out 4-¾"ϕ bars

PLAN OF FOOTING.

6"I @ 125#

8"BI @ 17.5#

Con. Ls & R. to be welded to Col. in field

5"x3"x⅜" Ls & 8"x14"x1'-8" R.

¾" bolts - 16" long + 4" bend.

1½" Grout

Enclose Col. Base When Pouring Floor

Elev. bottom of R. -32'-6"

" Top of rough Conc. -32'-7½"

" " of bolts -32'-3"

" bottom of footing -33'-10"

⅝"ϕ Bars @ 5" ⅝ both ways.

DETAIL-S-
Scale ½"=1'

Holes for ¾" bolts

DETAIL BASE R.

8WF31 @ 3'-0" 4 REQ'D

6-13/16"ϕ HOLES ON 3½" GA.

8-15/16"ϕ HOLES N.S.

L 6WF 15.5

WELD

L 3x3x¼

3-3UNIT ¾" CINCH A.

5"℄

DETAIL N. SEE PLAN FOR LOCATION
¾" = 1'-0"

FUEL OIL HEATER SUPPORT

Field weld

Provide 4-½"ϕ bars in bottom of each footing

Slope floor to drain north. Provide weep holes in footings.

Excavate under strut in place and back-fill with concrete.

SECTION H-H
Scale ¼"=1'

Note: All footings must go down to solid bearing.

℄ Footing for Col.

SECTION-I-I
Scale ½"=1'

Radius 30⅜"

Radius 24⅜"

Radius 13'-0"

Radius 7'-6"

Radius 2'-6"

Elev. 21'-11⅞"

EL. -24'-6"

EL. -29'-6"

5/8"- 2UNIT CINCH A

PL 27", ⅜" x 4'-2" ⅜" CSK M.S. 8" c/c

3℄ 4-1.7 x 4'-2" WELD TO PL 2" @ 12

L 6 x 4 x ⅜ x 0'-2½"

5/8" M.B

4℄ 5.4

L 3 x 2 x ¼ ON 3 SIDES

DETAIL P
¾"=1'-0"

BAILEY INSTRUMENT AIR FILTER SUPPORT.

⅜" R. on sides & back ½" R. on bottom. To be grouted in place

Finished floor level -10'-6"

DETAIL K
Scale ½"=1'

Beam Pockets for Removable Beams.

Make G, internal angles to be square, all welds to be on outside of box.

REV. 4-27-49 ADDED DET. P	J.H. NORMAN	REV. 4-1-48 ADDED DET. N	J.H. NORMAN

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

CIRCULATING LINE TUNNEL

APPROVED		DRAWN	Ralph S. Brooks	DATE May-1931
Elect. Engr.		TRACED	"	"
Mech. Engr.		CHECKED	A.H.L.	5-22-31
		CORRECTED		
Gen. Mgr.		CHANGES	A.H.L.	8-5-31

SCALE As shown.

DRWG. NO. 27-J Sheet 3 of 35 sheets.

FILE NO. 8-2-49

DEMO 4

PLAN
Scale ¼"=1'

SECTION H-H
Scale ¼"=1'

Note: All footings must go down to solid bearing.

SECTION-I-I
Scale ½"=1'

DETAIL P
¾"=1'-0"
BAILEY INSTRUMENT AIR FILTER SUPPORT.

DETAIL K
Scale ½"=1'
Beam Pockets for Removable Beams.
Make G, internal angles to be square, all welds to be on outside of box.

DETAIL-R-
Scale ½"=1'

PLAN OF FOOTING.

DETAIL-S-
Scale ½"=1'

DETAIL BASE PL.

DETAIL N.
¾"=1'-0"
SEE PLAN FOR LOCATION
FUEL OIL HEATER SUPPORT

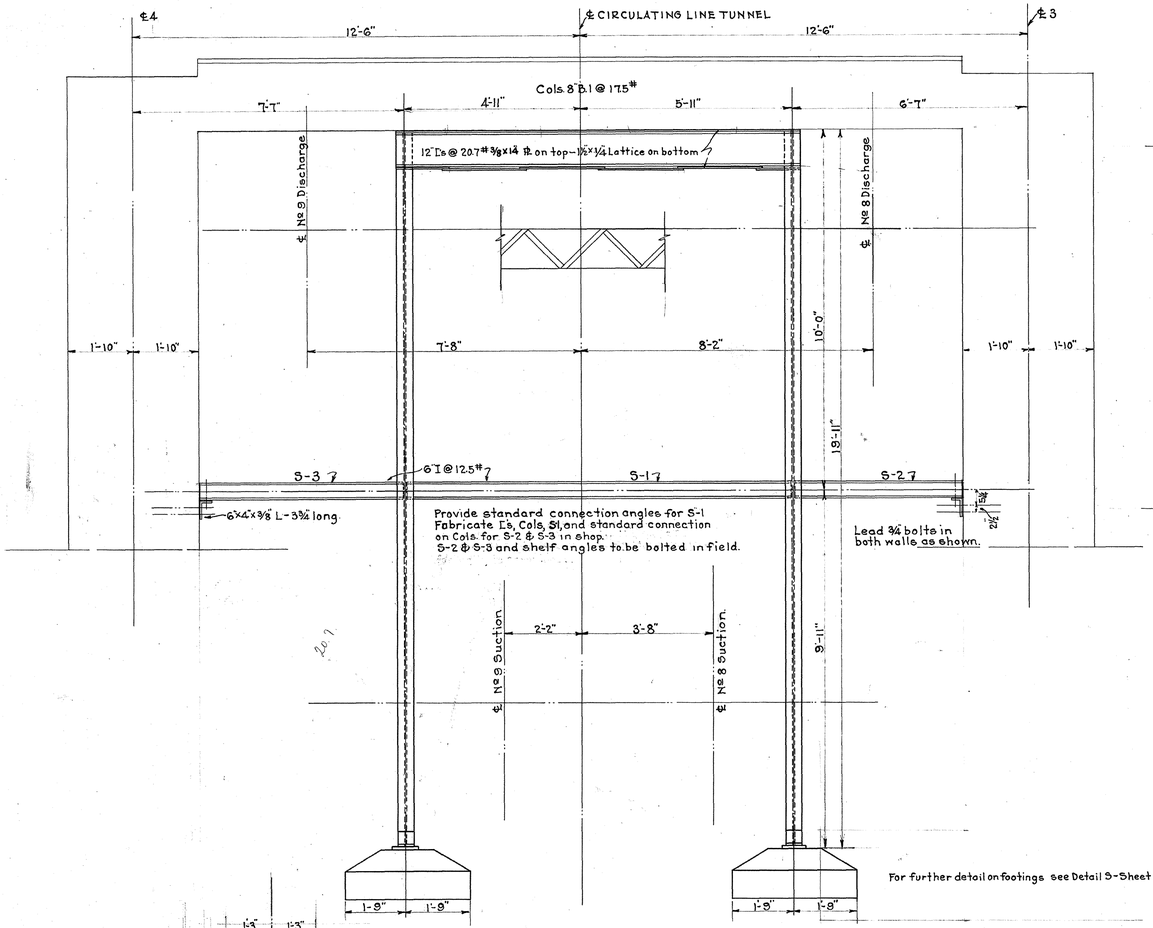
REV. 4-27-49	ADDED DET. P J.H. NORMAN
REV. 4-1-48	ADDED DET. N J.H. NORMAN

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

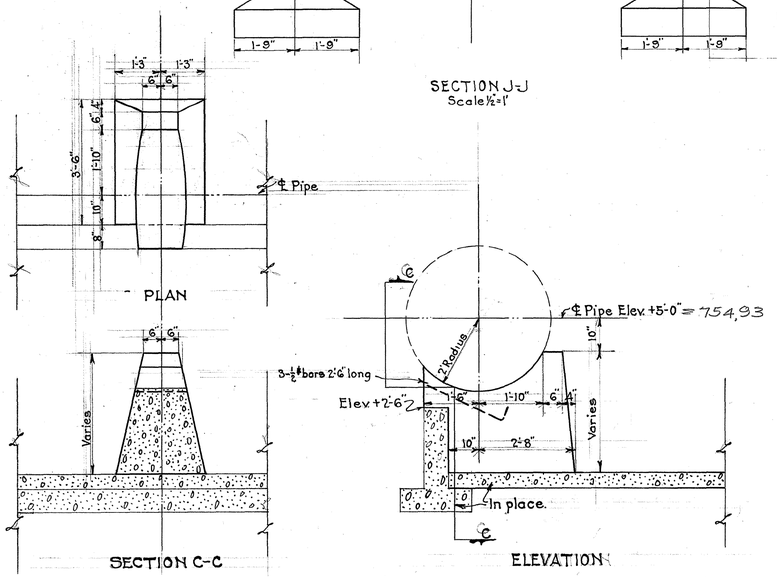
CIRCULATING LINE TUNNEL

APPROVED		DRAWN	Ralph S. Brooks	DATE May-1931
	Elect. Engr.	TRACED	"	"
	Mech. Engr.	CHECKED	A.H.L.	5-22-31
		CORRECTED		
		CHANGES	A.H.L.	8-5-31
	Gen. Mgr.			

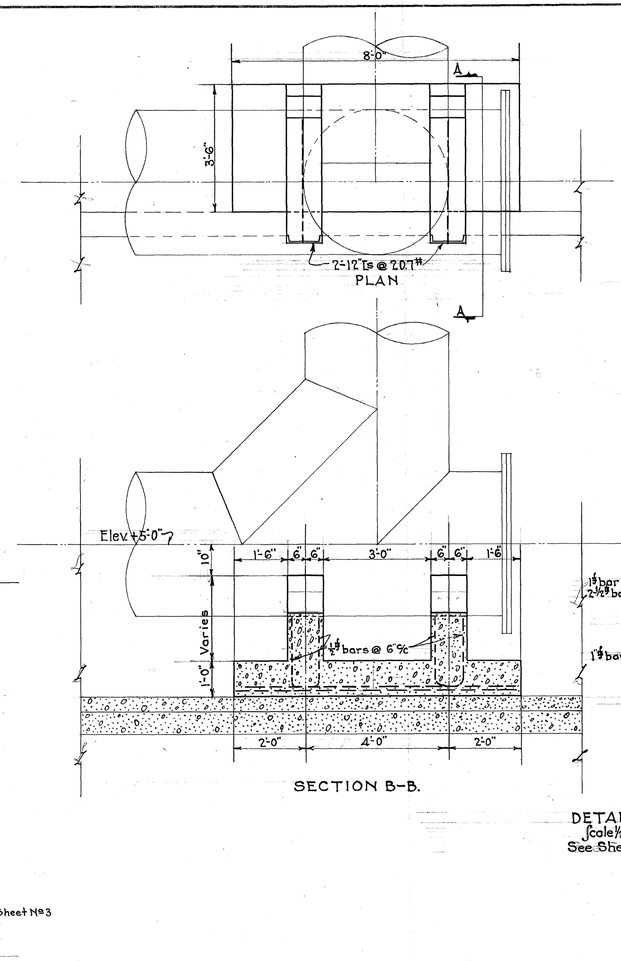
SCALE As shown. DRWG. NO. 27-J Sheet 3 of 35 sheets. FILE NO. 8-2-49



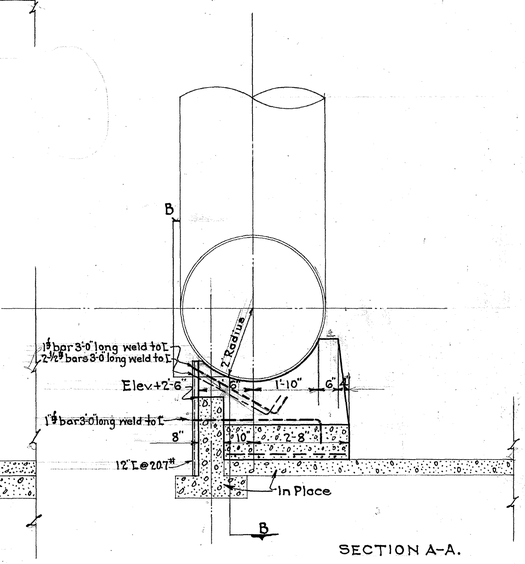
SECTION J-J
Scale ½" = 1'



DETAIL D
Scale ½" = 1'
See Sheet No. 5



DETAIL E
Scale ½" = 1'
See Sheet No. 5



SECTION A-A.

MUNICIPAL LIGHT AND POWER DEPT. CITY OF PASADENA			
CIRCULATING LINE TUNNEL			
APPROVED	DRAWN	Ralph S. Brooks	DATE May 1931.
Elect. Engr.	TRACED		
	CHECKED	[illegible]	5-22-31
Mech. Engr.	CORRECTED		
	CHANGES		
Gen. Mgr.			
SCALE As shown	DRWG. NO. 27-J Sheet 4 of 5 Sheets.	FILE NO.	

8-2-49

1 2 3 4 5 6 7 8 9

A B C D E F

EXIST. DUCTS
18-6"
DUCTS TO "RSB"
APPROX. GRADE
DUCTS TO "RSB"
EXIST. DUCTS
EXIST. DUCTS
"RSC" TUNNEL
4-6"
EXIST. M.H.
9-6"
"RSD" TUNNEL

PROFILE "A"
NOT TO SCALE

VAULT 4254

9-6" PVC-EB PASS THRU EXIST. M.H. (CONCRETE ENCASED)

INSTALL 9-6" PVC-EB INTO "RSD" TUNNEL. SEE NOTE" ON "RSC"

TUNNEL No. 2

18-6" & 18-3" PVC-EB SEE DWG. NO. 2-2-1562

13'

19236-MP 7098-MP 6137-MP 14237-MP 1699-MP 8079-MP

EDMONDSON ALLEY

14-6" ABS

695126-N

12-4½" VT & 2-6" ABS

8-6"

12-4"

DRIVEWAY

ELECTRIC GATE

KEY SWITCH

18-6" PVC-EB

SEE PROFILE "A" 50.5'

INSTALL 18-6" PVC-EB

INSTALL 9-6" PVC-EB INTO "RSC" TUNNEL NOTE: COORDINATE WITH THE DEPT. PRIOR TO CORING THE TUNNEL

NOTE: PORTION OF EXISTING 8-6" AND 12-4" WERE REMOVED TO FACILITATE VAULT INSTALLATION & RECONNECTED INTO NEW VAULT.

VISITOR PARKING

EMPLOYEE PARKING

DISPATCHING CENTER

CAP. RACK 34 KV.

LIGHTNING ARRESTERS

SPACE ARROYO

CAP. BK-1 TIE BK-2

CAP. BK-2 MARENGO

CAP. BK-3 AUX. BK-1

ELDORADO PLAZA-1

6-9 UPPER BUS-TIE

6-9 LOWER SPARE

AUX. BK-3 GB UPPER

BUS POTS AUX. BK-2

WAVERLY SPARE

PLAZA-2 TIE BK-1

No. 9 TRANSF. 13.8 / 17 KV

"R.S.B." 17 KV

TIE BK. No. 2 34/17 KV.

TIE BK. No. 1 34/17 KV.

"R S C" 34 KV

"R S D" 34 KV

TIE BK-2

TIE BK-1

LINE 34-33 SPARE LINE 34-22 LINE 34-31 LINE 34-2

B-2

E. SIDE SWGR BK. B

C.T. LINE 34-25

LINE 34-4

LINE 34-7 SPARE E. SIDE SWGR BK. A

B-1

C.T. LINE 34-16 C.T. LINE 34-15

34-1 34-38

L.A. SOUTH L.A. NORTH

GT-2 (EAST) GT-1 (WEST)

39-21 39-34

NORTH BUS TIE

34-3 34-13

B-3

34-14 34-6

SOUTH BUS TIE CAP. BK'S 2&3

GAS CAN'T.

WALK

LOADING AREA

GLENARM SUB

1A 34/4KV SWGR. 1B

OIL SW'S.

2A 34/4KV SWGR. 2B

TRUCK PARKING AREA

GLENARM STEAM PLANT

GLENARM ST.

182.58'

TUNNEL No. 1

TUNNEL No 1A

PROP. LINE

BLDG.

DRIVE WAY

PRIVATE PROPERTY

83' 88' 91' 449.99' 123.5' 194'

SOUTH RAYMOND AVE.

PICK UP 2-5" (BOTTOM) & EXTEND TO TUNNEL

6-6" & 2-3" A.B.S. TO GAS TURBINES

3511-MP 14651-MP

TO GAS TURBINE SITE 6-6" & 2-3" A.B.S.

4-6" & 2-3" ABS TO GAS TURBINES

NOTES:
C.T. LINE - CROSS TOWN
GT - GAS TURBINE

NO	DATE	REVISIONS	BY	CHKD	APVD
5	10/2002	NEW 34KV FEEDER - GT 3&4	TM		
4	2-2-95	NEW FEEDER POSITIONS	MTC		
3	1/95	NEW GLENARM SUB	T.M.		
2	9-21-82	REDRAWN - REMOVED ASSA SUB-STRUCT.	C.V.		

DISTRIBUTION: ENGINEERING 1

DESIGN
DRAWN D.S. 9-21-82
CHECKED
CIVIL
ELECT.
MECH.
DATE

REFERENCE DRAWINGS

FILE NO

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED Dennis Kenney ENGR. DATE 1-30-95
APPROVED CHIEF ENGR. DATE 1/30/95

RECEIVING STATIONS AND DISPATCHING CENTER ELECTRICAL PLOT PLAN

SHEET NUMBER

EJO NUMBER 1195-F706 | FILE 1
SCALE 1" = 20' | PAGE 6
DRAWING NUMBER 8-2-547

DIETERICH-POST CLEARPRINT 1000H 500 11/72

FOR DETAIL REFER TO DRAWING NO. 8-2-574

EDGE OF DRAWING NO. 8-2-574

EDMONDSON ALLEY

TUNNEL NO. 2

21'

20'

1'

GR

GX

SITE OF NEW CONTROL HOUSE AND 2.4 KV SUBSTATION

LEAVE TAILS

2-300 MCM B. STRD. CABLE TO BE LAID IN ROOF SLAB ONE ON EACH SIDE OF TUNNEL NO. 2

DISTANCE AS CONVENIENT

GND. TERM. TO BE FLUSH WITH CEILING AT EACH SIDE OF TUNNEL NO. 2 AND CONNECTED WITH ¼"×2" FLAT COPPER JUMPERS TO ESTABLISH TEST SECTIONALIZING POINT FOR GROUND SYSTEM

EAST GLENARM STREET

2-300 MCM B. STRD CABLE TO BE LAID IN TRENCH ABOVE VT DUCT

OLD | NEW

LEAVE TAIL

LEAVE TAILS

10-GX

EXISTING TUNNEL

LEAVE TAILS HANGING BELOW CEILING

VAULT

2-300 MCM LAID ABOVE VT DUCT

5-300 MCM B. STRD. CABLE TO BE LAID IN VAULT AND TUNNEL ROOF SLAB AS SHOWN

NOTES

TUNNEL TRANSVERSE LEADS TO BE AT LEAST #4/0 COND. GROUND SYSTEM INSTALLATION TO FOLLOW METHODS FOR REC. STA. SECTS. A & B WITH CABLE AT LEAST 1'-6" BELOW GROUND SURFACE TO PREVENT MECHANICAL DAMAGE. SUGGESTED BURNDY CONNECTORS SHOWN

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

POWERHOUSE TO RECEIVING STATION SECTION "A" INTER-CONNECTING TUNNEL GROUND SYSTEM

APPROVED
J.M. Goodrich ENGR.
DATE 10-13-48
GEN. MGR.
DATE

		DATE
DRAWN	J.E.P.	10-13-48
TRACED	J.E.P.	10-13-48
CHECKED	E.A. FINLEY	10-14-48
REF. DRWG.	8-2-182	8-2-461
	C-531 (8-2-547)	8-2-574

SCALE	DRWG. NO.	FILE NO.
1/8"=1'-0"	8-2-575	25-17

DIEPO—1000-H CLEARPRINT

EL. 0'-0" = EL. 750.11'

BRANCH 'T' CONSTRUCTION

EXISTING 6" LINE

EXCAVATION BY OTHERS

PASS THROUGH EXISTING CORED HOLE EL. -6'-4 3/4"

4"-40

4'-0" RADIUS

1'-3"

12'-6" ±

23'-8 1/2"

57'-4"

INV. EL. 744.90

31'-4"

EXCAVATION FROM HERE TO TANK BY OTHERS

4" EQUALIZER LINE RISES 4'-4 3/4" IN TUNNEL

62'-6" ±

21' MAX. HANGER SPACING

EXISTING SOFT WATER LINE STOPS HERE

6" SCHD 40

25' 4"

INV. EL. 749 OR -1'-1 3/8"

6" STD BLACK IRON PIPE & 6" BUTT WELD FITTINGS

INV. EL. 749 OR (-1'-1 3/8")

3'-10 3/8"

2'

WATER SOFTENERS

15'2"

WELD 'U' TYPE PIPE HANGERS TO TUNNEL ROOF BEAMS. HOLD PIPE CLOSE TO ROOF BEAMS.

PLUG EXISTING MANHOLE COVER CUT GASKET & BOLT IN PLACE & TEST NEW WORK BY OVERFLOWING TANK

CUT NEW HOLE FOR 4" PIPE IN BOTTOM OF TANK. SHORT COUPLE NIPPLE & FLANGE

CONNECT EXISTING TOWER TANK OVERFLOW INTO SURGE TANK HERE & REMOVE PRESENT LINE IN MANHOLE COVER NO NEW PIPE NECESSARY HERE

6'-6" ±

EXCAVATION BY OTHERS

204

18"

℄ EL. -2'

3" VENT

APPROX. 11' EACH OF RISER PIPING

CONNECT HERE TO EXISTING 3" OVER FLOW LINE TO COOLING TOWER

13' 4" ±

1 1/2" TRACER LINE

10" OIL LINE

LOWER EXISTING 'U' BEND & FUNNEL 1' 9"

OVER FLOW HEIGHT +23' OR 773.11 USE OPEN FUNNEL UNDER 'U' BEND

13'

6" TYP.

OVER FLOW FROM DISTILLED TANKS #1 & 2 TO INCINERATOR SUPPLY TANK

4"-40

10"x6"

6'-40

SECTION THROUGH SURGE TANK SHOWING NEW 4" CONNECTION

INCINERATOR SUPPLY TANK

8"

18"

2'

0'-0"

4"-40

6'-6"

USE 150# STEEL FLAT FACE FLANGES ON BOTH SIDES OF VALVE NO. 204

RE. PROPERTY LINE

3"

15'

INV. EL. 749

10 1/2"

9 1/2" SEE A-A

START HERE

6"-150# SLIP-ON FLANGE

2-6" 90° TUBE-TURN

203

9 1/2"

10 1/2"

45°

9'-8 1/4"

SOFT WATER

DISTILLED WATER TANK #2

DISTILLED WATER TANK #1

DRILL & TAP 1/4" N.P.T. SEE INSTRUMENT NOTES BELOW

9' | 24' | 8 | 16' | 16'-10"

18' DIA. x 24' 45,000 GAL. SOFT WATER STORAGE TANK BY CONSOLIDATED WESTERN STEEL

18' DIA. x 24' 45,000 GAL. DISTILLED WATER STORAGE TANK BY CONSOLIDATED WESTERN

18' DIA x 23'-9" 45,000 GAL DISTILLED WATER STORAGE TANK BY SOUTHWEST WELDING

18"

8 3/8" TO BOTTOM OF TANK

TYPICAL 3 PLACES

INSTRUMENT

TAPPED HOLES 8 3/8" FROM TANK BOTTOM & 2" FROM 6" VALVE. USE 1/4" 2 VALVE CHRISTMAS TREE & 1/2" o.d. 3/8" C.U. TUBE TO EXISTING SPARE TUBES AT 6" TEE

PE. PROPERTY LINE

BOTTOM OF TANK IS 750.11 OR EL. 0'-0" TYPICAL ALL THREE TANKS

STORM DRAIN

TEMPORARY DYKE FOR TESTING. USE EXCAVATED DIRT.

SAND FILL TO EL. 750.11

EXISTING LOWEST GRADE 750.07 HIGHEST " 750.28

45°

WHEN TANK IS COMPLETED PUMP HOT OIL INTO TEST PIPE UNTIL OIL IS WITHIN 2" OF TOP OF DYKE. INSPECT BOTTOM FOR LEAKS & CLOSE PIPE WITH SCREWED CAP.

CUT HOLE & WELD IN 1 1/2" x 6" PIPE AS CLOSE TO CENTER AS POSSIBLE

℄

9' R.I.D.

5"

12"

8"

12"

10' R.

EXCAVATE TO 749.67

TANK & SETTING BY OTHERS

SECTION THROUGH TANK SETTING
SCALE 1/2" = 1'

32 3/4

804

805

806

807

22 1/2"

44 7/8"

81 5/8"

14 5/8"

9 5/8"

0'-0"

6"-40

VIEW A-A

NOTES:

1-PIPE MATERIAL TO CONFORM TO ASTM A53 GRADE A
2-ALL PIPE SCHEDULE 40
3-USE 150# FLAT FACE STEEL FLANGES
4-EXCAVATION & CONCRETE CUTTING BY OTHERS

N

REVISIONS				
NO.	DATE	DESCRIPTION	BY	CK.
1	9/11/50	ADDED 2ND DIST. & SOFT H2O TANK	C.O.C.	
2	9/29/50	CHG. SURGE TANK TO INCIN. SUP.	C.O.C.	
3	10/3/50	REVISED SOFT H2O HDR SYS.	C.O.C.	

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

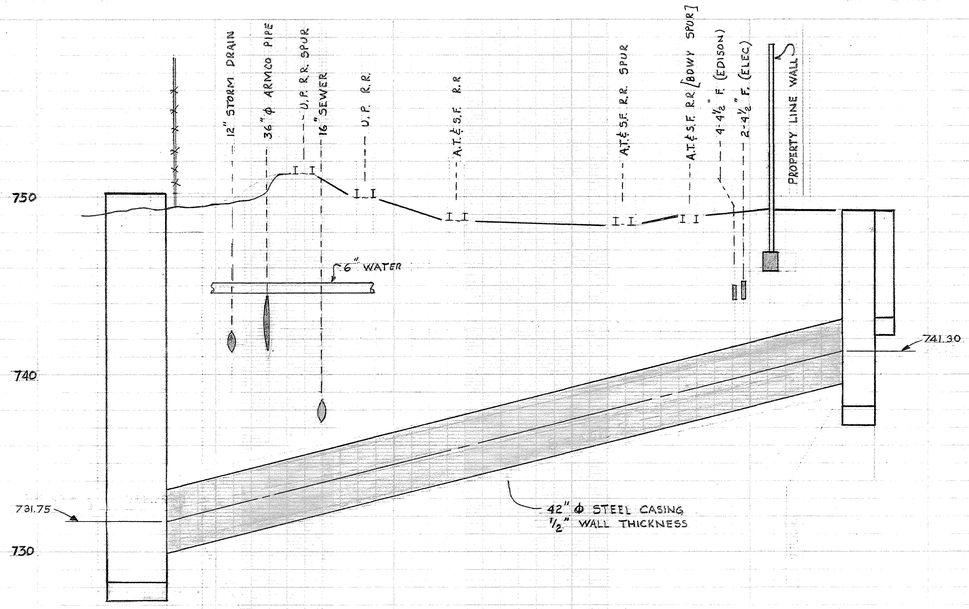
POWERHOUSE DISTILLED WATER STORAGE TANK LOCATION & PIPING

APPROVED
Engr. Date Jan 28/49
Gen. Mgr. Date Jan 28 '49

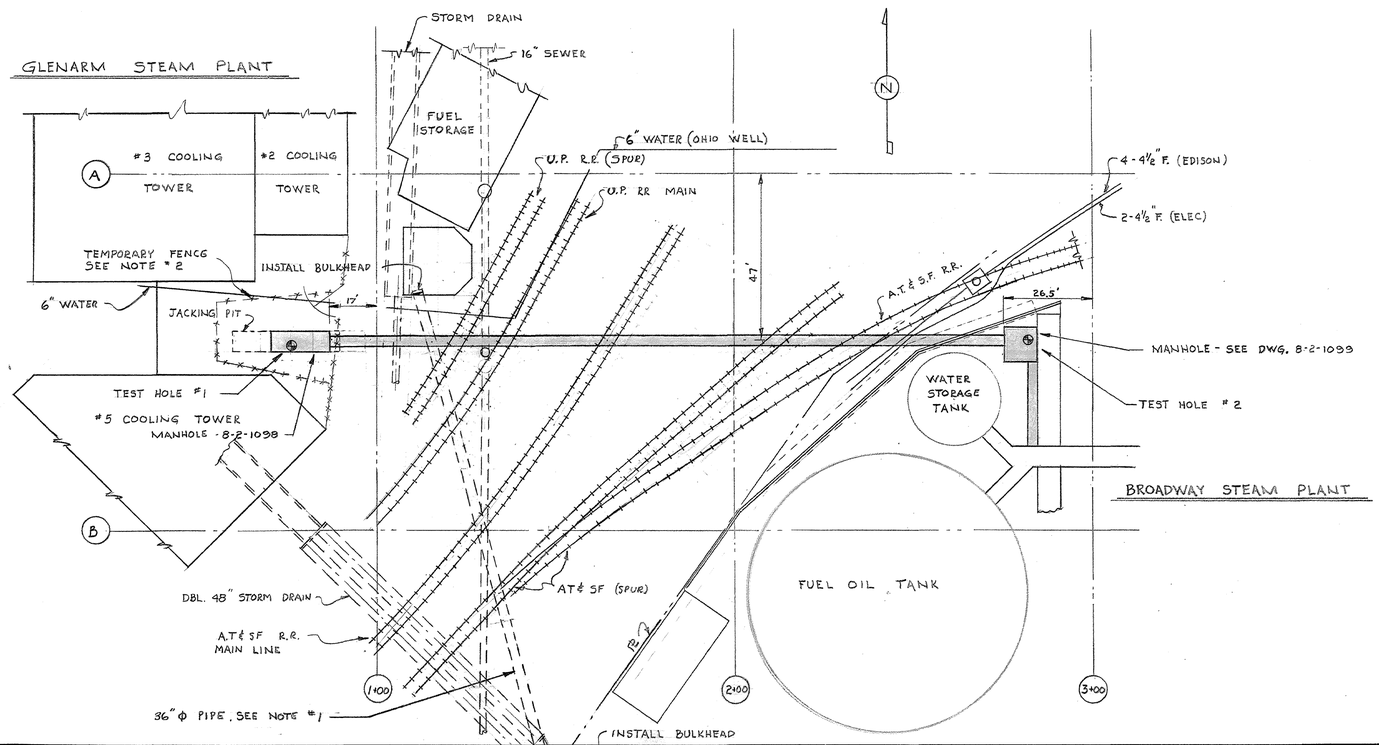
DRAWN	C.O.Connor	DATE 1/12/49
TRACED		
CHECKED	W.R.P.	
REF. DRWG.	8-2-482	
	7-6-36	

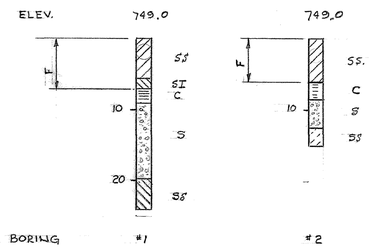
SCALE	DRWG. NO.	FILE NO.
1/8" = 1' & NOTED	8-2-598	

DIEPO 1000M CLEARPRINT



SCALE:
HORIZ ~ 1" = 20'
VERT. ~ 1" = 4'





NOTES:

1. 36"ϕ PIPE TO BE ABANDONED IN PLACE. BACKFILL WITH GROUT, SEE SPEC # D-9.
2. REMOVE EXISTING GATE AND FENCE IN JACKING PIT AREA. CONSTRUCT TEMPORARY FENCE TO MAINTAIN PLANT SECURITY. RE-INSTALL GATE & FENCE AT END OF PROJECT
3. MAX. ALLOWABLE DRIFT OF JACKED CASING AT TERMINUS IN ANY DIRECTION IS 1'-0" FROM THAT SHOWN.
4. USE EXTREME CAUTION WHEN JACKING IN THE VICINITY OF THE 16" SEWER.

NO	DATE	REVISIONS	BY	CHKD	APVD
1	7-13-66	CHGD DWG. PER RET. FIELD SET	JGH		DRS.

DISTRIBUTION

REFERENCE DRAWINGS	FILE NO
SPEC LD-65-16	
MANHOLE - STRUCTURAL DETS. - BDWY.	8-2-1099
MANHOLE - STRUCTURAL DETS: GLENARM	8-2-1098

DESIGN	D. SNYDER	2-5-65
DRAWN	D. SNYDER	2-8-65
CHECKED	G.H. WEDLUND	12-22-65
CIVIL		
ELECT.		
MECH.		DATE

MUNICIPAL LIGHT AND POWER DEPT.
CITY OF PASADENA

APPROVED ENGR. — DATE 12/22/65
APPROVED W.M. Goodrich GEN. MGR. — DATE 12-22-65

BROADWAY & GLENARM STEAM PLANTS

JACKED CASING FOR PIPE CROSSING

AUTH.	E.J.O.	ACCT.
800	11919	

PRINT FILE — SCALE 1"=20'

DRAWING NUMBER 2-2-949

PASADENA BLUEPRINT CO. PRINTED ON 1000H CLEARPRINT 200-7-65

OIL-WATER SEPARATOR, ITEM # 274—MANUFACTURER'S INFORMATION

- MANUFACTURER: FLOW TREND SYSTEMS, INC

- MODEL NO.: TPL-50

(See also Dwg. # 20001-274-M & Dwg. #20001-274-2-M enclosed with the facility plans)

TPL PHASE³
OIL / WATER SEPARATOR

The **PHASE³ Oil/Water Separator** provides optimum efficiency in gravity separation between two immiscible liquid fractions. The horizontal orientation of the **PHASE³** modules provide a uniform and non-clogging flow through the coalescing tubes. The rectangular openings in its tubular construction allow for settling solids to pass through the coalescing medium. The design versatility of the **PHASE³** also eliminates the staging that is necessary with other incline and horizontal coalescing plates.



MODEL TPL - 150

APPLICATIONS:

- Aviation
- Chemical Processing
- Machine Tools
- Metal Processing
- Oil Production
- Petrochemical
- Plastics
- Power Plants
- Processing Plants
- Steel Mills
- Storm Water Run-Off
- Transportation
- Utilities
- Vehicle Washes
- Water Treatment Plants



MODEL TPL - 150
with slotted tube coalescing medium in place.



Sotted tube **polypropylene coalescing medium. Efficient, fast separation.**

FLO TREND SYSTEMS, INC

TPL PHASE³
OIL / WATER SEPARATOR

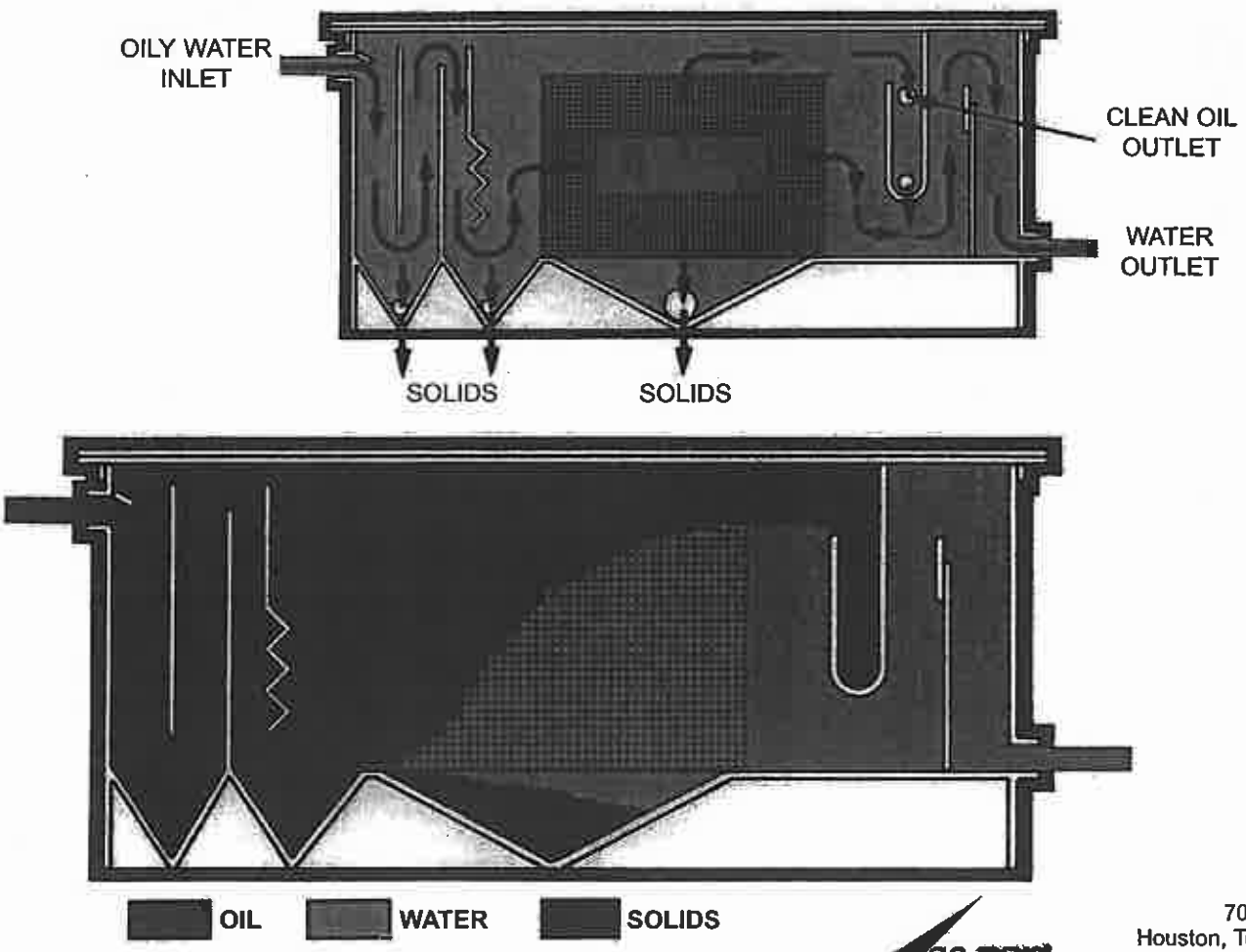
SOLUTIONS TO LIQUID/LIQUID SEPARATION PROBLEMS.

The **FTS PHASE³ Oil/Water Separator** is of a gravity accelerator design with coalescing slotted tube arrangements for processing both high oil and high solids content. The inlet baffles reduce the oil/water mixture feed to laminar flow. The liquid then enters the coalescing tubes under laminar conditions. The oleiphilic surfaces of the coalescing tubes attract small oil droplets which in turn, combine to form larger droplets for easier flotation. The oil rises to a collection point while the water continues through the medium to the water outlets.

FEATURES:

- No pretreatment.
- High efficiency separation due to high surface area coalescing medium.
- No moving parts
- Easy cleaning; minimal maintenance.
- All steel vessel construction.
- Large solids settling area.

OIL/WATER SEPARATOR FLOW DIAGRAMS



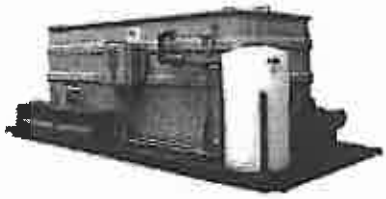
Custom designed and fabricated Oil/Water Separators.

FLO TREND SYSTEMS, INC
707 Lehman
Houston, Texas 7718
713-699-0152
Fax 713-699-8054
Toll Free: 800-762-9893
www.flotrend.com

PHASE 3 OIL WATER SEPARATOR

The Flo Trend® Systems' Phase 3 Oil / Water Separator uses coalescing tubes for the optimum separation of oil from water. A series of baffles and weirs in the vessel reduces turbulent flow and promotes laminar even flow through the vessel.





TPL-Phase 3 Oil Water Separator



Model TPL-50

Click Images For Larger View

It provides optimum efficiency in gravity separation between two immiscible liquid fractions. The horizontal orientation of the Phase 3 modules provides a uniform and non-clogging flow through the coalescing tubes. The rectangular openings in its tubular construction allow for settling solids to pass through the coalescing media. The design versatility of the Phase 3 also eliminates the staging that is necessary with other incline and horizontal coalescing plates.

Features:

- No pre-treatment.
- High efficiency separation due to high surface area coalescing media.
- No moving parts. (On standard units)
- Easy cleaning.
- Minimal maintenance.
- All steel vessel construction.
- Large solids settling area.

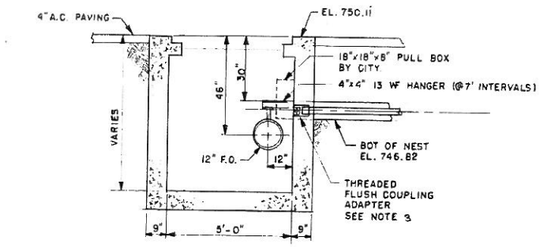
Applications:

- Aviation.
- Chemical Processing.
- Machine Tools.
- Marine Terminals.
- Metal Processing.
- Oil Production.
- Petrochemical.

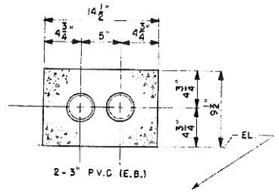
- Plastics.
- Power Plants.
- Processing Plants.
- Steel Mills.
- Storm Water Run-Off.
- Transportation.
- Utilities.
- Vehicle Washes.
- Water Treatment Plants.

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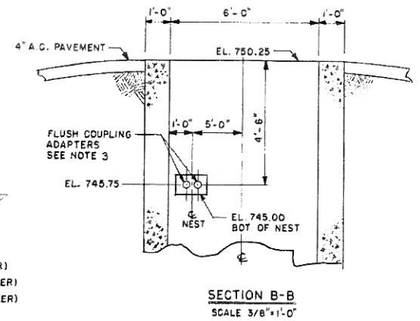
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SECTION A-A
SCALE: 3/8"=1'-0"



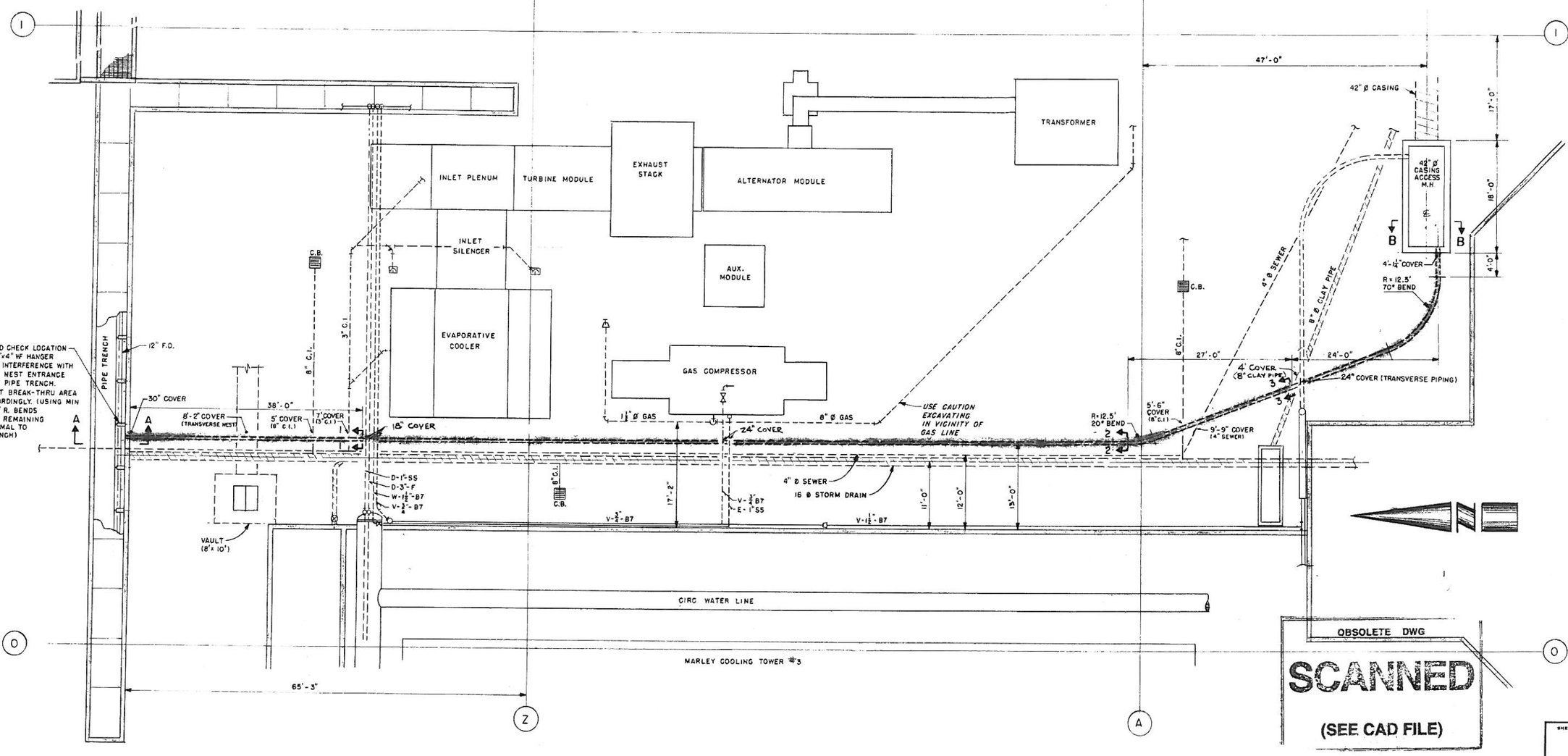
SECTION 1-1 EL. 746.10 (3' COVER)
SECTION 2-2 EL. 746.10 (2'-8" COVER)
SECTION 3-3 EL. 745.00 (3'-7" COVER)



SECTION B-B
SCALE 3/8"=1'-0"

NOTES

1. CONDUITS SHALL BE 3" P.V.C. E.B., CARLON CAT. NO. 48713 OR EQUIVALENT.
2. CONDUITS SHALL BE CONCRETE ENCASED THROUGHOUT ENTIRE LENGTH AS SHOWN IN SECTION 1-1.
3. CONDUITS SHALL BE TERMINATED USING FEMALE FLUSH COUPLINGS (FEMALE THREADS TO SOCKET) CARLON CAT. NO. E942L OR EQUIVALENT.
4. ALL FLUSH COUPLINGS SHALL BE FLUSH WITH TERMINATING SURFACE.
5. ALL BENDS IN CONDUIT SHALL HAVE A MINIMUM 12.5' RADIUS.
6. EXERCISE CAUTION EXCAVATING IN VICINITY OF 8"Ø GAS LINE.
7. EXERCISE CAUTION DIGGING UNDER AND IN AREA OF TRANSVERSE CONDUITS.
8. CONTRACTOR TO REPLACE ALL ASPHALT REMOVED DURING CONSTRUCTION.
9. MINIMUM 30" COVER SHALL BE MAINTAINED THROUGHOUT ENTIRE DUCT RUN.



