123374 Pasadena OE

Project Deliverables List

Report Date December 10, 2013

Document No.	Engineering Discipline	Document Title	Current Rev. Date	Current Rev. No.
081113	ARCHITECTURAL	HOLLOW METAL DOORS AND FRAMES	10-Oct-13	A
083323	ARCHITECTURAL	OVERHEAD COILING DOORS	10-Oct-13	A
087100	ARCHITECTURAL	DOOR HARDWARE	10-Oct-13	A
092900	ARCHITECTURAL	GYPSUM BOARD	10-Oct-13	A
093100	ARCHITECTURAL	CERAMIC TILE	10-Oct-13	A
095113	ARCHITECTURAL	ACOUSTICAL PANEL CEILINGS	10-Oct-13	A
096513	ARCHITECTURAL	RESILIENT BASE AND ACCESSORIES	10-Oct-13	A
096519	ARCHITECTURAL	RESILIENT TILE FLOORING	10-Oct-13	A
096723	ARCHITECTURAL	RESINOUS FLOOR COATING	10-Oct-13	A
096900	ARCHITECTURAL	ACCESS FLOORING	10-Oct-13	A
099123	ARCHITECTURAL	INTERIOR PAINTING	10-Oct-13	A
102113	ARCHITECTURAL	TOILET COMPARTMENTS	10-Oct-13	A
102800	ARCHITECTURAL	TOILET ACCESSORIES	10-Oct-13	A
105113	ARCHITECTURAL	METAL LOCKERS	10-Oct-13	A
123200	ARCHITECTURAL	MANUFACTURED WOOD CASEWORK	10-Oct-13	A
123553	ARCHITECTURAL	LABORATORY CASEWORK	10-Oct-13	A
133419	ARCHITECTURAL	METAL BLDG SYS SINGLE METAL PANELS WALLS AND ROOF	10-Oct-13	A
260000	ELECTRICAL	ELECTRICAL-MECHANICAL EQUIPMENT	10-Sep-13	D
260533	ELECTRICAL	NON-SEG BUS SPECIFICATION	9-Sep-13	A
261200.2	ELECTRICAL	MEDIUM VOLTAGE AUXILIARY TRANSFORMERS SPECIFICATION	9-Sep-13	B
262050	ELECTRICAL	LOW VOLTAGE MOTORS	10-Sep-13	C
263323.1	ELECTRICAL	125VDC BATTERY SYSTEM SPECIFICATION	9-Sep-13	B
480020	ALL	PASADENA SITE CONDITIONS	10-Sep-13	I
480033	ALL	NOISE CONTROL PERFORMANCE	10-Dec-13	B
480032.1	-	BALANCE OF PLANT CONTRACTOR PERFORMANCE TESTING	21-Oct-13	A
485072	MECHANICAL	COATING OF PIPING AND TANKS	9-Sep-13	A
485080	MECHANICAL	PIPING AND EQUIP INSULATION	18-Sep-13	A
485090	MECHANICAL	CATHODIC PROTECTION	9-Sep-13	A
485121	MECHANICAL	GENERAL SERVICE CONTROL VALVES	15-Jul-13	A
485172	MECHANICAL	FIELD FABRICATED TANKS - STEEL SPECIFICATION	15-Jul-13	A
485173	MECHANICAL	SHOP FABRICATED TANKS SPECIFICATION	10-Dec-13	C
485311.10	MECHANICAL	HORIZONTAL CENTRIFUGAL PUMPS – GENERAL SERVICE SPECIFICATION	10-Dec-13	C
485325.11	MECHANICAL	AMMONIA FORWARDING PUMP SKID SPECIFICATION	26-Jul-13	A
485422	MECHANICAL	SHELL AND TUBE HEAT EXCHANGER	9-Dec-13	B
485951.96	MECHANICAL	POTABLE WATER SYSTEM PUMP SKID	9-Dec-13	B
485952.05	MECHANICAL	CHEMICAL FEED SYSTEM - COOLING TOWER	14-Oct-13	B
485952.06	MECHANICAL	CHEMICAL FEED SYSTEMS - STEAM GENERATOR	14-Oct-13	B
485956	MECHANICAL	FIRE PREVENTION AND PROTECTION SYSTEM	29-Aug-13	A
485956.10	MECHANICAL	FIRE ALARM AND SIGNALING SYSTEMS	29-Aug-13	A
485956.30	MECHANICAL	FIRE WATER SPRINKLER SYSTEM	14-Oct-13	B
037-1758	ALL	SOIL EXCAVATION VOLUMES	18-Aug-11	A
037-5033	ALL	PASADENA GT-5 DESIGN CRITERIA	10-Dec-13	C
037-4780	CONTROLS	PCS/CONTROL SYSTEM SPECIFICATION	10-Dec-13	B
037-4920	CONTROLS	PLANT CONTROL SYSTEM PHILOSOPHY	26-Sep-13	A
037-5056	ARCHITECTURAL	ARCHITECTURAL SCOPE OF WORK	23-Oct-13	B
261300-1	ELECTRICAL	15KV SWITCHGEAR SPECIFICATION	10-Oct-13	B
261300-2	ELECTRICAL	5KV SWITCHGEAR SPECIFICATION	10-Oct-13	B
263323-2	ELECTRICAL	24VDC BATTERY SYSTEM SPECIFICATION	9-Sep-13	A
A1-2-1	ARCHITECTURAL	CONTROL BUILDING MAIN FLOOR PLAN	10-Oct-13	D
A1-3-1	ARCHITECTURAL	CONTROL BUILDING EXTERIOR ELEVATIONS	10-Oct-13	D
A1-9-1	ARCHITECTURAL	CONTROL BUILDING & WATER LAB ROOM FINISH, DOOR AND WINDOW SCHEDULES	10-Oct-13	D
A1-9-2	ARCHITECTURAL	CONTROL BUILDING & WATER LAB DOOR AND WINDOW DETAILS	10-Oct-13	D

123374 Pasadena OE

Project Deliverables List

Report Date December 10, 2013

Document No.	Engineering Discipline	Document Title	Current Rev. Date	Current Rev. No.
A2-1	ARCHITECTURAL	MAIN FLOOR PLAN	27-Mar-13	B
A2-1-1	ARCHITECTURAL	ROOF DEMOLITION PLAN	24-Sep-13	C
A2-1A	ARCHITECTURAL	WELDING SHOP FLOOR PLAN	16-Jul-13	A
A2-2	ARCHITECTURAL	MEZZANINE	16-Jul-13	A
A2-2-1	ARCHITECTURAL	MAINTENANCE SHOP MAIN FLOOR PLAN	10-Oct-13	D
A2-2-2	ARCHITECTURAL	MAINTENANCE SHOP MEZZANINE	24-Sep-13	C
A2-3-1	ARCHITECTURAL	MAINTENANCE SHOP EXTERIOR ELEVATIONS	24-Sep-13	C
A2-4-1	ARCHITECTURAL	MAINTENANCE SHOP SECTIONS	10-Oct-13	D
A2-5-1	ARCHITECTURAL	MAINTENANCE SHOP DETAILED PLANS	10-Oct-13	D
A2-9-1	ARCHITECTURAL	ROOM DOOR FINISH SCHEDULES	10-Oct-13	D
A3-1	ARCHITECTURAL	CONTROL BUILDING EXTERIOR ELEVATIONS	7-Mar-13	A
A3-2-1	ARCHITECTURAL	WELDING SHOP FLOOR PLAN	24-Sep-13	C
A3-3-1	ARCHITECTURAL	WELDING SHOP EXTERIOR ELEVATIONS	24-Sep-13	C
A4-1	ARCHITECTURAL	CONTROL BUILDING & WATER LAB BUILDING SECTIONS	10-Oct-13	D
A4-2-1	ARCHITECTURAL	WATER LABORATORY FLOOR PLAN	10-Oct-13	D
A4-3-1	ARCHITECTURAL	WATER LABORATORY EXTERIOR ELEVATIONS	24-Sep-13	C
C1-3	CIVIL	PRELIMINARY SITE PLAN LM6000 CONFIGURATION	2-Oct-13	K
C3-1	CIVIL	PRELIMINARY GRADING & DRAINAGE PLAN GAS TURBINE/AXIAL EXHAUST	2-Oct-13	F
C3-3	CIVIL	PRELIMINARY SITE SURFACING PLAN GAS TURBINE/AXIAL EXHAUST	2-Oct-13	A
C3-4	CIVIL	CONSTRUCTION PARKING, LAYDOWN, STAGING AND ACCESS PLAN	2-Oct-13	A
C3-5	CIVIL	PRELIMINARY SITE DETAILS GAS TURBINE/AXIAL EXHAUST	7-Oct-13	A
CSK-1	CIVIL	BOREHOLE LOCATION PLAN	29-Apr-11	B
E1-1A	ELECTRICAL	ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)	10-Dec-13	F
E1-2	ELECTRICAL	ELECTRICAL OVERALL CONCEPTUAL PDC BUILDING LAYOUT	10-Dec-13	E
E6-1	ELECTRICAL	ELECTRICAL UNDERGROUND NOTES AND LEGEND	4-Oct-13	A
E6-10	ELECTRICAL	PROPOSED ELECTRICAL UNDERGROUND ROUTING	10-Dec-13	B
I1-1	CONTROLS	PLANT CONTROL SYSTEM ARCHITECTURE	30-Aug-13	A
I1-2	CONTROLS	CONTROL ROOM WORKSTATIONS	30-Aug-13	A
ISK1-1	CONTROLS	CONTROL SYSTEM ARCHITECTURE	26-May-11	A
M1-1-1	MECHANICAL	GENERAL ARRANGEMENT GAS TURBINE/AXIAL EXHAUST	6-Dec-13	K
M1-1-6	MECHANICAL	TIE POINT DRAWING GAS TURBINE/AXIAL EXHAUST	9-Dec-13	D
M2-2-1	MECHANICAL	PROCESS FLOW DIAGRAM WATER BALANCE (W/ INLET CHILLING)	28-Feb-12	D
M2-2-4	MECHANICAL	GLENARM INDUSTRIAL WASTEWATER	17-Jul-13	C
M3-1-0	MECHANICAL	P&ID-COVER SHEET	15-Oct-13	E
M3-10-1	MECHANICAL	P&ID-GLAND STEAM SYSTEM	6-Dec-13	E
M3-1-1	MECHANICAL	P&ID - SYMBOLS AND LEGEND	15-Oct-13	C
M3-11-1	MECHANICAL	P&ID-CONDENSATE SYSTEM	6-Dec-13	G
M3-11-2	MECHANICAL	P&ID-CONDENSATE SYSTEM	6-Dec-13	G
M3-11-3	MECHANICAL	P&ID-CONDENSATE SYSTEM	6-Dec-13	G
M3-1-2	MECHANICAL	P&ID - SYMBOLS AND LEGEND	8-Oct-12	A
M3-12-1	MECHANICAL	P&ID-CONDENSER AIR EXTRACTION	29-Nov-13	F
M3-1-3	MECHANICAL	P&ID - SYMBOLS AND LEGEND	15-Oct-13	B
M3-13-1	MECHANICAL	P&ID-CIRCULATING WATER SYSTEM	6-Dec-13	G
M3-14-1	MECHANICAL	P&ID-AUXILIARY COOLING WATER SYSTEM	6-Dec-13	F
M3-15-1	MECHANICAL	P&ID-COMPONENT COOLING WATER SYSTEM	15-Oct-13	D
M3-15-2	MECHANICAL	P&ID-COMPONENT COOLING WATER SYSTEM	15-Oct-13	D
M3-15-3	MECHANICAL	P&ID-COMPONENT COOLING WATER SYSTEM	15-Oct-13	E
M3-16-1	MECHANICAL	P&ID-COOLING TOWER CHEMICAL FEED SYSTEM	13-Sep-13	D
M3-17-1	MECHANICAL	P&ID-AQUEOUS AMMONIA SYSTEM	6-Dec-13	G
M3-18-1	MECHANICAL	P&ID-FUEL GAS SYSTEM	6-Dec-13	G
M3-18-2	MECHANICAL	P&ID-FUEL GAS SYSTEM	6-Dec-13	G
M3-18-3	MECHANICAL	P&ID-FUEL GAS SYSTEM	13-Sep-13	A
M3-19-1	MECHANICAL	P&ID-SERVICE AIR SYSTEM	15-Oct-13	E

123374 Pasadena OE

Project Deliverables List

Report Date December 10, 2013

Document No.	Engineering Discipline	Document Title	Current Rev. Date	Current Rev. No.
M3-20-1	MECHANICAL	P&ID-INSTRUMENT AIR SYSTEM	13-Sep-13	D
M3-2-1	MECHANICAL	P&ID-GAS TURBINE INTERCONNECTIONS	15-Oct-13	E
M3-21-1	MECHANICAL	P&ID-FIREWATER SYSTEM	15-Oct-13	D
M3-22-1	MECHANICAL	P&ID-SERVICE WATER SYSTEM	15-Oct-13	E
M3-23-1	MECHANICAL	P&ID-DEMINERALIZED WATER SYSTEM	15-Oct-13	E
M3-23-2	MECHANICAL	P&ID-DEMINERALIZED WATER SYSTEM	15-Oct-13	C
M3-24-1	MECHANICAL	P&ID-POTABLE WATER SYSTEM	15-Oct-13	E
M3-25-1	MECHANICAL	P&ID-CHILLED WATER SYSTEM	6-Dec-13	F
M3-26-1	MECHANICAL	P&ID-WASTEWATER COLLECTION SYSTEM	15-Oct-13	E
M3-26-2	MECHANICAL	P&ID-WASTEWATER COLLECTION SYSTEM	15-Oct-13	D
M3-27-1	MECHANICAL	P&ID-AUXILIARY STEAM SYSTEM	15-Oct-13	C
M3-3-1	MECHANICAL	P&ID-OTSG INTERCONNECTIONS (EXHAUST GAS)	6-Dec-13	G
M3-3-2	MECHANICAL	P&ID-OTSG INTERCONNECTIONS (STEAM)	6-Dec-13	G
M3-4-1	MECHANICAL	P&ID-BOILER FEEDWATER SYSTEM	6-Dec-13	G
M3-5-1	MECHANICAL	P&ID-HIGH PRESSURE STEAM	6-Dec-13	E
M3-6-1	MECHANICAL	P&ID-STEAM TURBINE INTERCONNECTIONS	6-Dec-13	F
M3-7-1	MECHANICAL	P&ID-STEAM DRAINS ￢ﾀﾓ DRAIN TANK	10-Dec-13	G
M3-8-1	MECHANICAL	P&ID-STEAM AND WATER SAMPLING	15-Oct-13	D
M3-9-1	MECHANICAL	P&ID-CYCLE CHEMICAL FEED SYSTEM	13-Sep-13	D
M9-1	MECHANICAL	EQUIPMENT LIST	6-Dec-13	C
M9-10	MECHANICAL	TIE-IN LIST	20-Nov-13	D
M9-2	MECHANICAL	SERVICE INDEX	22-Nov-13	C
SKE6-1	ELECTRICAL	EXISTING ELECTRICAL UNDERGROUND ROUTING	4-Oct-13	A
SKE6-2	ELECTRICAL	EXISTING ELECTRICAL UNDERGROUND ROUTING	4-Oct-13	A
SKM1-7	MECHANICAL	AMMONIA (EXISTING)	4-Dec-13	A
SKM1-8	MECHANICAL	INTERIM/TEMPORARY CONFIGURATION	4-Dec-13	A
SKM1-9	MECHANICAL	FINAL CONFIGURATION	4-Dec-13	A

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 480031
Combined Cycle Power Island
Noise Control Performance

PROJECT NUMBER:
123374

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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