OBSOLETE DWG

SCANNED
(SEE CAD FILE)

NO	DATE	REVISIONS	BY	CHKD	APVD
1	6-87	AS BUILT	D.P		

NO	DATE	REVISIONS	BY	CHKD	APVD

DISTRIBUTION

SCADA COMM. CABLE ROUTING. 8-2-5211
GENERAL LOCATION PLAN 8-2-1002
REFERENCE DRAWINGS FILE NO

DESIGN		
DRAWN	DON PAZ	12-86
CHECKED	[illegible]	12-24-86
CIVIL	[illegible]	3/31/87
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 3/31/87
APPROVED [illegible] CHIEF ENGR. DATE 3-31-87

SCADA COMM. CABLE
B-3 - DISPATCH CTR., AUX. RUN
DUCT NEST CONSTR.

SHEET NUMBER

EJO NUMBER | FILE
SCALE 1/8"=1'-0" | PAGE
DRAWING NUMBER 8-2-6643

8/75 DIETERICH-POST CLEARPRINT 320RH

CONT'D ON DWG. #8-2-6506

#8 FUEL OIL TANK 60' DIA.

22'-9"

3'

26'-1"

GLENARM SHOP AREA

Y-1"-B7

30'-0"

10'-9"

O-8"-A1

GTO-19 (N.I.C.)

21'-6"

SUPPORT - TYP - SEE DWG #8-2-6513 (H1)

℄ EL. 2'-5"

℄ EL. 2'-5"

O-3"-A1

H1-TYPE SUPPORTS -TYP

1' O.C, TYP

O-4"-A1

FOR DETAIL SEE DWG #8-2-6511

CORING REQ. - 4 PL

8'

O-12"-A1 (IN)

2'-6"

E

E

A

A

D

D

O-1"-B1

8" TEE

UNLOADING PUMPS

#9 FUEL OIL LINE (EXISTING)

12"x8" CONC. RED.

EXISTING F.O. LINE TURNS SOUTH AT APPROX. THIS POINT; CONTRACTOR TO SPLICE IN WITH 8" NEW LINE FROM EAST.

EXISTING 12" TO BE REMOVED IN AREA OF TRENCH

AIR LINE TEE OUTET - CAPPED

SEE DWG #8-2-6516 FOR SECTIONS A-A, B-B, C-C. SEE #8-2-6517 FOR D-D & E-E.

GTO-15

FWD. PUMPS

STARTUP SYST

TRANSFER LINE

PIPING IN VALVE PIT & EAST IS EXISTING

#2 MANHOLE

B

B

C

C

82'-11¼"

39'

INV. EL. 742.0

CITY WATER SUPPLY TO EVAP. 1" NPT CONN EL 2'-4"

D-1"-SS

D-3"-F

W-1½"-B7

88'

SEE DWG #8-2-6518 FOR DETAILS OF ALL CONNECTIONS TO G.T.

NORTHERN DRAIN SYSTEM BY CONTR.

INV. EL. 736"

16" SEWER (EXISTING) INV. EL. 738.3

3' C.I. SOIL PIPE-TYP

48'-11"

REMOVAL ZONE

D-2"-PVC

4" SEWER - EXISTING

26'-4" TYP

INLET SILENCER

INLET PLENUM

FUEL OIL CONN. 4" 150# RF FLANGE ℄ ELEV. 1'-6"

DEMIN. WATER 3" S.S. PLAIN END ℄ ELEV. 1'-11"

DEMIN. BYPASS 1¼" NPT ℄ ELEV. 1'-11"

WASTE HEAT BOILER AREA

PREFILTER FILTER/COALESCER

WATER SUPPLY

D-2"-PVC

V-¾"-B7

W-1½"-B7

WALL

V-¾"-B7

SEE DWG #8-2-6513 FOR DRAIN DETAIL

GAS FILTER

WATER COND SKID & PUMP

EVAPORATIVE COOLER

WATER SUPPLY

13'

9'-0"

13'-0"

6"

20'

20'

10'

2"

32'-6"

TURBINE MODULE

19'

9'

COOLING TOWER

GAS ASSIST 1¼" NPT ℄ ELEV. 2'-4"

14'-6" TYP

SEE DWG #8-2-6513 FOR DETAIL OF SERVICE AIR & WATER CONNS.

33'

EXHAUST STACK

W-1½"-B7

V-¾"-B7

6'x10' UNDERGROUND ELEC. VAULT

4½'

GAS FUEL 6", 300# FLANGE ℄ ELEV. 6'-10"

GTV-3

AUXILIARY MODULE

ALTERNATOR MODULE

SOUTHERN DRAINS BY C-W-C

G-8"-B1

G-6"-B1

REF. ELEV. 0-0 = 750.11

CONT'D ON DWG #8-2-6508

FOR SPEC. #LD-74-13

SHEET NUMBER

NO	DATE	REVISIONS	BY	CHKD	APVD
1	10-10-74	FUEL STARTUP SYSTEM - GLENARM	JR.		
2	12-1-77	EVAP COOLER FILL & MAKE-UP WATER OF 2-1" ø LINES TAPPED FROM CITY WATER LINE	VE		
3	2-14-75	ADDED DEMIN VALVES	TI		
4	1-75	ADDED SERVICE AIR & WATER	TI		

DISTRIBUTION

REFERENCE DRAWINGS

FILE NO

DESIGN		
DRAWN	IM HOFF	8-74
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED _____ ENGR. DATE 9/4/74

APPROVED _____ CHIEF ENGR. DATE _____

GLENARM GAS TURBINE PLANT

PIPING AREA II

EJO NUMBER

FILE

SCALE 1/8" = 1'

PAGE

DRAWING NUMBER 8-2-6507

DIETZGEN-POST CLEARPRINT 3000H 200 11/72

Part of Glen B. demolished

(E) BLDG.

(E) WASH ROOM

(E) CIRC. LINE TUNNEL TOP EL. 750.01

LOW POINT

DIKE AREA

N

6" concrete strip slab with expansion joint cast after setting dike and constructing trench

Slope to drain

DOWN

SLOPE = 0.5%

NEW CONC. DECK EL. 751.11 (SEE SHT. 7)

℄ Existing 8" oil line

Exist. oil lines

F.L.-744.33 T-750.11

F.L.-744.83 T-750.11

F.L.-744.33 T-751.11

F.L.-744.83 T-751.11

F.L.-744.83 T-751.11

T-750.11

15'-9"

16'-0"

(E) 15"ϕ R.C.P.

(E) 4'ϕ SEWER

(E) 8'ϕ S.S. LATERAL

(E) RES. WALL

PRE-CAST CONC. PANELS

48'-0" (TYP.)

PLAN

LEGEND

T = TOP OF TRENCH
F.L. = FLOW LINE
℄ = EXISTING

CONSTRUCTION OF FIRST 14'-5⅝" OF TRENCH BY CURTISS WRIGHT CORP.

1½" GRATING (TYP.)

14'-5⅝" (TYP.)

EQ + 0

1+51

F.L.-744.62

T-750.11

⅝" ELASTITE EXP. JT. (TYP.)

2'-5⅜"

10'-9"

℄ R.C.P.

NEW 4'-0" I.D. TRENCH

WATER PUMP & WATER COND. SWD FDN. (TYP.)

NEW 4'-0" I.D. TRENCH

1/8" = 1'-0"

4'-0" I.D. TRENCH GRATING 1½" x ⅜" x 4'-3⅛"

5'-0" I.D. TRENCH GRATING 1½" x ⅜" x 5'-3⅛"

1½" x ½" BANDING BAR

L 1½" x 2" x ¼"

BAR ⅜" x 1" OR ⅜" x 4" NELSON STUDS @ 6'-0" C.C.

DETAIL 1

CONC. PANEL

EL. 750.11

BAR ⅜" x 4" x 4'-8" W/5 ⅜" x 4" NELSON STUDS STAGGERED 2" HORIZ

NELSON STUDS

1-⅞" ϕ x 2'-0" LG. BOLT THRU TOP & BOTTOM FOR MOUNTING BAR TO FORMS

DETAIL 2 PIPE SUPPORT BAR

PRIME PAINT (NO GALVANIZE)

5'-0"

6'-0"

4'-0"

5'-0"

9"

2" CLR.

1½"

EL. 750.11

SEE DETAIL 1

STEEL BAR SEE SEC. B-B & DET. 2

#4 @ 9 (TYP.)

VARIES

2'-0"

#6 DOWELS @ 6

ROUGHEN CONST. JT.

5'CLR.

#6 @ 6

2'-0"

SECTION A-A

NOTE: SECTION A-A APPLIES TO 4'-0" I.D. TRENCH W/GRATING AND 5'-0" I.D. TRENCH W/GRATING

7 SPCS @ 7'-0" = 49'-0"

EL. 751.11

PRE-CAST CONC. PANELS

1½" GRATING

EL. 750.11

SEE DETAIL 2 PIPE SUPPORT BAR (NOT TO BE GALVANIZED) PRIME PAINT ONLY

SECTION B-B

NOTES:

1. ~~SCHEDULE TRENCH CONSTRUCTION PRIOR TO LOCAL FOUNDATION CONSTRUCTION.~~
2. ALL STRUCTURAL & GRATING STEEL SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION PER ASTM-123 UNLESS NOTED.
3. STRUCTURAL STEEL SHAPES, PLATES AND BARS ASTM A-36 DETAILED PER AISC CODE 7TH EDITION, SUBMIT SHOP DWG. FOR APPROVAL PRIOR TO FABRICATION.
4. ALL GRATING SHALL BE WESTGRATE OR EQUAL PW-7 W/ BEARING BAR @ 1 7/32" C.C. WITH SPACER BAR @ 4' C.C. & 1½" x ⅜" BANDING BAR EACH END WELDED TO EVERY BEARING BAR.
5. ALL WELDING SHALL BE PERFORMED BY CERTIFIED WELDERS IN ACCORDANCE WITH AWS STANDARDS.
6. ALL REINFORCING STEEL SHALL BE ASTM-A615 GRADE 60, DETAILED PER ACI CODE, SUBMIT SHOP DWG. FOR APPROVAL PRIOR TO FABRICATION.
7. LONGITUDINAL BARS SHALL BE LAPPED 20 DIAMETERS AT SPLICES.
8. CONCRETE MIX SHALL BE 6 SACK, ¾" MAX. AGGREGATE, MIN. COMPRESSIVE STRENGTH OF 3000 PSI @ 28 DAYS.
9. LONGITUDINAL STEEL FOR THE PORTION OF TRENCH CONSTRUCTED BY CURTISS WRIGHT CORP. SHALL EXTEND 30 DIA. FROM THE NORTH END OF THE TRENCH.
10. FIRST 14'-5⅝" OF 4'-0" I.D. TRENCH WILL BE CONSTRUCTED AND BACKFILLED BY CURTISS WRIGHT CORP. CONTRACTOR TO REMOVE BACKFILL MATERIAL AND PROVIDE GRATING.
11. INSTALL DRAIN GRATE AT LOW POINT OF 5'-0" I.D. TRENCH AND CONNECT TO EXISTING 15" R.C.P.

SHEET NUMBER S-1

NO	DATE	REVISIONS	BY	CHKD	APVD
1	9-27-74	CORR. GRATING, 5½" TO 11" ADD CONC. PANELS	LJT		DAS

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS

FILE NO

DESIGN	B. HEDLUND	7-26-74
DRAWN	L. JONES	7-26-74
CHECKED	B. HEDLUND	7-29-74
CIVIL	[signature]	8-1-74
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED [signature] ENGR. DATE 8/1/74.

APPROVED [signature] CHIEF ENGR. DATE 8-1-74

GLENARM GAS TURBINE PLANT
FUEL OIL STORAGE AND PUMPING FACILITIES
PIPE TRENCH PLAN AND DETAILS

EJO NUMBER | FILE
SCALE U.T.S. | PAGE
DRAWING NUMBER S-2-6606

DISTRIBUTION

DIETZGEN-POST CLEARPRINT 2000H 200 11/72

AIR COMPRESS. ROOM

CIRC. LINE TUNNEL

#6 & 7 TUNNELS

#8 F.O. LINE (EXISTING) TO BE ABANDONED

SEE DWG #8-2-6519

V-1"-87

GTO-20

EXISTING

CONTR. TO TEE FROM EXISTING 12" LINE TO #8 F.O. LINE – SEE DWG # 8-2-6517 FOR DETAIL

15'-9"

O-12"-AI (EXISTING)

SOFTENERS

EXISTING AIR LINE IN STORM DRAIN

SEE DWG #8-2-6514 FOR DETAIL OF PIPING IN THIS AREA

5'-8"

4" SEWER (EXISTING) INV. EL. 748.0 CAST IRON

DEMINERALIZED WATER STORAGE TANK

WATER TANK

WATER TANK

CIRC. WATER LINE

CITY WATER LINE (EXISTING)

SEE DWG #8-2-6515 FOR LINE IDENTIFICATION

ACID FEED PUMP HOUSE

SEE DWG #8-2-6517 FOR PIPING DETAILS

MARLEY #3 COOLING TOWER

CAUSTIC TANK

DEMINERALIZER

INV. EL. 748.51 - ½% SL. TO SEWER

FOR DETAIL OF DEMIN. AREA SEE DWG #8-2-6515

BRINE TANK

QUONSET HUTS

STORM DRAIN

ACID TANK

R.R. SPUR

REF. ELEV. 0-0" = 750.11

CONT'D ON DWG #8-2-6507

FOR SPEC. #LD-74-13

NO	DATE	REVISIONS	BY	CHKD	APVD
3	9-16-75	DEMIN DRAINS & AIR LINES	TI		
2	4-30-75	RE-ROUTED AIR LINE	TI		
1	2-17-75	ADD. SERVICE AIR & WATER & SEWER	TI		

DISTRIBUTION

DIETERICH-POST CLEARPRINT 3000H 1006 11/72

DESIGN		
DRAWN	IMHOFF	8-74
CHECKED		
CIVIL		
ELECT.		
MECH.		

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED _____ ENGR. DATE 9/4/74

APPROVED _____ CHIEF ENGR. DATE _____

GLENARM GAS TURBINE PLANT

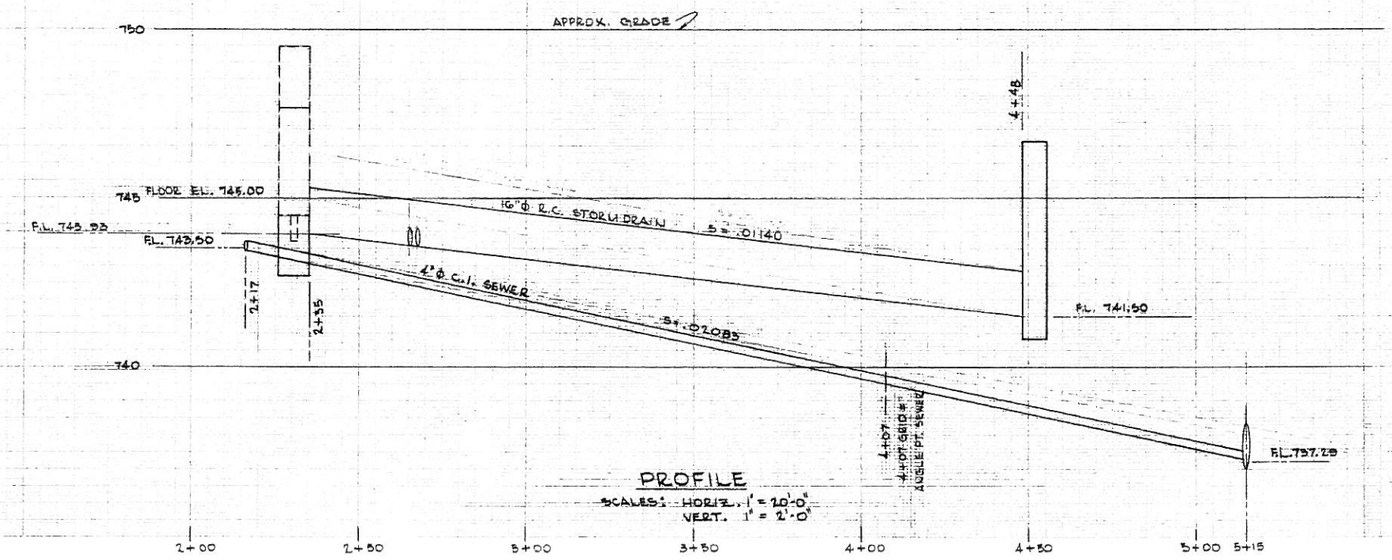
PIPING AREA V - DEMINERALIZER

EJO NUMBER | FILE

SCALE 1/8" = 1' | PAGE

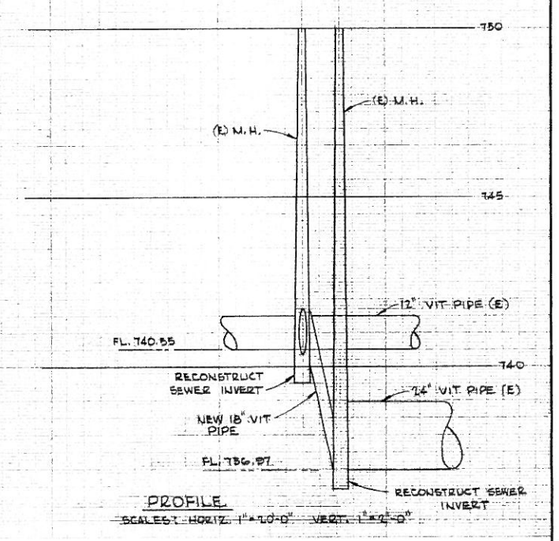
DRAWING NUMBER 8-2-6510

SHEET NUMBER



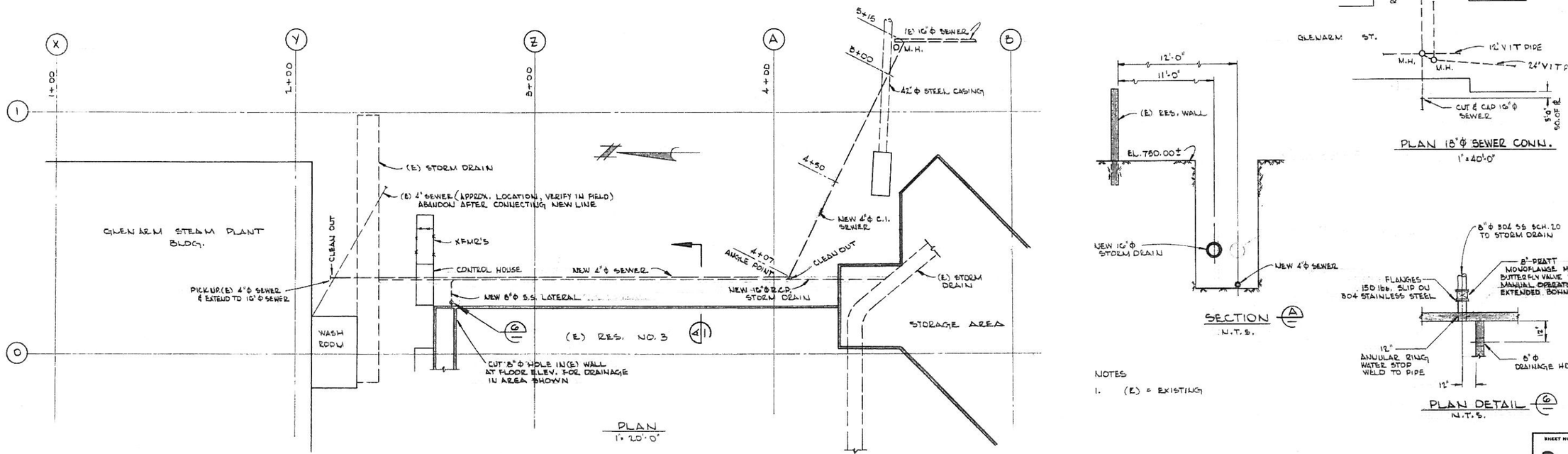
PROFILE

SCALES: HORIZ. 1" = 10'-0"
VERT. 1" = 2'-0"



PROFILE

SCALES: HORIZ. 1"=10'-0" VERT. 1"=4'-0"



PLAN

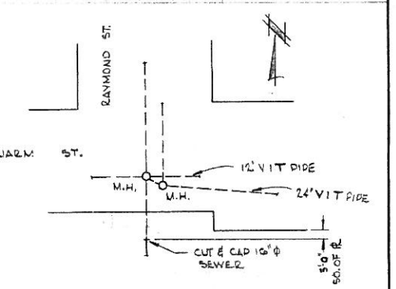
1" = 20'-0"

SECTION A

N.T.S.

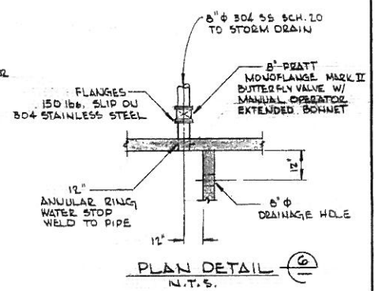
NOTES

1. (E) = EXISTING



PLAN 18"Ø SEWER CONN.

1" = 40'-0"



PLAN DETAIL

N.T.S.

SHEET NUMBER S-3

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	BH HEDLUND	1-11-74
DRAWN	L. JONES	12-18-73
CHECKED	BH HEDLUND	1-11-74
CIVIL	BH Hedlund	1-11-74
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED J Healy ENGR. DATE 1/14/74
APPROVED G Brooks CHIEF ENGR. DATE 1-14-74

GLENARM GAS TURBINE PLANT

SITE PREPARATION

4"Ø SEWER, 16"Ø STORM DRAIN, 18"Ø SEWER.

EJO NUMBER	071-03-51
FILE	
SCALE	UDTED
PAGE	
DRAWING NUMBER	8-2-66603

DIETZGEN-POST CLEARPRINT 3000H 200 11/72

NOTES:
1. REMOVE TEMPORARY WIRE FABRIC CONSTRUCTION FENCE.
2. SALVAGE AND RE-USE EXISTING PED. GATE.
3. ALL MANHOLE COVERS SHALL BE SET TO FINISHED PAVING GRADE.
4. EXISTING GRADE OF AREA 751.0 ±

NEW CONC. DRIVEWAY APRON

GILENARM BASELINE

(E) PARKWAY

(E) SIDEWALK

NEW CURB W/O FENCE

NEW CURB W/ FENCE

LIMITS OF A.C. PAVING

A.T. AND S.F. RAILWAY

NEW 10'-0" x 30'-0" CONC. SLAB (SEE SHT. C4 DETAIL B)

G.T. TANK NO. 2

F.O. TANK NO. 8

G.T. TANK NO. 1

(E) SLABS & TANK

SEE SHT. C

NEW CONC. SLAB

NEW 17' x 48' CONC. SLAB (SEE SHT. C4 DETAIL B)

C.B. JUNCTION

RIDGE

(E) 42" ϕ STEEL CASING

100'-0" ±

(E) 16" ϕ SEWER

(E) WATER MAIN

O.H.

3'-0" PED. GATE

(E) STORM DRAIN

NEW 8'-0" HIGH WIRE FABRIC FENCE W/O CURB

NEW 17' x 48' CONC. SLAB (SEE SHT. C DETAIL B)

GLENARM ST.

GLENARM STEAM PLANT

(E) PIPE TRENCH

WASH R.M.

CONTROL HOUSE

(E) 15" ϕ STORM DRAIN

CATCH BASIN JUNCTION

(E) C.B.

MARLEY NO. 3 COOLING TOWER (OLD BRAUN)

(E) BLDGS.

STORAGE AREA

(NEW 1" A.C. PAVING STORAGE AREA ONLY)

NEW 4" A.C. PAVING

LIMITS OF NEW 4" A.C. PAVING

140' RADIUS

NEW CURB W/O FENCE

STATE ST.

SPUR TRACK

SHEET NUMBER S-1

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	5	5-12-75	ADDED ADDITIONAL C.B., CHGD. DRIVEWAY RADIUS	L.J.	GJ	JF

DIETERICH-POST CLEARPRINT 2000H 800 11/72

DESIGN	L. JONES	11-25-74
DRAWN	L. JONES	11-25-74
CHECKED	L. Hairston	2-7-75
CIVIL	L. Hairston	2-7-75
ELECT.		
MECH.		DATE

REFERENCE DRAWINGS

FILE NO

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED
DATE 2/4/75 ENGR.

APPROVED
DATE 2-14-75 CHIEF ENGR.

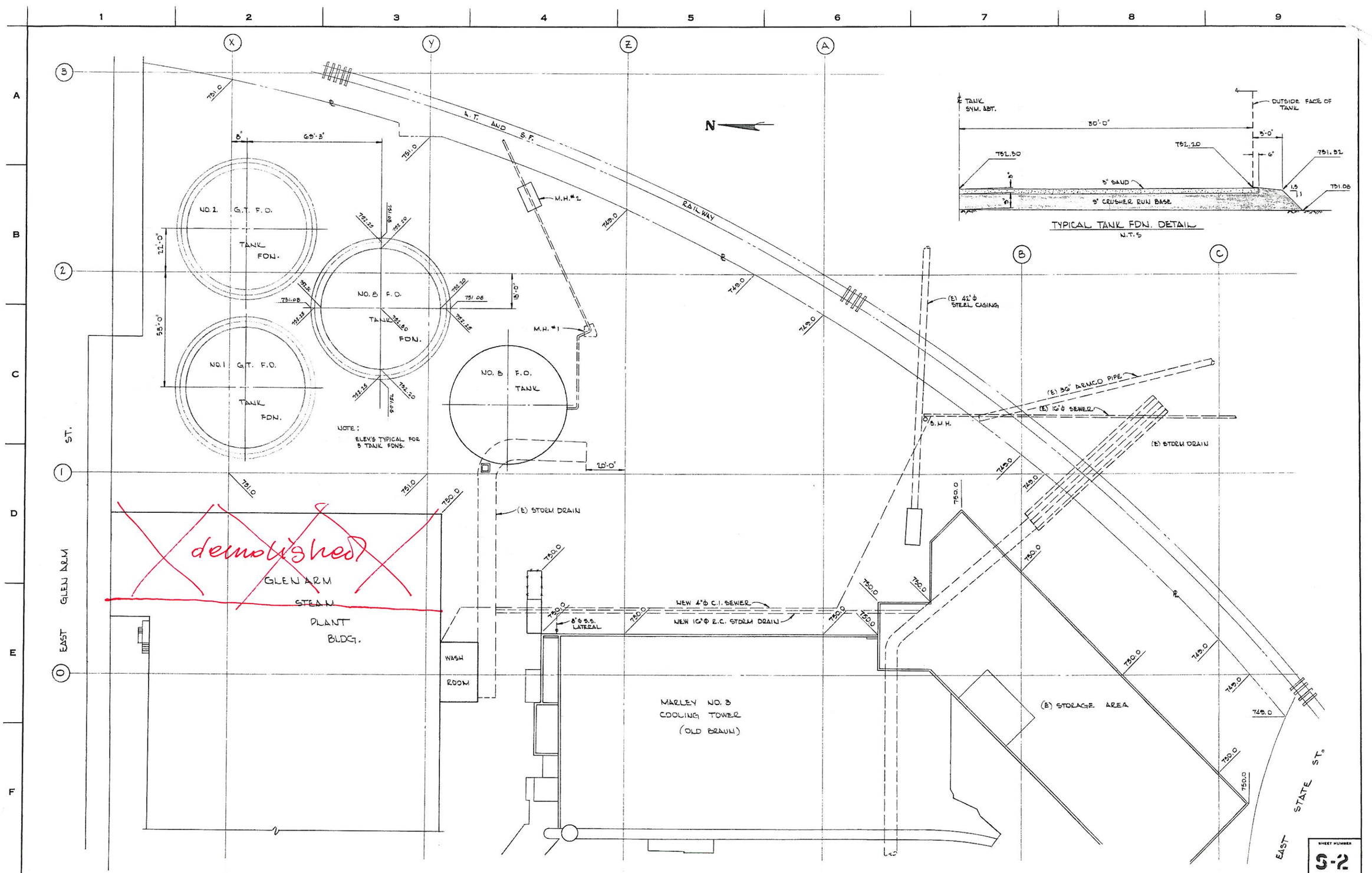
GLENARM GAS TURBINE PLANT

PLOT PLAN
GRADING & PAVING

EJO NUMBER | FILE

SCALE 1" = 20'-0" | PAGE

DRAWING NUMBER 8-2-6613



DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DIETERICH-POST CLEARPRINT 330DH 800 11/72

DESIGN	B.H.HEDLUND	1-11-74
DRAWN	L. JONES	1-74
CHECKED	B.H.HEDLUND	1-11-74
CIVIL	B.H.Hedlund	1-11-74
ELECT.		
MECH.		DATE

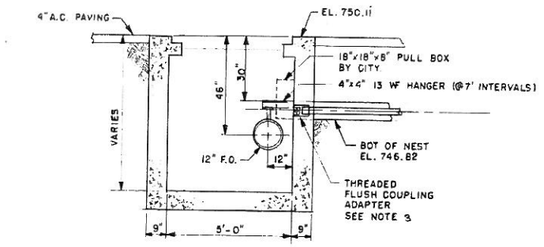
POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED J. Tracy ENGR. DATE 1/16/74
APPROVED CHIEF ENGR. DATE 1-16-74

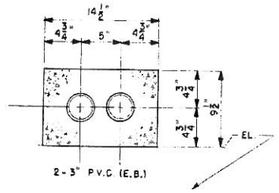
GLENARM GAS TURBINE PLANT

SITE PREPARATION GRADING PLAN

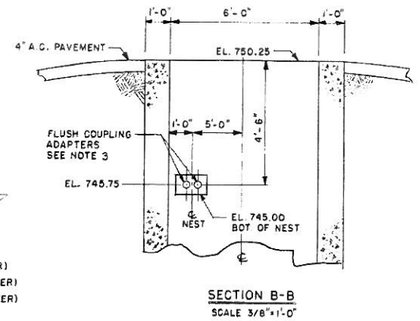
EJO NUMBER 071-03-51 FILE
SCALE 1"=20'-0" PAGE
DRAWING NUMBER B-2-6602
SHEET NUMBER S-2



SECTION A-A
SCALE: 3/8"=1'-0"



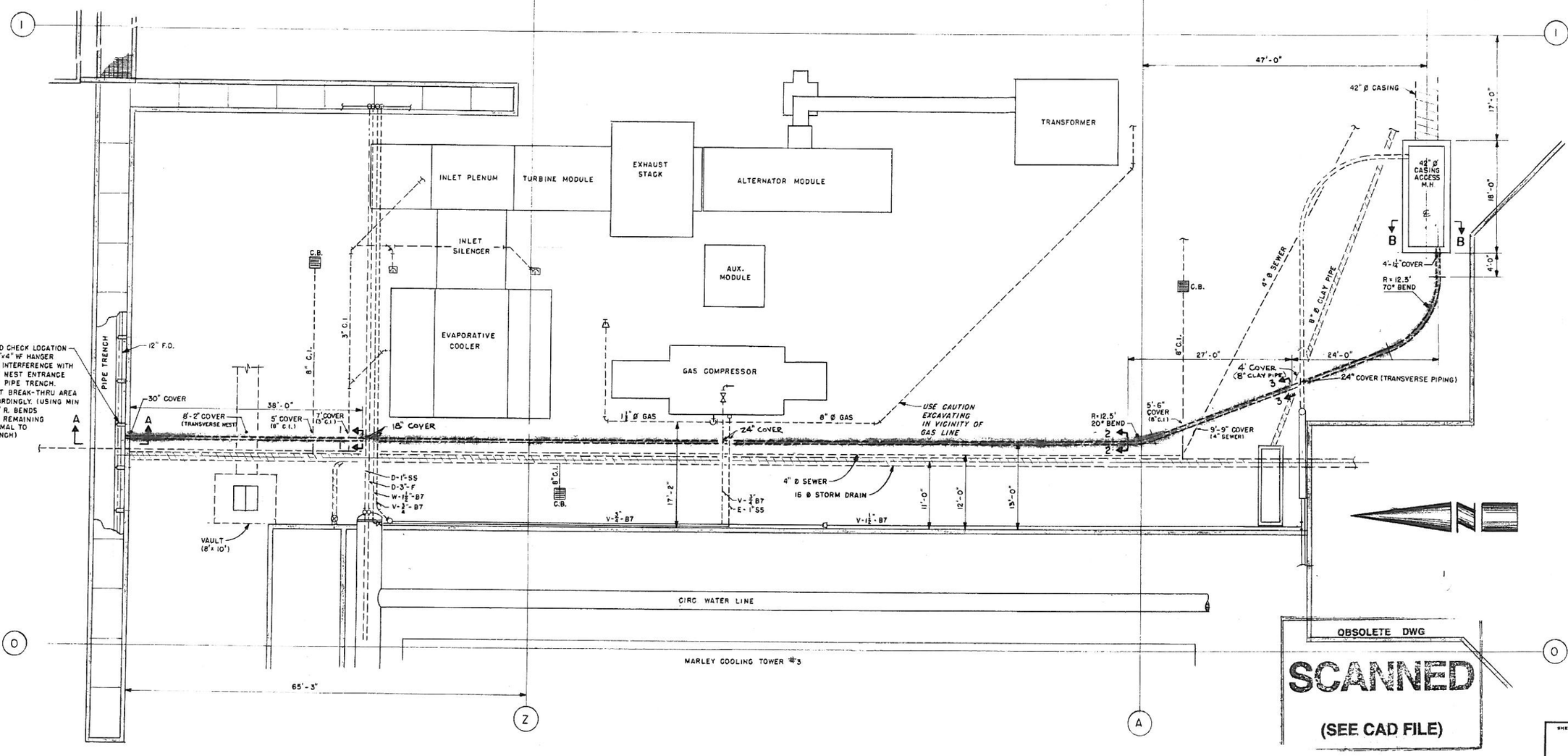
SECTION 1-1 EL. 746.10 (3' COVER)
SECTION 2-2 EL. 746.10 (2'-8" COVER)
SECTION 3-3 EL. 745.00 (3'-7" COVER)



SECTION B-B
SCALE 3/8"=1'-0"

NOTES

1. CONDUITS SHALL BE 3" P.V.C. E.B., CARLON CAT. NO. 48713 OR EQUIVALENT.
2. CONDUITS SHALL BE CONCRETE ENCASED THROUGHOUT ENTIRE LENGTH AS SHOWN IN SECTION 1-1.
3. CONDUITS SHALL BE TERMINATED USING FEMALE FLUSH COUPLINGS (FEMALE THREADS TO SOCKET) CARLON CAT. NO. E942L OR EQUIVALENT.
4. ALL FLUSH COUPLINGS SHALL BE FLUSH WITH TERMINATING SURFACE.
5. ALL BENDS IN CONDUIT SHALL HAVE A MINIMUM 12.5' RADIUS.
6. EXERCISE CAUTION EXCAVATING IN VICINITY OF 8"Ø GAS LINE.
7. EXERCISE CAUTION DIGGING UNDER AND IN AREA OF TRANSVERSE CONDUITS.
8. CONTRACTOR TO REPLACE ALL ASPHALT REMOVED DURING CONSTRUCTION.
9. MINIMUM 30" COVER SHALL BE MAINTAINED THROUGHOUT ENTIRE DUCT RUN.



OBSOLETE DWG

SCANNED
(SEE CAD FILE)

NO	DATE	REVISIONS	BY	CHKD	APVD
1	6-87	AS BUILT	D.P		

NO	DATE	REVISIONS	BY	CHKD	APVD

DISTRIBUTION

SCADA COMM. CABLE ROUTING. 8-2-5211
GENERAL LOCATION PLAN 8-2-1002
REFERENCE DRAWINGS FILE NO

DESIGN		
DRAWN	DON PAZ	12-86
CHECKED	[illegible]	12-24-86
CIVIL	[illegible]	3/31/87
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED [illegible] ENGR. DATE 3/31/87
APPROVED [illegible] CHIEF ENGR. DATE 3-31-87

SCADA COMM. CABLE
B-3 - DISPATCH CTR., AUX. RUN
DUCT NEST CONSTR.

SHEET NUMBER

EJO NUMBER | FILE
SCALE 1/8"=1'-0" | PAGE
DRAWING NUMBER 8-2-6643

8/75 DIETERICH-POST CLEARPRINT 320RH

CONT'D ON DWG. #8-2-6506

#8 FUEL OIL TANK 60' DIA.

22'-9"

3'

26'-1"

GLENARM SHOP AREA

Y-1"-B7

30'-0"

10'-9"

O-8"-A1

GTO-19 (N.I.C.)

21'-6"

SUPPORT - TYP - SEE DWG #8-2-6513 (H1)

℄ EL. 2'-5"

℄ EL. 2'-5"

O-3"-A1

H1-TYPE SUPPORTS -TYP

1' O.C, TYP

O-4"-A1

FOR DETAIL SEE DWG #8-2-6511

CORING REQ. - 4 PL

8'

O-12"-A1 (IN)

2'-6"

E

E

A

A

D

D

O-1"-B1

8" TEE

UNLOADING PUMPS

#9 FUEL OIL LINE (EXISTING)

12"x8" CONC. RED.

EXISTING F.O. LINE TURNS SOUTH AT APPROX. THIS POINT; CONTRACTOR TO SPLICE IN WITH 8" NEW LINE FROM EAST.

EXISTING 12" TO BE REMOVED IN AREA OF TRENCH

AIR LINE TEE OUTET - CAPPED

SEE DWG #8-2-6516 FOR SECTIONS A-A, B-B, C-C. SEE #8-2-6517 FOR D-D & E-E.

GTO-15

FWD. PUMPS

STARTUP SYST

TRANSFER LINE

PIPING IN VALVE PIT & EAST IS EXISTING

#2 MANHOLE

B

B

C

C

82'-11¼"

39'

INV. EL. 742.0

CITY WATER SUPPLY TO EVAP. 1" NPT CONN EL 2'-4"

D-1"-SS

D-3"-F

W-1½"-B7

88'

SEE DWG #8-2-6518 FOR DETAILS OF ALL CONNECTIONS TO G.T.

NORTHERN DRAIN SYSTEM BY CONTR.

INV. EL. 736"

16" SEWER (EXISTING) INV. EL. 738.3

3' C.I. SOIL PIPE-TYP

48'-11"

REMOVAL ZONE

D-2"-PVC

4" SEWER - EXISTING

26'-4" TYP

INLET SILENCER

INLET PLENUM

FUEL OIL CONN. 4" 150# RF FLANGE ℄ ELEV. 1'-6"

DEMIN. WATER 3" S.S. PLAIN END ℄ ELEV. 1'-11"

DEMIN. BYPASS 1¼" NPT ℄ ELEV. 1'-11"

WASTE HEAT BOILER AREA

PREFILTER FILTER/COALESCER

WATER SUPPLY

D-2"-PVC

V-¾"-B7

W-1½"-B7

WALL

V-¾"-B7

SEE DWG #8-2-6513 FOR DRAIN DETAIL

GAS FILTER

WATER COND SKID & PUMP

EVAPORATIVE COOLER

WATER SUPPLY

13'

9'-0"

13'-0"

6"

20'

20'

10'

2"

32'-6"

TURBINE MODULE

19'

9'

COOLING TOWER

GAS ASSIST 1¼" NPT ℄ ELEV. 2'-4"

14'-6" TYP

SEE DWG #8-2-6513 FOR DETAIL OF SERVICE AIR & WATER CONNS.

33'

EXHAUST STACK

W-1½"-B7

V-¾"-B7

6'x10' UNDERGROUND ELEC. VAULT

4½'

GAS FUEL 6", 300# FLANGE ℄ ELEV. 6'-10"

GTV-3

AUXILIARY MODULE

ALTERNATOR MODULE

SOUTHERN DRAINS BY C-W-C

G-8"-B1

G-6"-B1

REF. ELEV. 0-0 = 750.11

CONT'D ON DWG #8-2-6508

FOR SPEC. #LD-74-13

SHEET NUMBER

NO	DATE	REVISIONS	BY	CHKD	APVD
1	10-10-74	FUEL STARTUP SYSTEM - GLENARM	JR.		
2	12-1-77	EVAP COOLER FILL & MAKE-UP WATER OF 2-1" ø LINES TAPPED FROM CITY WATER LINE	VE		
3	2-14-75	ADDED DEMIN VALVES	TI		
4	1-75	ADDED SERVICE AIR & WATER	TI		

DISTRIBUTION

REFERENCE DRAWINGS

FILE NO

DESIGN		
DRAWN	IM HOFF	8-74
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED _____ ENGR. DATE 9/4/74

APPROVED _____ CHIEF ENGR. DATE _____

GLENARM GAS TURBINE PLANT

PIPING AREA II

EJO NUMBER

FILE

SCALE 1/8" = 1'

PAGE

DRAWING NUMBER 8-2-6507

DIETZGEN-POST CLEARPRINT 3000H 200 11/72

Part of Glen B. demolished

(E) BLDG.

(E) WASH ROOM

(E) CIRC. LINE TUNNEL TOP EL. 750.01

LOW POINT

DIKE AREA

N

6" concrete strip slab with expansion joint cast after setting dike and constructing trench

Slope to drain

DOWN

SLOPE = 0.5%

NEW CONC. DECK EL. 751.11 (SEE SHT. 7)

℄ Existing 8" oil line

Exist. oil lines

F.L.-744.33 T-750.11

F.L.-744.83 T-750.11

F.L.-744.33 T-751.11

F.L.-744.83 T-751.11

F.L.-744.83 T-751.11

T-750.11

15'-9"

16'-0"

(E) 15"ϕ R.C.P.

(E) 4'ϕ SEWER

(E) 8'ϕ S.S. LATERAL

(E) RES. WALL

PRE-CAST CONC. PANELS

48'-0" (TYP.)

PLAN

LEGEND

T = TOP OF TRENCH
F.L. = FLOW LINE
℄ = EXISTING

CONSTRUCTION OF FIRST 14'-5⅝" OF TRENCH BY CURTISS WRIGHT CORP.

1½" GRATING (TYP.)

14'-5⅝" (TYP.)

EQ + 0

1+51

F.L.-744.62

T-750.11

⅝" ELASTITE EXP. JT. (TYP.)

2'-5⅜"

10'-9"

℄ R.C.P.

NEW 4'-0" I.D. TRENCH

WATER PUMP & WATER COND. SWD FDN. (TYP.)

NEW 4'-0" I.D. TRENCH

1/8" = 1'-0"

4'-0" I.D. TRENCH GRATING 1½" x ⅜" x 4'-3⅛"

5'-0" I.D. TRENCH GRATING 1½" x ⅜" x 5'-3⅛"

1½" x ½" BANDING BAR

L 1½" x 2" x ¼"

BAR ⅜" x 1" OR ⅜" x 4" NELSON STUDS @ 6'-0" C.C.

DETAIL 1

CONC. PANEL

EL. 750.11

BAR ⅜" x 4" x 4'-8" W/5 ⅜" x 4" NELSON STUDS STAGGERED 2" HORIZ

NELSON STUDS

1-⅞" ϕ x 2'-0" LG. BOLT THRU TOP & BOTTOM FOR MOUNTING BAR TO FORMS

DETAIL 2 PIPE SUPPORT BAR

PRIME PAINT (NO GALVANIZE)

5'-0"

6'-0"

4'-0"

5'-0"

9"

2" CLR.

1½"

EL. 750.11

SEE DETAIL 1

STEEL BAR SEE SEC. B-B & DET. 2

#4 @ 9 (TYP.)

VARIES

2'-0"

#6 DOWELS @ 6

ROUGHEN CONST. JT.

5'CLR.