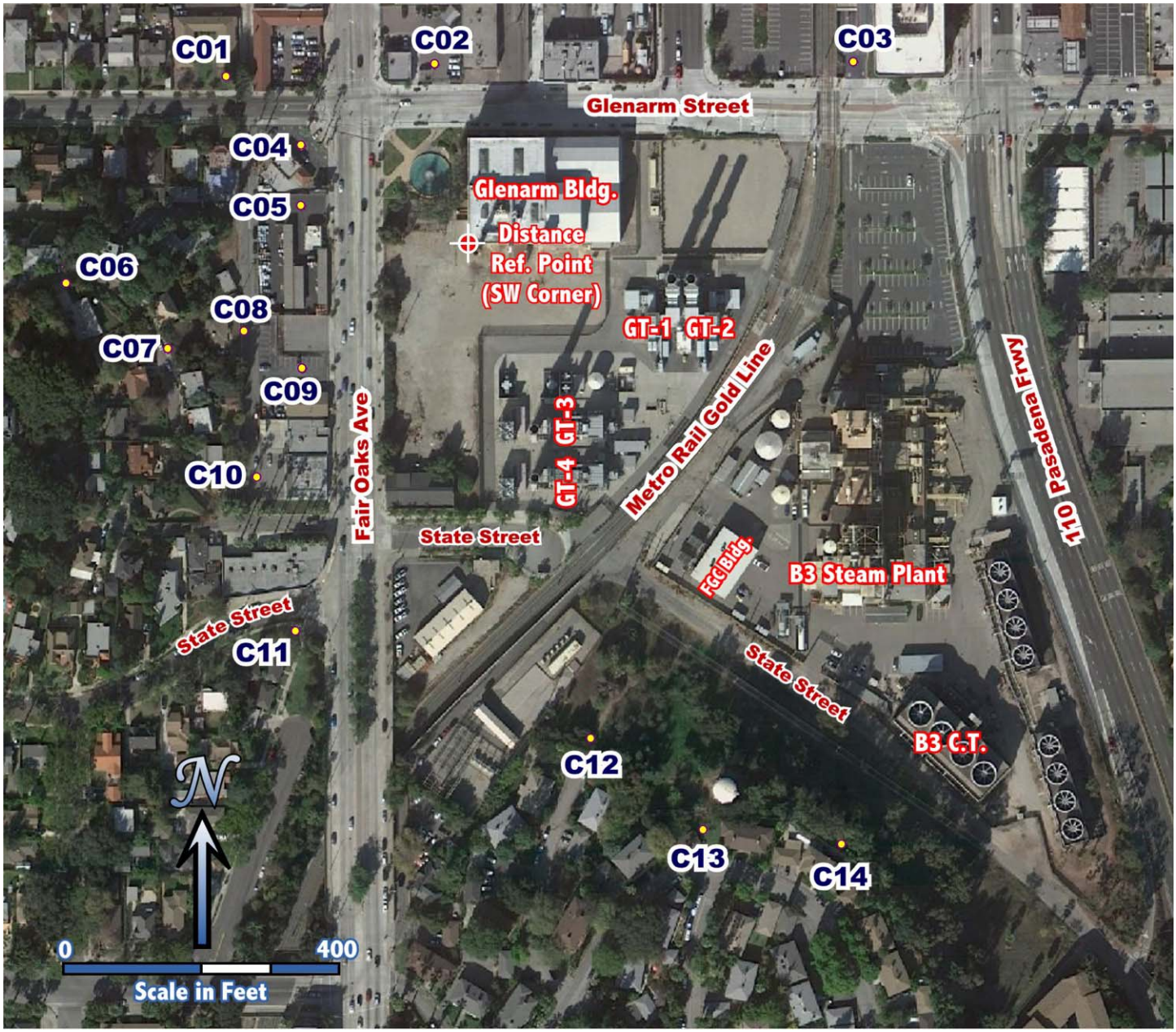


Exhibit A. Locations Outside the Plant for the Noise Performance Guarantees and the Noise Performance Acceptance Tests

July 15, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485172

Field Fabricated Tanks - Steel

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123374

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Section 485172
Field Fabricated Tanks - Steel

PREPARED FOR: PASADENA WATER & POWER
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REVISION HISTORY		
DATE	REVISED BY	REVISION
7/15/13	T. Clark	A

SECTION 485172
FIELD FABRICATED TANKS - STEEL

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP 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 SCHEDULE 3
1.8 SYSTEM DESCRIPTION 3
1.9 SUBMITTALS 4
1.10 QUALITY ASSURANCE 5
1.11 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.12 SITE CONDITIONS 5
1.13 WARRANTY 5

PART 2 - PRODUCTS 6

2.1 MATERIALS AND WELDING 6
2.2 COMPONENTS 7
2.3 SOURCE QUALITY CONTROL 10

PART 3 - EXECUTION 10

3.1 SPARE PARTS 10
3.2 FIELD QUALITY CONTROL 10
3.3 FABRICATION AND INSTALLATION 11
3.4 CLEANING, PAINTING & COATING 12

PART 4 - ATTACHMENTS 13

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER 13

SECTION 485172
FIELD FABRICATED TANKS - STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. This document defines the scope and services, responsibilities and terminal points for design, fabrication, field installation, inspection, testing and certification of field fabricated steel tanks. The tanks shall be complete, including all coatings, linings, internal piping for suction, fill, overflow, etc., pipe support guides, covers, manways, vents, drains, overflow piping, piping connections, instrument connections, and other appurtenances as required per the referenced specifications including their attachments. The tanks shall also satisfy the requirements noted within regulations, codes, and standards listed as reference and others which are applicable to the site.

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 BOP Contractors guarantee in a manner acceptable to the General Manager.

C. The BOP 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. The BOP Contractor shall design, fabricate, construct, test, certify, and guarantee the following specified equipment:

1. Demineralized Water Storage Tank
2. Wastewater Storage Tank

1.2 FURNISHED BY BOP CONTRACTOR

A. The BOP Contractor will be responsible for the following activities, all in accordance with the requirement of the specification, the data sheets included as an attachment to the specification, and applicable codes and standards:

1. Design, supply, fabrication, field installation, QA/QC inspection, and certification of all equipment and materials specified herein.
2. Site specific drawings and design data to support facility design, construction and maintenance
3. Finish painting
4. Inspection certificates and quality control documentation listed in this Section
5. Complete set of component cut sheets
6. Priced list of recommended spare parts for two years of operation

7. 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.
8. Site preparation, foundations, felt pads, grout and anchor bolts.
9. Construction utilities, except where specifically stated otherwise.
10. Scaffolding, manlifts, equipment, ladders, etc., to facilitate construction, coating and testing of the tanks.
11. All piping to/from BOP Contractor's terminal points
12. Wiring, conduit, cable trays, etc, external to the equipment.
13. Electrical grounding of tanks.
14. All counter flanges, gaskets, fasteners, expansion joints (as required) to external piping.
15. Cathodic protection if required for design
16. Building permits required by government agencies, as applicable.
17. Staging, laydown and storage of any tank supplier materials.

1.3 FURNISHED BY OTHERS

A. Supply by Others shall be limited to the following:

1. Water at the site of suitable quantity and pressure for testing. Any reuse of test water and its disposal shall be mutually agreed upon by BOP Contractor and the General Manager.

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

C. Section 485072, Coatings for Piping and Tanks

D. 485975 - General Welding Requirements

1.5 CODES AND STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant 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 Civil Engineers (ASCE)

   a. ASCE 7 - Minimum Design Loads for Buildings and Other Structures
2. American Society of Mechanical Engineers (ASME)
   a. ASME B16.5 Pipe Flanges and Flanged Fittings

3. American Water Works Association (AWWA)

   a. D100 - Welded Carbon Steel Tanks for Water Storage
   b. D102 - Coating Steel Water Storage Tanks

4. Steel Tank Institute (STI)

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 specified directly or by reference in 481200, Combined Cycle Balance of Plant.

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 SCHEDULE

A. For all equipment provided as part of this specification, the schedule contained herewith, or revisions to it as agreed to by the General Manager and BOP Contractor shall be binding. The BOP Contractor shall submit any requested changes to the schedule to the General Manager for approval.

1.8 SYSTEM DESCRIPTION

A. General

1. The field fabricated tanks, coatings, and accessories 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.

B. Performance Requirements

1. Tanks shall perform at, or exceed, the performance listed herein.
2. Certified mill test reports, covering all steel plates and structural shapes to be used in the work, shall be furnished as evidence that such materials are new and in compliance with the governing specifications.

C. Design Requirements

1. All tank design drawings and calculations shall be performed under the supervision of, and sealed by a Professional Engineer registered to work in the local jurisdiction of the site.
2. Openings of 4-inch diameter and larger require consideration of reinforcing rings or plates.
3. BOP Contractor shall specify the limiting forces and moments on each equipment nozzle and submit these parameters to the General Manager for review.

4. Tank shall be designed and manufactured according to all current and applicable codes and standards including AWWA D100.
5. Tank shall include design allowances for seismic loads as published in ASCE 7 and AWWA D100. Refer to 480020, Site Conditions for seismic design conditions.
6. Tanks designated for fire water service shall meet requirements of NFPA 22.
7. Tank foundation design and construction shall be provided by the General Manager. BOP Contractor shall provide all anchor bolts and anchor bolt attachments.
8. The tank, ladders, stairs, and handrails shall comply with ANSI, OSHA and Cal-OSHA requirements.

1.9 SUBMITTALS

A. Information to be furnished with bid:

1. Proposal shall be prepared in accordance with 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:

    a. BOP Contractor's list of previous field fabricated tank installations.
    b. Preliminary general arrangement drawing showing the dimensions of each tank, including tank diameter, the height to bottom and top capacity levels, sizes of principal members, and thickness of plates. Names and sizes of all connections appurtenances, and accessories.
    c. Protective coatings, number of coats applied inside and outside and painting information.
    d. Completed tank data sheets enclosed as an attachment to specification.
    e. Full detail of any modification to the BOP Contractor standard design required to meet the specified requirements.

B. Information to be furnished after contract award:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award.
2. BOP Contractor to provide complete package including the following:

    a. General arrangement drawing showing the tank dimensions, including tank diameter, the height to bottom and top capacity levels, sizes of principal members, and thickness of plates. Names and sizes of all connections, appurtenances, and accessories.
    b. Component item data including model, rated capacities (nominal/design), pressure rating, weights.
    c. Complete details of required clearances, methods of assembly of components, piping connections, grades of materials, flange orientation and anchor bolt arrangement.
    d. Maximum wind or seismic gross moment and shear on the foundations shall be identified.
    e. BOP Contractor shall submit a complete set of design calculations demonstrating that the tank and anchorages have been adequately designed for the seismic and wind conditions.

f. Painting and lining information including application details, materials, and number of coats.
g. Type of inspection to be performed on complete joint penetration welded shell butt joints.
h. Details on stairways, rest platforms, handrails, or other safety devices as required.
i. BOP Contractor shall provide all loads necessary for foundation design, including live loads, dead loads, wind loads, and seismic loads.
j. Certification of compliance with codes, standards, and regulations.

C. Prior to product completion, the BOP Contractor shall provide the following:

1. Field quality control test reports confirming successful testing.
2. Quality assurance testing and examination report.
3. Purging and disinfecting reports as applicable confirming successful disinfection.
4. Operating and maintenance manual of all components furnished.

D. Shop Drawings

1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

E. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.

1.10 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

1.11 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.12 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.13 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

B. Painting/coatings shall be warranted for a period of 10 years. If any materials or workmanship prove to be defective within the period of warranty, they shall be replaced or repaired by the BOP Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Materials

1. Materials for tank shall comply with ASTM specifications and shall be selected for the specified design conditions. Tank shall be fabricated from steel and shall be internally coated as required by to meet the service conditions. Stainless steel tanks shall not be coated.
2. Minimum quality of plate material for carbon steel tanks shall be ASTM A36, Structural Steel.
3. Corrosion allowances shall be sufficient to ensure a minimum operating life as specified in data sheets included as an attachment to the specification but shall not be less than 0.063 inches. The corrosion allowance specified on the drawings shall be added to the calculated sections of all carbon steel surfaces exposed to the contained liquid regardless of any requirement for interior lining.
4. Reinforcing pads and rolled-plate nozzle necks shall be the same quality material as specified for the tank part to which the reinforcing pads and nozzle necks are attached.
5. Flanges shall comply with the material requirements for forged steel flanges required by ANSI B16.5, B16.47A and ASTM A105, Specification for Forgings, Carbon Steel, for Piping Components.

B. Welding

1. All welding shall be in accordance with ASME Section IX, Welding and Brazing Requirements, AWWA D100, NFPA 22, and the additional requirements herein. Welding procedures, procedure qualifications and performance qualifications shall be maintained in the BOP Contractor's files and shall be available for review by the General Manager prior to start of welding.
2. The BOP Contractor shall locate longitudinal and girth weld seams so that the welds do not interfere with welded attachments, such as nozzles, manways, and insulation supports. Location of all weld seams shall be indicated on the vendor's tank drawings. A clearance of at least 1.5 times the plate thickness shall be maintained from the edge of any weld to the toe of any other weld or penetration.
3. Shell joints shall be butt welds with full penetration and complete fusion. This requirement applies to both vertical and horizontal weld seams.
4. Floor plate welds on field fabricated tanks shall be lap joints with a minimum lap of five (5) times the nominal thickness of the thinner plate and a full fillet weld.
5. Cone roof plates that have lap joints shall have 1 inch minimum lap and a full fillet weld. The direction of the overlap shall be such that the roof does not retain rainwater.
6. Base rings shall have full fillet welds per AWWA D100 on both the inside and outside surfaces of the shell to the point of the base ring junction.
7. Alignment of the top of the shell with the floor of the shell shall not be out of plumb more than 1/200 of the total tank height. The amount any one shell plate is out of plumb shall not exceed the values specified for mill tolerances in ASTM A6, Specification for General Requirements for Rolled Steel Plates, or in ASTM A20, Specification for General Requirements for Steel Plates for Pressure Vessels. Customer tie-in connections shall be held to within plus or minus 3mm (1/8") of all specified dimensions.

2.2 COMPONENTS

1. Tank Shell

   a. Shell plate thickness for carbon steel tanks shall be calculated in accordance with the applicable AWWA standard.
   b. Shell design thickness shall be computed for a full tank. The hydrostatic test shell thickness shall be computed for a water filled tank.
   c. External attachments on water tanks such as ring plates, stiffeners, brackets, clips, and pipe guides shall be seal-welded at all joining edges and at strength welds.
   d. All welding shall be completed prior to the application of any finish coating/lining.

2. Tank Floor

   a. Floor plate thickness for the tank, not including corrosion allowance, shall be greater than or equal to ¼ inch. Floor plates shall project at least 1 inch beyond the outside edge attaching the floor to the shell plate.
   b. Tank floor shall have ¼ inch per foot slope from center to outer edge.

3. Tank Roof

   a. Roof to shell joints shall be sized so that in case of excessive internal pressure, the joints will fail before failure of the tank shell joints or the shell-to-floor joints. Tanks without this design feature are not acceptable unless approved in writing by the General Manager.
   b. Minimum roof-plate thickness for the tank shall be 3/16 inch, not including corrosion allowance.
   c. Edges of roof parts may be flanged horizontally in order to rest flat against the top angle.
   d. The cone roof shall be completely free standing without any internal supports.
   e.

4. Anchor Bolts

   a. Anchor bolts will be provided by the BOP Contractor. Anchor bolt design shall be based on ASTM F1554 Grade 36 bolt material. Minimum anchor bolt size shall be per API or AWWA. Anchor bolt projections shall allow double nuts plus washers plus 1" thread extension. Tanks shall be self supporting and designed to withstand the wind load and seismic load specified. The wind load shall apply to the vertical projection of the tank including insulation, platforms, and other attached appurtenances specified on the data sheet.

5. Foundation

   a. Foundation will be provided by the BOP Contractor. Each tank shall be designed for erection on a mat foundation consisting of a concrete ring wall or concrete slab foundation. One-half inch minimum oil impregnated felt pad noted as fiber joint filler will be placed directly under the tank floor plate and will be supplied by the BOP Contractor. The felt shall meet the requirements of ASTM D1751.

6. Venting

a. A vent to allow for normal breathing of the tank as a result of temperature change and or liquid movement into and out of the tank shall be provided.
b. Vent sizing shall be adequate to preclude the development of a pressure or vacuum condition within the tank caused by filling, discharging, draining, or line rupture.
c. Tank vents shall be provided in accordance with AWWA D100 and other applicable codes, standards, or regulations.
d. At a minimum the vent shall be equipped with a weather hood and stainless steel insect screen.
e. The demineralized water tank shall have a HEPA filter installed to limit the ingress of particulate matter.