#6 @ 6

2'-0"

SECTION A-A

NOTE: SECTION A-A APPLIES TO 4'-0" I.D. TRENCH W/GRATING AND 5'-0" I.D. TRENCH W/GRATING

7 SPCS @ 7'-0" = 49'-0"

EL. 751.11

PRE-CAST CONC. PANELS

1½" GRATING

EL. 750.11

SEE DETAIL 2 PIPE SUPPORT BAR (NOT TO BE GALVANIZED) PRIME PAINT ONLY

SECTION B-B

NOTES:

1. ~~SCHEDULE TRENCH CONSTRUCTION PRIOR TO LOCAL FOUNDATION CONSTRUCTION.~~
2. ALL STRUCTURAL & GRATING STEEL SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION PER ASTM-123 UNLESS NOTED.
3. STRUCTURAL STEEL SHAPES, PLATES AND BARS ASTM A-36 DETAILED PER AISC CODE 7TH EDITION, SUBMIT SHOP DWG. FOR APPROVAL PRIOR TO FABRICATION.
4. ALL GRATING SHALL BE WESTGRATE OR EQUAL PW-7 W/ BEARING BAR @ 1 7/32" C.C. WITH SPACER BAR @ 4' C.C. & 1½" x ⅜" BANDING BAR EACH END WELDED TO EVERY BEARING BAR.
5. ALL WELDING SHALL BE PERFORMED BY CERTIFIED WELDERS IN ACCORDANCE WITH AWS STANDARDS.
6. ALL REINFORCING STEEL SHALL BE ASTM-A615 GRADE 60, DETAILED PER ACI CODE, SUBMIT SHOP DWG. FOR APPROVAL PRIOR TO FABRICATION.
7. LONGITUDINAL BARS SHALL BE LAPPED 20 DIAMETERS AT SPLICES.
8. CONCRETE MIX SHALL BE 6 SACK, ¾" MAX. AGGREGATE, MIN. COMPRESSIVE STRENGTH OF 3000 PSI @ 28 DAYS.
9. LONGITUDINAL STEEL FOR THE PORTION OF TRENCH CONSTRUCTED BY CURTISS WRIGHT CORP. SHALL EXTEND 30 DIA. FROM THE NORTH END OF THE TRENCH.
10. FIRST 14'-5⅝" OF 4'-0" I.D. TRENCH WILL BE CONSTRUCTED AND BACKFILLED BY CURTISS WRIGHT CORP. CONTRACTOR TO REMOVE BACKFILL MATERIAL AND PROVIDE GRATING.
11. INSTALL DRAIN GRATE AT LOW POINT OF 5'-0" I.D. TRENCH AND CONNECT TO EXISTING 15" R.C.P.

SHEET NUMBER S-1

NO	DATE	REVISIONS	BY	CHKD	APVD
1	9-27-74	CORR. GRATING, 5½" TO 11" ADD CONC. PANELS	LJT		DAS

NO	DATE	REVISIONS	BY	CHKD	APVD

REFERENCE DRAWINGS

FILE NO

DESIGN	B. HEDLUND	7-26-74
DRAWN	L. JONES	7-26-74
CHECKED	B. HEDLUND	7-29-74
CIVIL	[signature]	8-1-74
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED [signature] ENGR. DATE 8/1/74.

APPROVED [signature] CHIEF ENGR. DATE 8-1-74

GLENARM GAS TURBINE PLANT
FUEL OIL STORAGE AND PUMPING FACILITIES
PIPE TRENCH PLAN AND DETAILS

EJO NUMBER | FILE
SCALE U.T.S. | PAGE
DRAWING NUMBER S-2-6606

DISTRIBUTION

DIETZGEN-POST CLEARPRINT 2000H 200 11/72

AIR COMPRESS. ROOM

CIRC. LINE TUNNEL

#6 & 7 TUNNELS

#8 F.O. LINE (EXISTING) TO BE ABANDONED

SEE DWG #8-2-6519

V-1"-87

GTO-20

EXISTING

CONTR. TO TEE FROM EXISTING 12" LINE TO #8 F.O. LINE – SEE DWG # 8-2-6517 FOR DETAIL

15'-9"

O-12"-AI (EXISTING)

SOFTENERS

EXISTING AIR LINE IN STORM DRAIN

SEE DWG #8-2-6514 FOR DETAIL OF PIPING IN THIS AREA

5'-8"

4" SEWER (EXISTING) INV. EL. 748.0 CAST IRON

DEMINERALIZED WATER STORAGE TANK

WATER TANK

WATER TANK

CIRC. WATER LINE

CITY WATER LINE (EXISTING)

SEE DWG #8-2-6515 FOR LINE IDENTIFICATION

ACID FEED PUMP HOUSE

SEE DWG #8-2-6517 FOR PIPING DETAILS

MARLEY #3 COOLING TOWER

CAUSTIC TANK

DEMINERALIZER

INV. EL. 748.51 - ½% SL. TO SEWER

FOR DETAIL OF DEMIN. AREA SEE DWG #8-2-6515

BRINE TANK

QUONSET HUTS

STORM DRAIN

ACID TANK

R.R. SPUR

REF. ELEV. 0-0" = 750.11

CONT'D ON DWG #8-2-6507

FOR SPEC. #LD-74-13

NO	DATE	REVISIONS	BY	CHKD	APVD
3	9-16-75	DEMIN DRAINS & AIR LINES	TI		
2	4-30-75	RE-ROUTED AIR LINE	TI		
1	2-17-75	ADD. SERVICE AIR & WATER & SEWER	TI		

DISTRIBUTION

DIETERICH-POST CLEARPRINT 3000H 1006 11/72

DESIGN		
DRAWN	IMHOFF	8-74
CHECKED		
CIVIL		
ELECT.		
MECH.		

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED _____ ENGR. DATE 9/4/74

APPROVED _____ CHIEF ENGR. DATE _____

GLENARM GAS TURBINE PLANT

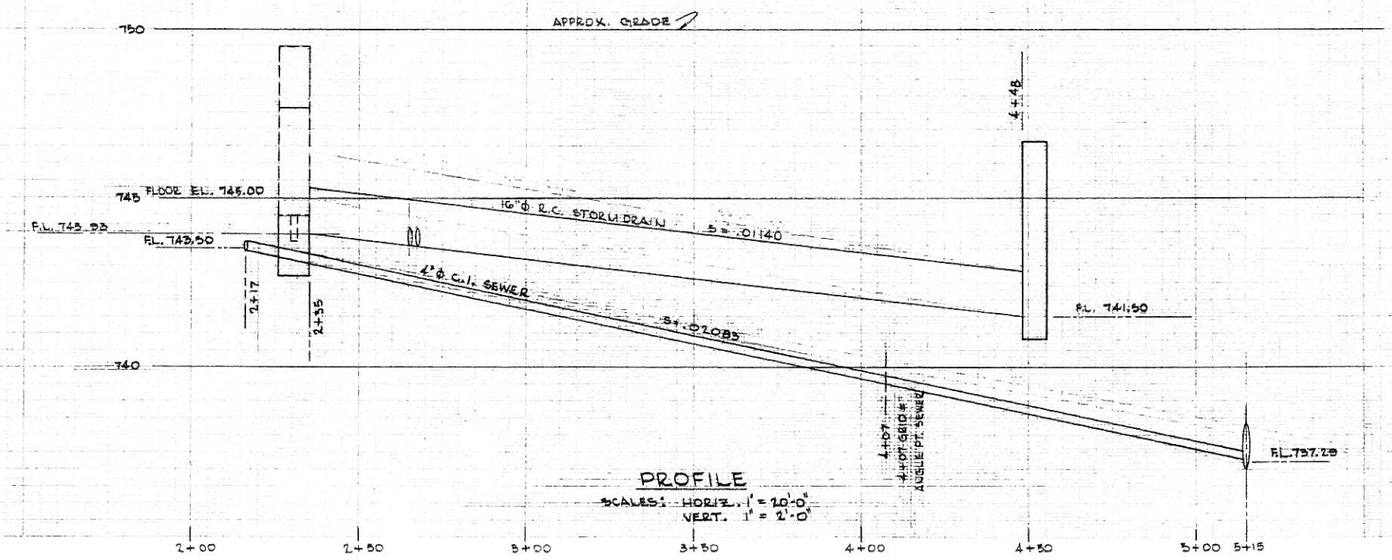
PIPING AREA V - DEMINERALIZER

EJO NUMBER | FILE

SCALE 1/8" = 1' | PAGE

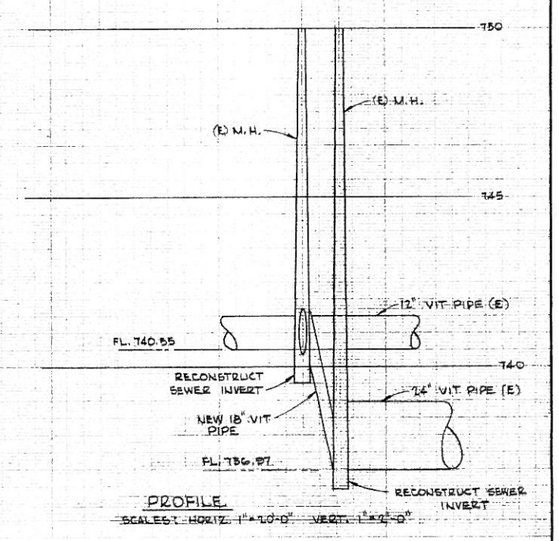
DRAWING NUMBER 8-2-6510

SHEET NUMBER



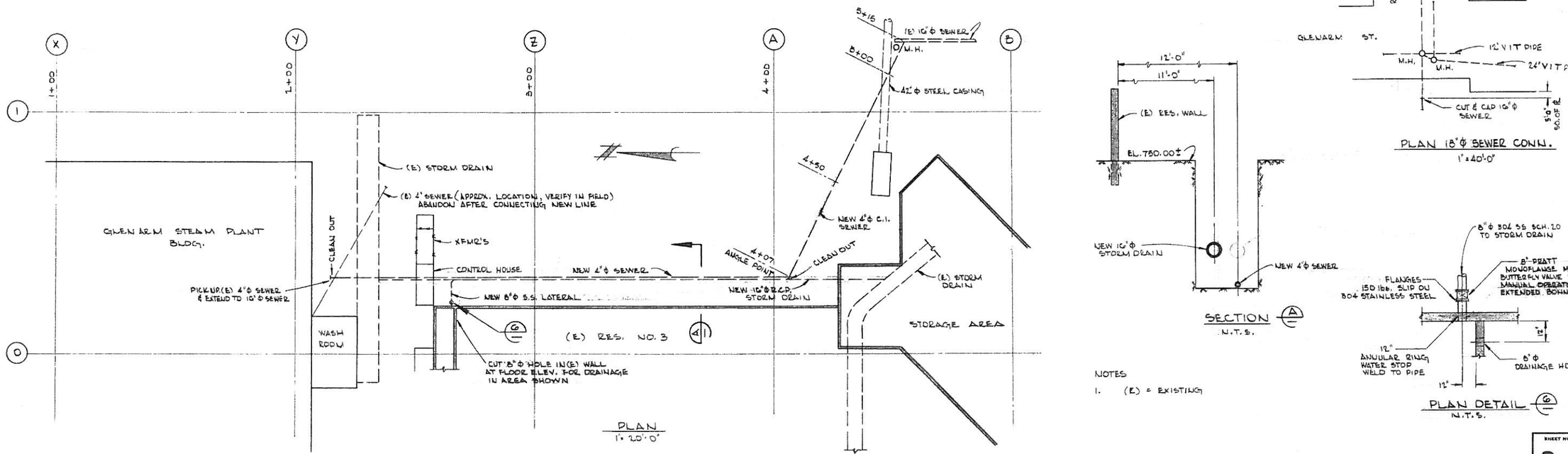
PROFILE

SCALES: HORIZ. 1" = 10'-0"
VERT. 1" = 2'-0"



PROFILE

SCALES: HORIZ. 1"=10'-0" VERT. 1"=4'-0"



PLAN

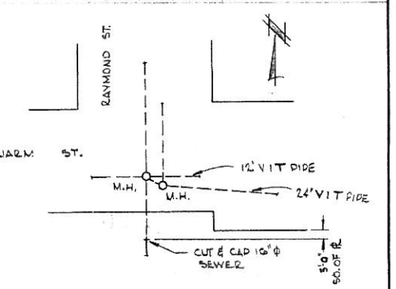
1" = 20'-0"

SECTION A

N.T.S.

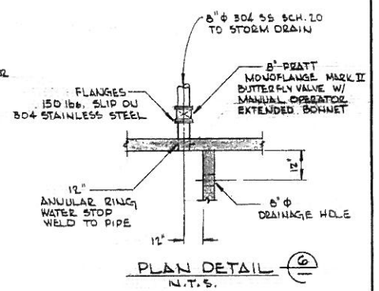
NOTES

1. (E) = EXISTING



PLAN 18"Ø SEWER CONN.

1" = 40'-0"



PLAN DETAIL

N.T.S.

SHEET NUMBER S-3

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN	BH HEDLUND	1-11-74
DRAWN	L. JONES	12-18-73
CHECKED	BH HEDLUND	1-11-74
CIVIL	BH Hedlund	1-11-74
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED J Healy ENGR. DATE 1/14/74
APPROVED G Brooks CHIEF ENGR. DATE 1-14-74

GLENARM GAS TURBINE PLANT

SITE PREPARATION

4"Ø SEWER, 16"Ø STORM DRAIN, 18"Ø SEWER.

EJO NUMBER	071-03-51
FILE	
SCALE	UDTED
PAGE	
DRAWING NUMBER	8-2-66603

DIETZGEN-POST CLEARPRINT 3000H 200 11/72

NOTES:
1. REMOVE TEMPORARY WIRE FABRIC CONSTRUCTION FENCE.
2. SALVAGE AND RE-USE EXISTING PED. GATE.
3. ALL MANHOLE COVERS SHALL BE SET TO FINISHED PAVING GRADE.
4. EXISTING GRADE OF AREA 751.0 ±

NEW CONC. DRIVEWAY APRON

GILENARM BASELINE

(E) PARKWAY

(E) SIDEWALK

NEW CURB W/O FENCE

NEW CURB W/ FENCE

LIMITS OF A.C. PAVING

A.T. AND S.F. RAILWAY

NEW 10'-0" x 30'-0" CONC. SLAB (SEE SHT. C4 DETAIL B)

G.T. TANK NO. 2

F.O. TANK NO. 8

G.T. TANK NO. 1

(E) SLABS & TANK

SEE SHT. C

NEW CONC. SLAB

NEW 17' x 48' CONC. SLAB (SEE SHT. C4 DETAIL B)

C.B. JUNCTION

RIDGE

(E) 42" ϕ STEEL CASING

100'-0" ±

(E) 16" ϕ SEWER

(E) WATER MAIN

O.H.

3'-0" PED. GATE

(E) STORM DRAIN

NEW 8'-0" HIGH WIRE FABRIC FENCE W/O CURB

NEW 17' x 48' CONC. SLAB (SEE SHT. C DETAIL B)

GLENARM ST.

GLENARM STEAM PLANT

(E) PIPE TRENCH

WASH R.M.

CONTROL HOUSE

(E) 15" ϕ STORM DRAIN

CATCH BASIN JUNCTION

(E) C.B.

MARLEY NO. 3 COOLING TOWER (OLD BRAUN)

(E) BLDGS.

STORAGE AREA

(NEW 1" A.C. PAVING STORAGE AREA ONLY)

NEW 4" A.C. PAVING

LIMITS OF NEW 4" A.C. PAVING

140' RADIUS

NEW CURB W/O FENCE

STATE ST.

SPUR TRACK

SHEET NUMBER S-1

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD
	5	5-12-75	ADDED ADDITIONAL C.B., CHGD. DRIVEWAY RADIUS	L.J.	GJ	JF

DIETERICH-POST CLEARPRINT 2000H 800 11/72

DESIGN	L. JONES	11-25-74
DRAWN	L. JONES	11-25-74
CHECKED	L. Hairston	2-7-75
CIVIL	L. Hairston	2-7-75
ELECT.		
MECH.		DATE

REFERENCE DRAWINGS

FILE NO

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED
DATE 2/4/75 ENGR.

APPROVED
DATE 2-14-75 CHIEF ENGR.

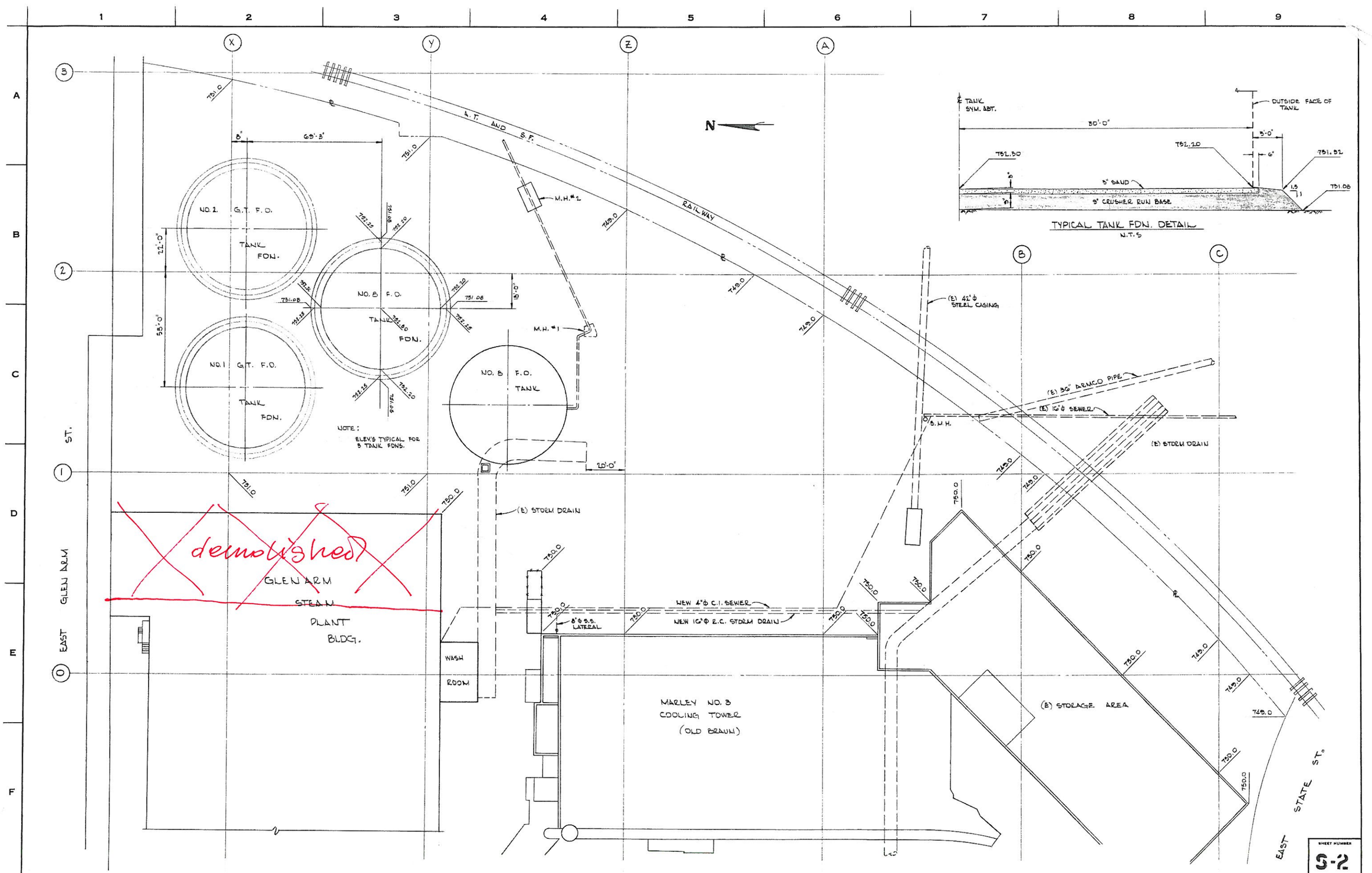
GLENARM GAS TURBINE PLANT

PLOT PLAN
GRADING & PAVING

EJO NUMBER | FILE

SCALE 1" = 20'-0" | PAGE

DRAWING NUMBER 8-2-6613



DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DIETERICH-POST CLEARPRINT 330DH 800 11/72

DESIGN	B.H.HEDLUND	1-11-74
DRAWN	L. JONES	1-74
CHECKED	B.H.HEDLUND	1-11-74
CIVIL	B.H.Hedlund	1-11-74
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED J. Tracy ENGR. DATE 1/16/74
APPROVED CHIEF ENGR. DATE 1-16-74

GLENARM GAS TURBINE PLANT

SITE PREPARATION GRADING PLAN

EJO NUMBER 071-03-51 FILE
SCALE 1"=20'-0" PAGE
DRAWING NUMBER B-2-6602
SHEET NUMBER S-2

hydrologue, Inc.

Consulting Engineers & Geologists *http://www.hydrologue.com*

Remediation Engineering *Hazardous Substances* *Geology and Hydrogeology* *Geotechnical Engineering*

August 10, 2011 Project No. 3626-04-01

Dan Angeles
City of Pasadena
Water and Power Department
85 East State Street
Pasadena, California 91105-3418

DRAFT

Re: Soil Thermal Resistivity
Pasadena Power Plant
Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Dear Mr. Angeles:

The laboratory tests have been completed for the subject project. The purpose of the laboratory testing was to determine thermal resistivity of the on-Site soil with varying moisture content and density. Thermal soil resistivities are provided as 'data only' in order to aid Geovision complete their investigation.

We understand that the proposed project consists of the construction of the Glenarm Repowering Project (GT-5 Combined Cycle Installation).

The Site is located at the southeast corner of Fair Oaks Avenue and Glenarm Street in the City of Pasadena, California (hereinafter referred to as "Site") (Figures 1 and 3), in the northwestern portion of the City of Pasadena Power Plant, the south side of old Power Plant Building.

The scope of this study is limited to a determination of on-Site soil thermal resistivity at varying density and moisture content.

Undisturbed and bulk samples of the on-Site soils were used in this study. Bulk samples of the on-site soils were compacted to various densities and moisture content. The dry density and moisture content of the bulk samples were determined using ASTM D 2216. After measuring the thermal resistivity of the soil samples, they were saturated for 24 hours. Thermal resistivity and moisture content of the saturated samples once again were determined.

Dry density and moisture content of the undisturbed on-Site soils were determined in accordance with ASTM D 2216. After measuring the thermal resistivity of the soil samples, they were saturated for 24 hours. Thermal resistivity and moisture content of the saturated samples once again were determined.

Thermal resistivity testing was performed using a Decagon KD2 portable meter. The KD2 Pro portable meter works in accordance with ASTM D 5334-08 by providing a linear heat source and temperature measuring element. Calibration in accordance with ASTM D 5334-08 was performed using a Glycerol calibration standard. ASTM D5334-08 references a published thermal conductivity for Glycerol of 0.292 Wm*1 K*1 at 25 °C. The calibration results for the KD2 meter are in the attached laboratory data sheets.

Our services have been performed with usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

This opportunity to be of service is sincerely appreciated. If you have any questions concerning this report, please do not hesitate to contact this office.

Very Truly Yours,
HYDROLOGUE, INC.

DRAFT

Seyed M. Mortazavi, Ph.D.
R.G.E. 2216
G.E.G. 1724

Attachment: Figures 1 and 2
Laboratory Measurements

CC: John Diehl, P.E., GEOVision Inc.

3626-04-01

Sample I.D.	MC %	Dry density lbs/cu.ft	date	time	K($Wm^{-1}K^{-1}$) Reading	Rho ($°Ccmw^{-1}$) Reading	T (°C) Reading	Err Reading
BH-1 @ 1-5'pt1	7.8	130.5	7/19/11	10:54	1.879	53.23	24.42	0.0039
				11:27	1.857	53.8	22.85	
				11:57	1.859	53.8	21.18	0.0035
BH-1 @ 1-5'pt2	11.1	126.6	7/25/11	2:00	1.770	56.48	22.78	0.0018
				3:18	1.783	56.09	20.38	0.0057
BH-4 @ 1-5'pt2	7.4	129.2	7/19/11	13:42	1.606	62.30	24.63	0.0096
				14:24	1.576	63.44	24.31	0.0158
	20	129.2	7/20/11	2:51	1.68	59.53	21.89	0.0033
					1.687	59.28	21.95	0.0043
BH-8 @ 1-5'pt3	8.4	131.5	7/25/11	9:46	1.441	62.4	23.31	
				10:31	1.505	66.46	23.10	0.0125
	14.3	131.5	7/27/11	1:45	1.653	60.5	22.81	0.0052
					1.646	60.75	22.84	0.0050

3626-04-01

Sample I.D.	MC %	Dry density lbs/cu.ft	date	time	K($Wm^{-1}K^{-1}$) Reading	Rho ($°Ccmw^{-1}$) Reading	T (°C) Reading	Err Reading
BH-1@ 30-31.5'	9.1	112.9	8/4/11	11:43	1.347	74.3	23.77	0.0033
				12:15	1.341	74.6	23.84	0.0031
	21	112.9	8/8/11	10:52	1.408	71.01	22.17	0.0025
				11:21	1.426	70.12	22.38	0.0028
BH-1@ 40-40.5'	7.8	104.4	8/04/11	12:45	0.785	127.4	24.11	0.0244
				12:22	0.748	133.7	24.3	0.0280
	21.7	104.4	8/8/11	11:44	1.581	63.24	22.13	0.0036
				12:03	1.575	63.50	22.35	0.0032
BH-3 @ 5-6.5'	7	109.3	8/4/11	1:49	1.550	64.5	24.65	0.0074
				2:25	1.531	65.33	24.71	0.0064
	17.4		8/8/11	12:34	1.863	53.67	21.97	0.0088

3626-04-01

Sample I.D.	MC %	Dry density lbs/cu.ft	date	time	K($Wm^{-1}K^{-1}$) Reading	Rho ($°Ccmw^{-1}$) Reading	T (°C) Reading	Err Reading
BH-3@ 20-21'	3.2	106.8	8/4/4	11:55	0.860	116.3	25.84	0.0066
				11:27	0.871	114.9	25.57	0.0067
	17.2		8/8/11	12:58	1.633	61.25	21.64	0.0037
				1:16	1.589	62.93	22.2	0.003
BH-3 @ 25'-26'	21.3	103.0	8/5/11	9:27	1.323	75.6	21.85	0.0023
				10:01	1.313	76.14	22.05	0.0017
	23.5		8/8/11	1:46	1.394	71.73	22.07	0.0021
BH-5@5'	7.3	114.9	8/5/11	10:38	1.504	66.49	39.09	0.0026
				11:01	1.561	64.07	23.22	0.0032
				11:34	1.551	64.47	23.48	0.0032
	17.5		8/8/11	2:05	1.622	61.67	22.26	0.0029

3626-04-01

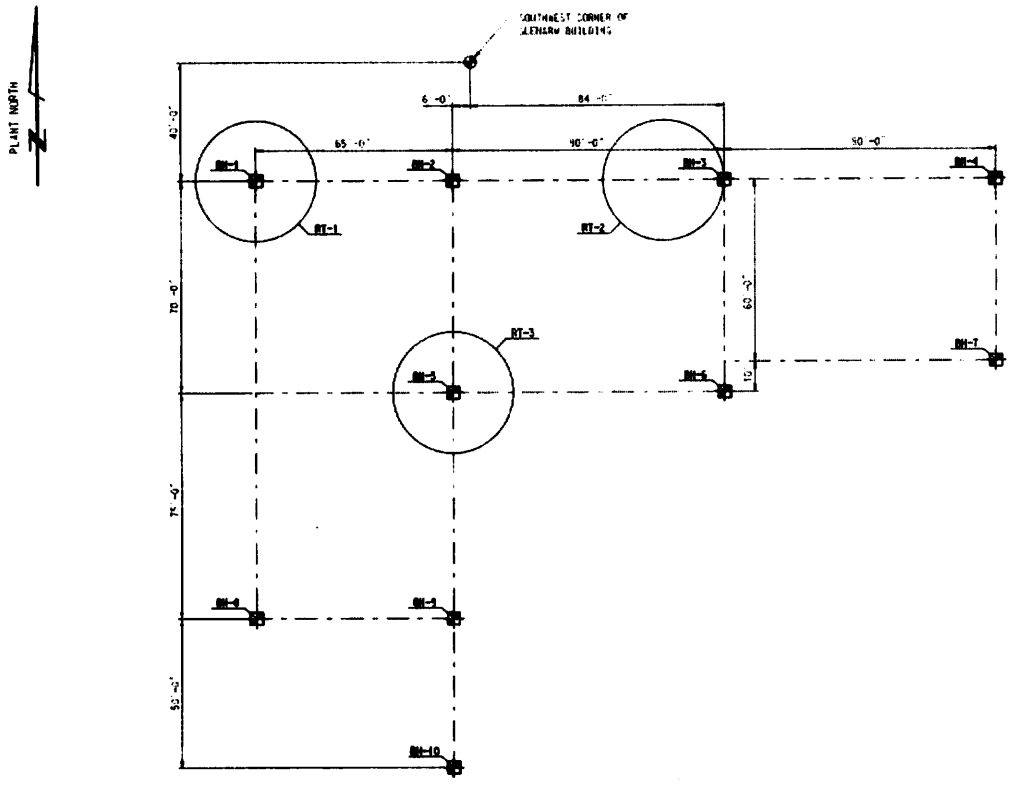
Sample I.D.	MC %	Dry density lbs/cu.ft	date	time	K($Wm^{-1}K^{-1}$) Reading	Rho ($^{\circ}Ccmw^{-1}$) Reading	T ($^{\circ}C$) Reading	Err Reading
BH-5@19.5-21'	1.4	110.2	8/5/11	12:21	0.113	883.6	24.42	0.0345
	1.4	110.2	8/5/11	12:54	0.109	915.4	24.87	0.0341
	10.2		8/8/11	2:30	2.186	45.75	21.98	0.0057
				2:50	2.044	48.91	22.56	0.0054
BH-5@ 35-36.5'	6.5	102.7	8/5/11	1:18	0.802	124.8	24.74	0.0049
				!:48	0.828	120.8	24.92	0.006
	26.9		8/8/11	3:10	1.333	75.0	22.2	0.0023

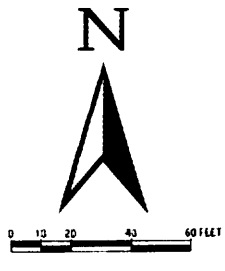


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N

CLIENT	PASADENA WATER AND POWER
LOCATION	SE Corner of Fair Oaks Ave & Glenarm Street, Pasadena, CA
TITLE	SITE LOCATION MAP
FIGURE NUMBER	1
PROJECT	3626-04-01
hydrologue, Inc. Consulting Engineers & Geologists	Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs.cdr





LEGEND

- BH-1 BOREHOLE LOCATION
- REFERENCE POINT
- RT-1 RESISTIVITY TEST AREA

NOTES

1. CONTRACTOR SHALL COORDINATE WITH APPROPRIATE UNDERGROUND UTILITY LOCATE SERVICES TO ESTABLISH THE LOCATION OF EXISTING UTILITIES IN THE WORK AREA PRIOR TO COMMENCEMENT OF DRILLING OPERATIONS. ANY DAMAGE TO EXISTING FACILITIES, EITHER ABOVE OR BELOW GRADE, CAUSED BY CONTRACTOR DURING DRILLING OPERATIONS SHALL BE REPAIRED BY CONTRACTOR TO THE OWNERS SATISFACTION.
2. LOCATIONS DESIGNATED AS RESISTIVITY TEST AREAS ARE 40' DIAMETER AND LOCATED AS SHOWN. EARTH AND THERMAL RESISTIVITY TESTS CAN BE CONDUCTED ANYWHERE WITHIN THESE ZONES.

Source: Pasadena Power Plant

CLIENT
PASADENA WATER AND POWER

LOCATION
SE Corner of Fair Oaks Ave & Glenarm Street, Pasadena, CA

TITLE
BORING LOCATIONS PROPOSED GT5 COMBINED CYCLE

FIGURE NUMBER
3

PROJECT
3626-04-01

hydrologue, Inc.
Consulting Engineers & Geologists

Z:Reports:Phase2:3626-00 Pasadena Power Plan PPP:3626-04-01 figs:3626-04-01 figs.cdr

GEOVision
geophysical services

Date: 7/19/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

PPP

Client: _____ Location: BH-1 pt. 1

Test Location ID: _____ Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

Moisture 7.8%
Wet density 140.7 lb
130.5
dry ~ 16/cu ft

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	1054	1.879	53.23	24.42	0.0039
	1127	1.857	53.8	22.85	
	1157	1.859	53.8	21.18	0.0035

GV Personnel: _____

Notes: _____

GEOVision
geophysical services

Date: 7/25/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: _____ Location: BH-1 pt. 2

Test Location ID: _____ Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

Moisture 11.1
wet Density 140.7
dry " 126.6

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	9:00	1.770	56.48	22.78	0.0018
	3:18	1.783	56.09	20.38	0.0057

GV Personnel: _____

Notes: _____

GEOVision
geophysical services

Date: 7/19/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: _____ Location: BH-4 pt 2

Test Location ID: _____ Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1}K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	13:42	1.606	62.30	24.63	0.0096
	14:24	1.576	63.44	24.31	0.0158
	after 24 hr saturate			7/20/11 – 7/21/11	
	2:51	1.68	59.53	21.89	0.0033
		1.687	59.28	21.95	0.0043

Moisture 7.4%
Wet Density 138.8 lb/ft³
Dry Density 129.2 lb/ft³

← 4A (3.65')
wet/sat soil + tub 128.4
dry " " 107.6
M% 20%

GV Personnel: _____

Notes: _____

GEOVision
geophysical services

Date: 7/25/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: _____ Location: BH-8 pt 3

Test Location ID: _____ Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	9:46	1.441	69.4	23.31	
	10:31	1.505	66.46	23.10	0.0125
	after 24 hr natural			7/27/11	
	1:45	1.653	60.5	22.81	0.0052
		1.646	60.75	22.84	0.0050

GV Personnel: _____

Notes: _____

After drying
Moisture 8.4%
wet density 142.6
dry " 131.5

96 3.65 r.
Sat wt + dish 137.6
dry " 120.8
M% 14.3%

GEOVision
geophysical services

Date: 8/4/11 & 8/8/11

Job No. 3626-04-01

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP Location: _____

Test Location ID: BH-1 @ 30-31.5' Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1}K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading	
Sensor Performance Verification	11:10	0.383	261.3	24.71	0.0031	→ 8/4/11
	10:17	0.380	262.8	24.43	0.0028	→ 8/8/11

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading	
Readings	11:43	1.347	74.3	23.77	0.0033	→ 8/4/11
	12:15	1.341	74.6	23.84	0.0031	
	10:52	1.408	71.01	22.17	0.0025	→ 8/8/11
	11:21	1.426	70.12	22.38	0.0028	

GV Personnel: _____

Notes: _____

M% 9.1%
dry density 112.9 lb/ft³

Sat. M%
at bal + dish 224.7
dry " " 200.3
dish 84.0
M% 21.0%

GEOVision
geophysical services

Date: 8/4/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP Location: _____

Test Location ID: BH-1 40 – 40.5 Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading	
Readings	12:45	0.785	127.4	24.11	0.0244	} 8/4/11
	12:22	0.748	133.7	24.3	0.0280	
	11:44	1.581	63.24	22.13	0.0036	} 8/8/11
	12:03	1.575	63.50	22.35	0.0032	

M. 7.8 %
dry density 104.4 lb/ft³

Sat M%
wt soil + dish : 229.7
" " dry " dish 84
203.7
21.7%

GV Personnel: _____

Notes: _____

GEOVision
geophysical services

Date: 8/4/11

Job No. 3626-04-01

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP

Location: _____

Test Location ID: BH-3 @ 5-6.5'

Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1}K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

M% 7
dry density 109.3 lb/ft³

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	1:49	1.550	64.50	24.65	0.0074
	2:25	1.531	65.33	24.71	0.0064
	12:34	1.863	53.67	21.97	0.0088

} 8/4/11
} 8/8/11

wt soil + dish 216.7
dry " + dish 198.7
dish 84
Soil M% 17.4%

GV Personnel: _____

Notes: _____

GEOVision
geophysical services

Date: 8/4/11

Job No. 3626-04-01

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP Location: _____

Test Location ID: BH-3 20-21' Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	11:55	0.860	116.3	25.84	0.0066
	11:27	0.871	114.9	25.57	0.0067
	12:58	1.633	61.25	21.64	0.0037
	1:16	1.589	62.93	22.2	0.005

GV Personnel: _____

Notes: _____

H% 3.2%
dry dens 106.8 lb/ft³

8/4/11

8/8/11

Sat wt soil + dish 204.6
dry " " 186.9
dish 84
sat H% 17.2%

GEOVision
geophysical services

Date: 8/5/11
Job No. 3626-04-01

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP
Location:
Test Location ID: BH-3 25-26'
Sheet: of
Temperature: Humidity: In situ or Lab Sample:
Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐
KD2 Pro S/N: Sensor S/N:
Verification Standard block # (if any): K ($Wm^{-1}K^{-1}$) from QA Certification:
Test Material: Description:
Material Initial Moisture Content (% mass basis): Material Dry Density (kg/m^3):
Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐
Comments:

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification	8.30	0.383	261.2	23.0	0.0038

	Time (24:00)	K ($Wm^{-1}K^{-1}$) Reading	rho ($°Ccm\ W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	9:27	1.323	75.6	21.85	0.0023
	10:01	1.313	76.14	22.05	0.0017
	1:46	1.394	71.73	28.07	0.0021

8/5/11
8/8/11

GV Personnel:

Notes:

H% 21.3%
dry density 103.0 lb/ft³
wt soil + dish 198.9
dry " " 177.6
dish 84
M% 23.5

GEOVision
geophysical services

Date: 8/5/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: _____ Location: _____

Test Location ID: BH 5 S-1 Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	10:38	1.504	66.49	39.09	0.0026
	11:01	1.561	64.07	23.22	0.0032
	11:34	1.551	64.47	23.48	0.0032
	2:05	1.622	61.67	22.26	0.0029

GV Personnel: _____

Notes: _____

M% 7.3% dry density 114.9 lb/ft³

8/5/11

8/8/11

wet soil + dish 205.4
dry soil + dish 187.3
dish 84
M% 17.5

GEOVision
geophysical services

Date: 8/5/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP

Location: _____

Test Location ID: BH-5 @ 19.5'-21'

Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Readings	12:21	0.113	883.6	24.42	0.0345
	12:54	0.109	915.4	24.97	0.0341
	2:30	2.186	45.75	21.98	0.0057
	2:55	2.044	48.91	22.56	0.0054

8/5/11

8/8/11

GV Personnel: _____

Notes: _____

H% 1.4%
dry dens. 2g 110.2 lbs/ft

sat H% dish: 298.
sat wt soil + dish: 278.6
dry dish 84
10.2%

GEOVision
geophysical services

Date: 8/5/11

Job No. _____

THERMAL RESISTIVITY TESTING FIELD LOG

Client: PPP

Location: _____

Test Location ID: BH-5 35-36.5

Sheet: _____ of _____

Temperature: _____ Humidity: _____ In situ or Lab Sample: _____

Sensor Type: TR-1 (large) ☐ KS-1 (small) ☐ SH-1 (dual) ☐

KD2 Pro S/N: _____ Sensor S/N: _____

Verification Standard block # (if any): _____ K ($Wm^{-1} K^{-1}$) from QA Certification: _____

Test Material: _____ Description: _____

Material Initial Moisture Content (% mass basis): _____ Material Dry Density (kg/m^3): _____

Method of Needle Insertion into test material: Pushed ☐ Pre-drilled ☐

Comments: _____

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading
Sensor Performance Verification					

	Time (24:00)	K ($Wm^{-1} K^{-1}$) Reading	rho ($°Ccm W^{-1}$) Reading	Temperature (°C) Reading	Err Reading	
Readings	1:18	0.802	124.8	24.74	0.0049	} 8/5/11
	1:48	0.828	120.8	24.92	0.006	
	3:10	1.333	75.0	22.2	0.0023	8/8/11

M% 6.5% dry density 102.3 lb/ft

wet soil + dish 172.8

dry — — 154.0

dish 84.0

26.9

GV Personnel: _____

Notes: _____

FAIR OAKS

EDMONSON ALLEY

RAYMOND AVE.

S. ARROYO PARKWAY

CITY OF PASADENA D.P.W., GLENARM TO SR110 CONNECTOR 9/21/04 DRAWING RW-1 SHOWS A CURVED R/W RETURN HERE. THERE IS NO CURVE DATA ON THE DRAWING & WE HAVE FOUND NO RECORD OF A PREVIOUS R/W TAKING. NOTE: THE EXISTING SIDEWALK DOES CURVE AROUND THE CORNER WITH A ±23' BACK OF WALK RADIUS.

Fd Conc. Nails Per CEFB 1301-L Dwg.#1392

S 0°20'57" E 0.83'

Fd P.K. Nail

N 89°36'00" E 244.80'

PROPOSED TAKING LINE AS PER 9/21/04 COPY OF CITY OF PASADENA DPW DRAWING RW-1.

Fd 4 Strodlers Per CEFB 1302-L Dwg.#1398

N 0°20'17" W

MTA Control Pt# MPA25 2.155' Sly & 0.09' Wly

Fd Boat Spike & Washer Per CEFB 1302-L Dwg.#1398

N 89°35'49" E 440.62'

C.E. TRANSIT LINE

SOUTHERLY LINE OF STREET WIDENING DEED TO CITY REC. 05/21/1930 IN BK. 10038 PG.63 O.R.

Fd L&T Per CEFB 1150-L Dwg.#1035

5.49'

34.75'

30'

50.20'

45.25'

GLENARM STREET

EXISTING R/W LINE N 89°36'00" E

POSSIBLE TAKING PARCEL 2

6.00'

342.17'

407.75'

94.71'

S 1°01'54" E 2.55'

366.17'

246.48'

S 89°22'12" E 233.79'

P.O.B. PARCEL "B"

P.O.B. PARCEL "A" & "C"

35.58'

77.25'

NORTH FACE WALL ON LINE

N 89°36'00" E 171.82'

N 89°35'49" E 139.57'

92.57'

NORTH FACE WALL 0.05' IN

POINT "A" (PARCEL B)

N 0°24'33" W 15.26'

N 22°28'05" W 48.40'

TO CORNER OF WALL 0.27'

0.8'

PARCEL LINE TO Ey FACE OF WALL

MTA R/W

41'

41'

FAIR OAKS

EXPOSED FOUNDATION LINE

20'

35.58'

"A" 68,330 sq.ft. GROSS 66,835 sq.ft. NET

"B" 30,640 sq.ft. GROSS 28,625 sq.ft. NET

"C" 6,640 sq.ft. GROSS 5,910 sq.ft. NET

N 0°24'00" W 186.55'

186.35'

165.10'

185.30'

L=138.52'

SOUTHERLY LINE OF THE NORTHERLY 185.30' OF G.E. SMITH SUBDIVISION

N 89°36'00" E 151.45'

N 70°03'29" W (R)

Δ=28°07'29"

R=820.37'

R=940.37'

SOUTHERLY LINE OF NORTHERLY 186.55' OF G.E. SMITH SUBDIVISION

SHED

19.4'

19.7'

0.83'

366.35'

320.69'

N 89°36'00" E 401.93'

45.66'

35.58'

81.24' COVERED

1.25'

TRENCH

P.O.B. PARCEL D & F

T.P.O.B. PARCEL "F"

113.80'

83.80'

N 0°24'00" W

"D" 72,780 sq.ft.

"F" 24,000 sq.ft.

Δ=62°42'51" L=107.85'

Δ=62°56'38" L=32.96' R=30'

Δ=97°00'00" L=47.12' R=30'

PARCEL LINE TO FACE OF CURB 0.2'

PARCEL LINE TO FACE OF CURB 0.5'

SOUTHERLY LINE OF THE NORTHERLY 300.35' OF G.E. SMITH SUBDIVISION

192.65'

155.03'

N 89°36' E

11'

S 0°20'37" E 623.995'

568.98'

N 89°36'00" E 135.77'

8.00'

POINT "A" (PARCEL D)

PARCEL LINE TO FACE OF CURB 0.2'

"E" ACCESS EASEMENT

35.00'

63.00'

N 89°36'00" E 105.77'

N 42°20'05" W 41.02'

POINT "B" (PARCEL D)

382.43'

N 0°20'37" W 268.58'

WALLIS ST. (VACATED)

G.E. SMITH'S SUB. M.R. 14/93

WASHBURN'S SUB. M.R. 6/242

135.77'

16'

41'

41'

25'

STATE STREET

25'

Fd 4 Strodlers Per CEFB 1301-L Dwg.#1391-B

204.88'

N 89°34'52" E

Calc. Position

LEGEND

IN	INSIDE OF SUBJECT PROPERTY
OUT	OUTSIDE OF SUBJECT PROPERTY
P.O.B.	POINT OF BEGINNING OF LEGAL DESCRIPTION
T.P.O.B.	TRUE POINT OF BEGINNING OF LEGAL DESCRIPTION

Apr 10-20-04

30' 15' 0' 30' 60'

SCALE: 1" = 30'

CH&A CABRINHA, HEARN & ASSOCIATES
surveying & mapping
pasadena, ca 626-795-6926

APPROVED: CLYDE C. CABRINHA		BY	DATE
	SURVEY	RENE	07/21/04
	DRAWN	V.R.	08/09/04
	CHECKED	CCC	08/09/04

STRUCTURE LOCATION SURVEY AT PASADENA WATER & POWER GLENARM POWER PLANT PORTIONS OF G.E. SMITH'S SUBDIVISION WASHBURN'S SUBDIVISION & WALLIS ST. (VACATED)

PASADENA CALIFORNIA

1/1

JOB NO.	FILE NO.
270 034 01 LA	565 H7

SCALE: 1" = 30'

DATE: SEPT. 28, 2004

270-034-01
September 28, 2004

PARCEL A
GLENARM POWER PLANT SITE

All that certain real property situate in the City of Pasadena, County of Los Angeles, State of California and being portions of Lots 5 through 11 of G. E. Smith's Subdivision as recorded in Book 14 at page 93 of Miscellaneous Records of Los Angeles County; said property being more particularly described as follows:

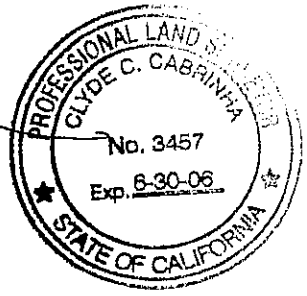
That portion of the Northerly 186.55 feet of said G. E. Smith's Subdivision lying Easterly of the existing Easterly right of way line of Fair Oaks Avenue (82 feet wide) and Westerly of the following described line: Beginning at a point on the Northerly line of said subdivision, being also the existing Southerly right-of-way line of Glenarm Street distant thereon N 89° 36' 00" E 342.17 feet from the Northwest corner of lot 7 of said "G. E. Smith's Subdivision"; thence leaving said northerly subdivision line and perpendicular thereto S 0° 24' 00" E 186.55 feet to the Southerly line of said Northerly 186.55 feet of G. E. Smith's Subdivision, said portion containing 68,330 square feet of land, more or less.

EXCEPTING therefrom the following described future Street widening parcels:

Parcel 1: Beginning at a point on the Northerly line of said subdivision, being also the existing Southerly right-of-way line of Glenarm Street distant thereon N 89° 36' 00" E 342.17 feet from the Northwest corner of lot 7 of said "G. E. Smith's Subdivision"; thence leaving said northerly subdivision line and perpendicular thereto S 0° 24' 00" E 20.20 feet to the general southerly Street widening line; thence along said widening line the following courses: S 89° 36' 00" W 12.75 feet, N 0° 24' 00" W 13.68 feet, N 89° 22' 12" W 233.79 feet and N 0° 01' 54" W 2.55 feet to said existing Southerly right-of-way line of Glenarm Street, thence along last said right-of-way line N 89° 36' 00" E 246.48 feet to the point of Beginning and containing an area of 1,365 square feet.

Parcel 2: Beginning at the intersection of said Southerly right-of-way line of Glenarm Street with said Easterly right-of-way line of Fair Oaks Avenue, thence along said Southerly line of Glenarm Street N 89° 36' 00" E 24.97 feet to a point of cusp; thence tangent to the previous course Southwesterly along the arc of a curve concave Southeasterly having a radius of 25 feet and a central angle of 89° 56' 37" an arc length of 39.25 feet to said Easterly line of Fair Oaks Avenue and a point of cusp; thence tangent to said curve along last said Easterly line N 0° 20' 37" W to the point of beginning and containing an area of 130 square feet.

Clyde C. Cabrinha, PLS 3457



270-034-01
September 28, 2004

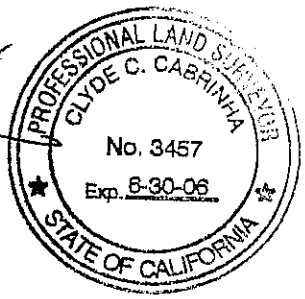
PARCEL B
GLENARM POWER PLANT SITE

All that certain real property situate in the City of Pasadena, County of Los Angeles, State of California and being portions of Lots 12 through 16 and portions of Lots 18 and 19 of G. E. Smith's Subdivision as recorded in Book 14 at page 93 of Miscellaneous Records of Los Angeles County; said property being more particularly described as being the following described portion of the Northerly 185.30 feet of said subdivision:

Beginning at a point on the Northerly line of said subdivision, being also the existing Southerly right-of-way line of Glenarm Street distant thereon N 89° 36' 00" E 407.75 feet from the Northwest corner of lot 7 of said "G. E. Smith's Subdivision"; thence leaving said Northerly subdivision line and perpendicular thereto S 0° 24' 00" E 20.20 feet to a point described as and hereinafter referred to as "Point A"; thence continuing on last said course 165.10 feet to the Southerly line of Northerly 185.30 feet of said subdivision; thence along last said Southerly line N 89° 36' 00" E 151.45 feet; thence leaving said Southerly line and from a tangent that bears N 19° 56' 32" E on the arc of a curve concave Northwesterly having a radius of 920.37 feet and a central angle of 8° 07' 32" an arc distance of 130.52 feet; thence N 22° 28' 05" W 48.40 feet to the Southerly line of that certain parcel granted to the City of Pasadena for Street widening purposes per Deed Recorded May 21, 1930 in Book 10038 at page 63 of Official Records of Los Angeles County; thence along the Southerly and Westerly lines of last said Deed S 89° 35' 49" W 92.57 feet and N 0° 24' 33" W 15.26 feet to said Northerly line of G. E. Smith's Subdivision; thence along said Northerly line S 89° 36' 00" W 77.25 feet to the point of beginning and containing 30,640 square feet of land, more or less.

EXCEPTING therefrom the following described future Street widening parcel:
That portion of the above described Parcel B lying Northerly of the following line: Beginning at the above described "Point A", a point on the general southerly future Street widening line; thence along said widening line N 89° 36' 00" E 171.82 feet to an intersection with the Easterly line of the above described Parcel B said future Street widening parcel containing an area of 2,015 square feet.

Clyde C. Cabrinha, PLS 3457



270-034-01
September 28, 2004

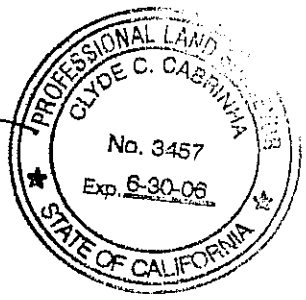
PARCEL C
GLENARM POWER PLANT SITE

All that certain real property situate in the City of Pasadena, County of Los Angeles, State of California and being portions of Lots 11 and 12 of G. E. Smith's Subdivision as recorded in Book 14 at page 93 of Miscellaneous Records of Los Angeles County; said property being more particularly described as follows:

That certain portion of the Northerly 186.55 feet of said subdivision lying 35.58 feet Easterly of the following described Westerly line thereof: Beginning at a point on the Northerly line of said subdivision, being also the existing Southerly right-of-way line of Glenarm Street distant thereon N 89° 36' 00" E 342.17 feet from the Northwest corner of lot 7 of said G. E. Smith's Subdivision; thence leaving said Northerly subdivision line and perpendicular thereto S 0° 24' 00" E 186.55 feet to the Southerly line of said Northerly 185.55 feet of G. E. Smith's Subdivision, said 35.58 foot by 186.55 foot parcel contains 6,640 square feet of land, more or less.

EXCEPTING therefrom the following described future Street widening parcel:
Beginning at the Northwest corner of the above described Parcel C: thence along the Westerly line thereof S 0° 24' 00" E 20.20 feet to the general Southerly Street widening line; thence along said widening line N 89° 36' 00" E 35.58 feet to the Easterly line of the above described parcel; thence along said Easterly line N 0° 24' 00" W 20.20 feet to said existing Southerly right-of-way line of Glenarm Street, thence along last said right-of-way line S 89° 36' 00" W 35.58 feet to the point of Beginning and containing an area of 720 square feet.

Clyde C. Cabrinha, PLS 3457



270-034-01
September 28, 2004

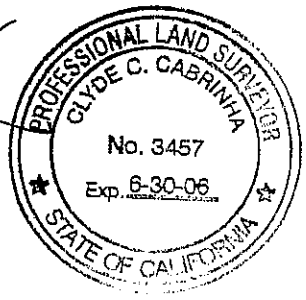
PARCEL D
GLENARM POWER PLANT SITE

All that certain real property situate in the City of Pasadena, County of Los Angeles, State of California being portions of G. E. Smith's Subdivision as recorded in Book 14 at page 93 of Miscellaneous Records, Washburn's Subdivision as recorded in Book 6 at Page 242 of Miscellaneous Records of Los Angeles County and Wallis Street, Vacated, said property being more particularly described as follows:

Beginning at the intersection of the Easterly right-of-way line of Fair Oaks Avenue (82 feet wide), said right-of-way line being parallel with and perpendicularly distant 6.00 feet Easterly of the West line of said G. E. Smith's Subdivision, with the Southerly line of the Northerly 186.55 feet of said G. E. Smith's Subdivision; thence along last said Southerly line N 89° 36' 00" E 320.69 feet: thence leaving said line and perpendicular thereto S 0° 24' 00" E 83.80 feet; thence along a curve concave Northwesterly having a radius of 30 feet and a central angle of 90° an arc length of 47.12 feet to the southerly line of the Northerly 300.35 feet of G. E. Smith's Subdivision; thence along last said Southerly line S 89° 36' 00" W 155.03 to a point on a line that is parallel with and perpendicularly distant 135.77 feet Easterly of said Easterly right-of-way line of Fair Oaks Avenue; thence along last said parallel line S 0° 20' 37" E 8.00 feet to a point described as and hereinafter referred to as "Point A"; thence continuing along last said parallel line S 0° 20' 37" E 63.00 feet to a point described as and hereinafter referred to as "Point B"; thence continuing along last said parallel line S 0° 20' 37" E 197.37 feet to the Northerly line of State Street (50 feet wide); thence along said Northerly line of State Street S 89° 34' 52" W 135.77 feet to said Easterly right-of-way line of Fair Oaks Avenue (82 feet wide); thence along last said right-of-way line N 0° 20' 37"W 382.43 feet to the Point of Beginning and containing 72,805 square feet of land, more or less

(PARCEL E)
Reserving therefrom a three dimensional emergency right-of-way access easement for use of the Pasadena Department of Water and Power over and 16.7 feet above a portion of the above described Parcel "D", the vertical limits of said easement being measured vertically above the surface grade of the following described portion of Parcel "D": Beginning at the above described "Point A"; thence S 89° 36' 00" W 135.77 feet to said Easterly right-of-way line of Fair Oaks Avenue; thence along last said right-of-way line S 0° 20' 27" E 35.00 feet; thence leaving said right-of-way line N 89° 36' 00" E 105.77 feet; thence S 47° 20' 55" E 41.02 feet to the above described "Point B"; thence N 0° 20' 37" W to "Point A" the Point of Beginning.

Clyde C. Cabrinha, PLS 3457



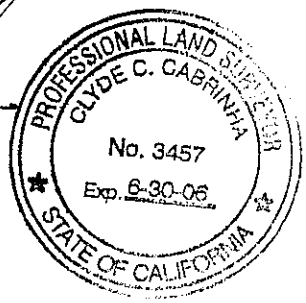
270-034-01
September 28, 2004

PARCEL F
GLENARM POWER PLANT SITE

All that certain real property situate in the City of Pasadena, County of Los Angeles, State of California being portions of lots 11, 12, 13 and portions of Lots 18 through 23 of G. E. Smith's Subdivision as recorded in Book 14 at page 93 of Miscellaneous Records of Los Angeles County said property being more particularly described as follows:

Beginning at the intersection of the Easterly right-of-way line of Fair Oaks Avenue (82 feet wide), said right-of-way line being parallel with and perpendicularly distant 6.00 feet Easterly of the West line of said G. E. Smith's Subdivision, with the Southerly line of the Northerly 186.55 feet of last said Subdivision; thence along last said Southerly line N 89° 36' 00" E 320.69 feet: to the **True Point of Beginning** of the parcel to be herein described; Thence from said **True Point of Beginning,** leaving last said Southerly line and perpendicular thereto S 0° 24' 00" E 83.80 feet; thence along a curve concave Northwesterly having a radius of 30 feet and a central angle of 90° an arc length of 47.12 feet to the southerly line of the Northerly 300.35 feet of said G. E. Smith's Subdivision and a point of cusp; thence tangent to said curve Easterly along last said Southerly line N 89° 36' 00" E 192.65 feet; thence leaving last said Southerly line and tangent thereto on the arc of a curve concave Northwesterly having a radius of 30 feet and a central angle of 62° 56' 38" an arc length of 32.96 feet to a point of compound curvature; thence tangent to last said curve on a curve concave Northwesterly having a radius of 920.37 feet and a central angle of 6° 42' 51" an arc length of 107.85 feet to the Southerly line of the Northerly 185.30 feet of said G. E. Smith's Subdivision; thence along last said Southerly line S 89° 36' 00" W 151.45 feet; thence leaving said Southerly line S 0° 24' 00" E 1.25 feet to the previously mentioned Southerly line of the Northerly 186.55 feet of said subdivision; thence along last said line S 89° 36' 00"W 81.24 feet to the **True Point of Beginning** and containing 24,000 square feet of land, more of less.

Clyde C. Cabrinha, PLS 3457



FAIR OAKS AVE.

PER OUR VERICATION WITH CHEMIC ENGINEERS
THEIR ARE NO FIRE SPRINKLER SYSTEMS
COMING OFF THE NEW HYD LINE.

NEW SECURITY WALL

NEW SECURITY FENCE

NEW FIRE ROAD

WAREHOUSE

STATE ST.

EXISTING 12" WTR. MAIN

NEW 12" CONN.
FOR FIRE HYD.
BY OTHERS

EXISTING FIRE HYDRANT

SCALE 1/32" = 1'-0"

3

DETAIL 1

NOTES:

1. PWP will sawcut, excavate, and tap 12" city water main. PWP install piping from existing City 12" main up to and including the 12" M.J. tee downstream of the backflow assemblies. PWP will provide all materials up to interface point. SPS to provide the 12" pipe material. SPS to perform all compaction and paving required.
2. PWP will sawcut, excavate, tap the existing 12" main, compact and pave to facilitate the installation of 6" hydrant lateral, and CLOW 2065 fire hydrant. PWP will provide all required materials except for fire hydrant head. SPS to provide CLOW 2065 fire hydrant

THIS PLAN IS FOR THE ADDITION OF THREE

FIRE HYDRANTS ONLY

GLENARM ST.

GLENARM STEAM PLANT

PARKING LOT

FAIR OAKS AVE

WAREHOUSE

STATE ST.

BROADWAY STEAM PLANT

PASADENA FRWY.

RAILROAD ST.

SCALE 1/64" = 1'-0"

CHEMIC ENGINEERS
UNDERGROUND MATERIAL

PIPE: 4" TO 12" CLASS 51 DUCTILE IRON PER ANSI/AWWA C151/A21.51 WITH CEMENT LINED AND ASPHALTIC COATING

FITTINGS 4" TO 12" CLASS 350 MJ DUCTILE IRON WITH CEMENT LINED AND ASPHALTIC COATING

FITTINGS 4" TO 12" CLASS 350 MJ BOLTING ALL HEAVEY HEX HEAD MACHINE BOLTS WITH HEAVY HEX NUTS, GALVANIZED, ASTM A307 GR.B

BRANCH CONNECTION ALL USE TEES

GATE VALVE 4" TO 12" 250 PSI WP MJ RESILIENT WEDGE GATE VALVE, UL LISTED AND FM APPROVED. MFG. AMERICAN FLOW SERIES 2500 OR EQUAL.

FIRE HYDRANTS TO BE # 865 CLOW WITH TWO 4" CONNECTIONS AND ONE 2½" CONNECTION, PER FIRE DEPARTMENTS REQUIREMENTS.

GENERAL NOTES

. 2 NEW FIRE HYDRANTS TO PROVIDE 5000 GPM FLOWING AT 20 PSI FOR ON SITE FIRE FLOW
. ALL UNDERGROUND PIPE, FITTINGS, AND THRUSTBLOCKS TO BE PER NFPA. UL LISTED AND FM APPROVED, FOR MATERIAL SPECIFICATIONS SEE CHEMIC ENGINEERS MATERIAL LIST ABOVE.
. ALL UNDERGROUNDING PIPE AND FITTINGS TO BE M. J.
. ALL UNDERGROUND TO MAINTAIN 3½' MIN. BURY. TO COVER.
. PLANS TO BE APPROVED BY PASADENA FIRE DEPARTMENT.

PLEASE NOTE: THAT THE USE OF RETAINER GLANDS ON ALL MECH. JOINTS, CAN BE USED INLEIU OF CONCRETE THRUST BLOCKS.

- HYDRANTS ARE TO BE CHROME YELLOW WITH GREEN CAPS AND 3 OUTLET
- EACH HYDRANT IS TO BE CLEARLY IDENTIFIED WITH BLUE REFLECTORS (APPROVED LOCATION IN THE ROADWAY.

90° ELBOW

6'x4'

8'x4'-6"

8'x4'-6"

6'x4' 1/4" BENT ROD

22 1/2° BENDS

11 1/4° BENDS

MINIMUM BEARING AREAS IN SQ FT

PIPE SIZE	TEE	90° BEND	45° BEND	22½° BEND
6"	4	4	4	3
8"	5	7	4	3
10"	9	12	6	4
12"	*2	16	9	6

BASED UPON SOILS REPORT
USE 1000 PSF FOR THIS SITE

SOIL TYPE	MAX. ALLOWABLE SOIL BEARING VALUES	FACTORS FOR INCREASING AREAS IN TABLE 1
LOOSE SAND	500 PSF	4
SOFT SANDY CLAY	1000 PSF	2
ADOBE	1000 PSF	2
COMPACT FINE SAND	20000 PSF	1
COMPACT COARSE SAND	2000 PSF	1
MEDIUM STIFF CLAY	2000 PSF	1

* BASED ON 150 PSI W.W.P. PRESSURE & SOIL BEARING VALUES OF 2000 PSF. THE RATIO OF WIDTH TO HEIGHT SHALL NOT EXCEED 1½ TO 1
** TEES, PLUGS, CAPS AND HYDRANTS
*** THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE SAFE SOIL BEARING VALUES, AND THE POSITION AND SIZE OF BEARING AREAS.

NOTES.

1. ALL ANCHOR AND THRUST BLOCKS SHALL BEAR AGAINST UNDISTURBED SOIL.
2. MINIMUM ALLOWABLE WATER PRESSURE FOR DESIGN OF THRUST BLOCKS IS 150 PSI BEARING AREA INCREASES DIRECTLY WITH INCREASE IN PRESSURE.
3. ALL CONCRETE USED IN THRUSTS BLOCKS SHALL ATTAIN 2000 PSI STRENGTH.
4. ALL ANCHOR RODS SHALL BE REINFORCING STEEL, AND A MINIMUM OF ½ INCH IN DIAMETER.
5. USE ANCHOR BLOCKS AT VERTIVICAL BENDS WHEN PIPE IS ABOVE OR BELOW GROUND. SIZE OF BLOCK AND ROD SHALL BE AS SHOWN ON THE PLANS, OR DETERMINED BY THE ENGINEER IN THE FIELD.
6. USE 30 POUND FELT TO INSURE COLD JOINT.
7. CONTRACTOR TO REDUCE BEARING AREAS PROPORTIONATELY FOR PIPE SIZES LESS THAN 6".
1. ALL ANCHOR AND THRUST BLOCKS SHALL TEAR AGAINST UNDISTURBED SOIL.

APPROVED
CITY OF PASADENA
BUILDING DIVISION

This issuance or granting of a permit or approval of any drawings or work done any plans shall not be a permit for or an approval of any violation of any of the provisions of the building code or of any other ordinance of the City. No permit presuming to give authority to violate or cancel the provisions of the building code or other ordinances of the City shall be valid except as far as the work or use is authorized by such permit.

ADDITIONAL SEPARATE PERMITS ARE REQUIRED FOR THE FOLLOWING WORK:
Electrical
Plumbing
Mechanical
Grading
Site Grading
Heating - Ventilating - Air Conditioning
Signs

NOTE: Changes to the approved plans may be made only as approved by the Building Official.

This permit will expire by limitation and become null and void if the work authorized by such permit is not commenced within 180 days from the date of such permit, or if the work authorized by such permit is suspended or abandoned for a period of 180 days at any time after the work is commenced.

AS-BUILTS REQUIRED TO BE IN CAD.

PLAN CHECK
FIR2003-000088
PASADENA FIRE DEPARTMENT
APPROVED
By D MYERS Date 3.17.3
☒ Field Inspection required
☒ Approved as noted on plans.

SPRINKLERS

	NOTES	SYMBOL	QTY
MODEL	STYLE	K	ORIFICE	TEMP.	RESPONSE	FINISH	ESCUTCHEON MOD. / FINISH	
MODEL	STYLE	K	ORIFICE	TEMP.	RESPONSE	FINISH	ESCUTCHEON MOD. / FINISH	

NO	DATE	BY	CORRECTION MADE
1	3.13.3	DM	FD comments
2	6.18.03	DM	Relocated FH per Jason W. & Dave Myers signed 6.18.03
3	6.20.03	DM	Per FD, Top location of added Antimon to back flow, instr. detail, Route of 3 fire hydrants

Simplex Grinnell LP
1701 W. Statuca Avenue
Orange, CA 92865-1015
Tel. 714-939-9130
Fax. 714-939-9131
www.simplexgrinnell.com

tyco Fire & Security

Simplex Grinnell

CONTRACT NAME: GE POWER PLANT
45 GLENARM ST.
PASADENA, CA.

LICENSED FIRE PROTECTION CONTRACTOR
CLASSIFICATION
C-16
LICENSE NO.
802591
LOS ANGELES
STATE OF CALIFORNIA

SCALE: 1/16 " = 1' -
DESIGNER: LTS
DATE: 02-13-03
CONTRACT #: 046-108441
SHEET #: FP 1 OF

PLOTTED [02-13-03] 10:41:29 SITEPLOT.mdl

CONT'D ON DWG# B-2-6507

CONT'D ON DWG.# B-2-6510

MARLEY COOLING TOWER

WATER SUPPLY

EVAPORATIVE COOLER

REMOVAL AREA

INLET SILENCER

INLET PLENUM

TURBINE MODULE

EXHAUST STACK

AUXILIARY MODULE

ALTERNATOR MODULE

AUX. TRANS

SWITCH GEAR

TRANSFORMER

CONTROL MODULE

DRAINAGE HOLDING TANK

WASTE HEAT BOILER AREA

GAS COMPRESSOR

GTV-3

TEE TO AIR LINE TRAP

4" EXISTING SEWER - INV. EL. 742'

12"

11"

6"

V-3/4"-B7

1½"×1¼" REDUCER TYP. 2 PL

℄ EL -2'-4"

GAS ASS/ST 1¼ NPT

G-1½"-B7

DEMIN. BYPASS 1¼" NPT ℄ EL 1'-11"

V-3/4"-B7

W-1½"-B7

REF. BASE LINES

SOUTHERN DRAINS BY C.W.C.

SEE DWG# B-2-6513 FOR WATER & AIR CONNS.

16'-3"

35'-0"

11'-3 5/8"

2"×1½" REDUC. TEE

1½"×¾" REDUCER

2" CITY WATER LINE (EXISTING)

SUPPORT FROM WALL

G-8"-B1

CIRC WATER LINE

V-1½"-B7

EXISTING 12" AIRLINE

ELEC. CONDUIT (BY OTHERS)

DRAIN INVERT ELEV. -30" (TYP)

STUB THRU ENTRANCE HOLE

MITER

G-6"-B1

76'-4 1/8"

DUCT NEST (BY OTHERS)

MITER 30°± AS REQ.

ROADWAY

8"×6 REDUCER

14'-2 3/8"

26'-10 1/4"

22'-0 1/4"

6" TYP

℄ ELEV -2'-6" TYP

GAS SUPPLY FROM METERING AREA

DRAIN INVERT ELEV. -22" (TYP)

INV. EL. -1'-4"

INV. EL. -1'-10"

NORTHERN DRAINS BY CONTR. - 3" C.I. SOIL PIPE

-30" INVERT ELEV. (TYP)

INV. EL 738.3

V-3/4"-B7

W-1½"-B7

SEE DETAIL D - DWG# B-2-6513

3" SOIL PIPE - INVERT ELEV. -15", 2% SLOPE TO HOLDING TANK (TYP)

16" SEWER

33'

6'×10' UNDERGROUND ELEC. VAULT

4'-6"

8'×14' U.G. ELEC. VAULT

3'-6"

48'-6"

39'-4"

16'-3"

REF. ELEV. 0-0 = 750.11

CONT'D ON DWG.# B-2-6509

FOR SPEC. # LD-74-13

SHEET NUMBER

NO	DATE	REVISIONS	BY	CHKD	APVD
4	4-30-75	ADDED AIR TIE TO B'WAY LINE	TI		
3	3-14-75	ADDED AIR SUPPLY TO GAS COMPS.	TI		
2	2-14-75	ADDED DEMIN VALVES	TI		
1	1-75	ADDED SERVICE AIR & WATER	TI		

DISTRIBUTION

REFERENCE DRAWINGS

FILE NO

DESIGN		
DRAWN	IMHOFF	8-74
CHECKED		
CIVIL		
ELECT.		
MECH.		DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED — ENGR. — DATE 9/4/74

APPROVED — CHIEF ENGR. — DATE

GLENARM GAS TURBINE PLANT

PIPING AREA III

EJD NUMBER

FILE

SCALE 1/8" = 1'

PAGE

DRAWING NUMBER 8-2-6508

MARLEY #3 TOWER

CONT'D ON DWG #8-2-6508

TEST HOLE #1

42" STEEL CASING

STORM DRAIN

ROADWAY

CONCRETE SLAB STORAGE AREA

GAS LINE TO GAS COMPRESSORS & EL. -2'-6"

G-8"-81

20'

6" TYP

PROPERTY LINE

REF. EL. EV. 0-0" = 750.11

44'-10½"

30'-0"

GAS CO. METER ENCLOSURE

TRIM EL AS REQ. TO PARALLEL ROAD

15°

2'-5⅞"

STUB UP - PIPING BY CONTR.

STATE ST. R.

TO GAS MAIN

BY OTHERS

FOR SPEC. #LD-74-13

SHEET NUMBER

DISTRIBUTION	NO	DATE	REVISIONS	BY	CHKD	APVD	NO	DATE	REVISIONS	BY	CHKD	APVD	REFERENCE DRAWINGS	FILE NO

DESIGN			
DRAWN	IMHOFF	8-74	
CHECKED			
CIVIL			
ELECT.			
MECH.			DATE

POWER DIVISION
WATER AND POWER DEPARTMENT
CITY OF PASADENA

APPROVED Healy ENGR. DATE 9/4/74

APPROVED _____ CHIEF ENGR. DATE _____

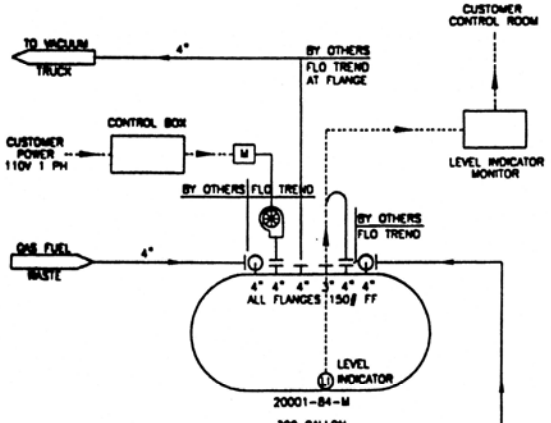
GLENARM GAS TURBINE PLANT

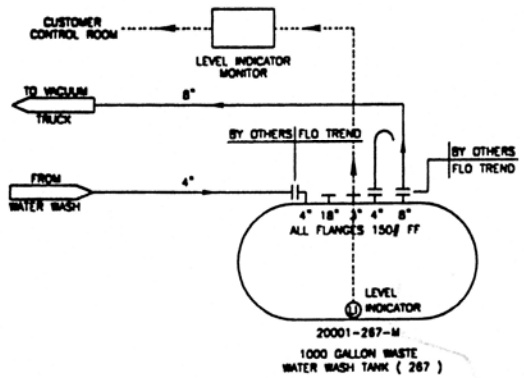
PIPING AREA IV

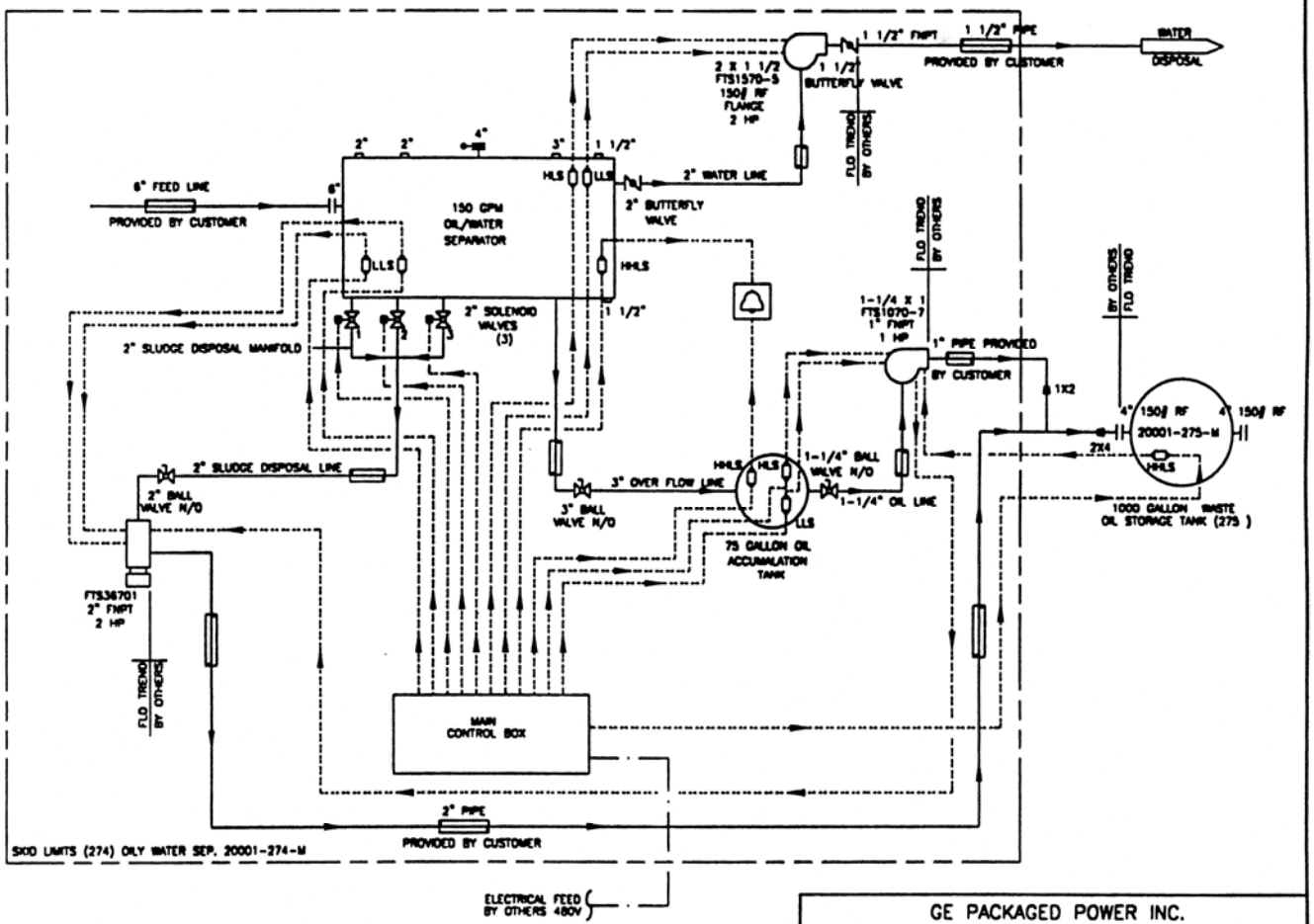
EJO NUMBER | FILE

SCALE 1/8" = 1' | PAGE

DRAWING NUMBER 8-2-6509







NOTES:
1 ALL LEVEL SWITCHES ARE 5A @ 120 VAC
2 —— INDICATES PROCESS LINES
3 ---- INDICATES INFORMATION & SIGNALS
4 ▭ INDICATES PIPE SUPPLIED AND SPECIFIED BY OTHERS

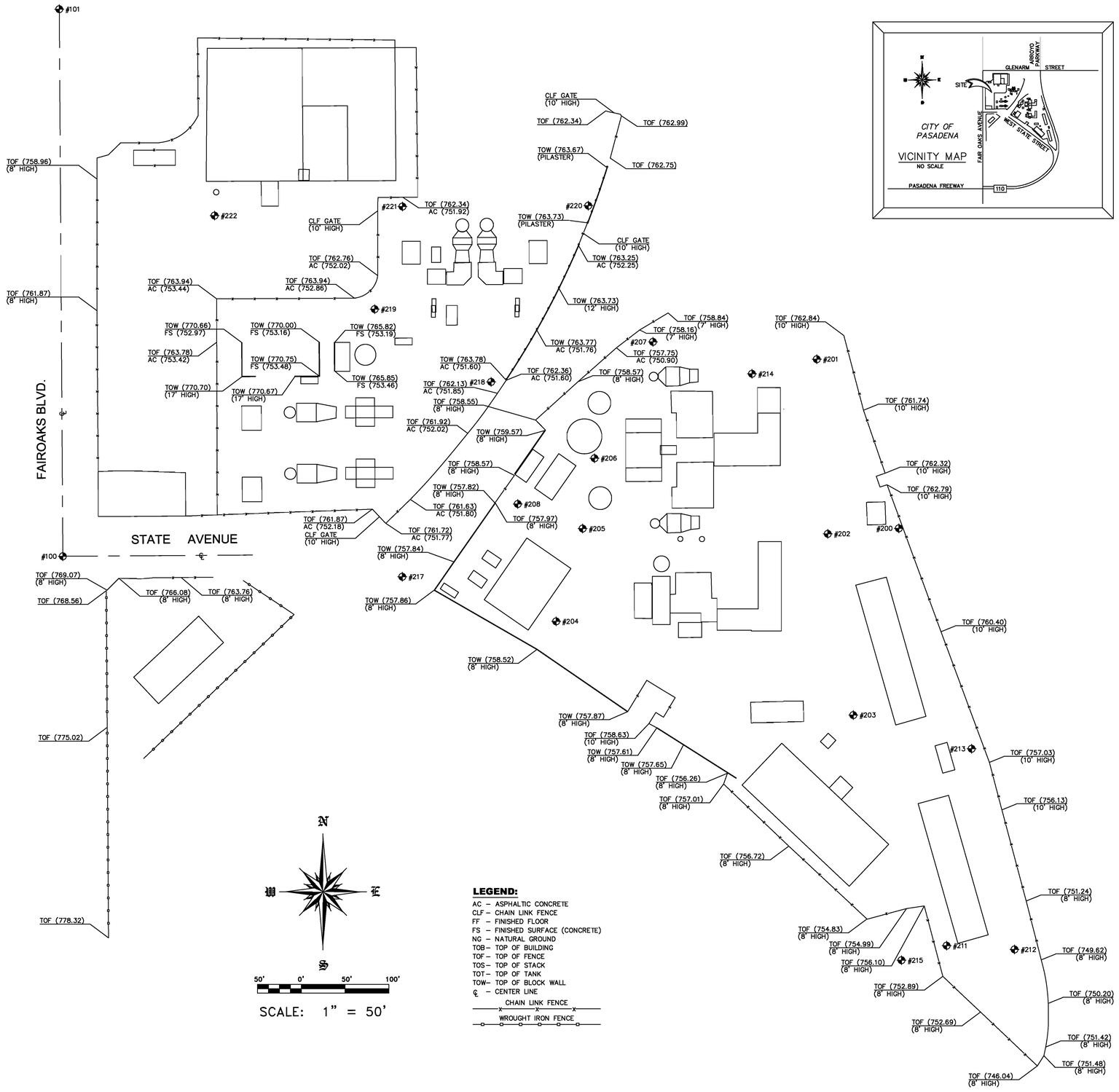
APPROVED BY: _____
APPROVED AS NOTED: _____
DISAPPROVED BY: _____
DATE: _____

THESE DRAWINGS CONTAIN CONFIDENTIAL PROPRIETARY INFORMATION. THEY ARE NOT TO BE COPIED, REPRODUCED OR USED IN ANY MANNER THAT WOULD COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION CONTAINED HEREIN. THESE DRAWINGS ARE NOT TO BE USED FOR CONSTRUCTION, FABRICATION OR SPECIFICATION WRITING PURPOSES UNLESS A SPECIFIC CONFIDENTIALITY AGREEMENT AND LICENSING AGREEMENT HAVE FIRST BEEN ENTERED INTO WITH FLO TREND SYSTEMS, INC. OF HOUSTON, TEXAS. FAILURE TO OBSERVE THE CONDITION OF THIS NOTICE WILL RESULT IN PROSECUTION AS ALLOWED UNDER THE LAWS OF THE STATE OF TEXAS, U.S.A. OR THOSE OF ANY OTHER APPROPRIATE JURISDICTION AS FLO TREND SYSTEMS, INC.

GE PACKAGED POWER INC.	
PROJECT # :	20001
PROJECT NAME :	CITY OF PASADENA
PROJECT LOCATION :	PASADENA, CA
PLOT PLAN NUMBER :	

FLO TREND SYSTEMS, INC.
707 LOHMAN HOUSTON, TEXAS 77018

SCALE: NONE	APPROVED BY	DRAWN BY: JM	
DATE: 10-11-02	DESCRIPTION: FCN DIAGRAM	DATE REVISED: 11-07-02	REV #: A
TITLE: 150 GAL. OIL/WATER SEPARATOR SYSTEM		DRAWING NUMBER: 20001-274-P&ID	



LEGEND:

AC – ASPHALTIC CONCRETE
CLF – CHAIN LINK FENCE
FF – FINISHED FLOOR
FS – FINISHED SURFACE (CONCRETE)
NG – NATURAL GROUND
TOB– TOP OF BUILDING
TOF– TOP OF FENCE
TOS– TOP OF STACK
TOT– TOP OF TANK
TOW– TOP OF BLOCK WALL
℄ – CENTER LINE
CHAIN LINK FENCE
WROUGHT IRON FENCE

CONTROL COORDINATES:

FIELD POINT #	NORTHING	EASTING	ELEVATION	NORTHING (UTM)	EASTING (UTM)
100	1868202.06	6516181.92	760.95	12390734.59	1292410.08
101	1868827.70	6516177.84	752.04	12391360.09	1292412.10
200	1868234.00	6517137.74	751.34	12390757.18	1293365.93
201	1868427.45	6517043.96	751.42	12390951.49	1293274.07
202	1868227.72	6517056.50	750.67	12390751.70	1293284.65
203	1868020.48	6517085.64	750.81	12390544.23	1293311.76
204	1868127.62	6516745.84	750.75	12390654.66	1292973.10
205	1868233.66	6516776.16	751.22	12390760.37	1293004.44
206	1868314.22	6516789.83	751.28	12390840.78	1293018.90
207	1868447.25	6516856.50	751.06	12390973.11	1293086.86
208	1868261.81	6516702.04	749.93	12390789.23	1292930.63
211	1867756.80	6517192.52	747.79	12390279.58	1293416.03
212	1867752.42	6517270.08	747.82	12390274.45	1293493.53
213	1867981.93	6517220.90	751.19	12390504.37	1293446.61
214	1868410.68	6516969.81	751.16	12390935.45	1293199.77
215	1867740.10	6517140.77	745.20	12390263.40	1293364.13
216	1867998.48	6516816.93	749.12	12390524.86	1293042.91
217	1868178.68	6516570.05	749.82	12390707.43	1292797.86
218	1868401.43	6516671.61	751.83	12390929.11	1292901.57
219	1868484.71	6516538.46	751.94	12391013.68	1292769.27
220	1868603.01	6516782.68	751.96	12391129.55	1293014.57
221	1868602.07	6516570.14	751.92	12391130.69	1292802.09
222	1868591.66	6516355.44	751.99	12391122.37	1292587.35

CONTROL NOTE:

POINT 100 IS A FOUND C–NAIL IN A CRACK IN CONCRETE.

POINT 101 IS A FOUND LEAD AND BRASS TACK IN CONCRETE.

POINTS 200–210 AND 215–222 ARE SET MAG NAIL AND ALUMINUM WASHER STAMPED "D. WOOLLEY & ASSOC CONTROL PT." (ALSO STAMPED WITH CORRESPONDING POINT NUMBER).

POINTS 211–213 ARE 2"X2" WOOD HUBS WITH BRASS TACKS AND WASHERS STAMPED "D WOOLLEY & ASSOC" (ALSO STAMPED WITH CORRESPONDING POINT NUMBER).

POINT 214 IS A SCRIBED "+" IN CONCRETE.

NOTE:

SEE SHEET 2 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 3 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 4 FOR NORTHEAST AND SOUTHWEST BUILDING ISOMETRIC VIEWS.

SEE SHEET 5 FOR NORTHWEST AND SOUTHEAST BUILDING ISOMETRIC VIEWS.

BASIS OF BEARINGS & DATUM STATEMENT:

(PURSUANT TO THE CALIFORNIA PUBLIC RESOURCE CODE, SECTIONS 8811, 8813.1, 8813.3, 8815.1 & 8857)

THE BEARINGS AND HORIZONTAL COORDINATES SHOWN HEREIN ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM (CCS83), ZONE 5, 2007.00 EPOCH AND WERE DETERMINED BY GLOBAL POSITIONING SYSTEM (G.P.S.) TIES TO TWO CALIFORNIA SPATIAL REFERENCE NETWORK (C.S.R.N.) STATIONS REFERRED TO AS CIT1 AND OXYC. PUBLISHED HORIZONTAL ACCURACIES ON THESE STATIONS MEET OR EXCEED FEDERAL GEOGRAPHIC DATA COMMITTEE (F.G.D.C.) 5–MILLIMETER ACCURACY CLASSIFICATION PER FGDC–STD–007.2–1998. SAID C.S.R.N. POSITIONS WERE HELD "FIXED" HORIZONTALLY IN THIS SURVEY.

THE CCS83 GRID BEARING BETWEEN C.S.R.N. STATIONS CIT1 AND OXYC BEING N83°19'42"E, AS DERIVED FROM THE POSITIONS FOR SAID STATIONS, IN SAID EPOCH, PUBLISHED BY THE CALIFORNIA SPATIAL REFERENCE CENTER (C.S.R.C.) ON JANUARY 18, 2007, WAS USED AS THE BASIS OF BEARINGS FOR THIS SURVEY.

THE ORTHOMETRIC ELEVATIONS SHOWN HEREIN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 1988) AND WERE DETERMINED BY GPS TIES TO THE ABOVE LISTED CGPS ALONG WITH THE APPLICATION OF THE NGS GEOID HEIGHT MODEL "GEOID99".

SURVEYOR'S STATEMENT:

THIS MAP CORRECTLY REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECTION IN CONFORMANCE WITH THE REQUIREMENTS OF THE PROFESSIONAL LAND SURVEYORS' ACT AT THE REQUEST OF COORY ENGINEERING IN AUGUST, 2011.

PROFESSIONAL LAND SURVEYOR DAVID E. WOOLLEY EXP. 12/31/12 No. 7304 STATE OF CALIFORNIA

DAVID E. WOOLLEY DATE: 10/25/11
P.L.S. NO. 7304
LICENSE EXPIRATION DATE: 12/31/12

CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
TEL: (714) 202–8700 FAX: (714) 202–8701
1718 N. NEVILLE STREET, ORANGE, CA 92865

REVISIONS				
NO	DESCRIPTION	BY	APPROVED	DATE

PERIMETER FENCE AND WALL
PASADENA GLENARM FACILITY

PASADENA, CA

PREPARED FOR: PASADENA WATER AND POWER
DRAWN BY: JDR | SCALE: 1" = 50' | SHEET: 1 OF 5
CHECKED BY: DEW | JOB NO: .
DISREGARD PRINTS BEARING EARLIER REVISION DATES →

FAIROAKS BLVD.

℄

N

W E

S

20' 0' 20' 40'

SCALE: 1" = 20'

PEAK (820.54)

TOB (839.88)

TOB (839.84)

TOB (819.84)
AC (752.55)

TOB(839.91)

TOB (783.27)

TOS (873.41)

TOB (766.42)
AC (752.30)

TOS (877.32)
FS (752.15)

TOS (877.37)

TOB (765.01)
AC (751.77)

TOB (768.85)
AC (751.75)

TOB (765.02)
AC (751.75)

TOB (765.17)

TOB (765.19)

TOB(792.95)

TOB(792.92)

TOB(786.45)

TOB(790.49)

TOB(790.56)

TOB (765.17)
AC (751.48)

TOB (765.08)

TOB (765.15)

TOB (790.53)

TOB (790.50)

TOB (790.59)

TOB(790.29)

TOB(790.02)
AC (752.46)

TOB(789.86)

TOB(790.67)

TOB(790.24)
AC (752.21)

TOB (765.36)

TOB (769.26)

TOB(760.69)

TOB (765.30)
AC (751.66)

TOB (766.03)

TOB (766.01)

TOB (765.99)
AC (751.83)

TOB (760.96)
AC (752.24)

TOB (760.72)

TOB(760.71)
AC (752.08)

PEAK (761.44)

TOB (761.03)
AC (752.35)

TOB(761.11)
FS (752.68)

TOB(761.05)
FS (752.59)

TOT (774.75)
FS (753.35)

TOB(761.90)
FS (753.48)

TOB(761.99)
FS (753.54)

TOB (783.35)

TOB (783.35)

TOB (785.85)
AC (753.66)

TOB (781.49)

TOB(768.20)

TOB(790.97)

TOB(768.40)

TOS (878.84)

TOB(768.40)
FS (753.05)

TOB (791.19)

TOB(791.01)
FS (753.17)

TOB (783.38)

TOB(771.72)
NG (755.25)

TOB(775.16)
NG (753.07)

PEAK (778.85)

PEAK (785.60)

TOB(782.93)

PEAK (786.07)

TOB (782.17)
FF (757.44)

TOB (773.26)
FS (757.73)

TOB (761.03)
FS (753.58)

TOB (783.40)

TOB (783.35)

TOB (785.81)
AC (753.66)

TOB(781.45)

TOB(791.07)

TOB(768.36)

TOS (878.77)

TOB (785.72)

TOB(781.33)

TOB (791.19)

TOB(768.36)
FS (752.37)

TOB(791.13)

NOTE:

SEE SHEET 1 FOR SURVEYOR'S STATEMENT, BASIS OF BEARINGS AND FENCE AND WALL ELEVATION CALLOUTS.

SEE SHEET 3 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 4 FOR NORTHEAST AND SOUTHWEST BUILDING ISOMETRIC VIEWS.