7. Overflow

a. An external overflow pipe with hinged, gasketed flapper outlet (horizontal discharge) shall be provided on each tank. An upturned 90° elbow shall be welded onto the inlet of the overflow pipe (inside the tank) to maximize tank storage volume.
b. Overflow piping shall be a designed for a minimum inside diameter.
c. Overflow pipe shall be rigidly supported at intervals not exceeding six feet. Load spreading pads shall be provided on the tank shell where pipe supports are attached.

8. Nozzles

a. Nozzle locations shall be located as specified to match the services indicated on the P&ID's. Wherever possible, nozzle locations will be low on the tank, with internal risers or standpipes specified as necessary for proper operation.
b. Nozzle flanges shall be in accordance with ANSI B16.5 and shall project a minimum of 6 inches from the tank surface unless specifically noted otherwise. Bolt holes on flanged nozzles shall straddle the centerline of the tank.
c. Tolerance in bolt hole location and in bolt circle diameter shall be 1/16 inch.
d. Tank connections 2 inches and smaller shall be a Bonney Class 3000 threadolet unless otherwise specified.
e. Nozzle reinforcement for process connections shall be a minimum 100% replacement based on the tank shell or roof new un-corroded thickness and the nozzle neck outside diameter.
f. Nozzle connections to 24 inches inclusive shall be flanged. Connections 26 inches and larger shall have welded joints unless flanged connections are specified on the drawings.
g. The minimum thickness of pipe for a nozzle neck shall be Schedule 80 for sizes 2 inches and smaller.
h. The minimum wall thickness of pipe for nozzle necks shall be standard weight for sizes 2½ inch and larger, unless walls heavier than standard weight are specified within the applicable design standard.
i. All tank flanged connections shall be furnished with an equivalent ANSI class blind flange including stud bolts, nuts, washers and gasket.
j. Flush-type cleanout fittings and bolted door sheets are not acceptable unless approved in writing.
k. Pump suction nozzles shall have anti-vortex plates at least twice the diameter size of the pipe.

l. Nozzles and piping extending inside the tank shall be stainless steel for the full length inside the tank and for a length of no less than 1 foot outside of the tank. This applies to both the demineralized water tank and the waste water storage tank.

9. Manways

a. Manways shall be provided in tank as required for inspection, cleaning and maintenance. The minimum size of any manway is 24 inches.
b. Unless specified otherwise one roof access manway with a nominal diameter of 24 inches, and one shell access manway with a nominal diameter of 30 inches shall be provided.
c. Each manway shall be provided with a davit or hinged cover to allow the cover to easily swing out of the way.
d. Each manway shall be provided with a sealing gasket to prevent leakage or dust migration into the tank.

10. Bolting

a. Bolting material grade for carbon steel tanks shall be equal to or greater than ASTM A307, Grade B.
b. Bolting for manways, flanges, and connections shall be stud bolts with hex nuts.
c. Bolting for assembling stainless steel or aluminum parts shall be made from material identical to the material being assembled.
d. A suitable thread lubricant shall be used for all thread makeup.

11. Gaskets

a. Flange facings and gasket types for external manways and nozzles shall be in accordance with the attached drawing. The finish of gasket-bearing areas shall be in accordance with the recommendations of the gasket manufacturer. Teflon gaskets shall have internal metal reinforcement.
b. BOP Contractor shall provide two gaskets for each manway, one for initial operation, and one spare.

12. Handrails, and Ladders

a. Design, fabrication, and erection of handrails shall be in accordance with OSHA, CalOSHA and ANSI requirements, applicable standards, codes, and regulations and shall be acceptable to the General Manager.
b. Each tank shall be provided with a caged ladder utilizing non-slip treads with intermediate platforms as required by codes and regulations, which extend from grade to the roof level.
c. Each intermediate platform shall be not less than 3 feet wide.
d. At the tank roof access a grated walkway 3 feet wide, with safety gate shall be provided. Non-slip grating shall be provided between manways and to the HEPA filter for access.
e. Platform design shall incorporate the best access and most economical use of space.
f. Support clips located on the tank shell shall be completely seal-welded.

g. Walkways shall extend from the stairway or roof termination to manways and other roof mounted appurtenances. The walkway shall be completely enclosed with handrails and kick plates.
h. Hand railing shall be 1½ inch Schedule 80 piping.
i. Tank ladders and handrails will be hot dip galvanized unless otherwise specified.

13. Grounding

a. The tank shall be provided with a minimum of two grounding pads or clips equally spaced around the exterior of the tank 6 inches above the foundation.
b. Grounding locations shall be Type 304 stainless steel welded to the tank. The contact surface shall be flat and smooth and shall be protected during shipment and erection to maintain the contact surface quality. The hole pattern shall be a standard NEMA two hole design.

14. Gauges

a. Each tank shall include a gauge board to indicate liquid level height for the entire tank volume from full to empty in US customary units.
b. Gauge boards shall be located so tank level can easily be viewed.
c. Gauge boards shall be stainless steel, complete including all necessary appurtenances, floats, guide wires, indicator board, target, piping, and support.
d. Local gauges shall be designed so that all readings can be taken from ground elevation.

2.3 SOURCE QUALITY CONTROL

A. Refer to Section 481200, Combined Cycle Balance of Plant for general source quality control, test, and inspection requirements.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481200, Combined Cycle Balance of Plant for general requirements regarding spare parts.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 481200, Combined Cycle Balance of Plant for general source quality control, test, and inspection requirements.
2. The tank shall be completely assembled on site by the BOP Contractor and tested fully prior to applying coatings. BOP Contractor to make all provisions necessary to ensure that finished product has structural integrity and free from leaks. Leaks encountered during site testing are the responsibility of the BOP Contractor. BOP Contractor shall

furnish any additional blind flanges necessary to temporarily close tank openings for hydrostatic test. Inspection shall be per AWWA D101 and NFPA 22.

3. Tanks shall be hydro tested in accordance with AWWA D100. The BOP Contractor shall submit for General Manager's review, detailed procedures for all tests to be performed.
4. The tank shall be tested by filling the tank with water to a height of 2 inches above the top leg of the top angle to the overflow. As the tank is being filled with water, frequent inspections shall be made to detect leakage and/or swelling. If leaks are detected, the tank shall be drained and the leaks repaired by the BOP Contractor. The minimum holding time for the test shall be 12 hours.
5. Welded tank floors shall be tested by approved air pressure or vacuum tests, as specified under AWWA D100, Section 11 prior to hydrotesting
6. All welds shall receive visual and radiographic examination in accordance with AWWA D100. Records of these examinations shall be created and documented. The General Manager shall be notified at least 48 hours before beginning nondestructive examinations.

3.3 FABRICATION AND INSTALLATION

A. Field Erection Procedures

1. The BOP Contractor shall furnish all labor, liability and compensation insurance, tools, falsework, scaffolding, and all other equipment necessary and shall erect the tank so that it is complete and ready for use by the General Manager.
2. BOP Contractor shall be responsible for strictly following site work procedures, site safety requirements, and site security provisions as established by the General Manager's site manager or their designated representative.
3. BOP Contractor shall be responsible for providing and maintaining accommodations for BOP Contractor's employees. BOP Contractor shall be responsible for removing accommodation facilities at conclusion of BOP Contractors' work.
4. All erection procedures shall closely adhere to AWWA D100 and NFPA 22 requirements.

B. Identification and marking

1. The tank shall be identified with a stainless steel nameplate containing the following information:

    a. Fabricator and Erecting Manufacturer
    b. Material specification number for each shell course
    c. General Manager assigned tank number
    d. Year constructed
    e. Nominal diameter and height in feet
    f. Design liquid level in feet
    g. Design pressure
    h. Maximum operating temperatures

2. The nameplate shall be permanently attached to the tank by continuous seal-welding around the nameplate.

3.4 CLEANING, PAINTING & COATING

A. Painting and protective coatings

1. Surface preparation and coating procedures shall follow the requirements of Section 485072, Coatings for Piping and Tanks with coating selection as specified for the intended service. All preparation and coating procedures shall be in accordance with SCAQMD Rule 403 requirements.
2. The external surface of the tank shall be painted and protected in accordance to NFPA 22 and AWWA D102 requirements. The tank shall be internally lined and externally painted as specified. Tank shall be designed for a minimum design life as specified in data sheets enclosed as an attachment to the specification. BOP Contractor shall submit details of their proposed external and internal coating systems; including manufacture, surface preparation, special handling requirements, and MSDS sheets for approval.
3. All field applied paints or coatings will be roller applied. Spraying will not be allowed on site.
4. The color scheme for the exterior of the tank shall be per specified and approved by the General Manager.

B. Tank Linings

1. Tanks shall be lined internally per AWWA D102.
2. Linings shall be applied in accordance with the lining manufacturer's recommendations.
3. Linings shall include all interior surfaces of the tank, all exposed steel surfaces inside the tank, all nozzles out to and including the exterior face of all nozzle flanges where piping or manway covers have been removed and the surface of all manway covers exposed to the inside of the tank.
4. The completed lining shall be tested by the BOP Contractor. The lining shall be checked for pinholes, holidays, and bare areas with a Tinkor Rasor Model APW Spark Tester or equivalent at a minimum of 1,500 volts. Any pinholes shall be re-moved by grinding out the coating area to the shell plate, followed by an inspection to assure the appropriate surface profile exists before reapplication of the coating. Repairs shall be in accordance with the lining manufacturer's recommendations.
5. Words "DO NOT WELD – LINED TANK" shall be stenciled on the outside of lined tanks. The words shall be visible from all sides of the tank.

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER

Equipment Name:		**Wastewater Storage Tank**
Equipment Tag:		**5WWS-TNK-010**
Fluid:		Wastewater
Number of Tanks		1
Tank Height		TBD by BOP Contractor
Tank Diameter		25 feet
Tank Volume, Useable		88,000 gallons
Design Pressure		Atmospheric + Hydrostatic Head
Design Temperatures		Refer to 480020, Site Conditions
Metal thicknesses Roof and shell Plates		As required by AWWA Standard D100, but not less than 6 mm (¼ inch) plus corrosion allowance
Bottom plates		As required by AWWA Standard D100, but not less than 10 mm (3/8 inch)
Corrosion allowance		1.5 mm (1/16 in.)
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	300 gpm (Estimated)
	Outflow	200 gpm (Estimated)
Shell, Floor, Roof Plates		ASTM A36 Carbon Steel Mill Flat Plate
Pipe Nozzles		ASTM A106 GR. B seamless 2” and smaller: Sch 80 min 2-1/2” and larger: Sch 40 min.
Tank Overflow		ASTM A53 GR. B, Std Wt.
Flanges		ASTM A105
Bolting		ASTM A307 Grade A bolts with hexagon heads and ASTM A563 Grade A hexagon nuts; all galvanized
Gaskets		Buna N
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		1-1/2 inch diameter, ASTM A53 Gr B, Schedule 80, galvanized piping. Posts and rails shall be Schedule 40.
Tank Coating		Epoxy coating complying with Coating Class U4 in Section 485072 Coatings for Piping and Tanks

Equipment Name:		**Demineralized Water Storage Tank**
Equipment Tag:		**5DWS-TNK-010**
Fluid:		Demineralized Water
Number of Tanks		1
Tank Height		TBD by Contractor
Tank Diameter		25 feet
Tank Volume, Useable		109,000 gallons
Design Pressure		Atmospheric + Hydrostatic Head
Design Temperatures		Refer to 480020, Site Conditions
Metal thicknesses Roof and shell Plates		As required by AWWA Standard D100, but not less than 6 mm (¼ inch) plus corrosion allowance
Bottom plates		As required by AWWA Standard D100, but not less than 10 mm (3/8 inch)
Corrosion allowance		1.5 mm (1/16 in.)
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	200 gpm (Estimated)
	Outflow	80 gpm (Estimated)
Shell, Floor, Roof Plates		304L Stainless Steel Plate
Pipe Nozzles		ASTM A312 TP304L seamless 2 inches and smaller: Sch 80S min 2-1/2 inches and larger: Sch 40S min.
Tank Overflow		ASTM A312 TP304L
Flanges		ASTM A182 F304L
Bolting		ASTM A193 Gr B8 bolts with hexagon heads and ASTM A194 Gr 8 hexagon nuts
Gaskets		Buna N
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		1-1/2 inch diameter, ASTM A53 Gr B, Schedule 80, galvanized piping. Posts and rails shall be Schedule 40.

Demineralized Water Storage Tank: 5DWS-TNK-010							
Mark	Connection				Orientation North = 0°	Height from Bottom	Remarks
	Size mm (inch)	Qty	Type	Rating			
A	*	1	Flanged	150	*	Top	Inlet
B	*	1	Flanged	150	*	*	Pump Suction
C	*	1	Flanged	150	*	Top	Minimum Flow Bypass Return 1
D	*	1	Flanged	150	*	Top	Minimum Flow Bypass Return 2
E	*	1	Flanged	150	*	1’-6”	Drain
F	*	1	Flanged	150	*	Roof	Vent, Normal
G	*	1	Flanged	150	*	Roof	Vent, Emergency
H	*	1	Flanged	*	*	Roof	Roof Manway
I	*	1	Flanged	150	*	3’-0”	Shell Manway with davit
J	*	1	Flanged	*	*	Roof	Level Gage w/level switches
K	*	1	Flanged	150	*	*	Level Transmitters
L	*	1	Flanged	150	*	*	SPRINT Return
M	*	1	Flanged	150	*	*	Overflow
N	*	1	Flanged	150	*	*	Emergency Supply
O	*	1	Flanged	150	*	*	Spare
P	*	1	Flanged	150	*	*	Spare
Q	*	1	Flanged	150	*	*	Spare
* - Indicates Equipment to be sized by BOP Contractor.							
Notes							

Wastewater Storage Tank: 5WWS-TNK-010							
Mark	Connection				Orientation North = 0°	Height from Bottom, mm	Remarks
	Size mm (inch)	Qty	Type	Rating			
A	*	1	Flanged	150	*	*	Inlet (from GT-3, GT-4 and GT-5)
B	*	1	Flanged	150	*	*	Inlet (from OWS)
C	*	1	Flanged	150	*	*	Pump Suction
D	*	1	Flanged	150	*	*	Minimum Flow Bypass Return
E	*	1	Flanged	150	*	1’-6”	Drain
F	*	1	Flanged	150	*	Roof	Vent, Normal
G	*	1	Flanged	150	*	Roof	Vent, Emergency
H	*	1	Flanged	*	*	Roof	Roof Manway
I	*	1	Flanged	150	*	3’-0”	Shell Manway with davit
J	*	1	Flanged	*	*	Roof	Level Gage w/level switches
K	*	1	Flanged	150	*	*	Level Transmitters
L	*	1	Flanged	150	*	*	Overflow
M	*	1	Flanged	150	*	*	Spare
N	*	1	Flanged	150	*	*	Spare
O	*	1	Flanged	150	*	*	Spare
* - Indicates Equipment to be sized by BOP Contractor.							
Notes							

December 10, 2013

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 485173

Shop Fabricated Tanks

PROJECT NUMBER:
123374

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Section 485173
Shop Fabricated Tanks

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: TONY CLARK

REVISION HISTORY		
DATE	REVISED BY	REVISION
7/26/2013	T. Clark	A
10/18/2013	T. Clark	B
12/10/2013	S. Goldstein	C

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP 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 5
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 COMPONENTS 7
2.3 FABRICATION 8
2.4 SOURCE QUALITY CONTROL 11

PART 3 - EXECUTION (NOT USED) 13

PART 4 - ATTACHMENTS 14

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER 14

PART 1 - GENERAL

1.1 SUMMARY

A. This document defines the scope, services, and responsibilities for design, manufacture fabrication, inspection, testing and certification of shop fabricated tanks. The shop fabricated tanks shall be complete, including all coatings, covers, manways, vents, silencers, drains, piping connections, instrument connections, and other appurtenances as a minimum, and as referenced by these specifications including their attachments. The tanks shall also satisfy the requirements noted within regulations, codes, and standards listed as reference and others which are applicable to the site.

B. It is not the intent to specify completely herein all details of the design and construction of this equipment/system. However, the equipment/system shall conform in all respects to high standards of engineering, design, and workmanship and shall be capable of performing in continuous commercial operation up to the BOP Contractor's guarantee in a manner acceptable to the General Manager.

C. The BOP 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. The BOP Contractor shall design, fabricate, construct, test, certify, and guarantee the following specified equipment:

1. Atmospheric Flash Tank
2. Condensate Storage Tank
3. Turbine Water Wash Drains Tank
4. **Bearing Cooling Water Expansion Tank**
5. **Fuel Gas Drains Tank**
6. **Fuel Gas Final Filter Drains Tank**
7. **Service Air Receivers**

1.2 FURNISHED BY BOP CONTRACTOR

A. The BOP Contractor will be responsible for the following activities, all in accordance with the requirement of the specification, the data sheets included as an attachment to the specification, and applicable codes and standards:

1. Design, supply, fabrication, shop testing, QA/QC inspection, and certification of all equipment and materials specified herein.
2. Site specific drawings and design data to support facility design, construction and maintenance
3. Finish painting
4. Inspection certificates and quality control documentation listed in this Section
5. Complete set of component cut sheets

6. Startup and commissioning spares
7. Priced list of recommended spare parts for two years of operation
8. 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.
9. Site preparation, foundations, grout and anchor bolts.
10. Construction utilities, except where specifically stated otherwise.
11. All piping to/from BOP Contractor's terminal points
12. Wiring, conduit, cable trays, etc, external to the equipment.
13. Electrical grounding of tanks.
14. All counter flanges, gaskets, fasteners, expansion joints (as required) to external piping.
15. Field inspection and testing.

1.3 FURNISHED BY OTHERS

A. Supply by Others shall be limited to the following:

1. Water at the site of suitable quantity and pressure for testing. Any reuse of test water and its disposal shall be mutually agreed upon by BOP Contractor and the General Manager.

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

C. Section 485072, Coatings for Piping and Tanks

D. Section 485080, Piping and Equipment Insulation

1.5 CODES AND STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant 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

a. BPVC Section VIII - Rules for Construction of Pressure Vessels
b. B31.1 - Power Piping
c. B31.3 - Process Piping

2. American Water Works Association (AWWA)

a. D100 - Welded Carbon Steel Tanks for Water Storage
b. D102 - Coating Steel Water Storage Tanks
c. M42 - Steel Water Storage Tanks

3. Steel Tank Institute (STI)

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 specified directly or by reference in 481200, Combined Cycle Balance of Plant.

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 shop fabricated tanks, coatings, and accessories 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.

B. Performance Requirements

1. Tanks shall perform at, or exceed, the performance listed herein.
2. Certified mill test reports, covering all steel plates and structural shapes to be used in the work, shall be furnished as evidence that such materials are new and in compliance with the governing specifications.

C. Design Requirements

1. Pressure vessels shall be designed to conform to ASME Section VIII, Division 1.
2. The corrosion allowance specified in the data sheets shall be added to the calculated wall thickness of all carbon steel surfaces exposed to the contained liquid regardless of any allowance for interior coating.
3. Each shop fabricated tank shall be designed so that it may be lifted and transported as a unit. A minimum of two lifting lugs shall be provided, each capable of supporting the entire unit. Lifting lugs shall be located to minimize tilt and allow lowering over the anchor bolts.
4. Shop fabricated tanks shall be designed to accommodate all dead loads, live loads (including test loads) and seismic loads based on applicable code requirements.
5. If specified, tank shall have emergency relief vents for fire exposure designed for oil storage tanks.
6. BOP Contractor shall specify the limiting forces and moments on each equipment nozzle to be submitted with the bid for General Manager review.
7. In designing the tanks, the manufacturer shall consider, wind, seismic, lifting, erection, and transportation loadings of the tank.
8. Provide a shell access manhole as specified the data sheet.

9. Piping and instrument connections shall be as specified in the data sheet.
10. Connections, unless otherwise specified shall have at a minimum:

    a. Projection length of 6 inches from the outside face of tank to **the back** face of any flange.
    b. Connections 2 ½" and larger shall be ASME B16.5 raised face weld neck flanges.
    c. Connections 2" and smaller shall be ASME B16.5 raised face weld neck flanges.
    d. Conform to the sizes and locations specified in the data sheet.

11. Structural design shall be provided based on the seismic site conditions as referenced within Section 480020, Site Conditions.
12. The tanks shall be provided with all necessary gaskets, bolts, nuts, and washers for attaching manway covers, ladder & platform.
13. Ladders shall be OSHA approved hot dip galvanized. Cages, intermediate platforms, walkways, handrails, etc., shall be OSHA approved hot dip galvanized as appropriate.
14. Spare nozzles shall be furnished and installed by BOP Contractor, size and location shall be provided by the General Manager upon submittal review.

1.8 SUBMITTALS

A. Information to be furnished with bid:

1. Proposal shall be prepared in accordance with 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets. and in addition provide the following documentations:

    a. Outline drawings of each tank adhering to sketches, if provided in this specification.
    b. List of all materials of construction.
    c. Spare Parts List including prices for items used during 2 years of plant operation.
    d. A description of the BOP Contractor's testing methods and capabilities.
    e. Equipment weights broken down into parts shipped separately and maximum lifts to assemble, install, and maintain the equipment.
    f. Summary of recent similar tanks completed by the Contractor, and the respective fluid services.
    g. Completed Contractor's data sheets provided in the attachments to this Section.
    h. Preliminary general arrangement drawing showing the dimensions of each tank, including tank diameter, the height to bottom and top capacity levels, sizes of principal members, and thickness of plates. Names, locations (elevation and angle of orientation) and sizes of all connections appurtenances, and accessories.
    i. The Contractor shall notify General Manager of any modifications to their standard design in order to meet these specifications.

B. Information to be furnished after contract award:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award.
2. BOP Contractor to provide complete package or individual tank submittals, for approval by the General Manager, including the following:

a. Schedule for design, fabrication, shop testing, and preparation of the engineering deliverables, and shipment of equipment furnished
b. Outline drawings, layouts, general assembly, components, foundation requirements, dimensions, weights, clearances, dimensional locations of the nozzle connections, maintenance access areas, and methods of assembly.
c. Component item data including model, rated capacities (nominal/design), pressure rating, weights.
d. Complete details of required clearances, methods of assembly of components, piping connections, grades of materials, flange orientation and anchor bolt arrangement.
e. Maximum wind or seismic gross moment and shear on the foundations shall be identified.
f. BOP Contractor shall submit a complete set of design calculations demonstrating that the tank and anchorages have been adequately designed for the seismic and wind conditions.
g. Painting and lining information including application details, materials, and number of coats.
h. Type of inspection to be performed on complete joint penetration welded shell butt joints.
i. Details on stairways, rest platforms, handrails, or other safety devices as required.
j. BOP Contractor shall provide all loads necessary for foundation design, including live loads, dead loads, wind loads, and seismic loads.
k. Certification of compliance with codes, standards, and regulations.

C. Prior to declaration of product completion, the Contractor shall provide the following:

1. Quality control test reports confirming successful testing.
2. Hydrostatic testing report
3. Quality assurance testing and examination report.
4. Operating and maintenance manual of all components furnished.

D. Shop Drawings

1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

E. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.

1.9 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.11 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.12 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

B. Painting/coatings shall be warranted for a period of 10 years. If any materials or workmanship prove to be defective within the period of warranty, they shall be replaced or repaired by the BOP Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Materials

1. Material selection shall comply with data sheets where specified and shall comply with ASTM specifications selected for the specified design conditions. Tank shall be fabricated from steel and shall be internally coated as required by the General Manager.
2. Minimum quality of plate material for carbon steel tanks shall be ASTM A36, Structural Steel.
3. Corrosion allowances shall be sufficient to ensure a minimum operating life as specified in data sheets included as an attachment to the specification but shall not be less than 0.063 inches. The corrosion allowance specified on the drawings shall be added to the calculated sections of all carbon steel surfaces exposed to the contained liquid regardless of any requirement for interior lining.
4. Reinforcing pads and rolled-plate nozzle necks shall be the same quality material as specified for the tank part to which the reinforcing pads and nozzle necks are attached.
5. Flanges shall comply with the material requirements for forged steel flanges required by ANSI B16.5, B16.47A and ASTM A105, Specification for Forgings, Carbon Steel, for Piping Components.
6. Tank walls, floors, and heads shall have a minimum thickness of 1/4 inch.
7. Piping support brackets located inside of tanks shall be of the same materials as the tank shell. If the tank is lined, the support brackets shall be coated to match the tank lining. Support brackets shall have a minimum thickness of 3/8 inch.
8. U-bolts or other fastenings in carbon steel tanks shall be of carbon steel having minimum diameter of 3/8 inch.
9. Gaskets for manholes and fill connections for atmospheric tanks shall be flat-faced gasket or an alternate acceptable to General Manager.

B. Welding

1. All welding shall be in accordance with ASME Section IX, Welding and Brazing Requirements and the additional requirements herein. Welding procedures, procedure qualifications and performance qualifications shall be maintained in the BOP Contractor's files and shall be available for review by the General Manager prior to start of welding.
2. The BOP Contractor shall locate longitudinal and girth weld seams so that the welds do not interfere with welded attachments, such as nozzles, manways, and insulation supports. Location of all weld seams shall be indicated on the BOP Contractor's tank drawings. A clearance of at least 1.5 times the plate thickness shall be maintained from the edge of any weld to the toe of any other weld.
3. Shell joints shall be butt welds with full penetration and complete fusion. This requirement applies to both vertical and horizontal weld seams.
4. Alignment of the top of the shell with the floor of the shell shall not be out of plumb more than 1/200 of the total tank height. The amount any one shell plate is out of plumb shall not exceed the values specified for mill tolerances in ASTM A6, Specification for General Requirements for Rolled Steel Plates, or in ASTM A20, Specification for General Requirements for Steel Plates for Pressure Vessels. Customer tie-in connections shall be held to within plus or minus 3mm (1/8") of all specified dimensions.

2.2 COMPONENTS

A. Flanges and Bolting

1. Flanges shall be raised face weld neck type and in accordance with ASME B16.5 for the rating specified in the data sheet. All flanged piping connections shall be furnished with blind flanges, gaskets and bolts. All bolting shall conform to ASTM A307 Grade A bolts, bolting with hexagon heads and ASTM A563 Grade A hexagon nuts.

B. Gaskets

1. One set of spare gaskets shall be furnished with all blind flanged nozzles and bolted joints. Gaskets used for hydro testing shall be removed / replaced before shipment.
2. Buna N gaskets shall be 1/8 inch thick, full faced.
3. Spiral wound gaskets shall be Flexitallic Compression Gage or similar product conforming to ASMT B16.20, 0.175" thick 304SS winding, with filler material appropriate for the service conditions and inner ring as required for the specific class of the connected piping system.

C. Identification and Marking

1. The tank shall be identified with a stainless steel nameplate and contain at a minimum the requirements set forth in ASME Section VIII Division 1.
2. The nameplate shall be permanently attached to the tank by continuous seal-welding around the nameplate.

D. Insulation

1. Where required, insulation will be provided on the tanks per Section 485080, Piping and Equipment Insulation. The required support rings for insulation shall be provided by the BOP Contractor.

E. Supports

1. Support clips for ladder, platforms, piping, insulation, instrumentation, and stairs shall be shop welded to the tank and installed prior to hydrotesting. If stress relieving is required, supports shall be welded prior to stress relieving. Supports shall be attached to tank by continuous welds.

F. Tank Structure

1. Welding, welding procedure specification and certification of welders shall comply with ASME Boiler and Pressure Vessels Code Section IX – Welding and Brazing Qualifications
2. All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances shall be factory coated in accordance with the provisions of these specifications. Field coating, except for touch-up will not be permitted.
3. Galvanized and stainless steel components shall not be painted.
4. Where carbon steel tank pressure containing surface (bottom) lies directly on concrete pad or slab, the tank surface shall be epoxy-coated to protect it from oxidation.
5. Insulated surfaces shall not be finish coated
6. Surface preparation and paint application shall be in accordance with the coating system manufacturer's instructions.

G. Spare Parts

1. The BOP Contractor shall furnish a complete priced list of recommended spare parts for two years operation. Spare parts may be purchased separately by the General Manager. A separate list shall identify any spare parts for startup and commissioning of the equipment furnished by the BOP Contractor.

H. **Manways**

1. Manways shall be provided in tank for inspection, cleaning and maintenance. The minimum size of any manway is 24 inches.
2. Unless specified otherwise one shell access manway with a nominal diameter of 30 inches shall be provided. Shell access manway shall be located sufficiently close to ground elevation/tank floor elevation to permit entrance and egress without the use of a ladder.
3. Each manway shall be provided with a davit or hinged cover to allow the cover to easily swing out of the way.
4. **Each manway shall be provided with a sealing gasket to prevent leakage or dust migration into the tank.**

2.3 FABRICATION

A. Shop Assembly

1. Tanks shall be all welded construction.
2. Tank plates shall be cold rolled to the proper radius with the grain in the circumferential direction. The required curvature shall be extended to the plate edge.
3. Edges of all tank plates to be welded shall be neatly and accurately cut to true lines. The final surfaces shall be clean of slag accumulations prior to any welding. Cuts shall be cleanly made without drawn, ragged, gouged or split edges.
4. Any temporary clips, jigs or lugs welded to the tank plates for fabrication purposes shall be removed without damaging the plates. The remaining weldments shall be ground smooth.
5. Shaping shall be done by either cold rolling or pressing not by blows.
6. All tanks shall be furnished complete with all connections and appurtenances shown and called for on the data sheets.
7. Longitudinal joints in cylindrical shells shall be located to avoid interference with openings and their reinforcements.
8. Circumferential joints in cylindrical shells shall not intersect openings and reinforcement when practical. When openings must be located in these joints (except for head to shell joints) and reinforcing pads are required, the weld shall be ground flush and examined before the pad is attached.
9. The reinforcement of openings in the shell and roof (including those for piping loads that are specified) shall be designed in accordance with the rules of the applicable code. Each reinforcing pad shall be provided with two 1/4-inch diameter NFT threaded "tell tale" holes.
10. The drilling for all flanges of external and internal pipe nozzles shall be as follows:

    a. When the nozzle axis lies in a plane perpendicular to the vessel, the bolt holes shall straddle the flange centerline parallel to the vessel axis.
    b. When the nozzle axis is parallel to or coincides with the vessel axis, or when the nozzle axis is radial to the vessel head surface, the bolt holes shall straddle the flange centerline lying in the plane containing the vessel axis.
    c. Tank Welding
    d. All welding shall be done in accordance with applicable code requirements and this specification. All welding procedures and welder performance qualifications shall be in accordance with the referenced code. BOP Contractor shall submit welding procedures specification and procedure qualification records for General Manager's review before start of fabrication.
    e. Shell seams and roof, head or end joints, shall be full penetration. Backing plates or strips are allowed only if they are removed after welding.
    f. Tanks shall be fabricated with the minimum practicable number of seams. Longitudinal shell seams shall be staggered at each circumferential seam.

11. Base material shall fully be prepared for welding in accordance with applicable codes. The edges or surfaces of the parts to be joined by welding shall be machined or thermal cut and cleaned of all oil, grease, scale, rust, or other deleterious material. Where thermal cutting is used, all loose scale must be removed. All kerf residue and sharp cut cavities must be removed or blended to ensure proper weld penetration.
12. No welding shall be done when the metal temperature is less than 50°F without suitable preheating to the extent necessary to make the work warm to the touch. When the material being welded contains over 0.25% carbon, is 1-inch or over in thickness or contains alloy elements, it shall be preheated to the extent necessary to produce sound welds.

13. Where possible, weld shall not interfere with welds of nozzles or anything else welded to the vessels. Longitudinal joints at adjacent courses shall be staggered.
14. The vessel or tank fabricator shall weld in place all necessary lugs and clips for ladders, platforms, pipe supports, etc., using fillet welds. The vessel or tank fabricator shall supply all ladders, platforms, lugs and clips.
15. Welding Inspection
16. Radiographic examination shall be in accordance with the applicable code standard.
17. The longitudinal seams of the inspection ports and nozzle necks made from rolled plate shall be l00% radiographed.
18. All longitudinal and girth welds shall be l00% X-rayed.
19. Heat Treating and Stress Relieving
20. When stress relieving is specified, the vessel shall preferably be treated as a unit. All attachments shall be welded in place before stress relieving. If the vessels is too large to be stressed relieved as a unit, it shall be stress relieved in accordance with the applicable code.
21. Seamless heads, parts of built-up heads, or similar pressure carrying parts of a vessel, if severely worked in the cold state, shall be stress relieved prior to subsequent operations.
22. BOP Contractor shall note on his drawings and stencil on the exterior of stress relieved tanks a warning to the effect that a tank has been stress relieved and not to strike an arc or apply heat.