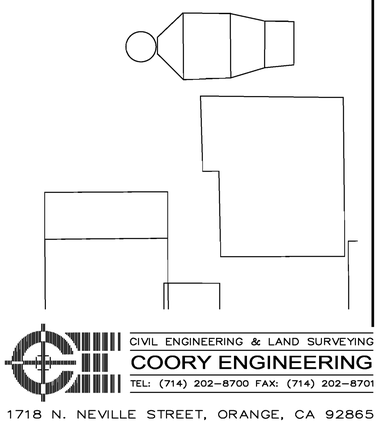
SEE SHEET 5 FOR NORTHWEST AND SOUTHEAST BUILDING ISOMETRIC VIEWS.

LEGEND:

AC – ASPHALTIC CONCRETE
CLF – CHAIN LINK FENCE
FF – FINISHED FLOOR
FS – FINISHED SURFACE (CONCRETE)
NG – NATURAL GROUND
TOB – TOP OF BUILDING
TOF – TOP OF FENCE
TOS – TOP OF STACK
TOT – TOP OF TANK
TOW – TOP OF BLOCK WALL
℄ – CENTER LINE

CHAIN LINK FENCE

WROUGHT IRON FENCE



CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
TEL: (714) 202-8700 FAX: (714) 202-8701
1718 N. NEVILLE STREET, ORANGE, CA 92865

REVISIONS

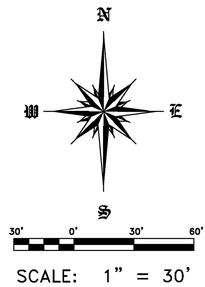
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PASADENA GLENARM FACILITY

PASADENA, CA

PREPARED FOR: PASADENA WATER AND POWER				
DRAWN BY: JDR	SCALE: 1" = 20'	SHEET: 2 OF 5		.
CHECKED BY: DEW	JOB NO: .			
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	.			





SCALE: 1" = 30'

LEGEND:

AC – ASPHALTIC CONCRETE
CLF – CHAIN LINK FENCE
FF – FINISHED FLOOR
FS – FINISHED SURFACE (CONCRETE)
NG – NATURAL GROUND
TOB– TOP OF BUILDING
TOF– TOP OF FENCE
TOS– TOP OF STACK
TOT– TOP OF TANK
TOW– TOP OF BLOCK WALL
℄ – CENTER LINE

CHAIN LINK FENCE

WROUGHT IRON FENCE

NOTE:

SEE SHEET 1 FOR SURVEYOR'S STATEMENT, BASIS OF BEARINGS AND FENCE AND WALL ELEVATION CALLOUTS.

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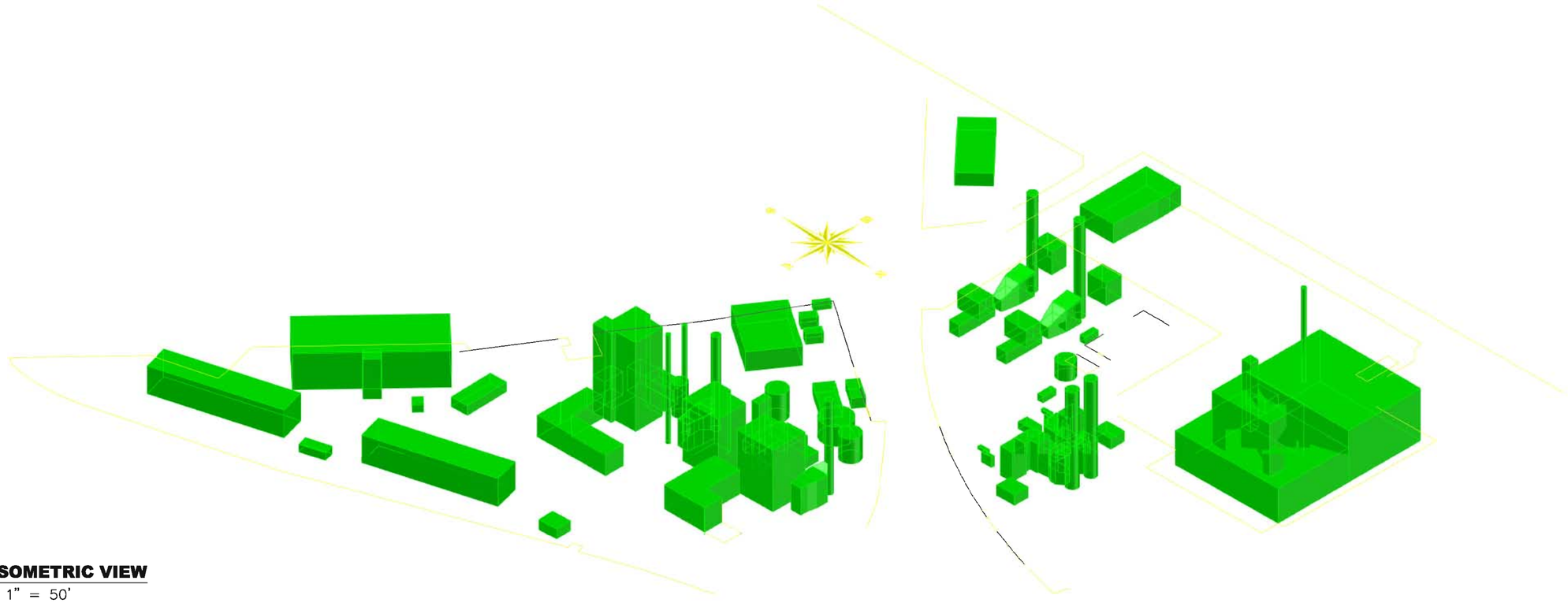
CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
TEL: (714) 202-8700 FAX: (714) 202-8701
1718 N. NEVILLE STREET, ORANGE, CA 92865

REVISIONS				
NO	DESCRIPTION	BY	APPROVED	DATE
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PASADENA GLENARM FACILITY

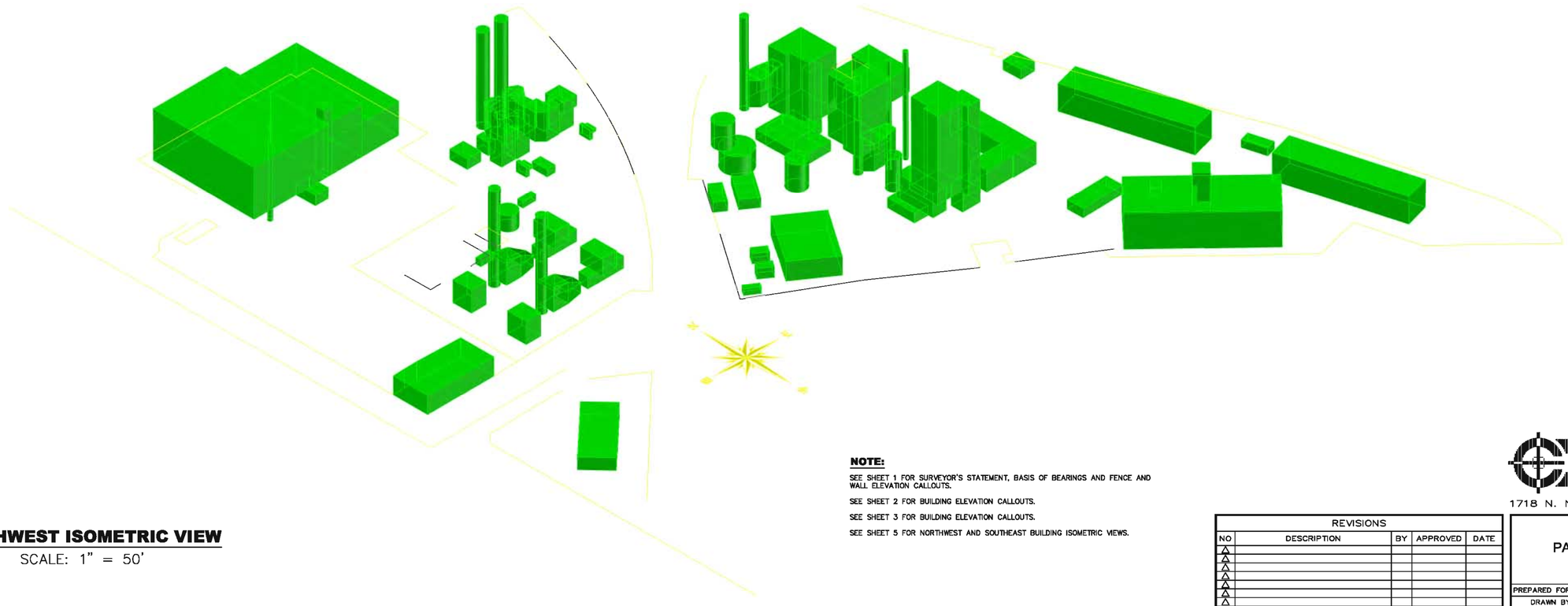
PASADENA, CA

PREPARED FOR:	PASADENA WATER AND POWER			
DRAWN BY: JDR	SCALE: 1" = 30'	SHEET: 3 OF 5		
CHECKED BY: DEW	JOB NO: .			
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	.			



NORTHEAST ISOMETRIC VIEW

SCALE: 1" = 50'



SOUTHWEST ISOMETRIC VIEW

SCALE: 1" = 50'

NOTE:

SEE SHEET 1 FOR SURVEYOR'S STATEMENT, BASIS OF BEARINGS AND FENCE AND WALL ELEVATION CALLOUTS.

SEE SHEET 2 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 3 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 5 FOR NORTHWEST AND SOUTHEAST BUILDING ISOMETRIC VIEWS.

REVISIONS				
NO	DESCRIPTION	BY	APPROVED	DATE

CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
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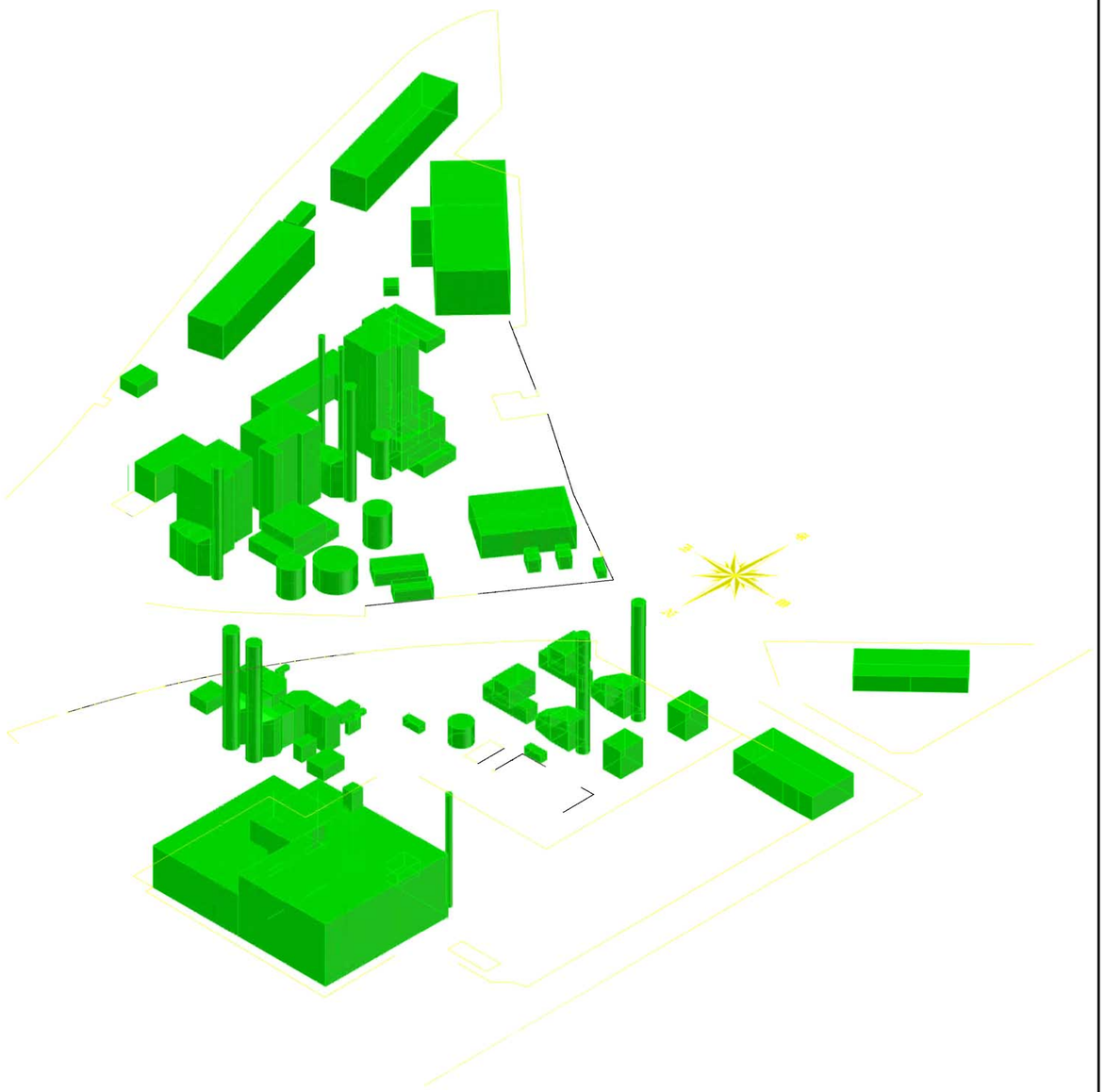
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PASADENA GLENARM FACILITY

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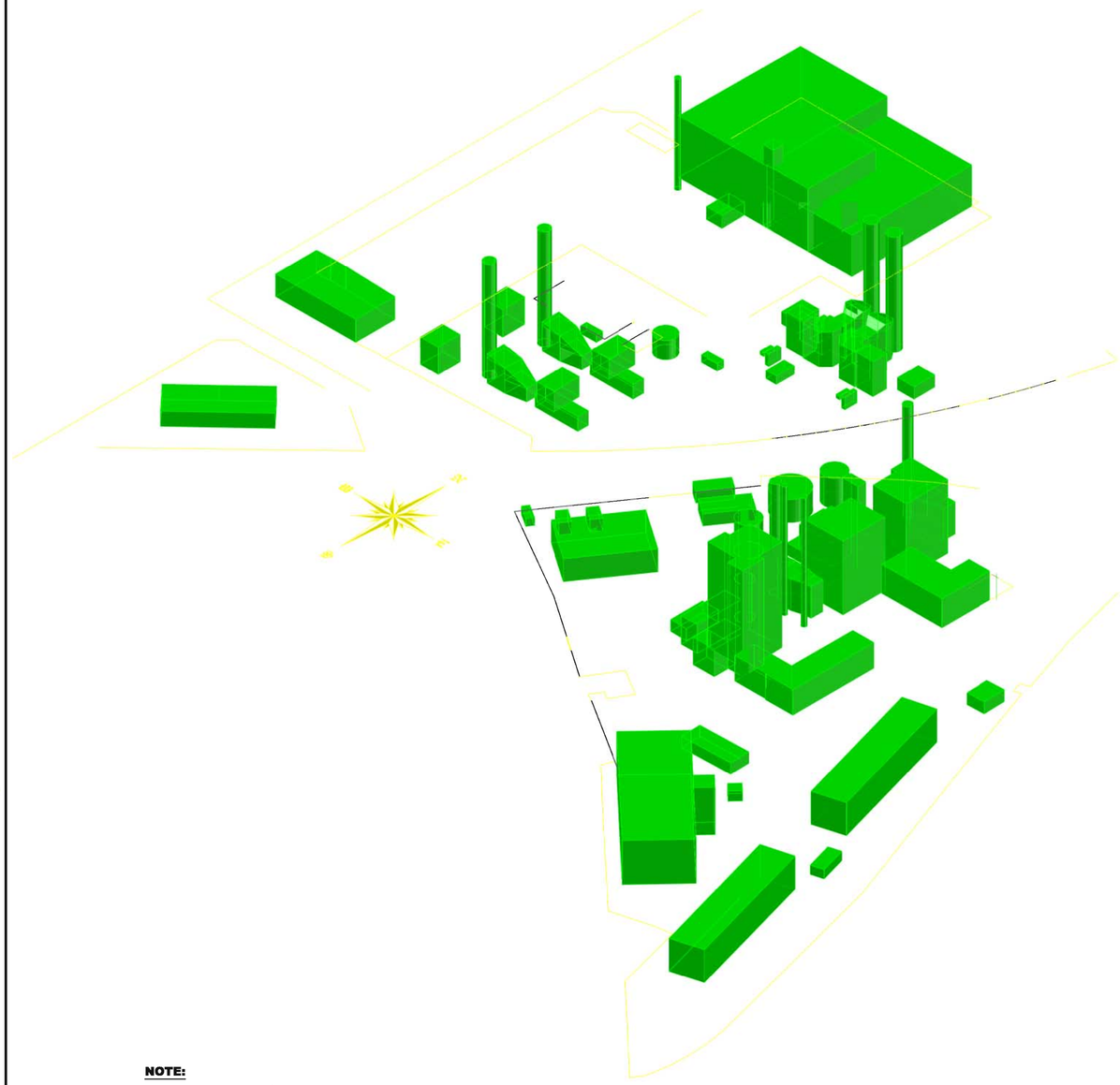
PASADENA, CA

PREPARED FOR:	PASADENA WATER AND POWER		
DRAWN BY: JDR	SCALE: 1" = 50'	SHEET: 4 OF 5	.
CHECKED BY: DEW	JOB NO: .		
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	.		



NORTHWEST ISOMETRIC VIEW

SCALE: 1" = 50'



SOUTHEAST ISOMETRIC VIEW

SCALE: 1" = 50'

NOTE:

SEE SHEET 1 FOR SURVEYOR'S STATEMENT, BASIS OF BEARINGS AND FENCE AND WALL ELEVATION CALLOUTS.

SEE SHEET 2 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 3 FOR BUILDING ELEVATION CALLOUTS.

SEE SHEET 4 FOR NORTHEAST AND SOUTHWEST BUILDING ISOMETRIC VIEWS.

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REVISIONS				
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PASADENA GLENARM FACILITY

PASADENA, CA

PREPARED FOR: PASADENA WATER AND POWER				
DRAWN BY: JDR	SCALE: 1" = 50'	SHEET: 5 OF 5		.
CHECKED BY: DEW	JOB NO: .			
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	.			

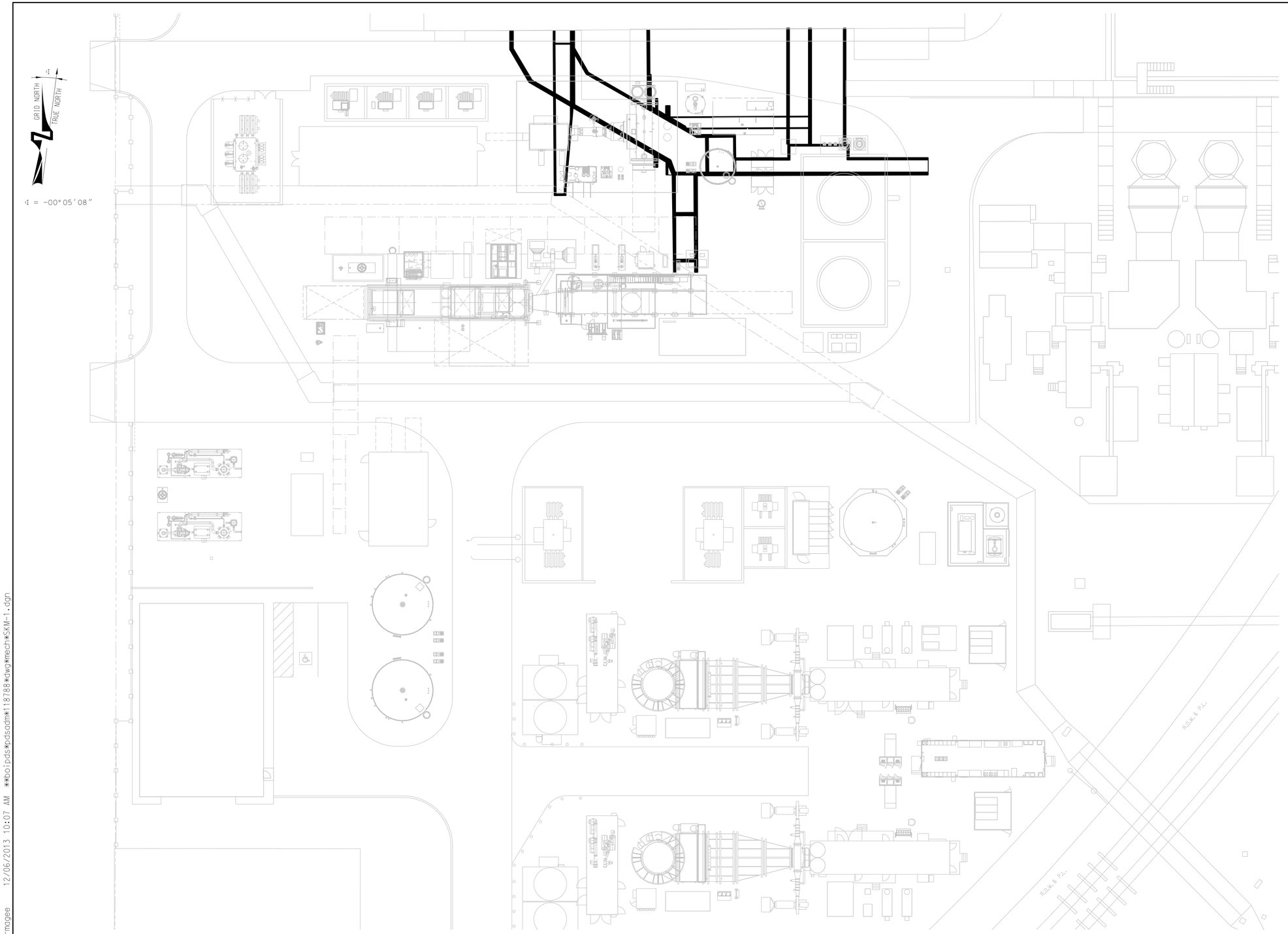
420X

12" MAIN TO 8" SERVICE CONNECTION FOR BROADWAY STEAM PLANT

CITY SERVICE 359 and Old 279

REFERENCE DRAWINGS
E-478 B-2-1001
E-478A B-2-1585
S.D. 6300 2-2-902-B

GLENARM ST.
W.O. Cmt Lnd 5632 8"C.I. W.O. 405
W.O. Cmt Lnd 5630 12"C.I. W.O. 403
8"C.I. W.O. 405
12"C.I.
EDMONDSON ALLEY
RAYMOND AVE.
OAKS AVE.
ARROYO SECO
MARENGO AV.
WALLIS ST. (Vacated)
STATE ST.
BROADWAY
RAILROAD ST.
GRACE TER.
FAIR Varies
PARKWAY
SUB. M.R. 14-98
ORIGINAL GLENARM STEAM PLANT
Fountain
Transformer
Mtr. Vault
Abandoned Sub-Structure for old MARLEY #3 COOLING TOWER
Abandoned Facility
Track Abandoned in Place
Glenarm Address
CITY 441
4"C.I. 79
8"Mtr.
6"C.I. LIGHT DEPT. Abandoned-in-Place
Welding Shop
WASHBURN'S Storage
SUB M.R. 6-24
HISTORIC PACIFIC ELECTRIC Railroad POWER HOUSE
M.R. 32-81
Under RR Tracks 16"Sh. Casing around 12"Sh. Pipe
12"Sh. Pipe in 16"Sh. Casing under Railroad Tracks
Main is 7'-4" of Fence
WASHBURN'S
SEE CONS ELECTRICAL CONSTRUCTION SHOP
Removed Per 9-21-81
Metrolink Former R.R.W. - SAN PEDRO-LOS ANGELES & SALT LAKE R.R.
Right-of-Way
ONE WAY
Tracks
Former R.R.W. - SAN PEDRO-LOS ANGELES & SALT LAKE R.R.
RAILROAD ST.
SUB M.R. 6-24
PASADENA
SO. PASADENA
Parking
Tap off Steele St.
35995 1"C H-1250 GB
Scale 1"=50'
CHECK OUT COLOR PRINTS
Do. Lot 2 Pasquel Blk. N.San Pasqual TR M.R. 32-81
Access Area
SEE DETAIL UPPER RIGHT
20,000 BBL.
FUEL OIL STORAGE TANK
WATER TANK
Fence-Wall
Enclosure
Steel Tank
Old City Well and C.I. Main
Buried and paved over
8"HEG 31'SN 73'E. of Fence from N.E. Corner
Valve operated by South Pasadena Water Company
Main originally laid by Pasadena Water under W.O. 3450-8"C.I.-Del 150
6"C.I. 8500 GPM to SOUTH PASADENA WATER CO.
Former Site of Raymond Hotel Passenger Depot
Former Raymond Hotel Passenger Depot
Former Site of Raymond Hotel
Metrolink "Blue Line" (Formerly A.T.K.S.F.R.R.)
A.T.K.S.F.R.R.
Pole Line
Track
Fence/wall follows Right-of-Way
Vacated
8"C.I. Main 4' W of Fence
Head at NE Cor. Bld. 90' W of Wall-Fence
6" Valve is 3½' W of Wall
Pipe Swing Ground Vaults
WASH ROOM
Parcel O.R. 0-20-30
G-B
GT-1
GT-2
FUEL STORAGE AREA
ENCLOSURE
12"MJC 17'NS 6'EE from North
Old Raymond Hotel Fire Service
Old Raymond Hotel Fire Service
Old Raymond Hotel Fire Service



NOTES

1. THE INTENT OF THIS DRAWING IS TO ILLUSTRATE FOR THE BOP CONTRACTOR THE APPROXIMATE LOCATION OF EXISTING UNDERGROUND PIPING TUNNELS IN RELATION TO THE NEW PROPOSED EQUIPMENT LOCATIONS. BOP CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF THESE UNDERGROUND STRUCTURES PRIOR TO START OF EXCAVATION AND DEMOLITION. COORDINATE WITH THE GENERAL MANAGER PRIOR TO DEMOLISHING ANY EXISTING INSTALLATIONS.
2. REFER TO DEMO DRAWINGS 1 THROUGH 6 FOR TUNNEL DETAILS.

0 10 20 40 60 FEET
1"= 20'

rmagee 12/06/2013 10:07 AM \\boipds\pdsadm\118788\dwg\mech\SKM-1.dgn

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT. TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ISSUED FOR INFORMATION	06/12/2013	RM	GTH	TRC	SLH
A	ISSUED FOR INFORMATION	08/11/2013	RM	GTH	TRC	SLH

DSGN	GH	07/11/2013
DRN	RM	07/11/2013
CKD	TC	07/11/2013

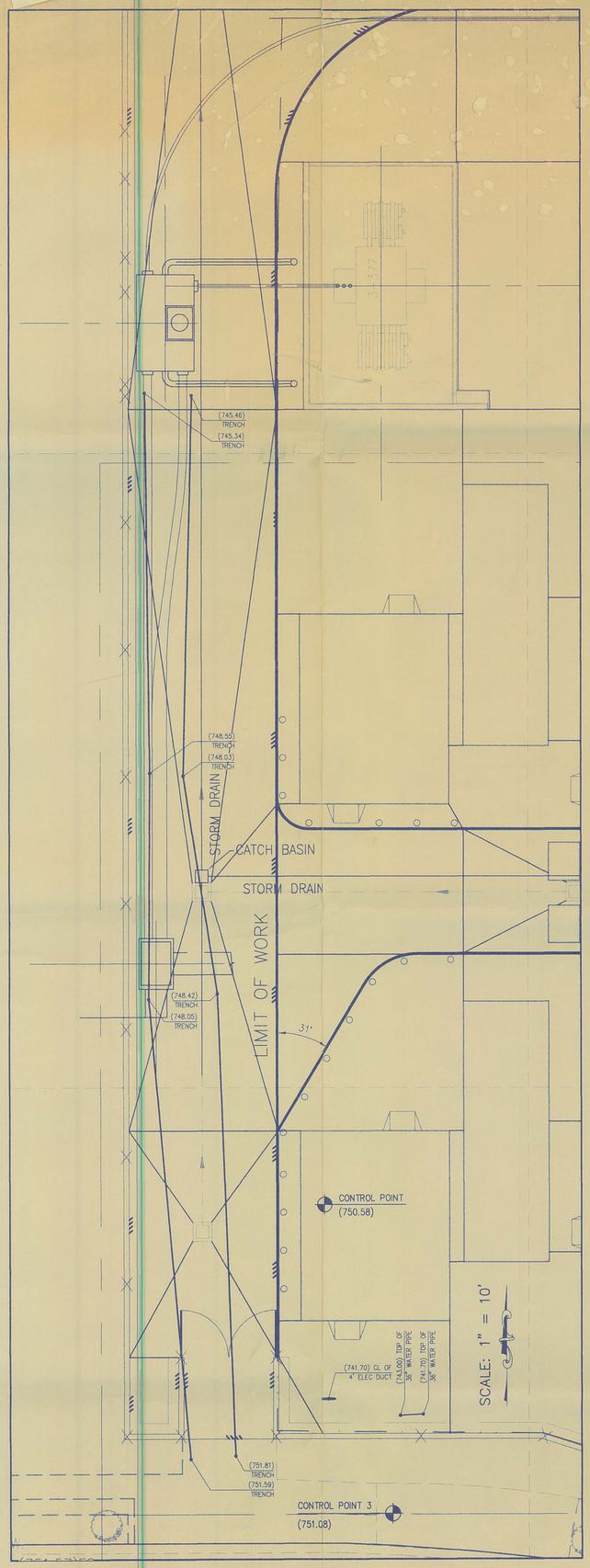
SCALE: 1" = 20'-0"
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

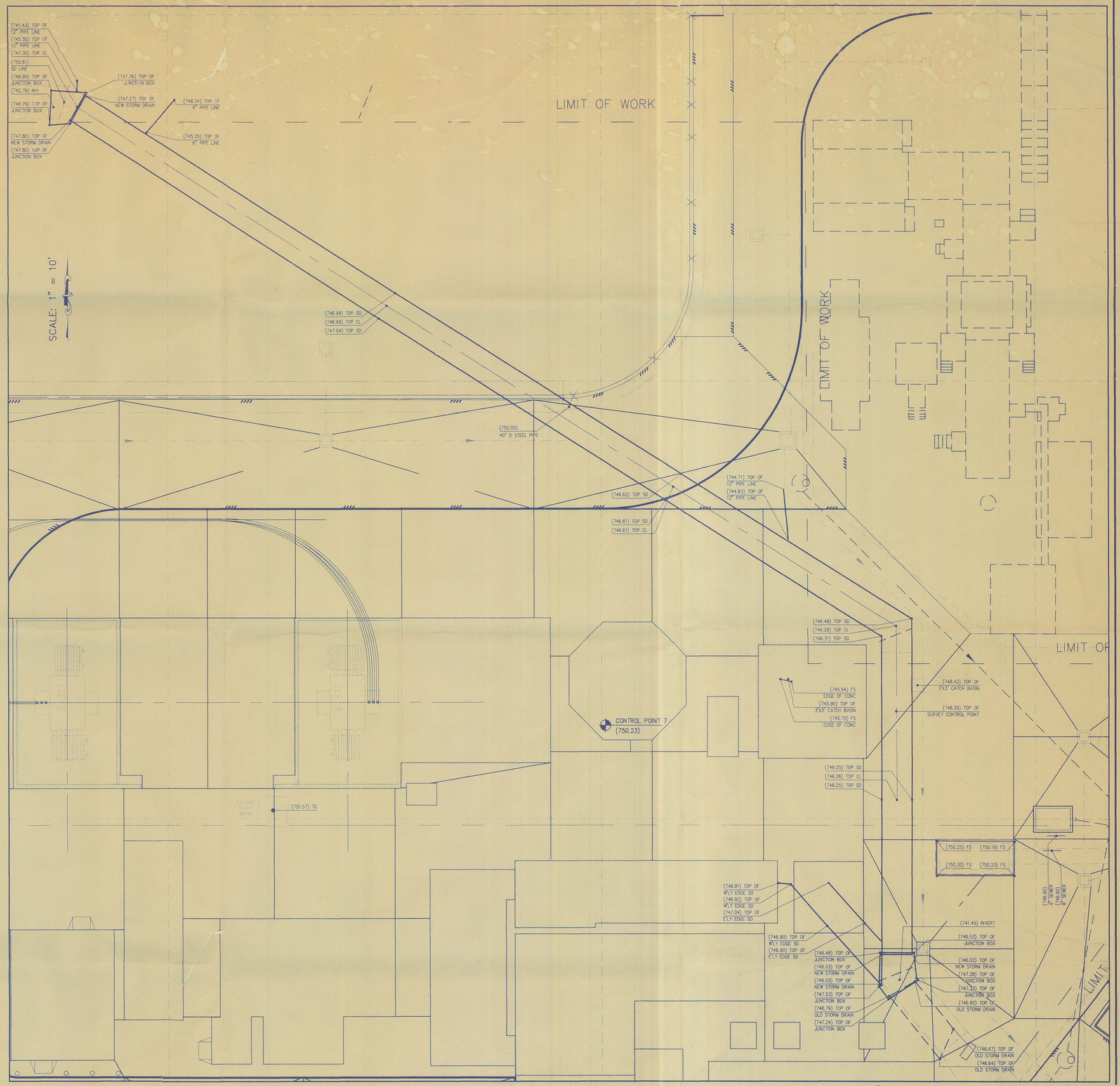
POWER ENGINEERS
www.powereng.com

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
EXISTING TUNNELS AND PROPOSED EQUIPMENT OVERLAY

JOB NUMBER 123374
REV B
DRAWING NUMBER SKM-1



ELECTRICAL CONDUIT TRENCH



STORM DRAIN LINE

CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
TEL: (562) 868-8266 FAX: (562) 868-0721
12631 East Imperial Hwy, Bldg F, Suite 124, Santa Fe Springs, CA 90670

PLANS PREPARED BY
COORY ENGINEERING
12631 E. IMPERIAL HWY. BLDG. F-124
SANTA FE SPRINGS, CA. 90670
(562) 868-8266

SAMIR M. KHOURY R.C.E. 30567, EXPIRES 3-31-2004

REGISTERED PROFESSIONAL ENGINEER
SAMIR M. KHOURY
No. 30567
EXP. 3-31-2004
CIVIL
STATE OF CALIFORNIA

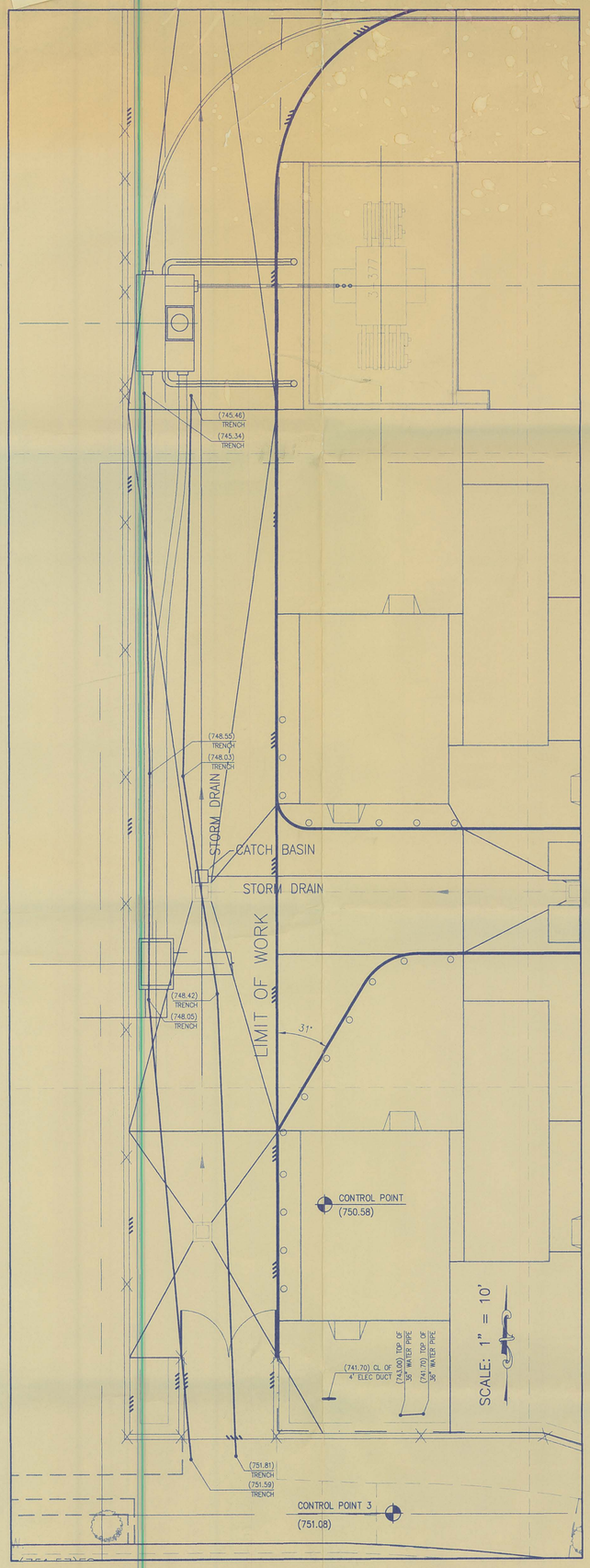
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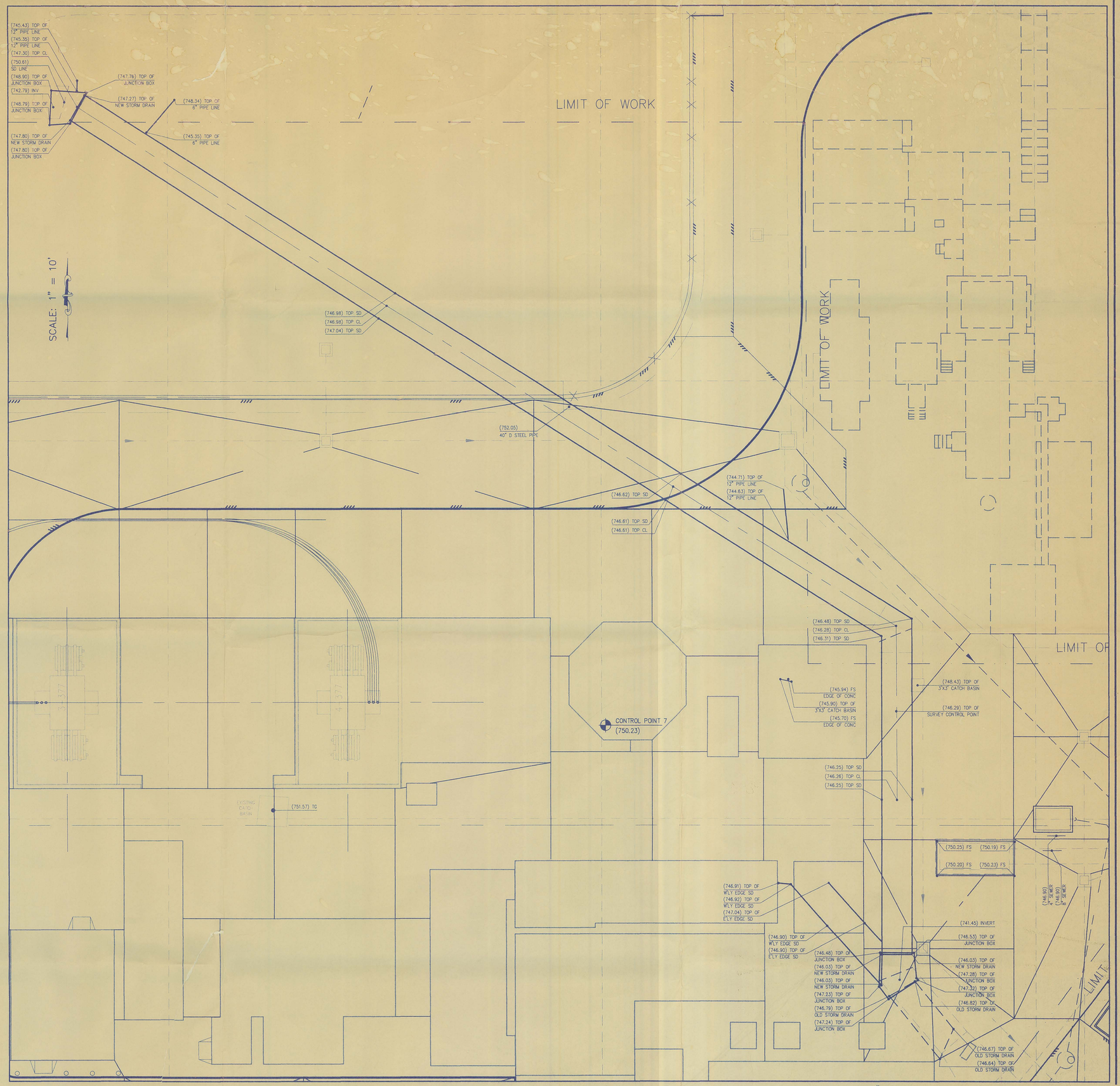
AS-BUILT SURVEY INFORMATION

STORM DRAIN LINE AND ELECTRICAL CONDUIT TRENCH
NORTHEAST CORNER OF FAIR OAKS AVE. AND STATE ST.
PASADENA, CALIFORNIA

PREPARED FOR:	PASADENA POWER PLANT		
DRAWN BY: KAS	SCALE: 1" = 10'	SHEET: 1 OF 1	
CHECKED BY: SMK	JOB NO: 505-101		
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	4-10-03		



ELECTRICAL CONDUIT TRENCH



STORM DRAIN LINE

CIVIL ENGINEERING & LAND SURVEYING
COORY ENGINEERING
TEL: (562) 868-8266 FAX: (562) 868-0721
12631 East Imperial Hwy, Bldg F, Suite 124, Santa Fe Springs, CA 90670

PLANS PREPARED BY
COORY ENGINEERING
12631 E. IMPERIAL HWY. BLDG. F-124
SANTA FE SPRINGS, CA. 90670
(562) 868-8266

SAMIR M. KHOURY R.C.E. 30567, EXPIRES 3-31-2004

REGISTERED PROFESSIONAL ENGINEER
SAMIR M. KHOURY
No. 30567
EXP. 3-31-2004
CIVIL
STATE OF CALIFORNIA

REVISIONS

NO	DESCRIPTION	BY	APPROVED	DATE
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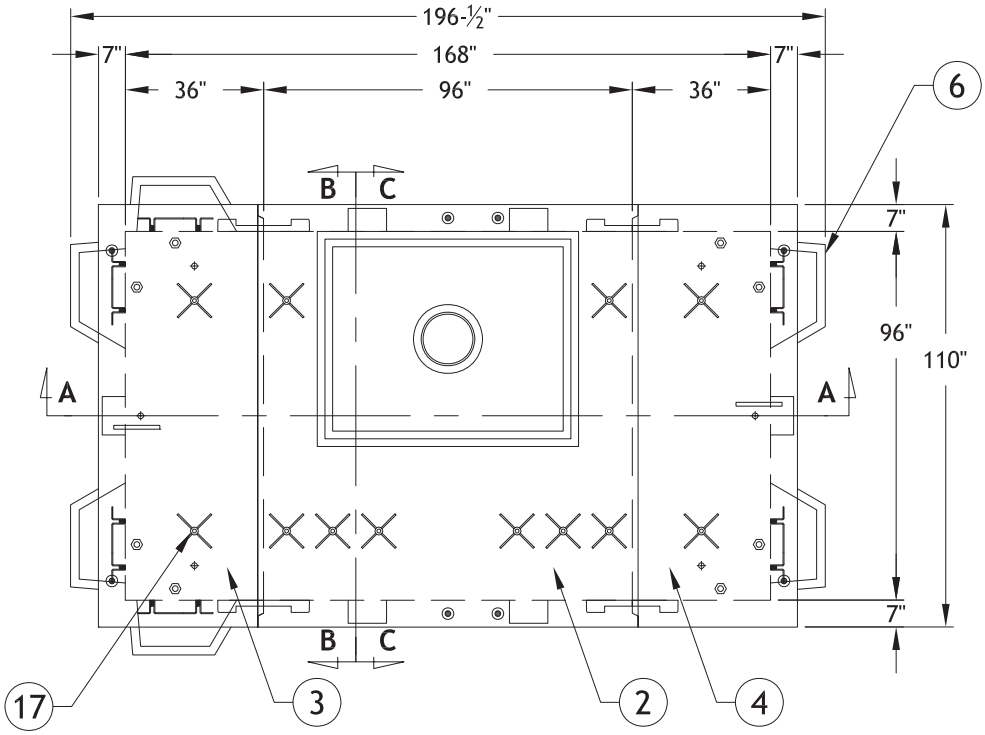
AS-BUILT SURVEY INFORMATION

STORM DRAIN LINE AND ELECTRICAL CONDUIT TRENCH
NORTHEAST CORNER OF FAIR OAKS AVE. AND STATE ST.
PASADENA, CALIFORNIA

PREPARED FOR:	PASADENA POWER PLANT		
DRAWN BY: KAS	SCALE: 1" = 10'	SHEET: 1 OF 1	
CHECKED BY: SMK	JOB NO: 505-101		
DISREGARD PRINTS BEARING EARLIER REVISION DATES →	4-10-03		

Scope V-228 - Describes Installation of an 8' x 14' Tunnel Vault

Figure V-228.1 - Top View



Plan View

Notes:

1. See V-202 for general notes
2. Center section
3. End section w/ (4) ducts
4. End section w/ (2) ducts
5. 13" x 14" dia. x 5-½" deep sump knockout to remain intact, w/grated cover. Center section.
6. 18" x 75" ducted knockout (8) each
7. 5" dia. conterms ducted knockout
8. 5" dia. x 2" deep ducted knockout
9. 2" x 2-½" dia. x 2" deep ducted knockout
10. 14" dia. vent x 6" deep center section (4); end sections (1) each
11. 1" dia. blind ground rod hole end section (3) each
12. Unistrut embedded
13. Install vault with 36" minimum from finish grade to top of vault roof
14. Install 6" or 12" grade ring to bring to grade
15. Install "Conseal" sealant joint material or mortar grout
16. Install (4) ¾" x 10' ground rods, one in each corner. Apply Sikaflex-1a or equivalent sealant around ground rod opening.
17. Provide 6" thick layer of leveled and compacted crushed rock at the bottom of excavation before vault installation.
18. Pulling eye

Suppliers:
Jensen Precast
TEL. NO. (800)257-6100
Utility Vault Co.
TEL. NO. (800)892-1538

Rev #	Date	Drawn	Checked	Approved
1				
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PASADENA Water&Power

Drawn	SV	12-26-06
Chk'd		6-27-07
Apv'd		6-27-07

Electric Distribution Standards
Vault, H-Type, Tunnel
8'-0" x 14'-0" x 9'-4"
with Monolithic Neck

UG

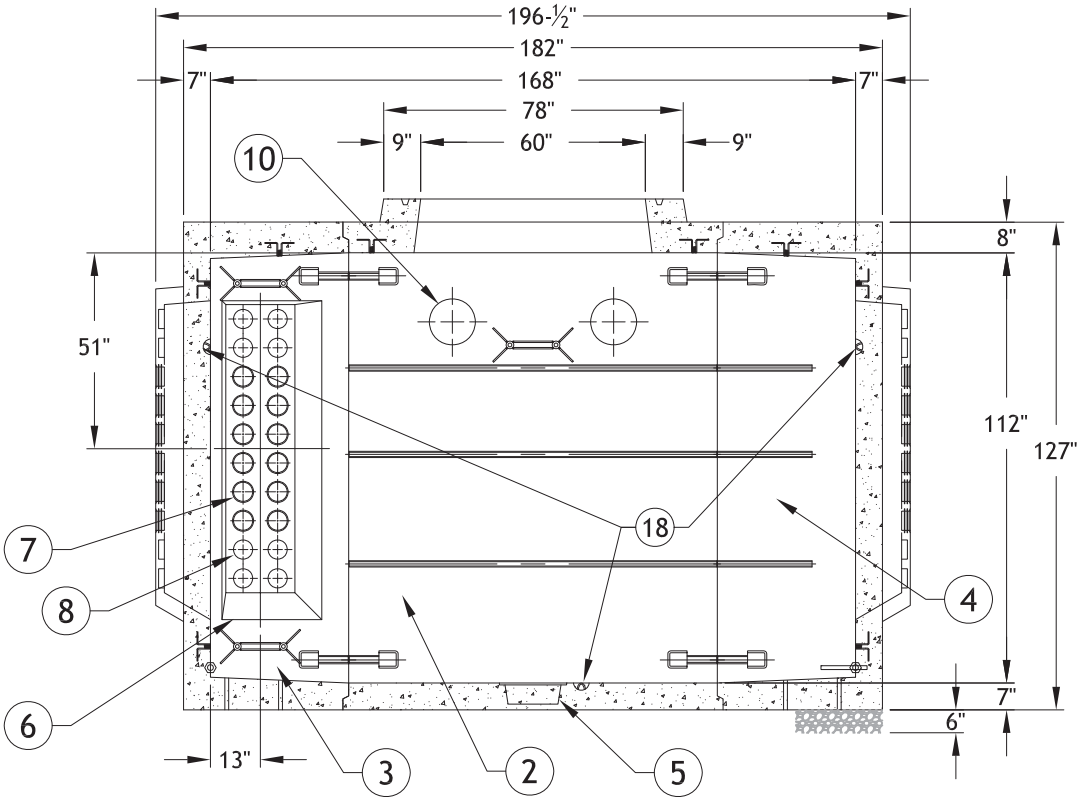
V-228

SHEET 1 OF 3

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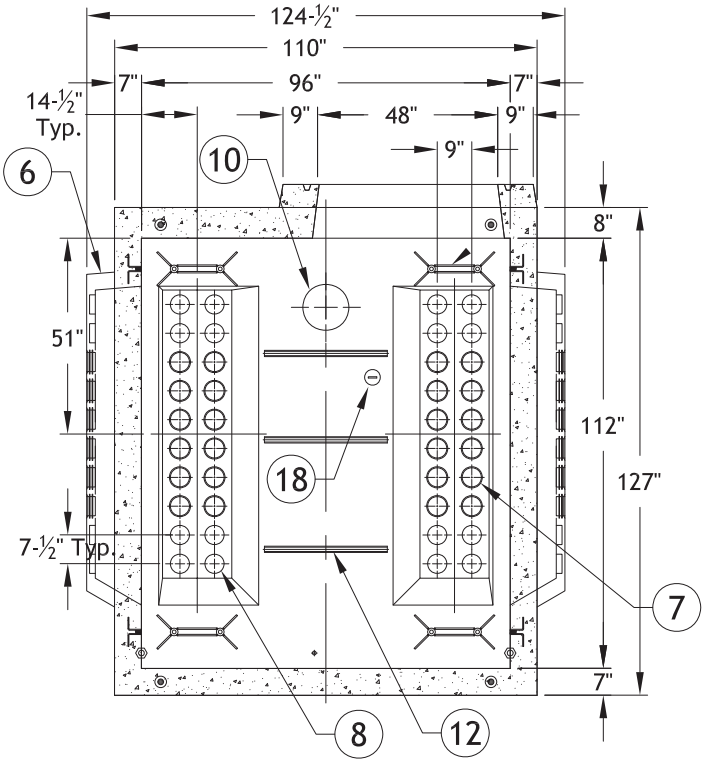
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Figure V-228.2 Side View



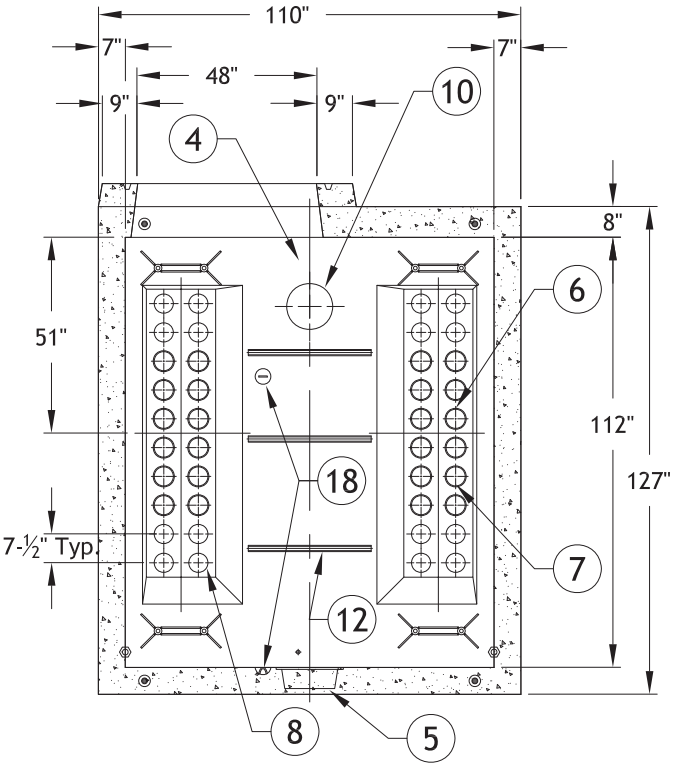
Section A-A

Figure V-228.3 End View



Section B-B

Figure V-228.4 End View



Section C-C

PASADENA Water&Power	Drawn	SV	12-26-06	Electric Distribution Standards
	Chk'd		6-27-07	Vault, H-Type, Tunnel 8'-0" x 14'-0" x 9'-4" with Monolithic Neck
	Apv'd		6-27-07	

UG

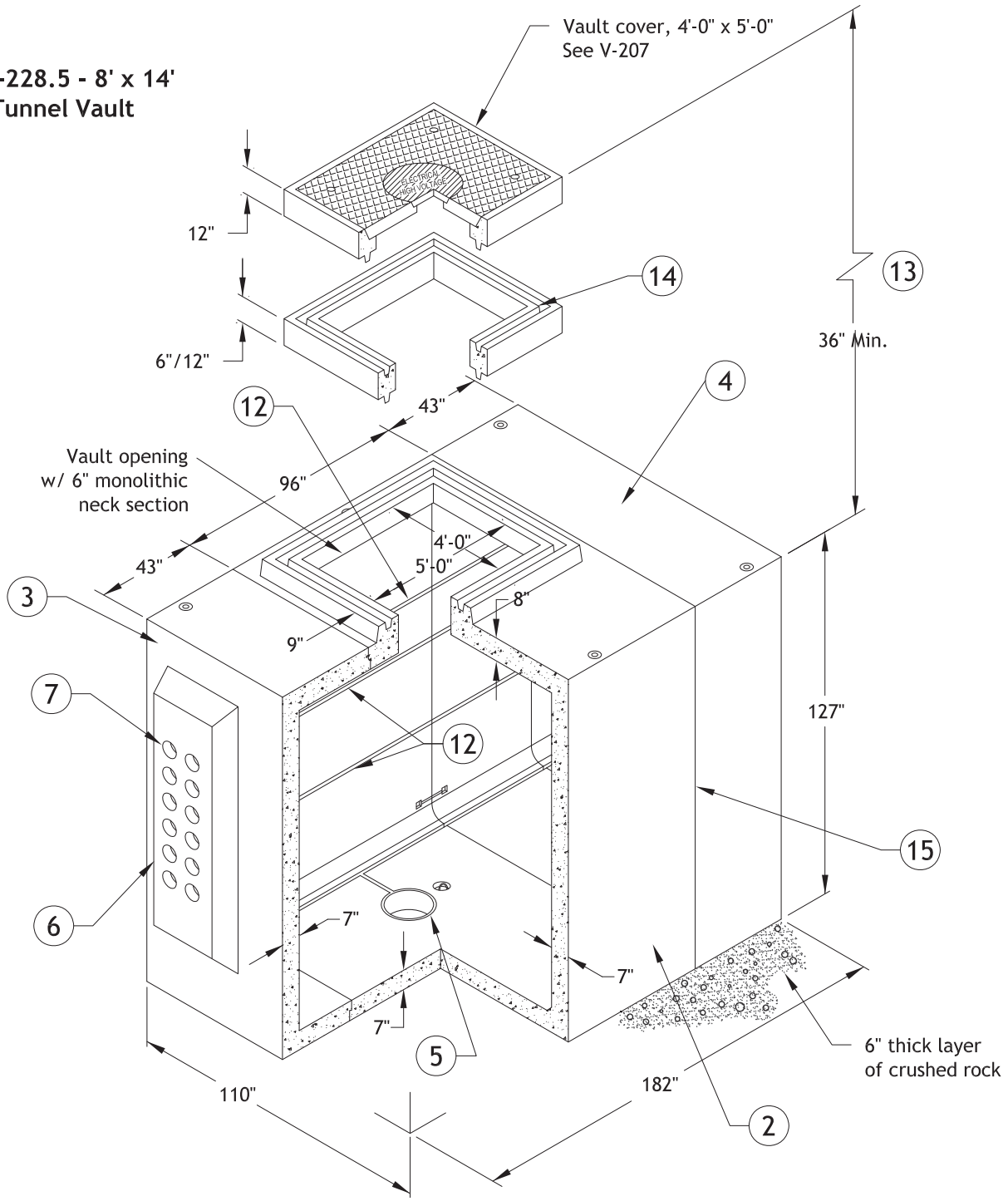
V-228

SHEET 2 OF 3

FILENAME:

Rev #	Date	Drawn	Checked	Approved
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Figure V-228.5 - 8' x 14'
H-Type Tunnel Vault



PASADENA Water&Power	Drawn	SV	12-26-06	Electric Distribution Standards	UG V-228
	Chk'd		6-27-07	Vault, H-Type, Tunnel 8'-0" x 14'-0" x 9'-4" with Monolithic Neck	SHEET 3 OF 3
	Apv'd		6-27-07		

FILENAME:

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City of Pasadena
Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
1000	**GAS TURBINE GENERATOR PACKAGE**					
1010	Gas Turbine Generator (GTG)	ENG	PIE	PIE	BOP	
1020	Air Intake Filter System	PIE	PIE	PIE	BOP	Filter element shipment to be coordinated with BOP.
1030	Air Intake Structural support	PIE	PIE	PIE	BOP	
1035	Intake air ductwork including supports	PIE	PIE	PIE	BOP	
1040	Inlet Conditioning System	PIE	PIE	PIE	BOP	
1045	Anti Icing System	-	-	-	-	Not required
1050	Auxiliary Module/s, consisting of water wash system, CT lube oil system, CT hydraulic start	PIE	PIE	PIE	BOP	
1060	Power Augmentation Injection Skid	PIE	PIE	PIE	BOP	
1070	NOx Water Injection system included in Aux skid	PIE	PIE	PIE	BOP	
1080	Interconnecting piping	PIE	PIE/BOP	PIE/BOP	BOP	Piping / Hoses normally supplied by the gas turbine vendor furnished with package. Interconnecting piping from plant systems
1090	Acoustical/Weatherproof Enclosures for	PIE	PIE	PIE	BOP	
1100	Generator, Exciter, & AVR	PIE	PIE	PIE	BOP	
1110	Grout for leveling GTG	PIE	BOP	BOP	BOP	
1120	Gas Turbine Foundations w Embedments / Anchor Bolts	PIE/BOP	PIE/BOP	PIE/BOP	BOP	Foundations, anchor bolts and embedments by others. Shear lugs for LM6000 by PIE Contractor. Anchor bolts by BOP Contractor.
1130	GT exhaust diffuser	PIE	PIE	PIE	BOP	Within GTG package
1140	Valves in GT Packaged Equipment.	PIE	PIE	PIE	PIE/BOP	Including valve operators. Valves normally supplied within skids supplied by PIE. Loose ship valves supplied with GTG installed by BOP.
1150	GT Neutral Grounding Equipment	PIE	PIE	PIE	BOP	
1160	GT Starting System	PIE	PIE	PIE	BOP	
1170	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	Supplied as part of the turbine control panel.
1180	Turbine Control and Interface to Plant Control System	PIE	PIE/BOP	PIE/BOP	PIE/BOP	Turbine Control Panels by PIE, located in BOP supplied PDC, with remote operation in the new Glenarm Building control room.
1190	Starters for all AC motors (MCC)	PIE	BOP	BOP	BOP	Part of GTG MCC located in PDC.
1200	Starters for all DC motors	PIE	BOP	BOP	BOP	
1210	Battery Bank w/ 2 Chargers	PIE	BOP	BOP	BOP	Battery fill by BOP, to be located in the PDC
1220	Lighting for GT and walkways	PIE/BOP	PIE/BOP	PIE/BOP	BOP	Inside of package by PIE. Outside on platforms by BOP.
1230	Ground Cables	PIE	PIE	BOP	BOP	
1240	Raceway, cable and wiring within skid	PIE	PIE	PIE	NA	

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1245	External raceway, cable and wiring	PIE/BOP	BOP	BOP	BOP	
1250	Raceway, cable and wiring between skids	PIE	PIE/BOP	BOP	BOP	
1260	Vibration Equipment	PIE	PIE	PIE	BOP	
1270	Lube Oil System, Lube Oil Supply and Drain Piping within skid or GTG	PIE	PIE	PIE	NA	
1280	Lube Oil Supply and Drain piping between skid and GTG	PIE	PIE	PIE	BOP	Drain connection up to skid only by PIE Contractor
1290	Control Oil System & Piping within skid or GTG	PIE	PIE	PIE	NA	
1300	Control Oil System Piping between skid and GTG	PIE	PIE	PIE/BOP	BOP	
1310	Final Fuel Gas Filter Skid	PIE	PIE	PIE	BOP	
1320	Fuel Gas Flow Meters	PIE	PIE	PIE	BOP	Comment: PIE Contractor provides the fuel gas flow meter for GTG control use only, not used for revenue.
1325	Site Fuel Gas Flow Meter	PWP	PWP	PWP	PWP	Metering station by Sempra
1330	Compressor Water Wash Skid	PIE	PIE	PIE	BOP	
1340	Pipe Insulation & Lagging	PIE	PIE	PIE	BOP	Insulation required for heat conservation and personnel protection on PIE skids by PIE. Interconnecting piping will be field insulated
1360	Fire and Gas Detection and Extinguishing System	PIE	PIE	PIE/BOP	BOP	Consists of gas, flame and thermal detectors, CO2 extinguishing system including storage cylinders, piping, valves and wiring, and fire protection system control panel. Exterior pipe & cable furnished & installed by BOP contractor
1370	Water Wash Drain Tank	BOP	BOP	BOP	BOP	Water wash drains tank shall be sized to contain four water washes prior to being emptied
1500	**CHILLER**					
1510	Chiller and Electrical Packages	ENG	PIE	PIE	BOP	Chiller package, chill water pumps, heater exchanger, expansion tank, integral piping within the chiller module
1520	Piping chiller to Intake	PIE	BOP	BOP	BOP	If equipped with a chiller
1530	Pipe insulation	BOP	BOP	BOP	BOP	Insulation internal to the chiller unit needs to be proivded by the chiller vendor. Insuation on interconnecting piping by BOP.
1575	Pot feeder tank & expansion tank.	PIE	PIE	PIE	BOP	
1580	External raceway, cable and wiring	BOP	BOP	BOP	BOP	
2000	**STEAM TURBINE:**					

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2010	Steam Turbine and Generator	ENG	PIE	PIE	BOP	
2020	Turning Gear	PIE	PIE	PIE	BOP	
2030	Shims, leveling wedges, keys	PIE	PIE	PIE	BOP	PIE supplies shims and leveling screws
2040	Foundation w/ Embedments	PIE/BOP	PIE/BOP	PIE/BOP	BOP	PIE will review BOP foundation design PIE Contractor provides sole plate for the Gearbox
2050	EHC System	PIE	PIE	PIE	BOP	
2060	Lube Oil System	PIE	PIE	PIE	BOP	Includes pumps, reservoir, filters, and valves, and interconnecting supply & return piping.
2070	Lube Oil Conditioner	PIE	PIE	PIE	BOP	BOP will design interconnecting piping for the lube oil system conditioner based on PIE requirements
2080	ST Drain & Vent Valves and Operators	PIE	PIE	PIE	BOP	
2090	ST Drain Piping to Condenser and/or Misc. Drains Receiver	PIE	BOP	BOP	BOP	Downstream of drain valves
2100	Turbine/Generator Proper Piping, incl. Supports	PIE	PIE	PIE	BOP	Piping terminal points are clarified in the drawings in Attachment 1 of the PIE Contract. Supports are not included by the PIE Contractor since they cannot be designed without knowledge of the layout and the plant structural design.
2110	Line Side Cubicle	PIE	PIE	PIE	BOP	
2120	Main Steam & LP Control/ Admission Valves	PIE	PIE	PIE	BOP	
2130	Steam Turbine Local Gauge Panel or Stanchions	PIE	PIE	PIE	BOP	
2140	Starters for all AC motors (MCC)	PIE	PIE/BOP	BOP	BOP	PIE to design all interconnections and terminations. BOP to route cables. Starters will be in the BOP supplied PDC. BOP to run field wiring into starter/MCC
2150	MOVs & Actuators	PIE	PIE	PIE	BOP	For those items supplied on the STG skid. MOV's in the BOP piping will be by BOP.
2160	Starters for all DC motors	PIE	PIE/BOP	BOP	BOP	PIE to design all interconnections and terminations. BOP to route cables. Starters will be in the BOP supplied PDC. BOP to run field wiring into starter/MCC
2170	Generator Terminal Enclosure	PIE	PIE	PIE	BOP	
2180	Wiring on the STG Proper & Auxiliary Skids	PIE	PIE	PIE	PIE	

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2190	Interconnecting Wiring	PIE	BOP	BOP	BOP	BOP to include in Cable Schedule those circuits installed in BOP designed raceway.
2200	Vibration Equipment (Sensors and Monitoring	PIE	PIE	PIE	BOP	
2210	ST Neutral Grounding Equipment	PIE	PIE	PIE	BOP	
2220	ST Thermal Insulation blankets & blocks	PIE	PIE	PIE	BOP	Steam turbine casing and emergency stop valve casing shall be insulated.
2240	Cross over piping insulation and lagging	PIE	PIE	PIE	BOP	not required
2250	ST Piping Insulation	PIE	BOP	BOP	BOP	
2260	Turbine Supervisory Instrumentation & Protection Devices	PIE	PIE	PIE	BOP	
2270	Generator, Exciter, & AVR	PIE	PIE	PIE	BOP	Includes generator protection panel, generator control panel, and PT cubicle. Located in BOP supplied PDC.
2280	Turbine Shaft Sealing System (excluding interconnecting piping)	PIE	PIE	PIE	BOP	STV supplies the steam seals and the steam seal makeup and dump valves (skid mounted). Con supplies piping (see item 2380).
2290	Gland Steam Condenser & Exhausters	PIE	PIE	PIE	BOP	
2300	Turbine Steam Bypass System, Incl.	PIE	PIE	PIE	BOP	
2310	Control Logic Software Configuration Development and Implementation including graphics and data	PIE	PIE	PIE	PIE	
2320	Local Control Packages and Control Room System Hardware	PIE	PIE	PIE	BOP	PIE provides excitation controls, EHC controls, generator panel, and STG control station. No local control panel is used.
2330	Acoustic Enclosure for Outdoor Installation	PIE	PIE	PIE	BOP	Enclosure covers turbine, condenser, steam bypass valves, lube oil skid, etc as shown on General Arrangement. Must have removeable panels for turbine maintenance.
2350	Turbine exhaust hood spray system (valves & pipe)	PIE	PIE	PIE	BOP	PIE supplies complete strainer, control valve, spray nozzles and ring header. BOP supplies piping
2360	Interconnecting EHC Piping & Tubing	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
2370	Generator and Lube Oil Cooler Water Piping &	PIE	PIE	PIE	BOP	

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2380	Shaft Sealing System Interconnecting Piping	PIE	BOP	BOP	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points. Seal super heater by PIE.
2400	Gland Leakoff Interconnecting Piping	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
2410	Lube Oil Supply and Drain Interconnecting Piping to STG	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
2420	Lube Oil Piping to and from Conditioner	PIE	PIE	PIE	BOP	
2430	Gland Steam Pressure Control Valve	PIE	BOP	BOP	BOP	
2435	Gland Steam Flow Control Valve	PIE	PIE	PIE	BOP	
2440	Steam Inlet Strainers	PIE	PIE	PIE	BOP	
2450	Deck Floor	PIE	BOP	BOP	BOP	
2460	Platforms, Ladders, Stairs, Handrails, Etc.	PIE	PIE	PIE	BOP	
3000	**ONCE THROUGH STEAM GENERATOR (OTSG)**					
3010	OTSG Modules	ENG	PIE	PIE	BOP	
3020	Structural Frame & Column Slide Plates	PIE	PIE	PIE	BOP	Shipping column base plates loose.
3030	Supplementary Firing Equipment	-	-	-	-	
3040	OTSG External Piping (ASME Section 1 code	PIE	PIE	PIE	BOP	
3050	Steam & Feedwater Piping Brought Down to About 35' Above Grade	PIE	PIE	PIE	BOP	
3060	Interconnecting Piping between Modules (All Sizes) Incl. Supports	PIE	PIE	PIE	PIE	Field welding is by BOP Contractor and not in PIE Contractor scope.
3070	Stairs, Platforms, and Ladders	PIE	PIE	PIE	BOP	Pipe Rack to OTSG Interconnecting Platform by BOP
3080	Flash & Blowdown Tanks	BOP	BOP	BOP	BOP	May be a single blow down/flash tank located by STG.
3090	Boiler Trim	PIE	PIE	PIE	BOP	
3100	OTSG External Valves (ASME OTSG Code Valves)	PIE	PIE	PIE	BOP	
3110	OTSG Drain & Vent Valves	PIE	PIE	PIE	BOP	
3120	Start-up Vent Valves & Silencers	PIE	PIE	PIE	BOP	Support from OTSG steel by BOP
3130	OTSG Safety Valves & Silencers	PIE	PIE	PIE	BOP	Support from OTSG steel by BOP

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3140	Piping and Supports for Silencers (start-up and safety valves) Indoor OTSG	PIE	PIE	PIE	BOP	Piping designed & furnished by OTSG. Supports designed by PIE from load data supplied by OTSG. Piping and supports supplied and installed by BOP.
3150	HP Steam Attemperators & Valves	ENG	PIE	PIE	BOP	
3160	Stack	ENG	PIE	PIE	BOP	Two 360 degree platforms for accessing PIE supplied stack damper and CEMS ports
3170	Stack Emissions Testing/Monitoring Ports Incl.	ENG	PIE	PIE	BOP	Per specification
3180	FAA Warning Lights	-	-	-	-	Not Required
3190	Stack Lightning Protection	BOP	BOP	BOP	BOP	
3200	Expansion Joint @ GTG Exhaust End	PIE	PIE	PIE	BOP	
3210	Stack Closure Damper	ENG	PIE	PIE	BOP	
3220	SCR Catalyst & CO Catalyst	ENG	PIE	PIE	BOP	
3230	SCR Ammonia Injection Grid	ENG	PIE	PIE	BOP	
3240	SCR Ammonia Injection Skid (Incl. Vaporizers and all Instrumentation)	ENG	PIE	PIE	BOP	Scope of supply includes blowers PIE Contractor to supply funtional control logic. BOP Contractor to integrate functional control logic into Plant Control System.
3250	Ammonia Storage Tank & Unloading System	-	-	-	-	Use existing tank. Piping modifications by BOP
3260	Ammonia Interconnecting Piping from Injection Skid to Injection Grid	PIE	PIE	BOP	BOP	
3270	Ammonia Interconnecting Piping & Valves- Tank to Injection Skid	BOP	BOP	BOP	BOP	New pump at existing tank area will be supplied.
3280	Sole plates and slides	PIE	PIE	PIE	BOP	
3290	Burner Management System and Gas Control Logic	-	-	-	-	Not Required
3300	Control Logic Diagrams and Description	PIE	PIE	PIE	PIE	PIE Contractor will include preparation of functional requirements of the OTSG in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included.
3310	Starters for all AC motors (MCC)	PIE	PIE/BOP	BOP	BOP	All MCC's associated with the OTSG will be supplied and installed in the PDC by the BOP contractor.

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3320	MOVs & Actuators	PIE	PIE	PIE	BOP	Each MOV shall have an integral starter and disconnect switch. MOV's and actuators for any ASME boundary valve or stack damper by the PIE contractor.
3330	Air receiver tanks for PIE supplied valves	PIE	PIE	PIE	BOP	Any PIE supplied valve that has an essential safety function shall be equipped with an air tank receiver local to the valve, to be installed by the BOP contractor
3340	Lighting for OTSG and walkways	BOP	BOP	BOP	BOP	
3350	Emissions Monitoring System (CEMS)	PIE	PIE	PIE	BOP	Umbilical tubing by PIE. PIE supplies DP transmitter across SCR
3360	NOx Test Ports Ahead of SCR	PIE	PIE	PIE	PIE	
3370	Drum Insulation	-	-	-	-	Not Required
3380	Pipe Insulation	PIE	BOP	BOP	BOP	
3390	Freeze Protection	-	-	-	-	Not Required
3400	Raceway, cable and wiring within skid	PIE	PIE	PIE	PIE	Control components and/or their primary sensing elements, if furnished, are without interconnecting tubing, wiring and piping by the PIE Contractor.
3410	External raceway, cable and wiring	PIE	BOP	BOP	BOP	
3420	Raceway, cable and wiring between skids	PIE	BOP	BOP	BOP	
4000	**STEAM SURFACE CONDENSER:**					
4010	Condenser	ENG	PIE	PIE	BOP	Water cooled
4020	Sole Plates	PIE	PIE	PIE	BOP	
4030	Vacuum pumps	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
4040	Hotwell	PIE	PIE	PIE	BOP	
4060	After Condenser Float Trap & Valves	PIE	PIE	PIE	BOP	
4070	Drain Piping	PIE	BOP	BOP	BOP	
4080	Rupture Disk	PIE	PIE	PIE	BOP	
4090	Turbine/Condenser Interface Expansion Joint	PIE	PIE	PIE	BOP	If required.

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4100	Vacuum Breaker	PIE	PIE	PIE	BOP	
4110	Hotwell Level Transmitters	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4120	Hotwell Level Switches	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4130	Hotwell Thermocouple	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4140	Waterbox Pressure Gauges	PIE	PIE	PIE	BOP	
4150	Condenser Pressure Transmitters	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4160	Hotwell Conductivity Probes	PIE	PIE	PIE	BOP	
4170	Control Logic Diagram and Description	PIE	PIE	-	-	
5000	**AUXILIARY BOILER:**	PIE	PIE	PIE	BOP	PIE shall provide an aux boiler, superheater and feed pump to supply startup steam to shaft seals and condenser
6000	**CIRCULATING WATER SYSTEM:**					
6010	Mechanical Draft Cooling Tower	ENG	PIE	PIE	BOP	Fiberglass construction, counterflow, fire retardant
6020	Circulating Water Pumps & Motors	ENG	PIE	PIE	BOP	Head loss as defined by PIE for BOP design criteria
6030	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
6040	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
6050	Lighting for Cooling Tower and walkways	BOP	BOP	BOP	BOP	
6060	Lightning Protection for Cooling Tower	BOP	BOP	BOP	BOP	
6070	Vibration Equipment for Tower Fans	PIE	PIE	PIE	BOP	
6080	Underground Piping	BOP	BOP	BOP	BOP	
6090	Above Ground Piping	BOP	BOP	BOP	BOP	
7000	**CONDENSATE SYSTEM:**					
7010	Condensate Pumps & Motors	ENG	PIE	PIE	BOP	
7020	Demin Transfer/Cycle Make-Up Pumps & Motors	BOP	BOP	BOP	BOP	
7030	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP/PIE	BOP	BOP	BOP	
7040	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC

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City of Pasadena
Repowering Project
Division of Responsibility

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7050	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
7060	Condensate Polishers	PIE	PIE	PIE	BOP	
7070	Condensate Storage Tank	ENG	BOP	BOP	BOP	
8000	**AUXILIARY COOLING WATER SYSTEM:**					
8010	Auxiliary Cooling Water Pump(s) and Motor(s)	ENG	PIE	PIE	BOP	3x50% pumps sized to operated chiller independent of CCW system plus one installed spare
8020	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP	BOP	BOP	BOP	
8030	Starters for all AC motors	BOP	BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
8040	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
9000	**CLOSED COOLING WATER SYSTEM:**					
9010	Closed Cooling Pumps	ENG	BOP	BOP	BOP	PIE to supply necessary heat rejection loads for BOP design
9020	Closed Cooling Heat Exchangers	ENG	BOP	BOP	BOP	PIE to supply necessary heat rejection loads for BOP design
9030	Closed Cooling Piping System	BOP	BOP	BOP	BOP	
10000	**CHEMICAL FEED SYSTEMS:**					
10010	Steam Cycle Chemical Feed System	ENG	BOP	BOP	BOP	BOP to coordinate with PWP for preferred chemical supplier.
10020	Circulating Water Chemical Feed System	ENG	BOP	BOP	BOP	BOP to coordinate with PWP for preferred chemical supplier.
10030	Closed Cooling System Chemical Feed	ENG	BOP	BOP	BOP	If required.
10040	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP/PIE	BOP	BOP	BOP	
10050	Starters for all AC motors	BOP	BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
11000	**FEEDWATER SYSTEM:**					
11010	HP Boiler Feedwater Pumps & Motors	ENG	PIE	PIE	BOP	
11020	Feed Water Flow Meters	PIE	PIE	PIE	BOP	
11030	Feedwater Control Valves	PIE	PIE	PIE	BOP	

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Repowering Project
Division of Responsibility

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11040	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
11050	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
11060	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
11070	Vibration Equipment	PIE	PIE	PIE	BOP	Vibration equipment is not specified and is not included.
12000	**FIRE PROTECTION SYSTEMS:**					
12010	Gas Turbine Fire Protection	PIE	PIE	PIE	BOP	
12010	Gas Turbine Aux Skid	PIE	PIE	PIE	BOP	Comment: Local dry chemical fire extinguisher type B is provided by PIE Contractor as standard offering with gas turbine package. BOP Contractor to provide fire suppression per the fire protection specifications.
12020	Steam Turbine	BOP	BOP	BOP	BOP	Lube oil and STG bearings. STG bearings preaction w/rate of rise
12030	Building Sprinkler Systems	BOP	BOP	BOP	BOP	
12040	Transformer Deluge Systems	-	-	-	-	Not Required
12050	Fire System Specialties	BOP	BOP	BOP	BOP	
12060	Hose Racks	-	-	-	-	Hose Racks will not be furnished
12070	Hydrants & Monitor Stations	BOP	BOP	BOP	BOP	
12080	Underground Fire Loop Piping	BOP	BOP	BOP	BOP	
12090	Fire Protection Signaling System / Smoke Detection Systems	BOP	BOP	BOP	BOP	
12100	Fire Alarm Control Panel	BOP	BOP	BOP	BOP	
12110	Cooling Tower	-	-	-	-	Not applicable for fiberglass cooling towers

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City of Pasadena
Repowering Project
Division of Responsibility

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12120	Fire Pumps: diesel, electric and jockey	TBD	TBD	TBD	TBD	The City has recently increased the water pressure in their water systems. Therefore pressure and volume testing will need to be done to determine if fire water pumps are required.
13000	**STEAM & WATER SAMPLING SYSTEMS:**					
13010	Sampling System & Analyzer Panel	BOP	BOP	BOP	BOP	Provide with stand alone weather enclosure
13020	In-Line Analyzers	BOP	BOP	BOP	BOP	
13030	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP	BOP	BOP	BOP	
14000	**ON-SITE FUEL GAS SYSTEM:**					
14010	Natural Gas Compressors & Motors	ENG	PIE	PIE	BOP	Supply on skid per Section 485374.22
14020	Interconnecting Piping	BOP	BOP	BOP	BOP	
14030	Fuel Gas Dew Point Heater	-	-	-	-	Not Required
14040	Primary Gas Filters/Separators	ENG	PIE	PIE	PIE	Included with Section 485374.22
14050	Primary Fuel gas pressure regulators	-	-	-	-	
14060	Pressure Relief Valves	ENG	PIE	PIE	PIE	Included with Section 485374.22
14070	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	PIE	PIE	PIE	Included with Section 485374.22 PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
14080	Acoustical Enclosure	ENG	PIE	PIE	BOP	If required for sound attenuation, BOP needs to make room to accommdate this enclosure.
14090	Drains tank receiver	ENG	BOP	BOP	BOP	Included with Section 485374.22
15000	**NATURAL GAS SUPPLY PIPELINE & INTERCONNECT STATION**					

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City of Pasadena
Repowering Project
Division of Responsibility

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15010	Gas Metering Station	Sempra	Sempra	Sempra	Sempra	
15020	Natural Gas U/G Pipeline from Meter to Compressor on Site	ENG	BOP	BOP	BOP	
16000	**NO. 2 FUEL OIL SYSTEM**	-	-	-	-	Not Required
17000	**INSTRUMENT/ SERVICE AIR SYSTEM:**					
17010	Air Compressors	ENG	PIE	PIE	BOP	Supply on skid per Section 485374.21
17020	Instrument Air Dryers (Desiccant)	ENG	PIE	PIE	PIE	included with Section 485374.21
17030	Compressed Air Receivers	ENG	PIE	PIE	PIE	included with Section 485374.21
17040	Instrument Air Distribution Piping	BOP	BOP	BOP	BOP	
17050	Service Air Distribution Piping	BOP	BOP	BOP	BOP	
17060	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	included with Section 485374.21 PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
17070	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC. Elect. To run all field wiring into starter/MCC
18000	**WATER TREATMENT SYSTEM**					
18010	Water Treatment Equipment Demin System	ENG	BOP	BOP	BOP	Use existing demin system for make-up.
18020	Interconnecting piping and wiring (external to process, interconnecting to balance of plant)	BOP	BOP	BOP	BOP	
18030	Interconnecting piping (skid-to-skid)	BOP	BOP	BOP	BOP	
18040	Interconnecting wiring (skid-to-skid)	BOP	BOP	BOP	BOP	
18050	Pipe Supports	BOP	BOP	BOP	BOP	
18060	Furniture and equipment	BOP	BOP	BOP	BOP	
18070	PLC, control logic, and programming	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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18080	Neutralization System	BOP	BOP	BOP	BOP	
19000	**DOMESTIC WATER SYSTEM:**					
19010	Connection to City Water supply	ENG	BOP	BOP	BOP	
19020	Safety Showers/Eye Wash Stations	ENG	BOP	BOP	BOP	
20000	**WATER SUPPLY PIPELINE & METERING STATION**					
20010	New line to plant	ENG	BOP	BOP	BOP	No new off site pipeline is anticipated. A new line from on-site is required.
20020	Make-up line from existing facility	ENG	BOP	BOP	BOP	
21000	**PROCESS WASTEWATER:**					
21010	Zero Liquid Discharge System	-	-	-	-	
21020	Plant Wastewater Sump	ENG	BOP	BOP	BOP	
21030	Miscellaneous Plant Wastewater Sumps	ENG	BOP	BOP	BOP	
21040	Oily water separator	ENG	BOP	BOP	BOP	Drain to existing GT 3 & 4 separator. Lift station may be required by BOP.
21050	Wastewater Storage Tank	ENG	BOP	BOP	BOP	
22000	**WASTEWATER DISCHARGE PIPELINE**					
22010	Wastewater Discharge Pipeline	ENG	BOP	BOP	BOP	Discharge to sewer
23000	**MISCELLANEOUS MECHANICAL SYSTEMS & EQUIPMENT**					
23010	Service Water System	ENG	BOP	BOP	BOP	
23020	Demineralized Water Supply System	ENG	BOP	BOP	BOP	
23030	Demin water forwarding pumps and piping	ENG	BOP	BOP	BOP	
23040	Service Water Storage Tank	ENG	BOP	BOP	BOP	
23050	Demineralized Water Storage Tanks	ENG	BOP	BOP	BOP	
23060	Steam Turbine Drains Tank	ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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24000	**BOP PIPING, VALVES & COMPONENTS:**					
24010	Shop Fabricated Plant Piping, (Non-Boiler External Piping)	ENG	BOP	BOP	BOP	
24020	Random Supplied Plant Piping, All Sizes (Non-Boiler External Piping)	ENG	BOP	BOP	BOP	
24030	Plant Tubing (Non-Boiler External), incl. Instrument Tubing	ENG	BOP	BOP	BOP	
24040	Engineered Pipe Hangers Large & Small Bore (2" and smaller) Pipe Greater than 300F (design)	ENG	BOP	BOP	BOP	
24050	Large Bore Standard Pipe Hangers less than 300F	ENG	BOP	BOP	BOP	
24060	Pipe Hanger Supports, Sleepers, Support Anchor Plates	ENG	BOP	BOP	BOP	
24070	Pipe Heat Tracing (as required)	ENG	BOP	BOP	BOP	
24080	Cathodic Protection	ENG	BOP	BOP	BOP	
24090	Steam Blow Temporary Piping	ENG	BOP	BOP	BOP	
24100	Relief and Safety Valves, Vent Stacks and Silencers (Excl. OTSG)	ENG	BOP	BOP	BOP	
24110	BOP Manual Valves	ENG	BOP	BOP	BOP	
24120	BOP Control Valves	ENG	BOP	BOP	BOP	
25000	**BOP INSULATION AND LAGGING:**					
25010	BOP Pipe and Valve Insulation	ENG	BOP	BOP	BOP	
25020	Equipment Insulation	PIE/BOP	PIE/BOP	BOP	BOP	Each for own scope of installation
25030	Lagging	ENG	BOP	BOP	BOP	As applicable. to equip. design
26000	**HVAC:**					
26010	PDC	ENG	BOP	BOP	BOP	
26020	Glenarm Building	ENG	BOP	BOP	BOP	
26030	GTG enclosures	PIE	PIE	PIE	BOP	
26040	STG enclosure	PIE	PIE	PIE	BOP	

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Repowering Project
Division of Responsibility

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27000	**TRANSFORMERS:**					
27010	Generator Step Up Transformer	PIE	PIE	PIE	BOP	Three winding
27020	Auxiliary Transformers	ENG	BOP	BOP	BOP	
27030	Main Transformer Field Dress, Oil Fill & Test	ENG	-	BOP	BOP	PIE supplies field service representatives.
27040	Other Transformers	ENG	BOP	BOP	BOP	Small lighting and power transformers and panels supplied by Elect
27050	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
28000	**GENERATOR BREAKERS:**					
28010	34.5 kV Breaker	PWP	PWP	PWP	PWP	Located off site in switchyard.
28020	Low Side Breakers (15kV Switchgear)	ENG	BOP	BOP	BOP	Located in PDC installed by BOP
29000	**STATION SWITCHGEAR:**					
29010	Medium Voltage Switchgear (4160)	ENG	BOP	BOP	BOP	Located in PDC
29020	Low Voltage Switchgear (480)	ENG	BOP	BOP	BOP	Located in PDC
29030	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
29040	Auxiliary Power Metering	ENG	BOP	BOP	BOP	Located in PDC
29500	**BLACK START GENERATOR:**					
29510	Packaged Diesel Engine Driven Generator with day tank, controls, enclosure	-	-	-	-	Not Required
30000	**HIGH VOLTAGE INTERCONNECT:**					
30010	From Switchyard Dead-End Structure	PWP/ENG	BOP	BOP	BOP	
30020	Underground High Voltage Cable	PWP/ENG	BOP	BOP	BOP	
31000	**MOTOR CONTROL CENTERS:**					

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31010	Station Service (BOP) MCCs	ENG	BOP	BOP	BOP	
31020	BOP AC Auxiliary Loads	ENG	BOP	BOP	BOP	
31030	MOVs & Actuators	ENG	BOP	BOP	BOP	
31040	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
32000	**FIELD INSTALLED CONDUCTORS:**					
32010	GTG Interconnecting Power & Control Cables	PIE	PIE/BOP	BOP	BOP	All cables from GTG and accessory skids.
32020	STG Interconnecting Power & Control Cables	PIE/BOP	BOP	BOP	BOP	
32030	OTSG Power & Control Cables	PIE/BOP	BOP	BOP	BOP	
32040	BOP Power & Control Cables	ENG	BOP	BOP	BOP	
32050	Non-segregated phase bus duct or cable from CT and ST Generators to low-side generator breakers	ENG	BOP	BOP	BOP	
32060	Nonsegregated phase bus duct from xfmrs to swgr	ENG	BOP	BOP	BOP	
32070	Cable	ENG	BOP	BOP	BOP	
32080	Underground Cable from Low-Side Generator Breakers to Main Transformer.	N/A	NA	NA	NA	
32090	U/G Cable	ENG/PWP	BOP	BOP	BOP	
32100	Ground Cables	ENG	BOP	BOP	BOP	
33000	**RACEWAYS:**					
33010	Cable Tray	ENG	BOP	BOP	BOP	
33020	GTG Conduit, Below Grade	ENG	BOP	BOP	BOP	
33030	GTG Conduit, Above Grade	ENG	BOP	BOP	BOP	
33040	STG, OTSG, Aux Boilers & BOP Conduit greater the 2 inch diameter	ENG	BOP	BOP	BOP	
33050	STG, OTSG, Aux Boilers & BOP Conduit less then 2 inch diameter	ENG	BOP	BOP	BOP	
33060	Cable Trench and Duct Runs	ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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34000	**MISCELLANEOUS ELECTRICAL SYSTEMS:**					
34010	Station Grounding Grid	ENG	BOP	BOP	BOP	
34020	Outdoor Lighting in Power Plant	ENG	BOP	BOP	BOP	
34030	UPS System	ENG	BOP	BOP	BOP	
34040	125V DC Distribution Panels - Balance of Plant	ENG	BOP	BOP	BOP	
34050	125V DC Station Battery - Balance of Plant	ENG	BOP	BOP	BOP	
34060	125VDC Station Battery Charger	ENG	BOP	BOP	BOP	
34070	Communication System (Phone and Information Network)	ENG	BOP	BOP	BOP	
34080	Communication/IT Raceway/Cable/Outlets	ENG	BOP	BOP	BOP	
34090	Telephone Line Protection/Isolation Equipment	ENG	BOP	BOP	BOP	
34100	BOP Electrical Heat Tracing	ENG	BOP	BOP	BOP	
34110	13.8kV-4160V Auxiliary Transformer Neutral Grounding	ENG	BOP	BOP	BOP	
34120	13.8kV-480V Auxiliary Transformer Neutral	ENG	BOP	BOP	BOP	Included with switchgear in PDC
34130	480V Ground Fault Protection System	ENG	BOP	BOP	BOP	High resistance type, included 480V switchgear in PDC
34140	Lightning Protection	ENG	BOP	BOP	BOP	
34150	Switchyard lighting	PWP	BOP	BOP	BOP	If new required
35000	**CONTROL / DATA ACQUISITION / LOGIC EQUIPMENT:**					
35010	Plant Control System	PIE/BOP/ENG	BOP	BOP	BOP	
35020	- Control Room and Engineering Workstation	PIE/ENG	BOP	BOP	BOP	
35030	- Event, Alarm, and Log Printers	PIE/ENG	BOP	BOP	BOP	
35040	Control System Hardware (Processors, I/O Cabinets, HMI's, etc.)	PIE/ENG	BOP	BOP	BOP	
35050	- I/O Database	PIE/ENG	BOP	BOP	BOP	
35060	- Control Logic Diagrams	PIE/ENG	BOP	BOP	BOP	Including AGC block load control
35070	- Review Control Configurations	PIE/ENG	BOP	BOP	BOP	
35080	- Alarm, Log, HSR Configuration	PIE/ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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35090	- System Graphics	PIE/ENG	BOP	BOP	BOP	
35100	Remote Transponder (RTU) for Energy Management System	PIE/ENG	BOP	BOP	BOP	
35110	PWP/CAISO Information Systems	PIE/ENG	BOP	BOP	BOP	Tie to existing system
35120	Interface equipment to PWP/Sempra	PIE/ENG	BOP	BOP	BOP	Includes any interface equipment required (Relay Panel).
36000	**RELAYING/METERING PROTECTION:**					
36010	GT Generator Protection	PIE	PIE/BOP	PIE	BOP	PIE responsible for those generator relay setting that do not involve coordination with external protection. BOP responsible for relay settings not performed by PIE, reviewing relay settings performed by PIE, and for ensuring proper coordination of all relay settings with external protection. Relay panel supplied by PIE but included in Electrical package.
36020	ST Generator Protection	PIE	PIE/BOP	PIE	BOP	PIE responsible for those generator relay setting that do not involve coordination with external protection. BOP responsible for relay settings not performed by PIE, reviewing relay settings performed by PIE, and for ensuring proper coordination of all relay settings with external protection. Relay panel supplied by PIE but included in Electrical package.
36030	High Voltage Metering and Protective Relaying	PWP/ENG	BOP	BOP	BOP	
36040	High Voltage Control and Monitoring Panel	PWP/ENG	BOP	BOP	BOP	
36050	Main Transformer Differential Protection	PWP/ENG	BOP	BOP	BOP	Located in PDC
36060	Auxiliary Transformers	ENG	BOP	BOP	BOP	Located in MV Switchgear in PDC
36070	All other auxiliary system protection, including medium voltage switchgear, low voltage switchgear, and MCCs	ENG	BOP	BOP	BOP	
37000	**INSTRUMENTATION:**					Mech responsible for installing all in-line devices, wells, orifices, venturis, etc.
37010	BOP Plant Instrumentation	BOP	BOP	BOP	BOP	
37020	GTG Instrumentation	PIE	PIE	PIE	BOP	
37030	STG Instrumentation	PIE	PIE	PIE	BOP	
37040	OTSG Instrumentation	PIE	BOP	BOP	BOP	Per OTSG Vendor P&ID
37050	Local (including face gauges, TC's, etc.)	BOP	BOP	BOP	BOP	
37060	Remote (inclusive of all xmtrs)	BOP	BOP	BOP	BOP	

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38000	**SITE WORK:**					
38010	Demolition	ENG	BOP	BOP	BOP	
38020	Remediation	ENG	BOP	BOP	BOP	
38030	Relocation of existing pipe, utilities, and Con	BOP	BOP	BOP	BOP	
38040	Clearing and Grubbing	BOP	BOP	BOP	BOP	
38050	Earthwork	BOP	BOP	BOP	BOP	
38060	Roads/Paving/Surfacing	BOP	BOP	BOP	BOP	
38070	Fencing/Gates	BOP	BOP	BOP	BOP	
39000	**STORM WATER:**	-	-	-	-	
39010	Drainage System	ENG	BOP	BOP	BOP	
39030	Erosion /Sediment Control	ENG	BOP	BOP	BOP	
40000	**SANITARY SEWER:**					
40010	Sanitary Sewage System	ENG	BOP	BOP	BOP	Process drain lines in plant and new sanitary sewer connection for Control and Lab Buildings
41000	**FOUNDATION WORK:**					
41010	-OTSG Foundations	PIE/ENG	BOP	BOP	BOP	
41020	-OTSG Stack Foundations	PIE/ENG	BOP	BOP	BOP	
41030	-GTG Foundations	PIE/ENG	BOP	BOP	BOP	
41040	-STG Foundation	PIE/ENG	BOP	BOP	BOP	
41050	-Cooling Tower Basins & Circ. Water System	ENG	BOP	BOP	BOP	
41060	-Circ. Water Pump Intake	ENG	BOP	BOP	BOP	
41070	-BOP Equip. and Structures Foundations	ENG	BOP	BOP	BOP	
41080	-Buildings	ENG	BOP	BOP	BOP	

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Division of Responsibility

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41090	-Infrastructure	ENG	BOP	BOP	BOP	
41100	-Misc. Foundations	ENG	BOP	BOP	BOP	
41110	-Trenches, Duct Banks & Manholes	ENG	BOP	BOP	BOP	
41120	Formwork	BOP	BOP	BOP	BOP	
41130	Expansion Joints	ENG	BOP	BOP	BOP	
41140	Reinforcements	ENG	BOP	BOP	BOP	
41150	Concrete	ENG	BOP	BOP	BOP	
41160	- Lean Concrete	ENG	BOP	BOP	BOP	
41170	- Walls	ENG	BOP	BOP	BOP	
41180	- Piers	ENG	BOP	BOP	BOP	
41190	- Footings	ENG	BOP	BOP	BOP	
41200	- Pads	ENG	BOP	BOP	BOP	
41210	- Elevated Slabs	ENG	BOP	BOP	BOP	
41220	Embedments	PIE/ENG	BOP	BOP	BOP	
41230	Anchor Bolts	PIE/ENG	BOP	BOP	BOP	
41240	Sole Plates	PIE/ENG	BOP	BOP	BOP	
41250	Finishing Work/Concrete Floor Finishing/Concrete Wall Finishing	ENG	BOP	BOP	BOP	
41260	Sealing off Existing Glenarm Circulating Water Trenches	ENG	BOP	BOP	BOP	
42000	**STRUCTURAL Steel**					
42010	Pipe, Utility Racks & Access/Service Platforms	ENG	BOP	BOP	BOP	Inclusive of all supplemental support for pipe, stairs, platforms, etc. BOP contractor's steel fabricator to shop detail and submit drawings to the engineer for review.
43000	**MISCELLANEOUS Steel**					
43010	Stairs, Walkways, Ladders, Handrails	ENG	BOP	BOP	BOP	Contractor's steel fabricator to shop detail and submit drawings to the engineer for review.