B. Shop/Factory Finishing

1. Lining

   a. BOP Contractor shall coat the interior of the vessel or tank with an epoxy lining suitable for the stated service. The lining shall as a minimum, be a two-coat system with the dry film thickness and application in accordance with the coating manufacturer's instructions. The coating shall be for the specific service intended and shall be subject to acceptance by General Manager.
   b. BOP Contractor shall note on his drawings and stencil on the exterior of lined tank or vessel a warning to the effect that this equipment is lined and not to strike an arc or apply heat.
   c. Linings shall be applied in accordance with the datasheets attached to this Section, AWWA Standard D102 and the lining manufacturer’s recommendations.
   d. Linings shall include all interior surfaces of the tank, all exposed steel surfaces inside the tank, all nozzles out to and including the exterior face of all nozzle flanges where piping or manway covers have been removed and the surface of all manway covers exposed to the inside of the tank.
   e. The completed lining shall be tested by the BOP Contractor. The lining shall be checked for pinholes, holidays, and bare areas with a Tinkor Rasor Model APW Spark Tester or equivalent at a minimum of 1,500 volts. Any pinholes shall be removed by grinding out the coating area to the shell plate, followed by an inspection to assure the appropriate surface profile exists before reapplication of the coating. Repairs shall be in accordance with the lining manufacturer’s recommendations.
   f. Words “DO NOT WELD – LINED TANK” shall be stenciled on the outside of lined tanks. The words shall be visible from all sides of the tank.

2. Painting and Coating

a. The external surface of the tank shall be painted and protected in accordance to NFPA 22 and AWWA D102 requirements. The tank shall be internally lined and externally painted per the Coating Class noted in the datasheet and specified in Section 485072 Coatings for Piping and Tanks. BOP Contractor shall submit details of their proposed external and internal coating systems; including manufacture, surface preparation, special handling requirements, and MSDS sheets for approval.

b. If BOP Contractor elects to perform finish exterior coating in the field, All preparation, coating procedures and materials used for preparation and coating shall be performed and furnished in accordance with applicable South Coast Air Quality Management District (SCAQMD) requirements, including but not limited to Rules 403, 1113, 1171, 1140. Contractor shall be fully responsible for compliance with any and all SCAQMD regulations, as well as other applicable State and Federal regulations governing the preparation for and application of field-applied coatings.

c. The color scheme for the exterior of the tank shall be per specified and approved by the General Manager.

2.4 SOURCE QUALITY CONTROL

A. Refer to Section 481200, Combined Cycle Balance of Plant for general source quality control, test, and inspection requirements.

B. Inspection

1. The BOP Contractor shall establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The BOP Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors.
2. Within 30 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan, which shall include pertinent manufacture and inspection operations. The General Manager may, within 30 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection before the item concerned can be released for further manufacture or shipment.
3. The BOP Contractor shall give the General Manager at least ten working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing. Unless the General Manager shall advise the BOP Contractor not to proceed with the inspection and testing prior to five days before the date which the BOP Contractor has stated in its notice, the BOP Contractor may proceed and any inspection and tests shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the inspection and test results.
4. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).
5. Major items supplied by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP

Contractor or a third party. A test procedure shall be prepared for each such test, which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be available for review by the General Manager. Successful completion of such test shall be a precondition to shipment of the tested item. The General Manager shall be notified in writing at least 14 days prior to any final factory test of any major components to be supplied.

C. Testing and Examinations

1. The tank shall be completely assembled on site by the BOP Contractor and tested fully prior to commissioning. BOP Contractor to make all provisions necessary to ensure that finished product has structural integrity and free from leaks. Leaks encountered during site testing are the responsibility of the BOP Contractor. BOP Contractor shall furnish any additional blind flanges necessary to temporarily close tank openings for hydrostatic test. Inspection shall be per AWWA M42.
2. Prior to water testing, all nozzle reinforcing pads shall be air and soap tested with a minimum air pressure of 15 PSIG for at least 10 minutes.
3. The tank shall be tested by filling the tank with water to a height of 2 inches above the top leg of the top angle. As the tank is being filled with water, frequent inspections shall be made to detect leakage and/or swelling. If leaks are detected, the tank shall be drained and the leaks repaired by the BOP Contractor. The minimum holding time for the test shall be 12 hours.
4. Welded tank floors shall be tested by approved air pressure or vacuum tests, as specified under AWWA D100. BOP Contractor shall furnish any additional blind flanges or other appurtenances necessary to temporarily close tank openings for approved air pressure or vacuum test(s).
5. Complete penetration and complete fusion is required for welds joining shell plates to shell plates. Inspection for quality of welds shall be made by radiographic examination. Inspections of fillet welds shall be made by visual examination. If visual inspection indicates unsatisfactory welds, acceptance or rejection shall be based on ultrasonic examination methods. Testing for structural welds that require ultrasonic testing shall be in accordance with AWWA D100.
6. The General Manager shall be notified at least 48 hours before beginning nondestructive examinations.

D. Hydrostatic Tests

1. Tanks 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.

E. Functional and Performance Tests

1. The equipment shall be subjected to functional and performance tests in the BOP Contractor’s shop to the greatest extent possible to verify the BOP 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 BOP Contractor.

F. Additional Testing Requirements:

1. AWWA Constructed tanks:

    a. Tanks shall be shop leak tested per AWWA D100 before application of exterior coating is permitted.

G. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.
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 and this specification.
5. For AWWA tanks:

    a. Inspections shall be carried out by Inspectors who have prior tank inspection experience and shall be a certified welding inspector in accordance with the provisions of AWS QC1.

PART 3 - EXECUTION (NOT USED)

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER

Equipment Name		**Atmospheric Flash Tank**
Equipment Tag Number		**5SDN-TNK-010**
Fluid		**Flashing steam drains**
Number of Tanks		1
Tank Type		Vertical cylinder with elliptical heads
Tank Height		*
Tank Diameter, feet		*
Useable Tank Volume, gallons		260 (estimate)
Design Pressure		50 psig
Design Temperatures		200-750˚F
Metal thicknesses: Shell and Heads		As required by ASME Section VIII Div 1.
Corrosion allowance		1.5 mm (1/16 in.)
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow, gpm	*
	Outflow, gpm	*
Shell		Carbon Steel
Nozzles		Carbon Steel
Tank Overflow		Carbon Steel
Flanges		Carbon Steel
Bolting		ASTM A307 Grade A hex head bolts ASTM A563 Grade A hexagon nuts
Gaskets		304SS spiral wound
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		Not applicable
Tank Coating		Exterior: Inorganic zinc primer Interior: None

Note:

- Vent silencer shall be provided by BOP Contractor if required to meet 480031 Combined Cycle Power Island Noise Control Performance specifications.
- Tank shall include internal attemperation spray nozzles for quenching of flash steam.

*Data fields to be completed by BOP Contractor

Fluid		**Condensate Storage Tank**
Equipment Tag Number		5CDS-TNK-010
Number of Tanks		1
Tank Type		Vertical cylinder, conical or elliptical roof
Tank Height		TBD by BOP Contractor
Tank Diameter		10 feet (estimated)
Tank Volume, Useable		5000 gallons (estimated)
Design Pressure		Atmospheric
Design Temperatures		Ambient Refer to 480020, Site Conditions
Metal thicknesses Shell and Heads		As required by AWWA Standard D100, but not less than 0.25 inch
Bottom plates		As required by AWWA Standard D100, but not less than 3/8 inch
Corrosion allowance		none
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	*
	Outflow	*
Shell		Stainless Steel
Nozzles		Stainless Steel
Tank Overflow		Stainless Steel
Flanges		Stainless Steel
Bolting		ASTM A307 Grade A hex head bolts ASTM A563 Grade A hexagon nuts
Gaskets		304SS spiral wound
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		Not applicable
Tank Coating		None
Note: HEPA filter required on tank vent *Data fields to be completed by BOP Contractor		

Equipment Name		**Turbine Water Wash Drains Tank**
Equipment Tag Number		5GTS-ZXX-010
Fluid		Gas turbine wash water and detergent
Number of Tanks		1
Tank Type		Horizontal cylinder with elliptical heads, buried
Tank Height, feet		*
Tank Diameter, feet		*
Tank Volume, Useable		1,000 gallons
Design Pressure		5 psig
Design Temperatures		250˚F
Metal thicknesses Shell and heads		3/8 inch
Corrosion allowance		1.5 mm (1/16 in.)
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	10 gpm (Estimated)
	Outflow	100 gpm (Estimated)
Shell and heads		Carbon Steel
Pipe Nozzles		Carbon Steel
Tank Overflow		Carbon Steel
Flanges		Carbon Steel
Bolting		ASTM A307 Grade A hex head bolts ASTM A563 Grade A hexagon nuts
Gaskets		304SS spiral wound
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		Not applicable
Tank Coating		Exterior: Class U4, epoxy coating for buried tanks Interior: Class S2 or BOP Contractor equivalent
NOTE: BOP Contractor to supply means for cathodic protection		
*Data fields to be completed by BOP Contractor		

Equipment Tag		**Bearing Cooling Water Expansion Tank**
Equipment Tag Number		5BCW-TNK-010
Fluid		Closed cooling water system
Number of Tanks		1
Tank Type		Pressurized bladder expansion tank (field adjustable)
Tank Height		*
Tank Diameter		*
Tank Volume, Useable		*
Design Pressure		*
Design Temperatures		*
Metal thicknesses		*
Corrosion allowance		none
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	*
	Outflow	*
Shell		**Carbon steel**
Nozzles		**Carbon steel**
Tank Overflow		**n/a**
Flanges		**Carbon steel**
Bolting		ASTM A307 Grade A hex head bolts ASTM A563 Grade A hexagon nuts
Gaskets		304SS spiral wound
Structural Steel, Stairs, Ladder, Platforms		ASTM A36 Galvanized
Handrails		Not applicable
Tank Coating		None
*Data fields to be completed by BOP Contractor		

Equipment Name		**Fuel Gas Drains Tank**
Equipment Tag Number		5FGS-TNK-520
Fluid		Liquid heavy hydrocarbons from scrubber drain
Number of Tanks		1
Tank Type		Horizontal cylinder
Tank Height		TBD by BOP Contractor
Tank Diameter		TBD by BOP Contractor
Tank Volume, Useable		100 gallons (estimate)
Design Pressure		5 psig
Design Temperatures		17-113˚F
Metal thicknesses		¼”
Corrosion allowance		1/16”
Design Fluid Specific Gravity		*
Pumping Rates:	Inflow	*
	Outflow	*
Shell		SA 516-70
Nozzles		SA 106 Gr B or SA 333 Gr 6
Tank Overflow		SA 106 Gr. B or SA 333 Gr. 6
Flanges		SA 105 or SA 350 Gr. LF2 Cl. 1
Bolting		SA 193-B7 / SA 194-2H
Gaskets		Non asbestos, SS spiral wound, Flexitallic or equal
Structural Steel, Stairs, Ladder, Platforms		A 36
Handrails		Not applicable
Tank Coating		None
*Data fields to be completed by BOP Contractor		

Equipment Name		**FGS Final Filter Drains Tank**
Equipment Tag Number		5FGS-TNK-540
Fluid		Liquid heavy hydrocarbons and water
Number of Tanks		1
Tank Type		Horizontal cylinder, double wall with leak detection
Tank Height		*
Tank Diameter		*
Tank Volume, Useable		100 gallons
Design Pressure		5 psig
Design Temperatures		17-113˚F
Metal thickness		¼”
Corrosion allowance		1/16”
Design Fluid Specific Gravity		1.0
Pumping Rates:	Inflow	*
	Outflow	*
Shell		SA 516-70
Nozzles		SA 106 Gr B or SA 333 Gr 6
Tank Overflow		SA 106 Gr. B or SA 333 Gr. 6
Flanges		SA 105 or SA 350 Gr. LF2 Cl. 1
Bolting		SA 193-B7 / SA 194-2H
Gaskets		Non asbestos, SS spiral wound, Flexitallic or equal
Structural Steel, Stairs, Ladder, Platforms		A 36
Handrails		Not applicable
Tank Coating		None
*Data fields to be completed by BOP Contractor		

Equipment Name	**Service Air Receivers**
Equipment Tag Number	**5SAS-VSL-120A** **5SAS-VSL-120B**
Fluid	**Service Air**
Number of Tanks	**2**
Tank Type	**Vertical cylinder**
Tank Height	*****
Tank Diameter	*****
Tank Volume, Useable	**100 gallons**
Design Pressure	**130 psig (estimate)**
Design Temperatures	**17-113˚F**
Metal thickness	**TBD**
Corrosion allowance	**1/16”**
Design Fluid Specific Gravity	**1.0**
Shell	**Carbon Steel**
Nozzles	**Carbon Steel**
Flanges	**Carbon Steel**
Bolting	*****
Gaskets	*****
Structural Steel, Stairs, Ladder, Platforms	*****
Handrails	**Not applicable**
Tank Coating	*****
*Data fields to be completed by BOP Contractor	

Note:
Each receiver shall include:

- Inlet and outlet connections with spring loaded check valves on the outlet connections.
- Pressure gauge with isolation and test port valves.
- Pressure switch with isolation and test port valves and isolated connection for low pressure alarm.
- The interior of the air receiver shall be treated /coated to be corrosion resistant for at least a 30-year life.
- An automatic condensate trap shall be provided for each receiver. A drain connection and valve.
- A manhole shall be provided on each receiver sized sufficiently to permit inspection access.
- Each receiver shall have one spare 3" flanged nozzle, complete with blind flange, bolt-up hardware and gasket.

December 10, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485311.10
Horizontal Centrifugal Pumps – General Service

PROJECT NUMBER:
123374

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Section 485311.10
Horizontal Centrifugal Pumps – General Service

PREPARED FOR: *PASADENA WATER & POWER*
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REVISION HISTORY		
DATE	REVISED BY	REVISION
July 26, 2013	T. Clark	A
August 27, 2013	S. Goldstein	B
December 10, 2013	S. Goldstein	C

SECTION 485311.10
HORIZONTAL CENTRIFUGAL PUMPS -GENERAL SERVICE

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 2
1.5 DEFINITIONS 3
1.6 SYSTEM DESCRIPTION 3
1.7 SUBMITTALS 4
1.8 QUALITY ASSURANCE 6
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 6
1.10 SITE CONDITIONS 6
1.11 WARRANTY 6

PART 2 - PRODUCTS 7

2.1 MATERIALS AND WELDING 7
2.2 EQUIPMENT 8
2.3 COMPONENTS 10
2.4 FABRICATION 12
2.5 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 15

3.1 SPARE PARTS 15
3.2 FIELD QUALITY CONTROL 15
3.3 SCHEDULE 16

PART 4 - ATTACHMENTS 17

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER 17
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR 24

SECTION 485311.10
HORIZONTAL CENTRIFUGAL PUMPS -GENERAL SERVICE

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of the horizontal centrifugal water pumps for general service. 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 BOP Contractor's guarantee in a manner acceptable to the General Manager.

B. The BOP 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY BOP CONTRACTOR

A. The following equipment, materials and services shall be provided by the BOP Contractor for each pump and driver set:

1. Base frame mounted pump and driver selected to perform as required for each pump datasheet attached to this Section.
2. All seals, bearing lubrication systems, couplings, coupling guards, drivers, baseplates/support systems and other standard accessories or as specified herein.
3. Cleaning and finishing prior to shipment
4. Painting
5. Startup spares and special tools
6. Performance testing at factory and certificates of results
7. Drawings and design data to support facility design, construction and maintenance
8. Inspection certificates and quality control documentation listed in this Section
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. 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.
13. Foundation and anchor bolts
14. Skid grouting (if necessary)
15. Piping external to pump skids
16. Motor starters and power wiring

17. Receipt and off-loading at site, material lay-down area defined by the General Manager
18. Installation at site including, alignment, rotation verification, lubricant first fill (if needed), and all other incidental labor and materials typically required to support the requirements of this Section
19. Plant Control System configuration and graphics programming
20. Electrical, instrumentation and controls wiring
21. Instrumentation
22. Field inspection and testing in accordance with this and all related Sections

1.3 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 481200, Combined Cycle Balance of Plant

1.4 CODES AND STANDARDS

A. Refer to 481200 Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. Antifriction Bearing Manufacturer's Association (ABMA)
2. American National Standards Institute (ANSI)

    a. ANSI/HI 1.3 – American National Standard for Centrifugal Pumps Design and Application

3. American Petroleum Institute (API)

    a. API 610 – Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries

4. American Society of Mechanical Engineers (ASME)

    a. PTC 8.2 Power Test Code for Centrifugal Pumps

5. Hydraulic Institute Standards (HI)
6. International Standards Organization (ISO)

    a. ISO 10816 – Mechanical Vibration: Evaluation of machine vibration by measurements on non-rotating parts

1.5 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.