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City of Pasadena
Repowering Project
Division of Responsibility

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44000	**PRE-ENGINEERED ENCLOSURES:**	PIE/ENG	PIE/BOP	PIE/BOP	BOP	Steam Turbine Acoustical enclosure provided by PIE Contractor.
44200	**POWER DISTRIBUTION CENTER(S) (PDC) -Prepackaged Buildings**					
44210	Building Package inclusive of structure, HVAC, lighting, doors, windows, control equipment, etc.	PIE/ENG	PIE/BOP	BOP	BOP	
44220	Plant Auxiliary Electrical System Equipment	PIE/ENG	PIE/BOP	BOP	BOP	
44230	PCS Field Termination (I/O) Cabinets	-	-	-	-	Not Required
44240	Internal PDC Wiring	PIE/ENG	PIE/BOP	BOP	BOP	Includes all internal PDC wiring for building wiring as well as cabinet to cabinet wiring internal to PDC, e.g. MCC to I/O cab
44250	External PDC Wiring	ENG	BOP	BOP	BOP	Includes all wiring from devices in PDC to devices external to the
44260	PDC Internal Electrical Raceway	ENG	BOP	BOP	BOP	Includes tray, conduit, floor duct, etc.
44270	PDC External Electrical Raceway	ENG	BOP	BOP	BOP	Includes all raceway external to the PDC.
44300	MAINTENANCE **BUILDING**					
44310	Demolition	PWP/ENG	BOP	BOP	BOP	
44320	Remediation	PWP/ENG	BOP	BOP	BOP	
44330	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
44340	HVAC	PWP/ENG	BOP	BOP	BOP	
44350	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
44360	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
44370	Building finishes	PWP/ENG	BOP	BOP	BOP	
44380	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
44390	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
44300	WELDING SHOP **BUILDING**					
44330	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
44340	HVAC	PWP/ENG	BOP	BOP	BOP	
44350	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

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44360	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
44370	Building finishes	PWP/ENG	BOP	BOP	BOP	
44380	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
44390	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
45000	**CONTROL BUILDING**					
45030	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
45040	HVAC	PWP/ENG	BOP	BOP	BOP	
45050	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
45060	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
45070	Building finishes	PWP/ENG	BOP	BOP	BOP	
45080	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
45090	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
45000	**WATER LAB BUILDING**					
45030	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
45040	HVAC	PWP/ENG	BOP	BOP	BOP	
45050	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
45060	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
45070	Building finishes	PWP/ENG	BOP	BOP	BOP	
45080	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
45090	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
46000	**PAINTING, COLOR CODING AND IDENTIFICATION:**					
46010	Finish Painting					
46020	- GT	ENG	-	BOP	BOP	

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Repowering Project
Division of Responsibility

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46030	- ST	ENG	-	BOP	BOP	
46040	- OTSG	ENG	-	BOP	BOP	
46050	- Balance of Plant	ENG	-	BOP	BOP	
46060	Plant Cable & Systems Labeling	ENG	-	BOP	BOP	
46070	Plant Piping Labeling	ENG	-	PWP	PWP	PWP tp provide labeling specification
46080	Labeling / Tagging	ENG	All	All	All	Each responsible for their own.
47000	**STEAM BLOWS, CHEMICAL CLEANING, BOIL OUT & FLUSHING:**					
47010	- OTSG	PIE	BOP	BOP	BOP	
47020	- GT & ST	PIE	BOP	BOP	BOP	
47030	-Steam Lines	PIE/ENG	BOP	BOP	BOP	
47040	-On Site Gas Lines	PIE/ENG	BOP	BOP	BOP	No gas blows permitted on site.
47050	-On Site Fuel Oil Lines	-	-	-	-	Not Required
48000	**CONSUMABLES, FUELS & OPERATIONAL CHEMICALS:**					
48010	Lube Oils for CTs and ST	PIE	PIE	BOP	BOP	
48020	Initial Fills for Pumps and Equipment	PIE/BOP	PIE/BOP	BOP	BOP	BOP Contractor responsible for first fills.
49000	**ENGINEERING AND DESIGN SERVICES:**					
49010	Design Criteria	ENG	ENG	-	-	
49020	Cycle Definition & Thermal Design	ENG	PIE/BOP	-	-	
49030	Heat Balances	ENG	PIE/BOP	-	-	
49040	Plot Plan & Arrangement Drawings	ENG	BOP	-	-	
49050	Engineering Schedule	-	-	ENG	-	
49060	Drawing Schedule	-	-	PIE/ENG/BOP	-	Each party for own scope
49070	Commissioning, Start-up & O&M Manuals	-	-	PIE/ENG/BOP	-	Each party for own scope
49080	Spare Parts Lists	-	-	PIE/ENG/BOP	-	Each party for own scope

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City of Pasadena
Repowering Project
Division of Responsibility

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49090	System/Functional Description	PIE/ENG/BOP		PIE/ENG/BOP	-	Each party for own scope. GTG System/Functional Description is included in the O&M and I&C manuals by the PIE Contractor.
49100	Site Survey & Preliminary Geotech Report	-	-	ENG/PWP	-	
49110	Final Geotech Report	-	-	PWP	-	
49120	Site Environmental Investigation (Phase I and II)	-	-	PWP	-	
49130	Cast-in-place Concrete Design	ENG	BOP	-	-	
49140	Foundations Design	ENG	BOP	-	-	
49150	Building Design	PWP/ENG	BOP	-	-	
49160	Painting Requirements	ENG	BOP/PIE	-	-	
49170	Grading and Drainage Design	ENG	BOP	-	-	
49180	Sedimentation and Erosion Control Plans	ENG	BOP	-	-	General Services to maintain erosion control
49190	Underground Utilities Design	ENG	BOP	-	-	
49200	BOP P&ID's	ENG	BOP	-	-	
49210	Major Equipment P&ID's	PIE	PIE	-	-	
49220	Mechanical Equipment List	ENG	BOP	-	-	
49230	Valve List	ENG	BOP	-	-	
49240	Line List	ENG	BOP	-	-	
49250	Control Valve Data Sheets	ENG	BOP	-	-	
49260	Instrument Data Sheets	ENG	BOP	-	-	
49270	Instrument Locations	ENG	BOP	-	-	
49280	Instrument Installation Details	ENG	PIE/BOP	-	-	Each party for own scope
49290	Piping and Hanger Design/Stress Analysis	ENG	PIE/BOP	-	-	Each party for own scope
49300	Thermal Insulation	ENG	PIE/BOP	-	-	Each party for own scope
49310	Water Balance	ENG	BOP	-	-	
49320	One-Line, Three line, Phasing, Distribution Bus Front elevations and BOM's, and Panel Schedule	ENG/PIE	BOP	-	-	
49330	Electrical Load List	ENG	BOP	-	-	
49340	Raceway, cable, wiring, grounding	ENG	BOP	-	-	

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City of Pasadena
Repowering Project
Division of Responsibility

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49350	Electrical and Instrument Location Drawings	ENG	BOP	-	-	Including GTG, OTSG, STG field mounted instruments
49360	Electrical Schematic and Termination Drawings	ENG	BOP	-	-	
49370	Cable and Raceway Schedule	BOP	BOP	-	-	All raceway, cables and wiring to be installed by the contractor will be in the cable data base except field run conduit, lighting panel cuts, cathodic protection ckts, and heat tracing panel ckts. Cable routing will include the equipment cubicle number in all multi-
49380	Outdoor Lighting Design	ENG	BOP	-	-	
49390	Ground Resistivity and Corrosivity	ENG	BOP	BOP	-	Info furnished as part of Geotech report.
49400	Design of High Voltage elec Interconnections	ENG	BOP	-	-	
49410	SWYD Instrument and Relay Settings	ENG	BOP	-	BOP	
49420	Plant Instrument and Relay Settings	ENG	BOP	-	BOP	
49430	Control Logic Diagrams	ENG	BOP	-	-	Each party for own scope
49440	Switchyard Design	PWP/ENG	PWP	-	-	Work consists of SF6 Breaker, structural steel and foundations, including dead end structure, air switches and CTs/PTs, fence, grounding and rock surfacing.
49450	Transmission Lines Design	PWP/ENG	BOP	-	-	
49460	Natural Gas Interconnect Design	Sempra	Sempra	Sempra	Sempra	
49470	Water Supply Interconnect Design	PWP/ENG	BOP	BOP	BOP	
49480	Fire Protection Design	PIE/ENG	PIE/BOP	PIE/BOP	BOP	PIE for GTG only. BOP does detailed design for automatic fire protection and detection systems
49490	As-Built Drawings	-	-	PIE/BOP	-	Each party for own scope
50000	**PROJECT SERVICES:**					
50010	Overall Project Management	-	-	PWP	-	
50020	Project Master Schedule	-	-	ENG/BOP	-	Engineer maintains until BOP awarded
50030	Engineering Schedule	-	-	BOP	-	
50040	Equipment Procurement and Delivery Schedule	-	-	ENG/BOP	-	Each party for own scope
50050	Construction Schedule	-	-	ENG/BOP	-	Detailed schedule by con
50060	Systems Turnover Schedule	-	-	BOP	-	Contractor to incorporate in its schedule
50070	Electrical Interconnect Engineering Schedule	-	-	BOP	-	
50080	Electrical Interconnect Construction Schedule	-	-	BOP	-	

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City of Pasadena
Repowering Project
Division of Responsibility

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50090	Natural Gas Interconnect Schedule	-	-	PWP	-	
50100	Water Supply Interconnect Schedule	-	-	PWP	-	
50110	Overall Project Status Reports	-	-	BOP	-	
50120	Equipment O&M Manuals	-	-	PIE/BOP	-	Each party for own scope
50130	Factory Tests Reports	-	-	PIE/BOP	-	Each party for own scope
50140	Transportation Risk Insurance	-	-	PIE/BOP	-	
50150	Training Equipment	-	-	PIE/BOP	-	City furnishes facilities, screen and projector.
50160	Operating and Maintenance Personnel Training Program	-	-	PIE/BOP	-	Each party for own scope.
50170	Source Inspections	-	-	PIE/BOP	-	Each party for own scope
50180	Performance Bond	-	-	PIE/BOP	-	
51000	**SPARE PARTS:**					
51010	Start-up Spares	-	-	PIE/BOP	-	Each party for own scope
51020	Operational Spares	-	-	PWP	-	
51030	B-O-P Start Up Spares	-	-	PWP	-	
52000	**TEMPORARY FACILITIES:**					
52010	Access Roads within Site, (Paved areas, yard surfacing, as required)	BOP	BOP	BOP	BOP	
52020	Access Roads & Laydown Areas Outside Site Boundary	PWP/ENG	PWP/BOP	BOP	BOP	Jacobs Parking
52030	Construction Facilities for Labor such as Toilets, Shelters, Change Rooms, etc.	BOP	BOP	BOP	BOP	
52040	Construction Parking	PWP/ENG	BOP	BOP	BOP	Jacobs Parking
52050	Laydown Area, (establish, control & restore)	PWP/ENG	BOP	BOP	BOP	
52060	Owner's Trailers	BOP	BOP	BOP	BOP	Contractor will be required to install stairs, utilities, office furniture, filing cabinets, phone wiring and computer network wiring.
52070	Constructor's Site Construction Office, Including all furniture, supplies, etc.	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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52080	Field Trailers for PIE TA's Including all Furniture	BOP	BOP	BOP	BOP	BOP will arrange for trailers and their site location and to install stairs, utilities, etc.
52090	Site Vehicles and Fuels	-	-	Each his own	Each his own	Mules, Fuel Trucks, Erection Hauler, etc.
52100	First Aid Station, Safety and Health Facilities			Each his own	Each his own	
52110	Site Security	-	-	BOP	BOP	Security will be provided by contractor at remote site and main project site on a 24hr/7day schedule.
52120	Fire Prevention and Fighting	BOP	BOP	BOP	BOP	
52130	Temporary Water and Con. Supply & Distribution	BOP	BOP	BOP	BOP	
52140	Temporary Site Telephone/Communications	BOP	BOP	BOP	BOP	
52150	Temporary Sewage Collection, Treatment and Disposal			BOP	BOP	
52160	Construction Erosion Control			BOP	BOP	
52170	Dust Control	-	-	BOP	BOP	
52180	Dirt and Mud Control (Temporary graveling of site area)	-	-	BOP	BOP	Maintain public roadways to be free of mud/dirt.
52190	Housekeeping for On-Site Facilities	-	-	BOP	BOP	
52200	Clean-up and Removal of Temporary Facilities	-	-	BOP	BOP	
52210	Site Warehouse and Storage for all Equipment and Materials			BOP	BOP	
53000	**LOGISTICS:**					
53010	Transportation of Equipment To Construction Site	-	-	PIE/BOP	BOP	Each party for own equipment, PIE responsible for rail deliveries to nearest rail site
53020	Heavy Haul from Rail Siding to Site / Laydown / From Laydown to Site			BOP	BOP	
53030	Preparation and Arrangement for Receiving Unloaded Equipment & Materials (including Warehouse Craneage, etc.)	-	-	BOP	-	Heavy haul by BOP
53040	Duties, Permits (For Construction)	-	-	BOP	-	
53050	Local Registration Fee, Licenses, etc., if required	-	-	Each his own	-	
53060	Rights of Ways/Clearance for Special Shipments	-	-	Each his own	-	Each party for own equipment to point of delivery
53070	On Site/Off Site Storage Of Equipment	-	-	BOP	-	

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Repowering Project
Division of Responsibility

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53080	Equipment Unloading And Handling	-	-	BOP	-	
53090	Indoor and Outdoor Equipment & Material Storage Facilities			BOP	-	
53100	Equipment and Materials Receiving, Inspection, Inventorying, Shipment Damage Claim Processing	-	-	Each his own	-	
53110	Supervising, Maintaining, and Monitoring all Equipment and Materials at the Site	-	-	Each his own	-	
53120	Transportation of Equipment and Materials from Site Storage Point to Permanent Location	-	-	BOP	-	
53130	Transportation of Damaged or Defective Materials or Equipment for Repair or Replacement	-	-	Each his own	-	
54000	**SITE SERVICES:**					
54010	Overall Construction Management	-	-	PWP	-	
54020	Site Construction Quality Assurance/Quality Control	-	-	PWP/BOP	-	
54030	Site Material Coordinator	-	-	BOP	-	
54040	Construction Labor & Craft Supervision	-	-	BOP	-	
54050	Labor for Start-up, Commissioning & Testing			BOP	-	PWP provides operators, BOP provides craft support as
54060	Construction Equipment	-	-	BOP	BOP	
54070	Site Progress Reporting	-	-	Each his own	-	
54080	Comprehensive General Liability Insurance	-	-	Each his own	-	By vehicle owner
54090	Insurance of Temporary Facilities, Tools, Construction Equipment, Etc.	-	-	BOP	-	
54100	Builder's All Risk Insurance Coverage	-	-	PWP	-	
54110	Federal Permits, Licenses and Approvals	-	-	PWP	-	
54120	Environmental Assessment	-	-	PWP	-	
54130	Modification or Obtaining New Water Discharge Permit(s)	-	-	PWP	-	
54140	Coordination for Compliance with City's Noise Ordinance	-	-	BOP	-	
54150	Zoning Board Approvals	-	-	PWP	-	

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Repowering Project
Division of Responsibility

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54160	Building & Construction Permits	-	-	PWP	-	BOP will supply necessary documents for PWP to facilitate construction permitting.
54170	Coordination of the County Inspector's Site	-	-	BOP	-	
54180	Maintaining & Guarding Facilities, Equipment & Materials up to time agreed in Construction	-	-	BOP	-	
54190	Construction Equipment, Tools, Instruments & Aids	-	-	BOP	-	
54200	Construction and Erection Tests, Third Party Testing Services			BOP	-	BOP contractor will provide the services of a third party testing agency for soils compaction verification, concrete and grout compression testing, x-ray, stress relief, etc. Contractor will provide daily reports and test reports from these entities and will permit PWP to contact to discuss issues as needed. Hold points for inspection will be identified in the contractors site-specific
54210	Technical Advisors (TAs)	-	-	PIE/BOP	-	As required to complete the project.
54220	Supervision, Labor and Site Safety Reporting	-	-	Each his own	-	PIE Contractor provides technical advice only.
54230	Construction Overall Safety Program		PWP	BOP		
55000	**START-UP AND COMMISSIONING:**	PIE/BOP	PIE/BOP	PIE/BOP	PIE/BOP	BOP leads commissioning with technical assistance from PIE for own supplied equipment
56000	**PLANT PERFORMANCE, EMISSIONS, AND NOISE TESTS:**					
56010	Lead Organization	-	-	PWP/BOP	-	PWP has established the noise criteria for the plant and will use their noise consultant to perform the noise testing.
56020	Operators and Data Collectors	-	-	PWP/BOP/PIE	-	PIE Contractor provides technical advice only.
56030	Test Advisors	-	-	PIE/BOP	-	PIE may provide TA time as required by warranty and contract
56040	Craft Labor and Supervision Support	-	-	BOP	-	Cost reimbursable
56050	TA Services	-	-	PIE/BOP	-	Each for their own equipment
56060	Final Report	-	-	Each his own	-	
56070	Equipment Guarantee Responsibility	-	-	PIE/BOP	-	Each their own
56080	Equipment functionality and baseline testing	ENG	BOP/PIE	BOP	BOP	Each to povide their own equipment test procedures, BOP to perform tests
56090	Power Island Performance Verification	ENG	PIE	BOP	BOP	

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Repowering Project
Division of Responsibility

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1000	**GAS TURBINE GENERATOR PACKAGE**					
1010	Gas Turbine Generator (GTG)	ENG	PIE	PIE	BOP	
1020	Air Intake Filter System	PIE	PIE	PIE	BOP	Filter element shipment to be coordinated with BOP.
1030	Air Intake Structural support	PIE	PIE	PIE	BOP	
1035	Intake air ductwork including supports	PIE	PIE	PIE	BOP	
1040	Inlet Conditioning System	PIE	PIE	PIE	BOP	
1045	Anti Icing System	-	-	-	-	Not required
1050	Auxiliary Module/s, consisting of water wash system, CT lube oil system, CT hydraulic start	PIE	PIE	PIE	BOP	
1060	Power Augmentation Injection Skid	PIE	PIE	PIE	BOP	
1070	NOx Water Injection system included in Aux skid	PIE	PIE	PIE	BOP	
1080	Interconnecting piping	PIE	PIE/BOP	PIE/BOP	BOP	Piping / Hoses normally supplied by the gas turbine vendor furnished with package. Interconnecting piping from plant systems
1090	Acoustical/Weatherproof Enclosures for	PIE	PIE	PIE	BOP	
1100	Generator, Exciter, & AVR	PIE	PIE	PIE	BOP	
1110	Grout for leveling GTG	PIE	BOP	BOP	BOP	
1120	Gas Turbine Foundations w Embedments / Anchor Bolts	PIE/BOP	PIE/BOP	PIE/BOP	BOP	Foundations, anchor bolts and embedments by others. Shear lugs for LM6000 by PIE Contractor. Anchor bolts by BOP Contractor.
1130	GT exhaust diffuser	PIE	PIE	PIE	BOP	Within GTG package
1140	Valves in GT Packaged Equipment.	PIE	PIE	PIE	PIE/BOP	Including valve operators. Valves normally supplied within skids supplied by PIE. Loose ship valves supplied with GTG installed by BOP.
1150	GT Neutral Grounding Equipment	PIE	PIE	PIE	BOP	
1160	GT Starting System	PIE	PIE	PIE	BOP	
1170	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	Supplied as part of the turbine control panel.
1180	Turbine Control and Interface to Plant Control System	PIE	PIE/BOP	PIE/BOP	PIE/BOP	Turbine Control Panels by PIE, located in BOP supplied PDC, with remote operation in the new Glenarm Building control room.
1190	Starters for all AC motors (MCC)	PIE	BOP	BOP	BOP	Part of GTG MCC located in PDC.
1200	Starters for all DC motors	PIE	BOP	BOP	BOP	
1210	Battery Bank w/ 2 Chargers	PIE	BOP	BOP	BOP	Battery fill by BOP, to be located in the PDC
1220	Lighting for GT and walkways	PIE/BOP	PIE/BOP	PIE/BOP	BOP	Inside of package by PIE. Outside on platforms by BOP.
1230	Ground Cables	PIE	PIE	BOP	BOP	

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Repowering Project
Division of Responsibility

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1240	Raceway, cable and wiring within skid	PIE	PIE	PIE	NA	
1245	External raceway, cable and wiring	PIE/BOP	BOP	BOP	BOP	
1250	Raceway, cable and wiring between skids	PIE	PIE/BOP	BOP	BOP	
1260	Vibration Equipment	PIE	PIE	PIE	BOP	
1270	Lube Oil System, Lube Oil Supply and Drain Piping within skid or GTG	PIE	PIE	PIE	NA	
1280	Lube Oil Supply and Drain piping between skid and GTG	PIE	PIE	PIE	BOP	Drain connection up to skid only by PIE Contractor
1290	Control Oil System & Piping within skid or GTG	PIE	PIE	PIE	NA	
1300	Control Oil System Piping between skid and GTG	PIE	PIE	PIE/BOP	BOP	
1310	Final Fuel Gas Filter Skid	PIE	PIE	PIE	BOP	
1320	Fuel Gas Flow Meters	PIE	PIE	PIE	BOP	Comment: PIE Contractor provides the fuel gas flow meter for GTG control use only, not used for revenue.
1325	Site Fuel Gas Flow Meter	PWP	PWP	PWP	PWP	Metering station by Sempra
1330	Compressor Water Wash Skid	PIE	PIE	PIE	BOP	
1340	Pipe Insulation & Lagging	PIE	PIE	PIE	BOP	Insulation required for heat conservation and personnel protection on PIE skids by PIE. Interconnecting piping will be field insulated
1360	Fire and Gas Detection and Extinguishing System	PIE	PIE	PIE/BOP	BOP	Consists of gas, flame and thermal detectors, CO2 extinguishing system including storage cylinders, piping, valves and wiring, and fire protection system control panel. Exterior pipe & cable furnished & installed by BOP contractor
1370	Water Wash Drain Tank	BOP	BOP	BOP	BOP	Water wash drains tank shall be sized to contain four water washes prior to being emptied
1500	**CHILLER**					
1510	Chiller and Electrical Packages	ENG	PIE	PIE	BOP	Chiller package, chill water pumps, heater exchanger, expansion tank, integral piping within the chiller module
1520	Piping chiller to Intake	PIE	BOP	BOP	BOP	If equipped with a chiller
1530	Pipe insulation	BOP	BOP	BOP	BOP	Insulation internal to the chiller unit needs to be proivded by the chiller vendor. Insuation on interconnecting piping by BOP.
1575	Pot feeder tank & expansion tank.	PIE	PIE	PIE	BOP	
1580	External raceway, cable and wiring	BOP	BOP	BOP	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
2000	**STEAM TURBINE:**					
2010	Steam Turbine and Generator	ENG	PIE	PIE	BOP	
2020	Turning Gear	PIE	PIE	PIE	BOP	
2030	Shims, leveling wedges, keys	PIE	PIE	PIE	BOP	PIE supplies shims and leveling screws
2040	Foundation w/ Embedments	PIE/BOP	PIE/BOP	PIE/BOP	BOP	PIE will review BOP foundation design PIE Contractor provides sole plate for the Gearbox
2050	EHC System	PIE	PIE	PIE	BOP	
2060	Lube Oil System	PIE	PIE	PIE	BOP	Includes pumps, reservoir, filters, and valves, and interconnecting supply & return piping.
2070	Lube Oil Conditioner	PIE	PIE	PIE	BOP	BOP will design interconnecting piping for the lube oil system conditioner based on PIE requirements
2080	ST Drain & Vent Valves and Operators	PIE	PIE	PIE	BOP	
2090	ST Drain Piping to Condenser and/or Misc. Drains Receiver	PIE	BOP	BOP	BOP	Downstream of drain valves
2100	Turbine/Generator Proper Piping, incl. Supports	PIE	PIE	PIE	BOP	Piping terminal points are clarified in the drawings in Attachment 1 of the PIE Contract. Supports are not included by the PIE Contractor since they cannot be designed without knowledge of the layout and the plant structural design.
2110	Line Side Cubicle	PIE	PIE	PIE	BOP	
2120	Main Steam & LP Control/ Admission Valves	PIE	PIE	PIE	BOP	
2130	Steam Turbine Local Gauge Panel or Stanchions	PIE	PIE	PIE	BOP	
2140	Starters for all AC motors (MCC)	PIE	PIE/BOP	BOP	BOP	PIE to design all interconnections and terminations. BOP to route cables. Starters will be in the BOP supplied PDC. BOP to run field wiring into starter/MCC
2150	MOVs & Actuators	PIE	PIE	PIE	BOP	For those items supplied on the STG skid. MOV's in the BOP piping will be by BOP.
2160	Starters for all DC motors	PIE	PIE/BOP	BOP	BOP	PIE to design all interconnections and terminations. BOP to route cables. Starters will be in the BOP supplied PDC. BOP to run field wiring into starter/MCC
2170	Generator Terminal Enclosure	PIE	PIE	PIE	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

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2180	Wiring on the STG Proper & Auxiliary Skids	PIE	PIE	PIE	PIE	
2190	Interconnecting Wiring	PIE	BOP	BOP	BOP	BOP to include in Cable Schedule those circuits installed in BOP designed raceway.
2200	Vibration Equipment (Sensors and Monitoring	PIE	PIE	PIE	BOP	
2210	ST Neutral Grounding Equipment	PIE	PIE	PIE	BOP	
2220	ST Thermal Insulation blankets & blocks	PIE	PIE	PIE	BOP	Steam turbine casing and emergency stop valve casing shall be insulated.
2240	Cross over piping insulation and lagging	PIE	PIE	PIE	BOP	not required
2250	ST Piping Insulation	PIE	BOP	BOP	BOP	
2260	Turbine Supervisory Instrumentation & Protection Devices	PIE	PIE	PIE	BOP	
2270	Generator, Exciter, & AVR	PIE	PIE	PIE	BOP	Includes generator protection panel, generator control panel, and PT cubicle. Located in BOP supplied PDC.
2280	Turbine Shaft Sealing System (excluding interconnecting piping)	PIE	PIE	PIE	BOP	STV supplies the steam seals and the steam seal makeup and dump valves (skid mounted). Con supplies piping (see item 2380).
2290	Gland Steam Condenser & Exhausters	PIE	PIE	PIE	BOP	
2300	Turbine Steam Bypass System, Incl.	PIE	PIE	PIE	BOP	
2310	Control Logic Software Configuration Development and Implementation including graphics and data	PIE	PIE	PIE	PIE	
2320	Local Control Packages and Control Room System Hardware	PIE	PIE	PIE	BOP	PIE provides excitation controls, EHC controls, generator panel, and STG control station. No local control panel is used.
2330	Acoustic Enclosure for Outdoor Installation	PIE	PIE	PIE	BOP	Enclosure covers turbine, condenser, steam bypass valves, lube oil skid, etc as shown on General Arrangement. Must have removeable panels for turbine maintenance.
2350	Turbine exhaust hood spray system (valves & pipe)	PIE	PIE	PIE	BOP	PIE supplies complete strainer, control valve, spray nozzles and ring header. BOP supplies piping
2360	Interconnecting EHC Piping & Tubing	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.

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City of Pasadena
Repowering Project
Division of Responsibility

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2370	Generator and Lube Oil Cooler Water Piping &	PIE	PIE	PIE	BOP	
2380	Shaft Sealing System Interconnecting Piping	PIE	BOP	BOP	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points. Seal super heater by PIE.
2400	Gland Leakoff Interconnecting Piping	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
2410	Lube Oil Supply and Drain Interconnecting Piping to STG	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
2420	Lube Oil Piping to and from Conditioner	PIE	PIE	PIE	BOP	
2430	Gland Steam Pressure Control Valve	PIE	BOP	BOP	BOP	
2435	Gland Steam Flow Control Valve	PIE	PIE	PIE	BOP	
2440	Steam Inlet Strainers	PIE	PIE	PIE	BOP	
2450	Deck Floor	PIE	BOP	BOP	BOP	
2460	Platforms, Ladders, Stairs, Handrails, Etc.	PIE	PIE	PIE	BOP	
3000	**ONCE THROUGH STEAM GENERATOR (OTSG)**					
3010	OTSG Modules	ENG	PIE	PIE	BOP	
3020	Structural Frame & Column Slide Plates	PIE	PIE	PIE	BOP	Shipping column base plates loose.
3030	Supplementary Firing Equipment	-	-	-	-	
3040	OTSG External Piping (ASME Section 1 code	PIE	PIE	PIE	BOP	
3050	Steam & Feedwater Piping Brought Down to About 35' Above Grade	PIE	PIE	PIE	BOP	
3060	Interconnecting Piping between Modules (All Sizes) Incl. Supports	PIE	PIE	PIE	PIE	Field welding is by BOP Contractor and not in PIE Contractor scope.
3070	Stairs, Platforms, and Ladders	PIE	PIE	PIE	BOP	Pipe Rack to OTSG Interconnecting Platform by BOP
3080	Flash & Blowdown Tanks	BOP	BOP	BOP	BOP	May be a single blow down/flash tank located by STG.
3090	Boiler Trim	PIE	PIE	PIE	BOP	
3100	OTSG External Valves (ASME OTSG Code Valves)	PIE	PIE	PIE	BOP	

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Repowering Project
Division of Responsibility

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3110	OTSG Drain & Vent Valves	PIE	PIE	PIE	BOP	
3120	Start-up Vent Valves & Silencers	PIE	PIE	PIE	BOP	Support from OTSG steel by BOP
3130	OTSG Safety Valves & Silencers	PIE	PIE	PIE	BOP	Support from OTSG steel by BOP
3140	Piping and Supports for Silencers (start-up and safety valves) Indoor OTSG	PIE	PIE	PIE	BOP	Piping designed & furnished by OTSG. Supports designed by PIE from load data supplied by OTSG. Piping and supports supplied and installed by BOP.
3150	HP Steam Attemperators & Valves	ENG	PIE	PIE	BOP	
3160	Stack	ENG	PIE	PIE	BOP	Two 360 degree platforms for accessing PIE supplied stack damper and CEMS ports
3170	Stack Emissions Testing/Monitoring Ports Incl.	ENG	PIE	PIE	BOP	Per specification
3180	FAA Warning Lights	-	-	-	-	Not Required
3190	Stack Lightning Protection	BOP	BOP	BOP	BOP	
3200	Expansion Joint @ GTG Exhaust End	PIE	PIE	PIE	BOP	
3210	Stack Closure Damper	ENG	PIE	PIE	BOP	
3220	SCR Catalyst & CO Catalyst	ENG	PIE	PIE	BOP	
3230	SCR Ammonia Injection Grid	ENG	PIE	PIE	BOP	
3240	SCR Ammonia Injection Skid (Incl. Vaporizers and all Instrumentation)	ENG	PIE	PIE	BOP	Scope of supply includes blowers PIE Contractor to supply funtional control logic. BOP Contractor to integrate functional control logic into Plant Control System.
3250	Ammonia Storage Tank & Unloading System	-	-	-	-	Use existing tank. Piping modifications by BOP
3260	Ammonia Interconnecting Piping from Injection Skid to Injection Grid	PIE	PIE	BOP	BOP	
3270	Ammonia Interconnecting Piping & Valves- Tank to Injection Skid	BOP	BOP	BOP	BOP	New pump at existing tank area will be supplied.
3280	Sole plates and slides	PIE	PIE	PIE	BOP	
3290	Burner Management System and Gas Control Logic	-	-	-	-	Not Required
3300	Control Logic Diagrams and Description	PIE	PIE	PIE	PIE	PIE Contractor will include preparation of functional requirements of the OTSG in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included.

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City of Pasadena
Repowering Project
Division of Responsibility

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3310	Starters for all AC motors (MCC)	PIE	PIE/BOP	BOP	BOP	All MCC's associated with the OTSG will be supplied and installed in the PDC by the BOP contractor.
3320	MOVs & Actuators	PIE	PIE	PIE	BOP	Each MOV shall have an integral starter and disconnect switch. MOV's and actuators for any ASME boundary valve or stack damper by the PIE contractor.
3330	Air receiver tanks for PIE supplied valves	PIE	PIE	PIE	BOP	Any PIE supplied valve that has an essential safety function shall be equipped with an air tank receiver local to the valve, to be installed by the BOP contractor
3340	Lighting for OTSG and walkways	BOP	BOP	BOP	BOP	
3350	Emissions Monitoring System (CEMS)	PIE	PIE	PIE	BOP	Umbilical tubing by PIE. PIE supplies DP transmitter across SCR
3360	NOx Test Ports Ahead of SCR	PIE	PIE	PIE	PIE	
3370	Drum Insulation	-	-	-	-	Not Required
3380	Pipe Insulation	PIE	BOP	BOP	BOP	
3390	Freeze Protection	-	-	-	-	Not Required
3400	Raceway, cable and wiring within skid	PIE	PIE	PIE	PIE	Control components and/or their primary sensing elements, if furnished, are without interconnecting tubing, wiring and piping by the PIE Contractor.
3410	External raceway, cable and wiring	PIE	BOP	BOP	BOP	
3420	Raceway, cable and wiring between skids	PIE	BOP	BOP	BOP	
4000	**STEAM SURFACE CONDENSER:**					
4010	Condenser	ENG	PIE	PIE	BOP	Water cooled
4020	Sole Plates	PIE	PIE	PIE	BOP	
4030	Vacuum pumps	PIE	PIE	PIE	BOP	Refer to the flow schematics in Attachment 1 of the PIE Contract for terminal points.
4040	Hotwell	PIE	PIE	PIE	BOP	
4060	After Condenser Float Trap & Valves	PIE	PIE	PIE	BOP	
4070	Drain Piping	PIE	BOP	BOP	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

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4080	Rupture Disk	PIE	PIE	PIE	BOP	
4090	Turbine/Condenser Interface Expansion Joint	PIE	PIE	PIE	BOP	If required.
4100	Vacuum Breaker	PIE	PIE	PIE	BOP	
4110	Hotwell Level Transmitters	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4120	Hotwell Level Switches	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4130	Hotwell Thermocouple	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4140	Waterbox Pressure Gauges	PIE	PIE	PIE	BOP	
4150	Condenser Pressure Transmitters	PIE	PIE	PIE	BOP	Wiring and junction boxes by BOP
4160	Hotwell Conductivity Probes	PIE	PIE	PIE	BOP	
4170	Control Logic Diagram and Description	PIE	PIE	-	-	
5000	**AUXILIARY BOILER:**	PIE	PIE	PIE	BOP	PIE shall provide an aux boiler, superheater and feed pump to supply startup steam to shaft seals and condenser
6000	**CIRCULATING WATER SYSTEM:**					
6010	Mechanical Draft Cooling Tower	ENG	PIE	PIE	BOP	Fiberglass construction, counterflow, fire retardant
6020	Circulating Water Pumps & Motors	ENG	PIE	PIE	BOP	Head loss as defined by PIE for BOP design criteria
6030	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
6040	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
6050	Lighting for Cooling Tower and walkways	BOP	BOP	BOP	BOP	
6060	Lightning Protection for Cooling Tower	BOP	BOP	BOP	BOP	
6070	Vibration Equipment for Tower Fans	PIE	PIE	PIE	BOP	
6080	Underground Piping	BOP	BOP	BOP	BOP	
6090	Above Ground Piping	BOP	BOP	BOP	BOP	
7000	**CONDENSATE SYSTEM:**					
7010	Condensate Pumps & Motors	ENG	PIE	PIE	BOP	
7020	Demin Transfer/Cycle Make-Up Pumps & Motors	BOP	BOP	BOP	BOP	
7030	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP/PIE	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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7040	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
7050	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
7060	Condensate Polishers	PIE	PIE	PIE	BOP	
7070	Condensate Storage Tank	ENG	BOP	BOP	BOP	
8000	**AUXILIARY COOLING WATER SYSTEM:**					
8010	Auxiliary Cooling Water Pump(s) and Motor(s)	ENG	PIE	PIE	BOP	3x50% pumps sized to operated chiller independent of CCW system plus one installed spare
8020	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP	BOP	BOP	BOP	
8030	Starters for all AC motors	BOP	BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
8040	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
9000	**CLOSED COOLING WATER SYSTEM:**					
9010	Closed Cooling Pumps	ENG	BOP	BOP	BOP	PIE to supply necessary heat rejection loads for BOP design
9020	Closed Cooling Heat Exchangers	ENG	BOP	BOP	BOP	PIE to supply necessary heat rejection loads for BOP design
9030	Closed Cooling Piping System	BOP	BOP	BOP	BOP	
10000	**CHEMICAL FEED SYSTEMS:**					
10010	Steam Cycle Chemical Feed System	ENG	BOP	BOP	BOP	BOP to coordinate with PWP for preferred chemical supplier.
10020	Circulating Water Chemical Feed System	ENG	BOP	BOP	BOP	BOP to coordinate with PWP for preferred chemical supplier.
10030	Closed Cooling System Chemical Feed	ENG	BOP	BOP	BOP	If required.
10040	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP/PIE	BOP	BOP	BOP	
10050	Starters for all AC motors	BOP	BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
11000	**FEEDWATER SYSTEM:**					
11010	HP Boiler Feedwater Pumps & Motors	ENG	PIE	PIE	BOP	

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Repowering Project
Division of Responsibility

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11020	Feed Water Flow Meters	PIE	PIE	PIE	BOP	
11030	Feedwater Control Valves	PIE	PIE	PIE	BOP	
11040	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
11050	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC by BOP contractor. BOP to run all field wiring from motors into starter/MCC
11060	MOVs & Actuators	BOP	BOP	BOP	BOP	Each MOV shall have an integral starter and disconnect switch
11070	Vibration Equipment	PIE	PIE	PIE	BOP	Vibration equipment is not specified and is not included.
12000	**FIRE PROTECTION SYSTEMS:**					
12010	Gas Turbine Fire Protection	PIE	PIE	PIE	BOP	
12010	Gas Turbine Aux Skid	PIE	PIE	PIE	BOP	Comment: Local dry chemical fire extinguisher type B is provided by PIE Contractor as standard offering with gas turbine package. BOP Contractor to provide fire suppression per the fire protection specifications.
12020	Steam Turbine	BOP	BOP	BOP	BOP	Lube oil and STG bearings. STG bearings preaction w/rate of rise
12030	Building Sprinkler Systems	BOP	BOP	BOP	BOP	
12040	Transformer Deluge Systems	-	-	-	-	Not Required
12050	Fire System Specialties	BOP	BOP	BOP	BOP	
12060	Hose Racks	-	-	-	-	Hose Racks will not be furnished
12070	Hydrants & Monitor Stations	BOP	BOP	BOP	BOP	
12080	Underground Fire Loop Piping	BOP	BOP	BOP	BOP	
12090	Fire Protection Signaling System / Smoke Detection Systems	BOP	BOP	BOP	BOP	
12100	Fire Alarm Control Panel	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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12110	Cooling Tower	-	-	-	-	Not applicable for fiberglass cooling towers
12120	Fire Pumps: diesel, electric and jockey	TBD	TBD	TBD	TBD	The City has recently increased the water pressure in their water systems. Therefore pressure and volume testing will need to be done to determine if fire water pumps are required.
13000	**STEAM & WATER SAMPLING SYSTEMS:**					
13010	Sampling System & Analyzer Panel	BOP	BOP	BOP	BOP	Provide with stand alone weather enclosure
13020	In-Line Analyzers	BOP	BOP	BOP	BOP	
13030	Control Logic Software Configuration Development and Implementation including graphics and logs	BOP	BOP	BOP	BOP	
14000	**ON-SITE FUEL GAS SYSTEM:**					
14010	Natural Gas Compressors & Motors	ENG	PIE	PIE	BOP	Supply on skid per Section 485374.22
14020	Interconnecting Piping	BOP	BOP	BOP	BOP	
14030	Fuel Gas Dew Point Heater	-	-	-	-	Not Required
14040	Primary Gas Filters/Separators	ENG	PIE	PIE	PIE	Included with Section 485374.22
14050	Primary Fuel gas pressure regulators	-	-	-	-	
14060	Pressure Relief Valves	ENG	PIE	PIE	PIE	Included with Section 485374.22
14070	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	PIE	PIE	PIE	Included with Section 485374.22 PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
14080	Acoustical Enclosure	ENG	PIE	PIE	BOP	If required for sound attenuation, BOP needs to make room to accommdate this enclosure.
14090	Drains tank receiver	ENG	BOP	BOP	BOP	Included with Section 485374.22

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City of Pasadena
Repowering Project
Division of Responsibility

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15000	**NATURAL GAS SUPPLY PIPELINE & INTERCONNECT STATION**					
15010	Gas Metering Station	Sempra	Sempra	Sempra	Sempra	
15020	Natural Gas U/G Pipeline from Meter to Compressor on Site	ENG	BOP	BOP	BOP	
16000	**NO. 2 FUEL OIL SYSTEM**	-	-	-	-	Not Required
17000	**INSTRUMENT/ SERVICE AIR SYSTEM:**					
17010	Air Compressors	ENG	PIE	PIE	BOP	Supply on skid per Section 485374.21
17020	Instrument Air Dryers (Desiccant)	ENG	PIE	PIE	PIE	included with Section 485374.21
17030	Compressed Air Receivers	ENG	PIE	PIE	PIE	included with Section 485374.21
17040	Instrument Air Distribution Piping	BOP	BOP	BOP	BOP	
17050	Service Air Distribution Piping	BOP	BOP	BOP	BOP	
17060	Control Logic Software Configuration Development and Implementation including graphics and logs	PIE	PIE	PIE	PIE	included with Section 485374.21 PIE Contractor will include preparation of functional requirements of the BOP controlled items in PIE Contractor scope in order for the BOP plant control system designer to furnish control system design. Logic drawings are not included by the PIE Contractor.
17070	Starters for all AC motors	PIE	PIE/BOP	BOP	BOP	Will be provided in the PDC. Elect. To run all field wiring into starter/MCC
18000	**WATER TREATMENT SYSTEM**					
18010	Water Treatment Equipment Demin System	ENG	BOP	BOP	BOP	Use existing demin system for make-up.
18020	Interconnecting piping and wiring (external to process, interconnecting to balance of plant)	BOP	BOP	BOP	BOP	
18030	Interconnecting piping (skid-to-skid)	BOP	BOP	BOP	BOP	
18040	Interconnecting wiring (skid-to-skid)	BOP	BOP	BOP	BOP	
18050	Pipe Supports	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
18060	Furniture and equipment	BOP	BOP	BOP	BOP	
18070	PLC, control logic, and programming	BOP	BOP	BOP	BOP	
18080	Neutralization System	BOP	BOP	BOP	BOP	
19000	**DOMESTIC WATER SYSTEM:**					
19010	Connection to City Water supply	ENG	BOP	BOP	BOP	
19020	Safety Showers/Eye Wash Stations	ENG	BOP	BOP	BOP	
20000	**WATER SUPPLY PIPELINE & METERING STATION**					
20010	New line to plant	ENG	BOP	BOP	BOP	No new off site pipeline is anticipated. A new line from on-site is required.
20020	Make-up line from existing facility	ENG	BOP	BOP	BOP	
21000	**PROCESS WASTEWATER:**					
21010	Zero Liquid Discharge System	-	-	-	-	
21020	Plant Wastewater Sump	ENG	BOP	BOP	BOP	
21030	Miscellaneous Plant Wastewater Sumps	ENG	BOP	BOP	BOP	
21040	Oily water separator	ENG	BOP	BOP	BOP	Drain to existing GT 3 & 4 separator. Lift station may be required by BOP.
21050	Wastewater Storage Tank	ENG	BOP	BOP	BOP	
22000	**WASTEWATER DISCHARGE PIPELINE**					
22010	Wastewater Discharge Pipeline	ENG	BOP	BOP	BOP	Discharge to sewer
23000	**MISCELLANEOUS MECHANICAL SYSTEMS & EQUIPMENT**					
23010	Service Water System	ENG	BOP	BOP	BOP	
23020	Demineralized Water Supply System	ENG	BOP	BOP	BOP	
23030	Demin water forwarding pumps and piping	ENG	BOP	BOP	BOP	
23040	Service Water Storage Tank	ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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23050	Demineralized Water Storage Tanks	ENG	BOP	BOP	BOP	
23060	Steam Turbine Drains Tank	ENG	BOP	BOP	BOP	
24000	**BOP PIPING, VALVES & COMPONENTS:**					
24010	Shop Fabricated Plant Piping, (Non-Boiler External Piping)	ENG	BOP	BOP	BOP	
24020	Random Supplied Plant Piping, All Sizes (Non-Boiler External Piping)	ENG	BOP	BOP	BOP	
24030	Plant Tubing (Non-Boiler External), incl. Instrument Tubing	ENG	BOP	BOP	BOP	
24040	Engineered Pipe Hangers Large & Small Bore (2" and smaller) Pipe Greater than 300F (design)	ENG	BOP	BOP	BOP	
24050	Large Bore Standard Pipe Hangers less than 300F	ENG	BOP	BOP	BOP	
24060	Pipe Hanger Supports, Sleepers, Support Anchor Plates	ENG	BOP	BOP	BOP	
24070	Pipe Heat Tracing (as required)	ENG	BOP	BOP	BOP	
24080	Cathodic Protection	ENG	BOP	BOP	BOP	
24090	Steam Blow Temporary Piping	ENG	BOP	BOP	BOP	
24100	Relief and Safety Valves, Vent Stacks and Silencers (Excl. OTSG)	ENG	BOP	BOP	BOP	
24110	BOP Manual Valves	ENG	BOP	BOP	BOP	
24120	BOP Control Valves	ENG	BOP	BOP	BOP	
25000	**BOP INSULATION AND LAGGING:**					
25010	BOP Pipe and Valve Insulation	ENG	BOP	BOP	BOP	
25020	Equipment Insulation	PIE/BOP	PIE/BOP	BOP	BOP	Each for own scope of installation
25030	Lagging	ENG	BOP	BOP	BOP	As applicable. to equip. design
26000	**HVAC:**					
26010	PDC	ENG	BOP	BOP	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

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26020	Glenarm Building	ENG	BOP	BOP	BOP	
26030	GTG enclosures	PIE	PIE	PIE	BOP	
26040	STG enclosure	PIE	PIE	PIE	BOP	
27000	**TRANSFORMERS:**					
27010	Generator Step Up Transformer	PIE	PIE	PIE	BOP	Three winding
27020	Auxiliary Transformers	ENG	BOP	BOP	BOP	
27030	Main Transformer Field Dress, Oil Fill & Test	ENG	-	BOP	BOP	PIE supplies field service representatives.
27040	Other Transformers	ENG	BOP	BOP	BOP	Small lighting and power transformers and panels supplied by Elect
27050	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
28000	**GENERATOR BREAKERS:**					
28010	34.5 kV Breaker	PWP	PWP	PWP	PWP	Located off site in switchyard.
28020	Low Side Breakers (15kV Switchgear)	ENG	BOP	BOP	BOP	Located in PDC installed by BOP
29000	**STATION SWITCHGEAR:**					
29010	Medium Voltage Switchgear (4160)	ENG	BOP	BOP	BOP	Located in PDC
29020	Low Voltage Switchgear (480)	ENG	BOP	BOP	BOP	Located in PDC
29030	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
29040	Auxiliary Power Metering	ENG	BOP	BOP	BOP	Located in PDC
29500	**BLACK START GENERATOR:**					
29510	Packaged Diesel Engine Driven Generator with day tank, controls, enclosure	-	-	-	-	Not Required
30000	**HIGH VOLTAGE INTERCONNECT:**					
30010	From Switchyard Dead-End Structure	PWP/ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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30020	Underground High Voltage Cable	PWP/ENG	BOP	BOP	BOP	
31000	**MOTOR CONTROL CENTERS:**					
31010	Station Service (BOP) MCCs	ENG	BOP	BOP	BOP	
31020	BOP AC Auxiliary Loads	ENG	BOP	BOP	BOP	
31030	MOVs & Actuators	ENG	BOP	BOP	BOP	
31040	Control Logic Software Configuration Development and Implementation including graphics and logs	ENG	BOP	BOP	BOP	
32000	**FIELD INSTALLED CONDUCTORS:**					
32010	GTG Interconnecting Power & Control Cables	PIE	PIE/BOP	BOP	BOP	All cables from GTG and accessory skids.
32020	STG Interconnecting Power & Control Cables	PIE/BOP	BOP	BOP	BOP	
32030	OTSG Power & Control Cables	PIE/BOP	BOP	BOP	BOP	
32040	BOP Power & Control Cables	ENG	BOP	BOP	BOP	
32050	Non-segregated phase bus duct or cable from CT and ST Generators to low-side generator breakers	ENG	BOP	BOP	BOP	
32060	Nonsegregated phase bus duct from xfmrs to swgr	ENG	BOP	BOP	BOP	
32070	Cable	ENG	BOP	BOP	BOP	
32080	Underground Cable from Low-Side Generator Breakers to Main Transformer.	N/A	NA	NA	NA	
32090	U/G Cable	ENG/PWP	BOP	BOP	BOP	
32100	Ground Cables	ENG	BOP	BOP	BOP	
33000	**RACEWAYS:**					
33010	Cable Tray	ENG	BOP	BOP	BOP	
33020	GTG Conduit, Below Grade	ENG	BOP	BOP	BOP	
33030	GTG Conduit, Above Grade	ENG	BOP	BOP	BOP	
33040	STG, OTSG, Aux Boilers & BOP Conduit greater the 2 inch diameter	ENG	BOP	BOP	BOP	

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City of Pasadena
Repowering Project
Division of Responsibility

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33050	STG, OTSG, Aux Boilers & BOP Conduit less then 2 inch diameter	ENG	BOP	BOP	BOP	
33060	Cable Trench and Duct Runs	ENG	BOP	BOP	BOP	
34000	**MISCELLANEOUS ELECTRICAL SYSTEMS:**					
34010	Station Grounding Grid	ENG	BOP	BOP	BOP	
34020	Outdoor Lighting in Power Plant	ENG	BOP	BOP	BOP	
34030	UPS System	ENG	BOP	BOP	BOP	
34040	125V DC Distribution Panels - Balance of Plant	ENG	BOP	BOP	BOP	
34050	125V DC Station Battery - Balance of Plant	ENG	BOP	BOP	BOP	
34060	125VDC Station Battery Charger	ENG	BOP	BOP	BOP	
34070	Communication System (Phone and Information Network)	ENG	BOP	BOP	BOP	
34080	Communication/IT Raceway/Cable/Outlets	ENG	BOP	BOP	BOP	
34090	Telephone Line Protection/Isolation Equipment	ENG	BOP	BOP	BOP	
34100	BOP Electrical Heat Tracing	ENG	BOP	BOP	BOP	
34110	13.8kV-4160V Auxiliary Transformer Neutral Grounding	ENG	BOP	BOP	BOP	
34120	13.8kV-480V Auxiliary Transformer Neutral	ENG	BOP	BOP	BOP	Included with switchgear in PDC
34130	480V Ground Fault Protection System	ENG	BOP	BOP	BOP	High resistance type, included 480V switchgear in PDC
34140	Lightning Protection	ENG	BOP	BOP	BOP	
34150	Switchyard lighting	PWP	BOP	BOP	BOP	If new required
35000	**CONTROL / DATA ACQUISITION / LOGIC EQUIPMENT:**					
35010	Plant Control System	PIE/BOP/ENG	BOP	BOP	BOP	
35020	- Control Room and Engineering Workstation	PIE/ENG	BOP	BOP	BOP	
35030	- Event, Alarm, and Log Printers	PIE/ENG	BOP	BOP	BOP	
35040	Control System Hardware (Processors, I/O Cabinets, HMI's, etc.)	PIE/ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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35050	- I/O Database	PIE/ENG	BOP	BOP	BOP	
35060	- Control Logic Diagrams	PIE/ENG	BOP	BOP	BOP	Including AGC block load control
35070	- Review Control Configurations	PIE/ENG	BOP	BOP	BOP	
35080	- Alarm, Log, HSR Configuration	PIE/ENG	BOP	BOP	BOP	
35090	- System Graphics	PIE/ENG	BOP	BOP	BOP	
35100	Remote Transponder (RTU) for Energy Management System	PIE/ENG	BOP	BOP	BOP	
35110	PWP/CAISO Information Systems	PIE/ENG	BOP	BOP	BOP	Tie to existing system
35120	Interface equipment to PWP/Sempra	PIE/ENG	BOP	BOP	BOP	Includes any interface equipment required (Relay Panel).
36000	**RELAYING/METERING PROTECTION:**					
36010	GT Generator Protection	PIE	PIE/BOP	PIE	BOP	PIE responsible for those generator relay setting that do not involve coordination with external protection. BOP responsible for relay settings not performed by PIE, reviewing relay settings performed by PIE, and for ensuring proper coordination of all relay settings with external protection. Relay panel supplied by PIE but included in Electrical package.
36020	ST Generator Protection	PIE	PIE/BOP	PIE	BOP	PIE responsible for those generator relay setting that do not involve coordination with external protection. BOP responsible for relay settings not performed by PIE, reviewing relay settings performed by PIE, and for ensuring proper coordination of all relay settings with external protection. Relay panel supplied by PIE but included in Electrical package.
36030	High Voltage Metering and Protective Relaying	PWP/ENG	BOP	BOP	BOP	
36040	High Voltage Control and Monitoring Panel	PWP/ENG	BOP	BOP	BOP	
36050	Main Transformer Differential Protection	PWP/ENG	BOP	BOP	BOP	Located in PDC
36060	Auxiliary Transformers	ENG	BOP	BOP	BOP	Located in MV Switchgear in PDC
36070	All other auxiliary system protection, including medium voltage switchgear, low voltage switchgear, and MCCs	ENG	BOP	BOP	BOP	
37000	**INSTRUMENTATION:**					Mech responsible for installing all in-line devices, wells, orifices, venturis, etc.
37010	BOP Plant Instrumentation	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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37020	GTG Instrumentation	PIE	PIE	PIE	BOP	
37030	STG Instrumentation	PIE	PIE	PIE	BOP	
37040	OTSG Instrumentation	PIE	BOP	BOP	BOP	Per OTSG Vendor P&ID
37050	Local (including face gauges, TC's, etc.)	BOP	BOP	BOP	BOP	
37060	Remote (inclusive of all xmtrs)	BOP	BOP	BOP	BOP	
38000	**SITE WORK:**					
38010	Demolition	ENG	BOP	BOP	BOP	
38020	Remediation	ENG	BOP	BOP	BOP	
38030	Relocation of existing pipe, utilities, and Con	BOP	BOP	BOP	BOP	
38040	Clearing and Grubbing	BOP	BOP	BOP	BOP	
38050	Earthwork	BOP	BOP	BOP	BOP	
38060	Roads/Paving/Surfacing	BOP	BOP	BOP	BOP	
38070	Fencing/Gates	BOP	BOP	BOP	BOP	
39000	**STORM WATER:**	-	-	-	-	
39010	Drainage System	ENG	BOP	BOP	BOP	
39030	Erosion /Sediment Control	ENG	BOP	BOP	BOP	
40000	**SANITARY SEWER:**					
40010	Sanitary Sewage System	ENG	BOP	BOP	BOP	Process drain lines in plant and new sanitary sewer connection for Control and Lab Buildings
41000	**FOUNDATION WORK:**					
41010	-OTSG Foundations	PIE/ENG	BOP	BOP	BOP	
41020	-OTSG Stack Foundations	PIE/ENG	BOP	BOP	BOP	
41030	-GTG Foundations	PIE/ENG	BOP	BOP	BOP	

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41040	-STG Foundation	PIE/ENG	BOP	BOP	BOP	
41050	-Cooling Tower Basins & Circ. Water System	ENG	BOP	BOP	BOP	
41060	-Circ. Water Pump Intake	ENG	BOP	BOP	BOP	
41070	-BOP Equip. and Structures Foundations	ENG	BOP	BOP	BOP	
41080	-Buildings	ENG	BOP	BOP	BOP	
41090	-Infrastructure	ENG	BOP	BOP	BOP	
41100	-Misc. Foundations	ENG	BOP	BOP	BOP	
41110	-Trenches, Duct Banks & Manholes	ENG	BOP	BOP	BOP	
41120	Formwork	BOP	BOP	BOP	BOP	
41130	Expansion Joints	ENG	BOP	BOP	BOP	
41140	Reinforcements	ENG	BOP	BOP	BOP	
41150	Concrete	ENG	BOP	BOP	BOP	
41160	- Lean Concrete	ENG	BOP	BOP	BOP	
41170	- Walls	ENG	BOP	BOP	BOP	
41180	- Piers	ENG	BOP	BOP	BOP	
41190	- Footings	ENG	BOP	BOP	BOP	
41200	- Pads	ENG	BOP	BOP	BOP	
41210	- Elevated Slabs	ENG	BOP	BOP	BOP	
41220	Embedments	PIE/ENG	BOP	BOP	BOP	
41230	Anchor Bolts	PIE/ENG	BOP	BOP	BOP	
41240	Sole Plates	PIE/ENG	BOP	BOP	BOP	
41250	Finishing Work/Concrete Floor Finishing/Concrete Wall Finishing	ENG	BOP	BOP	BOP	
41260	Sealing off Existing Glenarm Circulating Water Trenches	ENG	BOP	BOP	BOP	
42000	**STRUCTURAL Steel**					

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Repowering Project
Division of Responsibility

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42010	Pipe, Utility Racks & Access/Service Platforms	ENG	BOP	BOP	BOP	Inclusive of all supplemental support for pipe, stairs, platforms, etc. BOP contractor's steel fabricator to shop detail and submit drawings to the engineer for review.
43000	**MISCELLANEOUS Steel**					
43010	Stairs, Walkways, Ladders, Handrails	ENG	BOP	BOP	BOP	Contractor's steel fabricator to shop detail and submit drawings to the engineer for review.
44000	**PRE-ENGINEERED ENCLOSURES:**	PIE/ENG	PIE/BOP	PIE/BOP	BOP	Steam Turbine Acoustical enclosure provided by PIE Contractor.
44200	**POWER DISTRIBUTION CENTER(S) (PDC) -Prepackaged Buildings**					
44210	Building Package inclusive of structure, HVAC, lighting, doors, windows, control equipment, etc.	PIE/ENG	PIE/BOP	BOP	BOP	
44220	Plant Auxiliary Electrical System Equipment	PIE/ENG	PIE/BOP	BOP	BOP	
44230	PCS Field Termination (I/O) Cabinets	-	-	-	-	Not Required
44240	Internal PDC Wiring	PIE/ENG	PIE/BOP	BOP	BOP	Includes all internal PDC wiring for building wiring as well as cabinet to cabinet wiring internal to PDC, e.g. MCC to I/O cab
44250	External PDC Wiring	ENG	BOP	BOP	BOP	Includes all wiring from devices in PDC to devices external to the
44260	PDC Internal Electrical Raceway	ENG	BOP	BOP	BOP	Includes tray, conduit, floor duct, etc.
44270	PDC External Electrical Raceway	ENG	BOP	BOP	BOP	Includes all raceway external to the PDC.
44300	MAINTENANCE **BUILDING**					
44310	Demolition	PWP/ENG	BOP	BOP	BOP	
44320	Remediation	PWP/ENG	BOP	BOP	BOP	
44330	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
44340	HVAC	PWP/ENG	BOP	BOP	BOP	
44350	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
44360	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
44370	Building finishes	PWP/ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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44380	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
44390	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
44300	WELDING SHOP BUILDING					
44330	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
44340	HVAC	PWP/ENG	BOP	BOP	BOP	
44350	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
44360	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
44370	Building finishes	PWP/ENG	BOP	BOP	BOP	
44380	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
44390	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
45000	**CONTROL BUILDING**					
45030	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
45040	HVAC	PWP/ENG	BOP	BOP	BOP	
45050	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
45060	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
45070	Building finishes	PWP/ENG	BOP	BOP	BOP	
45080	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	
45090	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
45000	**WATER LAB BUILDING**					
45030	Design of Interior Space and Finishes	PWP/ENG	BOP	BOP	BOP	
45040	HVAC	PWP/ENG	BOP	BOP	BOP	
45050	Electrical and Mechanical	PWP/ENG	BOP	BOP	BOP	
45060	Doors and Windows	PWP/ENG	BOP	BOP	BOP	
45070	Building finishes	PWP/ENG	BOP	BOP	BOP	
45080	Office equipment, furniture	PWP/ENG	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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45090	Electrical and Interior Lighting	PWP/ENG	BOP	BOP	BOP	
46000	**PAINTING, COLOR CODING AND IDENTIFICATION:**					
46010	Finish Painting					
46020	- GT	ENG	-	BOP	BOP	
46030	- ST	ENG	-	BOP	BOP	
46040	- OTSG	ENG	-	BOP	BOP	
46050	- Balance of Plant	ENG	-	BOP	BOP	
46060	Plant Cable & Systems Labeling	ENG	-	BOP	BOP	
46070	Plant Piping Labeling	ENG	-	PWP	PWP	PWP tp provide labeling specification
46080	Labeling / Tagging	ENG	All	All	All	Each responsible for their own.
47000	**STEAM BLOWS, CHEMICAL CLEANING, BOIL OUT & FLUSHING:**					
47010	- OTSG	PIE	BOP	BOP	BOP	
47020	- GT & ST	PIE	BOP	BOP	BOP	
47030	-Steam Lines	PIE/ENG	BOP	BOP	BOP	
47040	-On Site Gas Lines	PIE/ENG	BOP	BOP	BOP	No gas blows permitted on site.
47050	-On Site Fuel Oil Lines	-	-	-	-	Not Required
48000	**CONSUMABLES, FUELS & OPERATIONAL CHEMICALS:**					
48010	Lube Oils for CTs and ST	PIE	PIE	BOP	BOP	
48020	Initial Fills for Pumps and Equipment	PIE/BOP	PIE/BOP	BOP	BOP	BOP Contractor responsible for first fills.
49000	**ENGINEERING AND DESIGN SERVICES:**					
49010	Design Criteria	ENG	ENG	-	-	
49020	Cycle Definition & Thermal Design	ENG	PIE/BOP	-	-	

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Repowering Project
Division of Responsibility

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49030	Heat Balances	ENG	PIE/BOP	-	-	
49040	Plot Plan & Arrangement Drawings	ENG	BOP	-	-	
49050	Engineering Schedule	-	-	ENG	-	
49060	Drawing Schedule	-	-	PIE/ENG/BOP	-	Each party for own scope
49070	Commissioning, Start-up & O&M Manuals	-	-	PIE/ENG/BOP	-	Each party for own scope
49080	Spare Parts Lists	-	-	PIE/ENG/BOP	-	Each party for own scope
49090	System/Functional Description	PIE/ENG/BOP		PIE/ENG/BOP	-	Each party for own scope. GTG System/Functional Description is included in the O&M and I&C manuals by the PIE Contractor.
49100	Site Survey & Preliminary Geotech Report	-	-	ENG/PWP	-	
49110	Final Geotech Report	-	-	PWP	-	
49120	Site Environmental Investigation (Phase I and II)	-	-	PWP	-	
49130	Cast-in-place Concrete Design	ENG	BOP	-	-	
49140	Foundations Design	ENG	BOP	-	-	
49150	Building Design	PWP/ENG	BOP	-	-	
49160	Painting Requirements	ENG	BOP/PIE	-	-	
49170	Grading and Drainage Design	ENG	BOP	-	-	
49180	Sedimentation and Erosion Control Plans	ENG	BOP	-	-	General Services to maintain erosion control
49190	Underground Utilities Design	ENG	BOP	-	-	
49200	BOP P&ID's	ENG	BOP	-	-	
49210	Major Equipment P&ID's	PIE	PIE	-	-	
49220	Mechanical Equipment List	ENG	BOP	-	-	
49230	Valve List	ENG	BOP	-	-	
49240	Line List	ENG	BOP	-	-	
49250	Control Valve Data Sheets	ENG	BOP	-	-	
49260	Instrument Data Sheets	ENG	BOP	-	-	
49270	Instrument Locations	ENG	BOP	-	-	
49280	Instrument Installation Details	ENG	PIE/BOP	-	-	Each party for own scope

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City of Pasadena
Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
49290	Piping and Hanger Design/Stress Analysis	ENG	PIE/BOP	-	-	Each party for own scope
49300	Thermal Insulation	ENG	PIE/BOP	-	-	Each party for own scope
49310	Water Balance	ENG	BOP	-	-	
49320	One-Line, Three line, Phasing, Distribution Bus Front elevations and BOM's, and Panel Schedule	ENG/PIE	BOP	-	-	
49330	Electrical Load List	ENG	BOP	-	-	
49340	Raceway, cable, wiring, grounding	ENG	BOP	-	-	
49350	Electrical and Instrument Location Drawings	ENG	BOP	-	-	Including GTG, OTSG, STG field mounted instruments
49360	Electrical Schematic and Termination Drawings	ENG	BOP	-	-	
49370	Cable and Raceway Schedule	BOP	BOP	-	-	All raceway, cables and wiring to be installed by the contractor will be in the cable data base except field run conduit, lighting panel cuts, cathodic protection ckts, and heat tracing panel ckts. Cable routing will include the equipment cubicle number in all multi-
49380	Outdoor Lighting Design	ENG	BOP	-	-	
49390	Ground Resistivity and Corrosivity	ENG	BOP	BOP	-	Info furnished as part of Geotech report.
49400	Design of High Voltage elec Interconnections	ENG	BOP	-	-	
49410	SWYD Instrument and Relay Settings	ENG	BOP	-	BOP	
49420	Plant Instrument and Relay Settings	ENG	BOP	-	BOP	
49430	Control Logic Diagrams	ENG	BOP	-	-	Each party for own scope
49440	Switchyard Design	PWP/ENG	PWP	-	-	Work consists of SF6 Breaker, structural steel and foundations, including dead end structure, air switches and CTs/PTs, fence, grounding and rock surfacing.
49450	Transmission Lines Design	PWP/ENG	BOP	-	-	
49460	Natural Gas Interconnect Design	Sempra	Sempra	Sempra	Sempra	
49470	Water Supply Interconnect Design	PWP/ENG	BOP	BOP	BOP	
49480	Fire Protection Design	PIE/ENG	PIE/BOP	PIE/BOP	BOP	PIE for GTG only. BOP does detailed design for automatic fire protection and detection systems
49490	As-Built Drawings	-	-	PIE/BOP	-	Each party for own scope
50000	**PROJECT SERVICES:**					

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Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
50010	Overall Project Management	-	-	PWP	-	
50020	Project Master Schedule	-	-	ENG/BOP	-	Engineer maintains until BOP awarded
50030	Engineering Schedule	-	-	BOP	-	
50040	Equipment Procurement and Delivery Schedule	-	-	ENG/BOP	-	Each party for own scope
50050	Construction Schedule	-	-	ENG/BOP	-	Detailed schedule by con
50060	Systems Turnover Schedule	-	-	BOP	-	Contractor to incorporate in its schedule
50070	Electrical Interconnect Engineering Schedule	-	-	BOP	-	
50080	Electrical Interconnect Construction Schedule	-	-	BOP	-	
50090	Natural Gas Interconnect Schedule	-	-	PWP	-	
50100	Water Supply Interconnect Schedule	-	-	PWP	-	
50110	Overall Project Status Reports	-	-	BOP	-	
50120	Equipment O&M Manuals	-	-	PIE/BOP	-	Each party for own scope
50130	Factory Tests Reports	-	-	PIE/BOP	-	Each party for own scope
50140	Transportation Risk Insurance	-	-	PIE/BOP	-	
50150	Training Equipment	-	-	PIE/BOP	-	City furnishes facilities, screen and projector.
50160	Operating and Maintenance Personnel Training Program	-	-	PIE/BOP	-	Each party for own scope.
50170	Source Inspections	-	-	PIE/BOP	-	Each party for own scope
50180	Performance Bond	-	-	PIE/BOP	-	
51000	**SPARE PARTS:**					
51010	Start-up Spares	-	-	PIE/BOP	-	Each party for own scope
51020	Operational Spares	-	-	PWP	-	
51030	B-O-P Start Up Spares	-	-	PWP	-	
52000	**TEMPORARY FACILITIES:**					
52010	Access Roads within Site, (Paved areas, yard surfacing, as required)	BOP	BOP	BOP	BOP	

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Repowering Project
Division of Responsibility

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52020	Access Roads & Laydown Areas Outside Site Boundary	PWP/ENG	PWP/BOP	BOP	BOP	Jacobs Parking
52030	Construction Facilities for Labor such as Toilets, Shelters, Change Rooms, etc.	BOP	BOP	BOP	BOP	
52040	Construction Parking	PWP/ENG	BOP	BOP	BOP	Jacobs Parking
52050	Laydown Area, (establish, control & restore)	PWP/ENG	BOP	BOP	BOP	
52060	Owner's Trailers	BOP	BOP	BOP	BOP	Contractor will be required to install stairs, utilities, office furniture, filing cabinets, phone wiring and computer network wiring.
52070	Constructor's Site Construction Office, Including all furniture, supplies, etc.	BOP	BOP	BOP	BOP	
52080	Field Trailers for PIE TA's Including all Furniture	BOP	BOP	BOP	BOP	BOP will arrange for trailers and their site location and to install stairs, utilities, etc.
52090	Site Vehicles and Fuels	-	-	Each his own	Each his own	Mules, Fuel Trucks, Erection Hauler, etc.
52100	First Aid Station, Safety and Health Facilities			Each his own	Each his own	
52110	Site Security	-	-	BOP	BOP	Security will be provided by contractor at remote site and main project site on a 24hr/7day schedule.
52120	Fire Prevention and Fighting	BOP	BOP	BOP	BOP	
52130	Temporary Water and Con. Supply & Distribution	BOP	BOP	BOP	BOP	
52140	Temporary Site Telephone/Communications	BOP	BOP	BOP	BOP	
52150	Temporary Sewage Collection, Treatment and Disposal			BOP	BOP	
52160	Construction Erosion Control			BOP	BOP	
52170	Dust Control	-	-	BOP	BOP	
52180	Dirt and Mud Control (Temporary graveling of site area)	-	-	BOP	BOP	Maintain public roadways to be free of mud/dirt.
52190	Housekeeping for On-Site Facilities	-	-	BOP	BOP	
52200	Clean-up and Removal of Temporary Facilities	-	-	BOP	BOP	
52210	Site Warehouse and Storage for all Equipment and Materials			BOP	BOP	
53000	**LOGISTICS:**					

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Repowering Project
Division of Responsibility

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53010	Transportation of Equipment To Construction Site	-	-	PIE/BOP	BOP	Each party for own equipment, PIE responsible for rail deliveries to nearest rail site
53020	Heavy Haul from Rail Siding to Site / Laydown / From Laydown to Site			BOP	BOP	
53030	Preparation and Arrangement for Receiving Unloaded Equipment & Materials (including Warehouse Craneage, etc.)	-	-	BOP	-	Heavy haul by BOP
53040	Duties, Permits (For Construction)	-	-	BOP	-	
53050	Local Registration Fee, Licenses, etc., if required	-	-	Each his own	-	
53060	Rights of Ways/Clearance for Special Shipments	-	-	Each his own	-	Each party for own equipment to point of delivery
53070	On Site/Off Site Storage Of Equipment	-	-	BOP	-	
53080	Equipment Unloading And Handling	-	-	BOP	-	
53090	Indoor and Outdoor Equipment & Material Storage Facilities			BOP	-	
53100	Equipment and Materials Receiving, Inspection, Inventorying, Shipment Damage Claim Processing	-	-	Each his own	-	
53110	Supervising, Maintaining, and Monitoring all Equipment and Materials at the Site	-	-	Each his own	-	
53120	Transportation of Equipment and Materials from Site Storage Point to Permanent Location	-	-	BOP	-	
53130	Transportation of Damaged or Defective Materials or Equipment for Repair or Replacement	-	-	Each his own	-	
54000	**SITE SERVICES:**					
54010	Overall Construction Management	-	-	PWP	-	
54020	Site Construction Quality Assurance/Quality Control	-	-	PWP/BOP	-	
54030	Site Material Coordinator	-	-	BOP	-	
54040	Construction Labor & Craft Supervision	-	-	BOP	-	
54050	Labor for Start-up, Commissioning & Testing			BOP	-	PWP provides operators, BOP provides craft support as
54060	Construction Equipment	-	-	BOP	BOP	
54070	Site Progress Reporting	-	-	Each his own	-	

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City of Pasadena
Repowering Project
Division of Responsibility

Item Number	Item Description	Concept Engineering	Detail Design	Supply of Equip., Mat'l or	Field Install/ Erect	Comments / Clarifications
54080	Comprehensive General Liability Insurance	-	-	Each his own	-	By vehicle owner
54090	Insurance of Temporary Facilities, Tools, Construction Equipment, Etc.	-	-	BOP	-	
54100	Builder's All Risk Insurance Coverage	-	-	PWP	-	
54110	Federal Permits, Licenses and Approvals	-	-	PWP	-	
54120	Environmental Assessment	-	-	PWP	-	
54130	Modification or Obtaining New Water Discharge Permit(s)	-	-	PWP	-	
54140	Coordination for Compliance with City's Noise Ordinance	-	-	BOP	-	
54150	Zoning Board Approvals	-	-	PWP	-	
54160	Building & Construction Permits	-	-	PWP	-	BOP will supply necessary documents for PWP to facilitate construction permitting.
54170	Coordination of the County Inspector's Site	-	-	BOP	-	
54180	Maintaining & Guarding Facilities, Equipment & Materials up to time agreed in Construction	-	-	BOP	-	
54190	Construction Equipment, Tools, Instruments & Aids	-	-	BOP	-	
54200	Construction and Erection Tests, Third Party Testing Services			BOP	-	BOP contractor will provide the services of a third party testing agency for soils compaction verification, concrete and grout compression testing, x-ray, stress relief, etc. Contractor will provide daily reports and test reports from these entities and will permit PWP to contact to discuss issues as needed. Hold points for inspection will be identified in the contractors site-specific
54210	Technical Advisors (TAs)	-	-	PIE/BOP	-	As required to complete the project.
54220	Supervision, Labor and Site Safety Reporting	-	-	Each his own	-	PIE Contractor provides technical advice only.
54230	Construction Overall Safety Program		PWP	BOP		
55000	**START-UP AND COMMISSIONING:**	PIE/BOP	PIE/BOP	PIE/BOP	PIE/BOP	BOP leads commissioning with technical assistance from PIE for own supplied equipment
56000	**PLANT PERFORMANCE, EMISSIONS, AND NOISE TESTS:**					

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Repowering Project
Division of Responsibility

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56010	Lead Organization	-	-	PWP/BOP	-	PWP has established the noise criteria for the plant and will use their noise consultant to perform the noise testing.
56020	Operators and Data Collectors	-	-	PWP/BOP/PIE	-	PIE Contractor provides technical advice only.
56030	Test Advisors	-	-	PIE/BOP	-	PIE may provide TA time as required by warranty and contract
56040	Craft Labor and Supervision Support	-	-	BOP	-	Cost reimbursable
56050	TA Services	-	-	PIE/BOP	-	Each for their own equipment
56060	Final Report	-	-	Each his own	-	
56070	Equipment Guarantee Responsibility	-	-	PIE/BOP	-	Each their own
56080	Equipment functionality and baseline testing	ENG	BOP/PIE	BOP	BOP	Each to povide their own equipment test procedures, BOP to perform tests
56090	Power Island Performance Verification	ENG	PIE	BOP	BOP	

GLENARM REPOWERING PROJECT
SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

CONSTRUCTION, START-UP & TRAINING

ITEM	DESCRIPTION	PIE EQUIPMENT MANUFACTURER	BOP CONTRACTOR	PWP
	ADMINISTRATIVE			
1	Prepare System Descriptions		X	
2	Define Engineered System Codes		X	
3	Place System Boundary Tags		X	
4	Prepare System Turn-over Packages		X	
5	Develop and Maintain Start-Up Schedule		X	
6	Provide Craft Support for Start-Up		X	
7	Administer a Tagging and Lockout Procedure (Construction)		X	
8	Administer a Tagging and Lockout Procedure (Operations)			X
9	Prepare and Maintain Master System Punch List		X	X
10	Maintain Red Line As Builts –Copy for Turnover Package		X	
11	Prepare Required Data Sheets and Test Records	X	X	
12	Provide Complete O&M Manuals for each Equipment Item provided	X	X	
13	Provide Operator Training for Purchased Equipment	X	X	
14	Issue Start Up As-Built Drawings	X	X	
15	Scope Turnover Systems		X	
16	Prepare Plant Energization Procedures		X	
17	Conduct Plant Performance Test		X	
18	Prepare Performance Test Report		X	
19	Site Specific Training	X	X	
	MECHANICAL			
1	Install Mechanical Equipment		X	
2	Perform Equipment Alignment (Break Coupling)		X	
3	Grout Mechanical Equipment		X	
4	Complete Installation of Piping and Supports		X	
5	Perform non-destructive Tests: Piping & Equipment		X	
6	Design, Supply, Install and remove Temporary Piping for Steam Blows		X	
7	Furnish, Install & Remove Temp. Piping and Equipment for Oil Flushes.		X	
8	Flush Piping & Equipment		X	
9	Conduct Chemical Cleaning or Boil Out		X	
10	Install Insulation and Lagging		X	
11	Load Resins in Water Treatment System		X	
12	Clean Tanks and Equipment prior to		X	

GLENARM REPOWERING PROJECT
SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

ITEM	DESCRIPTION	PIE EQUIPMENT MANUFACTURER	BOP CONTRACTOR	PWP
	System Turnover to Start-Up			
13	Perform Condenser Leak Test		X	
14	Paint all Non-Insulated Equipment and Structures (Except Galvanized)		X	
15	First Fill Lubricants & Chemicals		X	
16	Verify Pump Strainers & Filters are Installed		X	
17	Couple Rotating Equipment (Final)		X	
18	Perform Vibration Checks	X	X	
19	Perform Oil Flushes		X	
20	Perform Steam Blows		X	
21	Remove Hanger Stops & Set in Cold Positions		X	
22	Furnish and Install Start-Up Strainers		X	
23	Operate Permanent Plant Equipment		X	X
24	Furnish Start-Up Spares	X	X	
25	Tag All Equipment and Valves	X	X	
	ELECTRICAL & INSTRUMENTATION			
1	Install Ground Grid & Test		X	
2	Install Transformers & Switchgear		X	
3	Provide Temp. Power for Motor/Equipment Space Heaters		X	
4	Store Electrical Equipment per Manufacturers Recommendations		X	
5	Complete Cable Installation & Termination		X	
6	Continuity Checks of All Cables		X	
7	Land PCS I/O Cables on Plastic		X	
8	Megger all Power Cables 120v and Higher		X	
9	HI Pot Medium Voltage Cable (2-15 Kv)		X	
10	Service & Fill Transformers		X	
11	Perform High Voltage Insulation Tests		X	
12	Test Transformers		X	
13	Provide Protective Relay Settings		X	
14	Backfeed Plant		X	X
15	Develop integrated Plant Coordination Study		?	
16	Test HV Breakers		X	
17	Test CT's & PT's		X	
18	Install Breakers in Switchgear/MCC's		X	
19	Megger Motors 25 HP and larger per Site QC Procedures		X	
20	Check Rotation		X	
21	Motor Run-in & Vibration checkout		X	
22	Final Relay Settings/Calibrate			X
23	Receive Instruments and verify per inst. data sheet		X	

GLENARM REPOWERING PROJECT
SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

ITEM	DESCRIPTION	PIE EQUIPMENT MANUFACTURER	BOP CONTRACTOR	PWP
25	Inspect Instruments for damage, identify shortages.		X	
26	Store Instruments per Manufacturers recommendations		X	
27	Provide Calibration Set Points	X	X	
28	Install Instruments and Tubing		X	
29	Initiate Instrument Control Card		X	
30	Final Instrument Calibration		X	
31	Tag Instruments with Instrument Identification Numbers		X	
32	Tag Electrical Panels CKT Breakers, etc.		X	
33	Provide and Install Panel Schedules		X	
34	Develop Final PCS Architecture		X	
35	Develop Logic and Graphics		X	
36	Design Logic and Graphics		X	
37	Configure PCS		X	
38	Perform/Witness PCS Factory Acceptance Testing		X	X
39	Loop Checkout of Devices		X	
40	Final In-Place Stroking of Valves		X	
41	Fine Tune PCS		X	
42	CEM Functional Testing		X	
43	CEM Certification Incl. Reporting Function	X	X	
44	Source Testing CEM		X	
45	Provide an Integrated Plant Instrument Index (Each Party For Own Scope)	X	X	

GLENARM REPOWERING PROJECT
SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

CONSTRUCTION, START-UP & TRAINING

ITEM	DESCRIPTION	PIE EQUIPMENT MANUFACTURER	BOP CONTRACTOR	PWP
	ADMINISTRATIVE			
1	Prepare System Descriptions		X	
2	Define Engineered System Codes		X	
3	Place System Boundary Tags		X	
4	Prepare System Turn-over Packages		X	
5	Develop and Maintain Start-Up Schedule		X	
6	Provide Craft Support for Start-Up		X	
7	Administer a Tagging and Lockout Procedure (Construction)		X	
8	Administer a Tagging and Lockout Procedure (Operations)			X
9	Prepare and Maintain Master System Punch List		X	X
10	Maintain Red Line As Builts –Copy for Turnover Package		X	
11	Prepare Required Data Sheets and Test Records	X	X	
12	Provide Complete O&M Manuals for each Equipment Item provided	X	X	
13	Provide Operator Training for Purchased Equipment	X	X	
14	Issue Start Up As-Built Drawings	X	X	
15	Scope Turnover Systems		X	
16	Prepare Plant Energization Procedures		X	
17	Conduct Plant Performance Test		X	
18	Prepare Performance Test Report		X	
19	Site Specific Training	X	X	
	MECHANICAL			
1	Install Mechanical Equipment		X	
2	Perform Equipment Alignment (Break Coupling)		X	
3	Grout Mechanical Equipment		X	
4	Complete Installation of Piping and Supports		X	
5	Perform non-destructive Tests: Piping & Equipment		X	
6	Design, Supply, Install and remove Temporary Piping for Steam Blows		X	
7	Furnish, Install & Remove Temp. Piping and Equipment for Oil Flushes.		X	
8	Flush Piping & Equipment		X	
9	Conduct Chemical Cleaning or Boil Out		X	
10	Install Insulation and Lagging		X	
11	Load Resins in Water Treatment System		X	
12	Clean Tanks and Equipment prior to		X	

GLENARM REPOWERING PROJECT
SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

ITEM	DESCRIPTION	PIE EQUIPMENT MANUFACTURER	BOP CONTRACTOR	PWP
	System Turnover to Start-Up			
13	Perform Condenser Leak Test		X	
14	Paint all Non-Insulated Equipment and Structures (Except Galvanized)		X	
15	First Fill Lubricants & Chemicals		X	
16	Verify Pump Strainers & Filters are Installed		X	
17	Couple Rotating Equipment (Final)		X	
18	Perform Vibration Checks	X	X	
19	Perform Oil Flushes		X	
20	Perform Steam Blows		X	
21	Remove Hanger Stops & Set in Cold Positions		X	
22	Furnish and Install Start-Up Strainers		X	
23	Operate Permanent Plant Equipment		X	X
24	Furnish Start-Up Spares	X	X	
25	Tag All Equipment and Valves	X	X	
	ELECTRICAL & INSTRUMENTATION			
1	Install Ground Grid & Test		X	
2	Install Transformers & Switchgear		X	
3	Provide Temp. Power for Motor/Equipment Space Heaters		X	
4	Store Electrical Equipment per Manufacturers Recommendations		X	
5	Complete Cable Installation & Termination		X	
6	Continuity Checks of All Cables		X	
7	Land PCS I/O Cables on Plastic		X	
8	Megger all Power Cables 120v and Higher		X	
9	HI Pot Medium Voltage Cable (2-15 Kv)		X	
10	Service & Fill Transformers		X	
11	Perform High Voltage Insulation Tests		X	
12	Test Transformers		X	
13	Provide Protective Relay Settings		X	
14	Backfeed Plant		X	X
15	Develop integrated Plant Coordination Study		?	
16	Test HV Breakers		X	
17	Test CT's & PT's		X	
18	Install Breakers in Switchgear/MCC's		X	
19	Megger Motors 25 HP and larger per Site QC Procedures		X	
20	Check Rotation		X	
21	Motor Run-in & Vibration checkout		X	
22	Final Relay Settings/Calibrate			X
23	Receive Instruments and verify per inst. data sheet		X	

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SCOPE OF RESPONSIBILITY MATRIX

Rev. A
10/11/13

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25	Inspect Instruments for damage, identify shortages.		X	
26	Store Instruments per Manufacturers recommendations		X	
27	Provide Calibration Set Points	X	X	
28	Install Instruments and Tubing		X	
29	Initiate Instrument Control Card		X	
30	Final Instrument Calibration		X	
31	Tag Instruments with Instrument Identification Numbers		X	
32	Tag Electrical Panels CKT Breakers, etc.		X	
33	Provide and Install Panel Schedules		X	
34	Develop Final PCS Architecture		X	
35	Develop Logic and Graphics		X	
36	Design Logic and Graphics		X	
37	Configure PCS		X	
38	Perform/Witness PCS Factory Acceptance Testing		X	X
39	Loop Checkout of Devices		X	
40	Final In-Place Stroking of Valves		X	
41	Fine Tune PCS		X	
42	CEM Functional Testing		X	
43	CEM Certification Incl. Reporting Function	X	X	
44	Source Testing CEM		X	
45	Provide an Integrated Plant Instrument Index (Each Party For Own Scope)	X	X	