1.6 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 and assembled to provide suitable access for operation and maintenance of the equipment.
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 pumps shall be suitable for continuous operation in the ambient conditions as detailed in Section 480020, Site Conditions.
5. Each pump shall be completely assembled, piped and mounted on a common base plate aligned with the electric driving motor.
6. When a standby pump is required it shall be designed to start automatically in an emergency situation when the failed operating pump shuts down.
7. Pump controls shall be designed to alternate lead pump between run/stop cycles
8. The pump materials shall be suitable for the fluid being pumped. Refer to attachments for fluid description and recommended pump materials.
9. When multiple pumps are supplied, 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 BOP Contractor shall guarantee the following:

    a. Capacity without negative tolerance.
    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. 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 BOP 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. 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.
6. The Suction Specific Speed shall not exceed 9,000 based upon Hydraulic Institute definitions.
7. 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.
8. BOP Contractor shall guarantee that the equipment supplied shall meet the specified noise criteria in Section 480031, Combined Cycle Power Island Noise Control Performance 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 BOP Contractor shall provide adequate redundancy to meet this requirement. BOP 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. BOP Contractor shall provide additives for redundancy for these systems and components.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:

1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:

a. Preliminary physical descriptions of all quoted equipment.
b. List of warranties and guarantees.
c. Completed "Technical Datasheets by BOP Contractor" attached to this Section

2. The BOP Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award including the following documentation:

a. Complete list of electrical loads associated with the BOP Contractor's scope of supply. For all loads, the list shall contain description, location of the interconnect, voltage, ampere rating, phase, rated load, operating load, service factor, and whether operation is continuous, intermittent, or emergency only.
b. Motor data including manufacturer, equipment tag number, horsepower (HP), voltage, ampere rating, phase, service factor, enclosure, insulation, rpm, efficiency, and accessories.
c. Noise data including estimated sound power levels for the eight octave bands, corrections for silencers, ducts distance etc. and an estimated logarithmic summation for the driver and driven equipment.
d. Characteristic Curves:

1) Certified pump characteristic curves shall be submitted for each pump. Curves shall indicate total head, efficiency, brake horsepower, NPSH required, and required submergence as ordinates, with capacity in gallons per minute as the abscissa.
2) Curves shall be submitted for maximum and minimum impeller designs which may be fitted to the pump casing and for the impeller design being provided. When variable speed or two speed drivers are specified, pump performance curves shall be submitted for rated impeller diameter at 10% speed increments from 60% - 100% speed.
3) The characteristic curves shall indicate pump performance from zero capacity to the pump runout capacity.
4) Speed-torque curves, including reverse rotation speed-torque characteristics and inertia (WR^2) values for the pump, shall also be submitted.

C. Shop Drawings

1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

D. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.
2. Maintenance instructions shall include as a minimum the following topics:

a. Data Sheets.
b. Special shipping, handling, and storage instructions.
c. Lubrication requirements.
d. Maintenance and repair instructions, including procedures, tolerances,
e. Special tool or facility needs, etc.
f. Bill of materials.
g. Descriptive literature.
h. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)

1.8 QUALITY ASSURANCE

A. Refer to Section 481200 Combined Cycle Balance of Plant 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

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general Packaging, Delivery, Storage, and Handling requirements.

1.10 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

B. The pumps shall be guaranteed to operate satisfactorily without damaging pitting, cavitations, or excessive vibration, when pumping against system head and when starting or stopping a pump with another pump in operation on the header.

1. The following shall be guaranteed:

a. Capacity at the design operating point.
b. Total developed head at the design operating point.
c. Pump efficiency at design operating point.
d. Horsepower required at the design operating point and maximum horsepower requirement.
e. Shutoff head.
f. Proper, stable operation with pumps in parallel over the range from recommended minimum flow to runout conditions, or 120 percent of design capacity, whichever capacity is greater.
g. Single pump operation from the recommended minimum flow to runout flow at minimum system resistance.

h. No critical speed at or near pump operating speed. All critical speeds shall be at least 25 percent greater than the highest operating speed.

2. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.
3. Pumps shall be designed to have a required NPSH at one pump run-out conditions of no more that 75% of the NPSH available. Reliability during all operation is a major consideration.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. 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.

B. Materials of Construction

1. The pump shall be manufactured using materials that meet or exceed the strength and corrosion-erosion resistance of the following listed materials. Selection of pump materials for each pump application shall be subject to the approval of the General Manager.
2. The construction materials for pumps identified as cast iron and bronze-fitted are as follows:

   a. Casing - Cast Iron ASTM A48 or General Manager approved equal.
   b. Impeller - Bronze ASTM B584, A48, C1 25B or 30B, or General Manager approved equal.
   c. Shaft - Stainless steel ASTM A276 Type 316 or General Manager approved equal.
   d. Shaft sleeves - Stainless steel ASTM A276 Type 316 or General Manager approved equal.
   e. Wear rings - Bronze ASTM B584 or General Manager approved equal.
   f. Base Plate – ASTM A283, A285 or General Manager approved equal.

3. The construction materials for pumps identified as all stainless steel are as follows:

   a. Casing – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
   b. Impeller – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
   c. Shaft - Stainless steel ASTM A276 Type 316 or General Manager equal.
   d. Base Plate – ASTM A283, A285, or General Manager approved equal.
   e. Wear Rings – ASTM A743 or General Manager approved equal.

4. Materials for manufacturing pumps shall be as specified on the individual pump data sheet. General material selections will follow API 610 guidelines for each fluid service. The BOP Contractor shall select suitable materials for pump wear rings and shaft sleeves based on the fluid analysis and technical requirements supplied for the project.

5. Austenitic stainless steel pump parts subject to welding shall be furnished in the "L" grade. Austenitic stainless steel shall be furnished in the solution-annealed condition. Stainless steel components shall not be cold worked by design to enhance mechanical properties. Internally wetted parts shall not utilize coatings.
6. Materials shall be identified with the applicable AISI, ASTM, ASME or SAE number, including material grade on pump data sheets and recommended spare parts lists supplied for the project.
7. If the BOP 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 BOP Contractor's proposal.
8. Minor parts not identified shall have corrosion resistance equal to that of specified parts in the same environment.
9. Mating parts, such as studs and nuts, constructed of 18-8 stainless steel or of materials having similar galling tendencies shall be lubricated with an anti-seize compound.

C. Welding

1. All welding shall be in accordance with ASME Section IX. Welding procedures for stainless steels shall be designed to minimize sensitization for the heat affected zone. Piping supplied by the pump manufacturer shall be designed to conform to piping code ASME B31.1.

D. Castings

1. Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters, and other defects. Casting surfaces shall be cleaned by standard methods such as sandblasting, shotblasting, or pickling. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.
2. Castings shall not be repaired by peening, plugging, burning in or impregnating. If weld repairs to castings are authorized by the ASTM specification for the material, repair welding shall be in accordance with the applicable ASTM specification. Weld repairs shall be inspected according to the same quality standards as for inspection of the castings. Repairs not covered by an ASTM specification shall be subject to approval of the General Manager.

2.2 EQUIPMENT

A. General Requirements

1. The project is an outdoor installation. The pumps shall be suitable for continuous operation in the ambient conditions exposed to the elements.
2. Pumps shall be designed for a continuous service life of 30 years. Pump 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. Design of rotating elements shall be such that all critical speeds shall be at least 25 percent greater than the operating speed.
4. Manufacturer shall provide all connections for suction, discharge, sealing, and venting. Piping shall be in accordance with ANSI B31.1. All piping furnished by the Manufacturer shall be provided in ANSI standard sizes in nominal English units (inch

sizes). The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.

5. BOP 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
    d. Alignment provisions and/or machine bases that permit field alignment without modification to the pump skid

B. Pumps

1. The pumps will be operated singly or in parallel. Each pump shall operate satisfactorily in two pump parallel operation, in single pump operation, and when bringing on or taking a pump out of service with any other pump, or pumps in service. The pumps shall deliver the head and capacity indicated in pump data sheets in this Section.
2. The pumps shall be capable of operating continuously at the minimum flow without damage to the pumping equipment.
3. Pump head curve shall rise continuously from design head point to shut-off. The pump shut-off head shall be a minimum of 120 percent of the total head at the design operating point and a maximum of 135 percent of the design head specified.
4. Pumps furnished for the same service shall be designed to operate continuously in parallel over the pump operating range without cavitations.
5. Where pumps are furnished for parallel operation, these pumps shall be "identical" as defined by the Hydraulic Institute standards, with all replacement parts being interchangeable.
6. The difference in flow for pumps operating in parallel shall not exceed 5 percent throughout the operating range.
7. Pumps shall be capable of both intermittent (start/stop) and continuous operation under flow conditions from minimum flow to runout conditions.
8. The horizontal pumps are centrifugal pumps of the horizontally or vertically split, single or double suction, single or multiple stage design, as specified in data sheets provided as Attachments.
9. Each pump submitted by the BOP Contractor shall be designed for operation as specified in data sheet.
10. Wetted pump parts shall be suitable for the fluid being pumped. Materials specified for the pumps are shown in the data sheets. BOP Contractor may propose alternate materials which in its own experience are more suited to the intended service. The alternate materials shall be subject to General Manager's approval.

C. Pump Characteristics

1. Pumps 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 the pumps have maximum efficiency at approximately design operating capacity and head.
3. Pumps shall be suitable for extended operation over the range from minimum flow to single pump runout flow at minimum system resistance, without damaging pitting, cavitations, excessive noise, or excessive vibration.

D. Additional Technical Requirements

1. The pump manufacturer shall be responsible for the overall sound pressure level of each pump/drive motor assembly under all operating conditions when the assembly is mounted on its concrete base. The equivalent "A" weighted sound pressure level for equipment furnished under these contract documents (excluding drive motors) shall not exceed 85 dBA free field measured 3 feet horizontally from the base of the equipment and 5 feet above floor level. The sound pressure levels stated are decibels to a reference of 20 micropascals. The noise level shall be measured at design conditions only.

2.3 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 BOP 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 BOP 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 BOP Contractor’s warranty to include all direct costs to the General Manager that may result from the BOP Contractor’s use of such procedures, components or assemblies.

B. Impellers

1. All impellers shall be statically and dynamically balanced.
2. Wear rings, as required, shall be replaceable.
3. Full size impellers shall not be used. An impeller diameter that is a least 10 percent larger than the minimum impeller diameter and at least 10 percent smaller than the maximum diameter for the pump casing is preferred.

C. Couplings

1. Shaft couplings, where applicable, shall be used between all drives and driven equipment. Couplings shall be attached to driver and driven shafts by press fits and keys.
2. Unless otherwise stated in the detailed equipment requirements, couplings shall be of the all metal lubricated gear flexible type.
3. Shaft couplings shall be sized to transmit the maximum brake horsepower requirements of the driven equipment with a service factor of not less than 2.
4. Couplings on pumps with mechanical seals shall be spacer type couplings to permit replacement of the mechanical shaft seals without disturbing the drive motor.

D. 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.

4. Safety guards for horizontal shafts, shaft couplings, belt sheaves, etc., shall be of the inverted "U" design with sides extending to the equipment base or base plate.

E. Base Plate

1. A cast iron or welded steel equipment base plate shall be provided which is to be installed on a concrete base. Each base plate shall support the unit and its drive assembly and shall be of a neat design with pads for anchoring the units. Motor mounting provisions shall be acceptable to the motor manufacturer. Base plates shall be designed to adequately support the equipment under all conditions without 100 percent grout fill inside the base plate frame. Equipment bases shall be designed to accept a connection to the plant grounding system. Anchor bolt pattern, number and diameter shall be determined by the Manufacturer, based on the assumption that anchor bolts shall be fabricated from ASTM A36 bar stock material.

F. Pump Seals

1. The mechanical seal of the pump specified shall comply with API 610 Seal Plan 14.
2. 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 the multiple spring balanced pusher type. If required mechanical shaft seals shall be furnished with a complete flushing system, consisting of no less than interconnecting piping, isolation and check valves, and flow measuring and metering apparatus. The flushing system shall not utilize the pumped fluid; a fresh water flush from an on-site potable water source shall be utilized.

G. Bearings

1. Pumps shall be furnished with removable shaft sleeves as required by system design. Where required, the shaft shall be completely protected and isolated from the pumped fluid by incorporating gasketed or similarly sealed joints between the sleeve and the shaft. If the manufacturer's design does not include sealed joints, the pump shaft shall be constructed of a material equivalent to the material of the shaft sleeve.
2. Pump bearings shall be of the oil-lubricated sleeve or anti-friction type. Anti-friction bearing shall be designed for AFBMA L-10 life rating of not less than 130,000 hours. Pumps shall be provided with thrust bearings as required by the system designed to prevent thrust loads from being imposed on the drive motor bearings. Thrust bearings shall be of the Kingsbury type or double roll anti friction bearing as required by the pump service.

H. Casing

1. The pump casing, including suction connection, shall be rated for the design conditions of the pumping system. Suction and discharge connections shall be flanged. Each pump casing shall be furnished with tapped connections for casing drain and vent. Each connection shall be furnished with a solid, hex head, forged steel pipe plug. Casing pressure, drain, and vent connections shall be threaded.

I. Accessories

1. Miscellaneous trim - All piping and valves required for seal or stuffing box injection 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.

J. 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 or rivets. 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

K. Auxiliary Equipment Requirements

1. Electrical Requirements: Refer to Section 262050 - Low Voltage Motors.

2.4 FABRICATION

A. Shop Assembly

1. The pump assembly and motor shall be installed on a common base plate.
2. The pump shall be connected to the motor by a flexible coupling. ASME B73.1 standard dimension pumps with back pullout construction will be considered.
3. The BOP Contractor shall provide only items that are of standard and current manufacturers' construction. Non-standard special items or any other difficult to replace items shall not be supplied without the General Manager's prior approval.

B. Shop/Factory Finishing

1. Cleaning

   a. Internal Surfaces

      1) All internal surfaces shall be free of gross contaminants, such as heavy deposits of mill or heat treating scale, oil, oxide films, slag, flux, weld splatter, dirt, metal chips, and abrasive particles.
      2) Manufacturer's cleaning plan shall ensure that cleaning materials do not adversely affect the surface or base metal in the cleaning, manufacturing, or

operational environments and that, once obtained; the cleanliness will be maintained during subsequent manufacturing, shipping, storage and handling.

3) Abrasive blasting shall not be used on surfaces containing areas where grit can accumulate and not be readily removed by subsequent cleaning, rinsing or flushing.

b. External Surfaces

c. External surfaces shall be smooth and free of gross contaminants such as heavy scale, rust, sand, blisters, weld splatter, metal chips, and heavy deposits of oil or grease.

2. Painting

a. Cleaning of surfaces that are not to be coated or painted shall be done in accordance with the Supplier's best recommended practice. Only non-corrosion-resistant materials shall be coated.

b. Insulated surfaces shall not be primed. Stainless steel shall not be painted.

2.5 SOURCE QUALITY CONTROL

A. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.
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.

B. Tests and Inspections

1. Steps shall be taken in the fabrication and assembly to ensure that all mechanical fits are concentric and true to ensure alignment during installation.
2. All welding, welding procedure qualifications and welder qualifications shall be in accordance with the BOP Contractors' ISO-9000 or equivalent qualified program.
3. Within 60 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent manufacture and inspection operations. The General Manager may, within 60 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection before the item concerned can be released for further manufacture or shipment.
4. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing. Unless the General Manager shall advise the BOP Contractor not to proceed with the inspection and testing prior to five days before the date which the BOP Contractor has stated in its notice, the BOP Contractor may proceed and any inspection and tests shall be deemed to

have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the inspection and test results.

5. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).
6. The General Manager reserves the right to witness all shop tests and re-tests.
7. Major items supplied by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP Contractor or a third party. A test procedure shall be prepared for each such test which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be available for review by the General Manager. Successful completion of such test shall be a precondition to shipment of the tested item. The General Manager shall be notified in writing at least 14 days prior to any final factory test of any major components to be supplied.

C. Hydrostatic Tests

1. 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.

D. Functional and Performance Tests

1. The equipment shall be subjected to functional and performance tests in the BOP Contractor's shop to the greatest extent possible to verify the BOP 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 BOP Contractor.

E. Shop Tests

1. Full information shall be submitted describing the Manufacturer's testing facilities. All tests performed shall use ASME PTC 8.2 as a basis.
2. If testing is specified one pump for each service shall be shop tested for capacity, NPSH required, power requirements, and efficiency at minimum flow recommended for continuous operation, runout head, design point head, shutoff head, and at as many other points as necessary for plotting an accurate performance curve. Each pump shall be tested with its own motor.
3. All rotating parts shall be statically and dynamically balanced. Impellers shall be dynamically balanced prior to assembly on the pump shaft. Motor rotors shall also be balanced. Pumps shall be balanced so that peak to peak amplitude of rotor vibration in any plane measured at the pump bearing housing under design speed shall not exceed 1.5 mils over the pump operating range.
4. 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 article.
5. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.

6. 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.
7. 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.
8. If the pumps are not to be shop tested, then the results of prototype model pump shop tests, previously performed by the manufacturer, shall be used to develop performance curves for the miscellaneous pumps.
9. 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.
10. 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.
11. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed, 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.
12. BOP 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. The BOP Contractor shall furnish a complete priced list of recommended spare parts for two years operation. Spare parts may be purchased separately by the General Manager. A separate list shall identify any recommended spare parts for startup and commissioning. Startup and commissioning spares shall be included in the base bid.

3.2 FIELD QUALITY CONTROL

A. Field Testing

1. Following erection/installation of equipment, General Manager may require equipment to be tested by the BOP Contractor in the installed condition to verify the equipment's ability to operate under the specified conditions and to meet the specified performance guarantees.
2. In the event that the pumps do not meet the performance guarantees in the erected/installed conditions, the BOP Contractor shall make alterations and modifications as necessary to meet the performance guarantees, at the Manufacturer's expense.

3.3 SCHEDULE

A. The BOP Contractor shall provide a schedule for the design, fabrication, shop testing, and preparation for shipment of the equipment furnished by the BOP Contractor. The schedule shall also provide anticipated durations for field erection and testing of the equipment furnished by the BOP Contractor.

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER

Item	Description:	Units	Demineralized Water Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5DWS-PMP-020A/B
1.2	Type:		Centrifugal
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Demineralized Water
1.7	Pump Materials:		Stainless Steel
	Casing		A276 Type 316
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		A743
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
1.9	Design Flow each (est.)	gpm	**125** (final flow will be based on GE data)
	Suction Pressure (est.)	psia	20
	Design Discharge Pressure (est.)	psia	150
	Design Temperature Range (est.)	°F	50-97
	Density of feed water at design temperature (est.)	lb/ft^3	62.4
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

Item	Description:	Units	Demineralized Water Forwarding Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5DWS-PMP-030A/B
1.2	Type:		Centrifugal
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Demineralized Water
1.7	Pump Materials:		Stainless Steel
	Casing		A276 Type 316
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		A743
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
1.9	Design Flow each (est.)	gpm	**125** (final size based on GE data)
	Suction Pressure (est.)	psia	20
	Design Discharge Pressure (est.)	psia	150
	Design Temperature Range (est.)	°F	50-97
	Density of feed water at design temperature (est.)	lb/ft^3	62.4
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

Item	Description:	Units	Condensate Make-Up Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5CDS-PMP-020A/B
1.2	Type:		Centrifugal
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Demineralized Water
1.7	Pump Materials:		Stainless Steel
	Casing		A276 Type 316
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		A743
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
20	Design Flow each (est.)	gpm	22
	Suction Pressure (est.)	psia	20
	Design Discharge Pressure (est.)	psia	40
	Design Temperature Range (est.)	°F	50-97
	Density of feed water at design temperature (est.)	lb/ft^3	62.4
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

Item	Description:	Units	Wastewater Transfer Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5WWS-PMP-020A/B
1.2	Type:		Centrifugal
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:		
	Casing		A48 Cast Iron
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		B584 Bronze
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
1.9	Design Flow each (est.)	gpm	195
	Suction Pressure (est.)	psia	20
	Design Discharge Pressure (est.)	psia	40
	Design Temperature Range (est.)	°F	75-100
	Density of feed water at design temperature (est.)	lb/ft^3	*
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

Item	Description:	Units	Bearing Cooling Water Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5BCW-PMP-010A/B
1.2	Type:		Centrifugal
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:		
	Casing		A48 Cast Iron
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		B584 Bronze
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
1.9	Design Flow each (est.)	gpm	~**2050** (pending final cooling loads and heat exchanger sizing)
	Suction Pressure (est.)	psia	74
	Design Discharge Pressure (est.)	psia	94
	Design Temperature Range (est.)	°F	75-120
	Density of feed water at design temperature (est.)	lb/ft^3	*
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

Item	Description:	Units	Process Drain Forwarding Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5MDS-PMP-020A/B
1.2	Type:		Centrifugal
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Process Drain Condensate
1.7	Pump Materials:		
	Casing		A48 Cast Iron
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Rings		B584 Bronze
	Impeller		A276 Type 316
	Mechanical Seals		API Seal Plan 14
1.8	Speed	RPM	1750
1.9	Design Flow each (est.)	gpm	**20**
	Suction Pressure (est.)	psia	35
	Design Discharge Pressure (est.)	psia	75
	Design Temperature Range (est.)	°F	75-250
	Density of feed water at design temperature (est.)	lb/ft^3	58.82-62.26
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	*
	Size, discharge	in. NPS	*
	Design Pressure	psig	*
	Design Temperature	°F	*
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
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		N/A
*Data fields to be completed by BOP Contractor			

4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR

Fill in for each applicable pump

Item	Description	Units	
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		

Item	Description	Units	
	Flow	gpm	
	Total head	ft	
	Efficiency	%	
	Max. sound level @ 3', (dBA)	dBA	
	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		

Item	Description	Units	
	Final thickness	in	
	Surface preparation		
	Item(s) or Section		
	Coating		
	Manufacturer & Designation		
	Final thickness	in	
	Surface preparation		

July 26, 2013

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE *INSTALLATION)*

Section 485325.11
Ammonia Forwarding Pump Skid

PROJECT NUMBER:
123374

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Section 4855325.11
Ammonia Forwarding Pump Skid

Prepared for: *PASADENA WATER & POWER*
Prepared by: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
7/26/13	T. Clark	A

SECTION 485325.11
AMMONIA FORWARDING PUMP SKID

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 2
1.5 DEFINITIONS 2
1.6 SYSTEM DESCRIPTION 3
1.7 SUBMITTALS 4
1.8 QUALITY ASSURANCE 5
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 6
1.10 SITE CONDITIONS 6
1.11 WARRANTY 6

PART 2 - PRODUCTS 6

2.1 MATERIALS AND WELDING 6
2.2 EQUIPMENT 8
2.3 COMPONENTS 10
2.4 FABRICATION 13
2.5 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 16

3.1 SPARE PARTS 16
3.2 FIELD QUALITY CONTROL 16
3.3 SCHEDULE 16

PART 4 - ATTACHMENTS 17

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER 17
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR 18
4.3 AMMONIA FORWARDING PUMP SKID PIPING ARRANGEMENT SKETCH 21

SECTION 485325.11
AMMONIA FORWARDING PUMP SKID

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of an ammonia transfer pump skid. It is not the intent to specify completely herein all details of design and construction of the transfer pump skid. 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 BOP Contractor's guarantee in a manner acceptable to the General Manager.

B. The BOP 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY BOP CONTRACTOR

A. The following equipment, materials and services shall be provided by the BOP Contractor for each pump and driver set:

1. Base frame mounted pump with close coupled electric motor driver and variable speed drive selected to perform as required for the pump datasheet attached to this Section.
2. All piping, accessories, and necessary instrumentation between the inlet and outlet tie points of the ammonia transfer skid assembled prior to shipment to the site
3. All seals, bearing lubrication systems, couplings, coupling guards, drivers, baseplates/support systems and other standard accessories or as specified herein.
4. Cleaning and finishing prior to shipment
5. Painting
6. Startup spares and special tools
7. If required for the project, performance testing at factory and certificates of results
8. Drawings and design data to support facility design, construction and maintenance
9. Inspection certificates and quality control documentation listed in this Section
10. Complete set of component cut sheets
11. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
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.
14. Sun shade cover or awning over the skid
15. Foundation and anchor bolts

16. Piping external to pump skids
17. Motor starters and power wiring
18. Receipt and off-loading at site
19. Installation at site, material lay-down area defined by the General Manager
20. Skid mounted Control System, with control system hardware, configuration Local HMI programming completed and tested.
21. Electrical, instrumentation and controls wiring
22. Field inspection and testing

1.3 RELATED SECTIONS

A. Section 260000, Electrical - Mechanical Equipment

B. Section 262050, Specification for Low Voltage Motors

C. Section 480020, Site Conditions

D. Section 480031, Combined Cycle Power Island Noise Control Performance

E. Section 481200, Combined Cycle Balance of Plant

1.4 CODES AND STANDARDS

A. Refer to 481200 Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. Antifriction Bearing Manufacturer's Association (ABMA)
2. American National Standards Institute (ANSI)
   a. ANSI/HI 3.6 Rotary Pump Tests - A110
   b. ANSI/HI 4.1-4.6 Sealless, Magnetically Driven Rotary Pumps for Nomenclature, Definitions, Application, Operation, and Test - A111
3. American Petroleum Institute (API)
   a. API 676 Positive Displacement Pumps - Rotary
4. Hydraulic Institute Standards (HI)
5. International Standards Organization (ISO)
   a. ISO 10816 Mechanical Vibration: Evaluation of machine vibration by measurements on non-rotating parts
   b. ISO 14847 Rotary Positive Displacement Pumps - Technical Requirements

1.5 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.

1.6 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 and assembled to provide suitable access for operation and maintenance of the equipment.
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 pumps shall be suitable for continuous outdoor operation in the ambient conditions as detailed in Section 480020, Site Conditions.
5. Each pump shall be completely assembled, piped and mounted on a common base plate aligned with the electric driving motor.
6. When a standby pump is required it shall be designed to start automatically in an emergency situation when the failed operating pump shuts down.
7. The pump materials shall be suitable for the fluid being pumped. Refer to attachments for fluid description and recommended pump materials.
8. When multiple pumps are supplied, 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.
9. 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 BOP Contractor shall guarantee the following:

    a. Capacity without negative tolerance.
    b. Total developed pressure without negative tolerance and plus 3% at the design capacity.
    c. NPIP (Net Positive Inlet Pressure) required without positive tolerance minus 10% at design capacity.
    d. Pump efficiency without negative tolerance.
    e. Shutoff pressure without positive tolerance above guarantee, minus 3%.
    f. Acceptable total developed pressure deviation amongst identical units of 2% at design capacity.
    g. Wire-to-fluid horsepower input at pump design operating point, corrected to actual fluid temperature within HI tolerances.

2. 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.
3. The pump selection shall maintain an $NPIP_{req}/NPIP_{avail}$ ratio of 50% at the runout flow condition. The pump run-out flow shall be defined as no more than 120% of design.
4. 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.
5. BOP Contractor shall guarantee that the equipment supplied shall meet the specified noise criteria in Section 480031, Combined Cycle Power Island Noise Control Performance 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 BOP Contractor shall provide adequate redundancy to meet this requirement. BOP 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. BOP Contractor shall provide additives for redundancy for these systems and components.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:
1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:
   a. Preliminary physical descriptions of all quoted equipment.
   b. List of warranties and guarantees.
   c. Completed “Technical Datasheets by BOP Contractor” attached to this Section
2. The BOP Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:
1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award including the following documentation:
   a. Complete list of electrical loads associated with the BOP Contractor’s scope of supply. For all loads, the list shall contain description, location of the interconnect, voltage, ampere rating, phase, rated load, operating load, service factor, and whether operation is continuous, intermittent, or emergency only.
   b. Motor data including manufacturer, equipment tag number, horsepower (HP), voltage, ampere rating, phase, service factor, enclosure, insulation, rpm, efficiency, and accessories.
   c. Noise data including estimated sound power levels for the eight octave bands, corrections for silencers, ducts distance etc. and an estimated logarithmic summation for the driver and driven equipment.
   d. Characteristic Curves:
      1) Certified pump characteristic curves shall be submitted for each pump. Curves shall indicate total head, efficiency, brake horsepower, NPSH required, and required submergence as ordinates, with capacity in gallons per minute as the abscissa.

2) Curves shall be submitted for maximum and minimum impeller designs which may be fitted to the pump casing and for the impeller design being provided. When variable speed or two speed drivers are specified, pump performance curves shall be submitted for rated impeller diameter at 10% speed increments from 60% - 100% speed.
3) The characteristic curves shall indicate pump performance from zero capacity to the pump runout capacity.
4) Speed-torque curves, including reverse rotation speed-torque characteristics and inertia (WR^2) values for the pump, shall also be submitted.

C. Shop Drawings
1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

D. Operation and Maintenance Manuals
1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.
2. Maintenance instructions shall include as a minimum the following topics:
a. Data Sheets.
b. Special shipping, handling, and storage instructions.
c. Lubrication requirements.
d. Maintenance and repair instructions, including procedures, checklists, tolerances, clearances and hazards.
e. Special tool or facility needs, etc.
f. Bill of materials.
g. Descriptive literature.
h. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)
i. Applicable MSDS
j. Mechanical/Electrical Drawings

1.8 QUALITY ASSURANCE

A. Refer to Section 481200 Combined Cycle Balance of Plant 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

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general Packaging, Delivery, Storage, and Handling requirements.

1.10 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

B. The pumps shall be guaranteed to operate satisfactorily without damaging pitting, cavitations, or excessive vibration, when pumping against system pressure and when starting or stopping a pump with another pump in operation on the header.

1. The following shall be guaranteed:

a. Capacity at the design operating point.
b. Total developed pressure at the design operating point.
c. Pump efficiency at design operating point.
d. Horsepower required at the design operating point and maximum horsepower requirement.
e. Shutoff pressure.
f. Proper, stable operation with pumps in parallel over the range from recommended minimum flow to maximum, or 120% of design capacity, whichever capacity is greater.
g. Single pump operation from the recommended minimum flow to runout flow at minimum system resistance.
h. No critical speed at or near pump operating speed. All critical speeds shall be at least 25 percent greater than the highest operating speed.

2. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.
3. Pumps shall be designed to have a required NPIP at one pump run-out conditions of no more that 75% of the NPIP available. Reliability during all operation is a major consideration.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. 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.

B. Materials of Construction

1. The pump shall be manufactured using materials that meet or exceed the strength and corrosion-erosion resistance of the following listed materials. Selection of pump materials for each pump application shall be subject to the approval of the General Manager.
2. Ammonia is corrosive to aluminum, zinc, and copper. Use of these materials should be minimized in aqueous ammonia handling systems and not allowed in contact with wetted parts.

3. The construction materials for pumps identified as all stainless steel are as follows:

    a. Casing – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    b. Driver and Idler Gears – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    c. Wear Plate - Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    d. Shaft - Stainless steel ASTM A276 Type 316 or General Manager equal.
    e. Base Plate – ASTM A283, A285, or General Manager approved equal.

4. Materials for manufacturing pumps shall be as specified on the individual pump data sheet. General material selections will follow API 676 guidelines for each fluid service. The BOP Contractor shall select suitable materials for pump wear rings and shaft sleeves based on the fluid analysis and technical requirements supplied for the project.
5. Austenitic stainless steel pump parts subject to welding shall be furnished in the "L" grade. Austenitic stainless steel shall be furnished in the solution-annealed condition. Stainless steel components shall not be cold worked by design to enhance mechanical properties. Internally wetted parts shall not utilize coatings.
6. Materials shall be identified with the applicable AISI, ASTM, ASME or SAE number, including material grade on pump data sheets and recommended spare parts lists supplied for the project.
7. If the BOP 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 BOP Contractor's proposal.
8. Minor parts not identified shall have corrosion resistance equal to that of specified parts in the same environment.
9. Mating parts, such as studs and nuts, constructed of 18-8 stainless steel or of materials having similar galling tendencies shall be lubricated with an anti-seize compound.
10. Control system components shall be enclosed in a skid-mounted NEMA 4X panel with ZeRust vapor capsules supplied as appropriate for enclosure volume.

C. Welding

1. All welding shall be in accordance with ASME Section IX. Welding procedures for stainless steels shall be designed to minimize sensitization for the heat affected zone. Piping supplied by the pump manufacturer shall be designed to conform to piping code ASME B31.1.

D. Castings

1. Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters, and other defects. Casting surfaces shall be cleaned by standard methods such as

sandblasting, shot blasting, or pickling. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.

2. Castings shall not be repaired by peening, plugging, burning in or impregnating. If weld repairs to castings are authorized by the ASTM specification for the material, repair welding shall be in accordance with the applicable ASTM specification. Weld repairs shall be inspected according to the same quality standards as for inspection of the castings. Repairs not covered by an ASTM specification shall be subject to approval of the General Manager.

2.2 EQUIPMENT

A. General Requirements

1. The project is an outdoor installation. The pumps shall be suitable for continuous operation in the ambient conditions exposed to the elements.
2. Pumps shall be designed for a continuous service life of 30 years. Pump 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. Design of rotating elements shall be such that all critical speeds shall be at least 25 percent greater than the operating speed.
4. Manufacturer shall provide all connections for suction, discharge, sealing, and venting. Piping shall be in accordance with ASME B31.1. All piping furnished by the Manufacturer shall be provided in ASME standard sizes in nominal English units (inch sizes). The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.
5. BOP 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. The ammonia forwarding pumps shall be rotary positive displacement external gear type pump design with sealless leak proof casings. The pumps shall be self-priming, designed for low NPIP, and run dry without damage to the pump.
2. The pumps shall be designed for pulseless fluid transfer from the existing aqueous ammonia storage tank to the ammonia vaporization skid. A charged accumulator shall be provided at the pump discharge if necessary to dampen pulsations in flow or pressure.
3. The pumps will be operated singly or in parallel. Each pump shall operate satisfactorily in two pump parallel operation, in single pump operation, and when bringing on or taking a pump out of service with any other pump, or pumps in service. The pumps shall deliver the pressure and capacity indicated in pump data sheets in this Section.
4. The pumps shall be capable of operating continuously at the minimum flow without damage to the pumping equipment.
5. Pumps furnished for the same service shall be designed to operate continuously in parallel over the pump operating range without cavitations.

6. Where pumps are furnished for parallel operation, these pumps shall be "identical" as defined by the Hydraulic Institute standards, with all replacement parts being interchangeable.
7. The difference in flow for pumps operating in parallel shall not exceed 5 percent throughout the operating range.
8. Pumps shall be capable of both intermittent (start/stop) and continuous operation under flow conditions from minimum flow to runout conditions.
9. Each pump submitted by the BOP Contractor shall be designed for operation as specified in data sheet.
10. Wetted pump parts shall be suitable for the fluid being pumped. Materials specified for the pumps are shown in the data sheets. BOP Contractor may propose alternate materials which in its own experience are more suited to the intended service. The alternate materials shall be subject to General Manager's approval.

C. Pump Characteristics

1. Pumps shall be designed to operate with variable speed motors to supply constant pressure at the outlet tie point with accurate turndown to 10% of normal flow to meet supply requirements of the ammonia vaporization and injection system supplied by the power island equipment Contractor under Section 485413, Once Through Heat Recovery Steam Generator.
2. It is preferred that the pumps have maximum efficiency at approximately design operating capacity and pressure.
3. Pumps shall be suitable for extended operation over the range from minimum to maximum flow without damaging pitting, cavitations, excessive noise, or excessive vibration.

D. Skid Assembly

1. The ammonia forwarding pumps and accessory piping shall be mounted on a common skid. The 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.
2. The skid will be installed in a curbed area for spill containment. The skid footprint must fit within the containment area provided.
3. 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.
4. 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.

E. Additional Technical Requirements

1. Noise requirements: Refer to Section 480031, Combined Cycle Power Island Noise Control Performance.

2.3 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 BOP 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 BOP 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 BOP Contractor's warranty to include all direct costs to the General Manager that may result from the BOP Contractor's use of such procedures, components or assemblies.

B. Couplings

1. Sealless magnetic couplings shall be supplied to reduce potential risk of leaking aqueous ammonia to atmosphere. The couplings shall have a high torque capacity to minimize slip between the driver and driven couplings.
2. Couplings shall be attached to driver and driven shafts by press fits and keys.
3. Shaft couplings shall be sized to transmit the maximum brake horsepower requirements of the driven equipment with a service factor of not less than 2.

C. 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.
4. Safety guards for horizontal shafts, shaft couplings, belt sheaves, etc., shall be of the inverted "U" design with sides extending to the equipment base or base plate.

D. Base Plate

1. A cast iron or welded steel equipment base plate shall be provided which is to be installed on a concrete base. Each base plate shall support the unit and its drive assembly and shall be of a neat design with pads for anchoring the units. Motor mounting provisions shall be acceptable to the motor manufacturer. Base plates shall be designed to adequately support the equipment under all conditions without 100% grout fill inside the base plate frame. Equipment bases shall be designed to accept a connection to the plant grounding system. Anchor bolt pattern, number and diameter shall be determined by the Manufacturer, based on the assumption that anchor bolts shall be fabricated from ASTM A36 bar stock material.

E. Bearings

1. Pumps shall be furnished with removable shaft sleeves as required by system design. Where required, the shaft shall be completely protected and isolated from the pumped fluid by incorporating gasketed or similarly sealed joints between the sleeve and the shaft. If the manufacturer's design does not include sealed joints, the pump shaft shall be constructed of a material equivalent to the material of the shaft sleeve.

2. Pump bearings shall be of the oil-lubricated sleeve or anti-friction type. Anti-friction bearing shall be designed for AFBMA L-10 life rating of not less than 130,000 hours. Pumps shall be provided with thrust bearings as required by the system designed to prevent thrust loads from being imposed on the drive motor bearings. Thrust bearings shall be of the Kingsbury type or double roll anti friction bearing as required by the pump service.

F. Casing

1. The pump casing shall be design for close-coupled connection to reduce installation footprint and need for pump alignment in the field.
2. Pump casing connections shall be at least NPS ½" and flanged or machined and studded and oriented for maintenance accessibility. Threaded connections may be used in sizes NPS ½" through NPS 1.5".
3. The pump casing, including suction connection, shall be rated for the design conditions of the pumping system. Suction and discharge connections shall be flanged. Each pump casing shall be furnished with tapped connections for casing drain and vent. Each connection shall be furnished with a solid, hex head, forged steel pipe plug. Casing pressure, drain, and vent connections shall be threaded.

G. Piping

1. The BOP Contractor shall supply all necessary piping, piping supports, isolation valves and fittings for all lines for ammonia, 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 attached Ammonia Forwarding Pump Skid Piping Arrangement Sketch is provided to show minimum requirements of on-skid piping. The BOP Contractor shall provide sufficient instrumentation to ensure reliable, efficient operation of the system.
3. The material and fabrication of all skid piping and connections to equipment shall conform to ANSI B31.1. Sizes 2" and smaller shall be Schedule 80 minimum and may be flanged, welded or socket welded. Threaded joints with seal welded construction are not permitted.
4. 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.
5. 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. Thermowell connections shall be 1" NPT.
6. Relief valves for all equipment shall meet all Federal, State, and local regulations. The BOP Contractor shall furnish and install all relief valves required on all piping and equipment within the Scope of Supply with settings clearly and indelibly marked on the valve or stamped onto the valve's nameplate. The BOP Contractor shall determine sizes and set pressures for relief valves related to the equipment to protect. The relief valve installations shall be complete with all valve vent piping individually routed back to the ammonia storage tank.

H. Instrumentation

1. Refer to Section 481200, Combined Cycle Balance of Plant for general instrumentation requirements.

2. The ammonia forwarding pump skid shall be supplied with a skid mounted control panel with an enclosure and all components suitable for the environment outlined in Section 480020, Site conditions. The control panel shall meet these requirements without the need for purging. Installation shall provide for local control and shall provide remote control by the Plant Control System (PCS) via Ethernet link. All hardware, software and programming required for the control system shall be provided. Local and Remote controls shall be capable of controlling, monitoring and alarming of all functions of system components.
3. Alarms shall be annunciated locally both audibly and visually. Alarms for the skid will consist of a minimum: system trouble, shutdown, pump fault, high temperature.
4. Instruments to be supplied as indicated on the system P&ID. Instruments shall conform to the following:
   a. Pressure gauges shall have a 316 SS block and bleed valve. 4.5" dials shall be used. Minimum ¾" socket weld gate valves shall be used for pressure tap root valves.
   b. Temperature indicators shall have a 4.5" dial. All Temperature indicators shall be supplied with 3/4" or 1" socket weld thermowells.
5. Wiring external to the control cabinet shall be installed in weatherproof rigid galvanized steel (RGS) conduit with appropriate seals and fittings.
6. All alarm and shutdown circuits shall be fail-safe
7. Terminations for external wiring to motor control center feeder shall be provided on a separate terminal strip with ample wiring space.
8. Voltages in the control panel shall not exceed 120vac or 125VDC.
9. Voltage sources to the control panel greater than 24VDC shall be isolable by means of a single switch external to the cabinet.

I. 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 or rivets. 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 Flow Capacity
   g. Design Pressure
   h. Design Temperature
   I. Maximum continuous speed
   J. General Manager's equipment tag number

J. Auxiliary Equipment Requirements

1. The BOP Contractor shall determine if the aqueous ammonia forwarding pump installation location meets hazardous area classification criteria defined in NFPA 70. If the location meets hazardous area classification, the BOP Contractor shall provide a hazardous area classification plan identifying the classification of each hazardous area and provide electrical equipment properly rated for installation in the hazardous area.
2. Electrical Requirements: Refer to Section 262050 - Low Voltage Motors.

2.4 FABRICATION

A. Shop Assembly

1. The pump assembly and motor shall be installed on a common base plate.
2. The pump shall be connected to the motor by a flexible coupling.
3. The BOP Contractor shall provide only items that are of standard and current manufacturers' construction. Non-standard special items or any other difficult to replace items shall not be supplied without the General Manager's prior approval.

B. Shop/Factory Finishing

1. Cleaning

    a. Internal Surfaces

        1) All internal surfaces shall be free of gross contaminants, such as heavy deposits of mill or heat treating scale, oil, oxide films, slag, flux, weld splatter, dirt, metal chips, and abrasive particles.
        2) Manufacturer's cleaning plan shall ensure that cleaning materials do not adversely affect the surface or base metal in the cleaning, manufacturing, or operational environments and that, once obtained; the cleanliness will be maintained during subsequent manufacturing, shipping, storage and handling.
        3) Abrasive blasting shall not be used on surfaces containing areas where grit can accumulate and not be readily removed by subsequent cleaning, rinsing or flushing.

    b. External surfaces shall be smooth and free of gross contaminants such as heavy scale, rust, sand, blisters, weld splatter, metal chips, and heavy deposits of oil or grease.

2. Painting

    a. Cleaning of surfaces that are not to be coated or painted shall be done in accordance with the Supplier's best recommended practice. Only non-corrosion-resistant materials shall be coated.
    b. Insulated surfaces shall not be primed. Stainless steel shall not be painted.

2.5 SOURCE QUALITY CONTROL

A. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.
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.

B. Tests and Inspections

1. All rotating parts shall be statically and dynamically balanced. Impellers shall be dynamically balanced prior to assembly on the pump shaft. Motor rotors shall also be balanced.
2. Steps shall be taken in the fabrication and assembly to ensure that all mechanical fits are concentric and true to ensure alignment during installation.
3. All welding, welding procedure qualifications and welder qualifications shall be in accordance with the BOP Contractors' ISO-9000 or equivalent qualified program.
4. Within 60 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent manufacture and inspection operations. The General Manager may, within 60 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection before the item concerned can be released for further manufacture or shipment.
5. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing. Unless the General Manager shall advise the BOP Contractor not to proceed with the inspection and testing prior to five days before the date which the BOP Contractor has stated in its notice, the BOP Contractor may proceed and any inspection and tests shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the inspection and test results.
6. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).
7. Major items supplied by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP Contractor or a third party. A test procedure shall be prepared for each such test which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be available for review by the General Manager. Successful completion of such test shall be a precondition to shipment of the tested item. The General Manager shall be notified in writing at least 14 days prior to any final factory test of any major components to be supplied.

C. Hydrostatic Tests

1. Equipment, piping, 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.

D. Functional and Performance Tests

1. The equipment shall be subjected to functional and performance tests in the BOP Contractor's shop to the greatest extent possible to verify the BOP 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 BOP Contractor.

E. Shop Tests

1. 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.
2. If testing is specified one pump for each service shall be shop tested for capacity, NPIP required, power requirements, and efficiency at minimum flow recommended for continuous operation, maximum pressure, design point pressure, shutoff pressure, and at as many other points as necessary for plotting an accurate performance curve. Each pump shall be tested with its own motor.
3. Pumps shall be balanced so that peak to peak amplitude of rotor vibration in any plane measured at the pump bearing housing under design speed shall not exceed 1.5 mils over the pump operating range.
4. 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 article.
5. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.
6. 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.
7. 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.
8. If the pumps are not to be shop tested, then the results of prototype model pump shop tests, previously performed by the manufacturer, shall be used to develop performance curves for the miscellaneous pumps.
9. 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.
10. 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.
11. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed, 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.
12. The General Manager reserves the right to witness all shop tests. Twenty (20) working days advance notice of all tests shall be given to the General Manager.
13. The General Manager reserves the right to witness all pumps re-testing.
14. BOP 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. The BOP Contractor shall furnish a complete priced list of recommended spare parts for two years operation. Spare parts may be purchased separately by the General Manager. A separate list shall identify any recommended spare parts for startup and commissioning. Startup and commissioning spares shall be included in the base bid.

3.2 FIELD QUALITY CONTROL

A. Field Testing

1. Following erection/installation of equipment, General Manager may require equipment to be tested by the BOP Contractor in the installed condition to verify the equipment's ability to operate under the specified conditions and to meet the specified performance guarantees.
2. In the event that the pumps do not meet the performance guarantees in the erected/installed conditions, the BOP Contractor shall make alterations and modifications as necessary to meet the performance guarantees, at the Manufacturer's expense.

3.3 SCHEDULE

A. The BOP Contractor shall provide a schedule for the design, fabrication, shop testing, and preparation for shipment of the equipment furnished by the BOP Contractor. The schedule shall also provide anticipated durations for field erection and testing of the equipment furnished by the BOP Contractor.

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER

Item	Description:	Units	Ammonia Forwarding Pumps
1.0	Client Name		Pasadena Water & Power
	Project Name		Glenarm Repowering Project (GT-5 Combined Cycle Installation)
1.1	Pump Tag No.(s)		5AST-ZXX-020
1.2	Type:		Rotary displacement
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		19% Aqueous Ammonia
1.7	Pump Materials:		
	Casing		A276 Type 316
	Shaft		A276 Type 316
	Shaft Sleeve		A276 Type 316
	Wear Plate		A743
	Impeller		A276 Type 316
1.8	Speed	RPM	TBD by BOP Contractor
1.9	Design Flow each (est.)	lb/hr	23
	Suction Pressure (est.)	psia	25
	Design Discharge Pressure (est.)	psia	94.7
	Design Temperature Range (est.)	°F	50-80
	Density of fluid at design temperature (est.)	lb/ft^3	TBD by BOP Contractor
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	TBD by BOP Contractor
	Size, discharge	in. NPS	TBD by BOP Contractor
	Design Pressure	psig	TBD by BOP Contractor
	Design Temperature	°F	TBD by BOP Contractor
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
1.12	Shop Test Required, y / n		No
1.13	Suction Strainer:		
	Type		Wye type with strainer flow area not less than 4 times the pipe size
	Mesh		50
	Fasteners		Quick Opening
	Material		SS
1.14	Minimum Recirculation		Yes, check valve and orifice

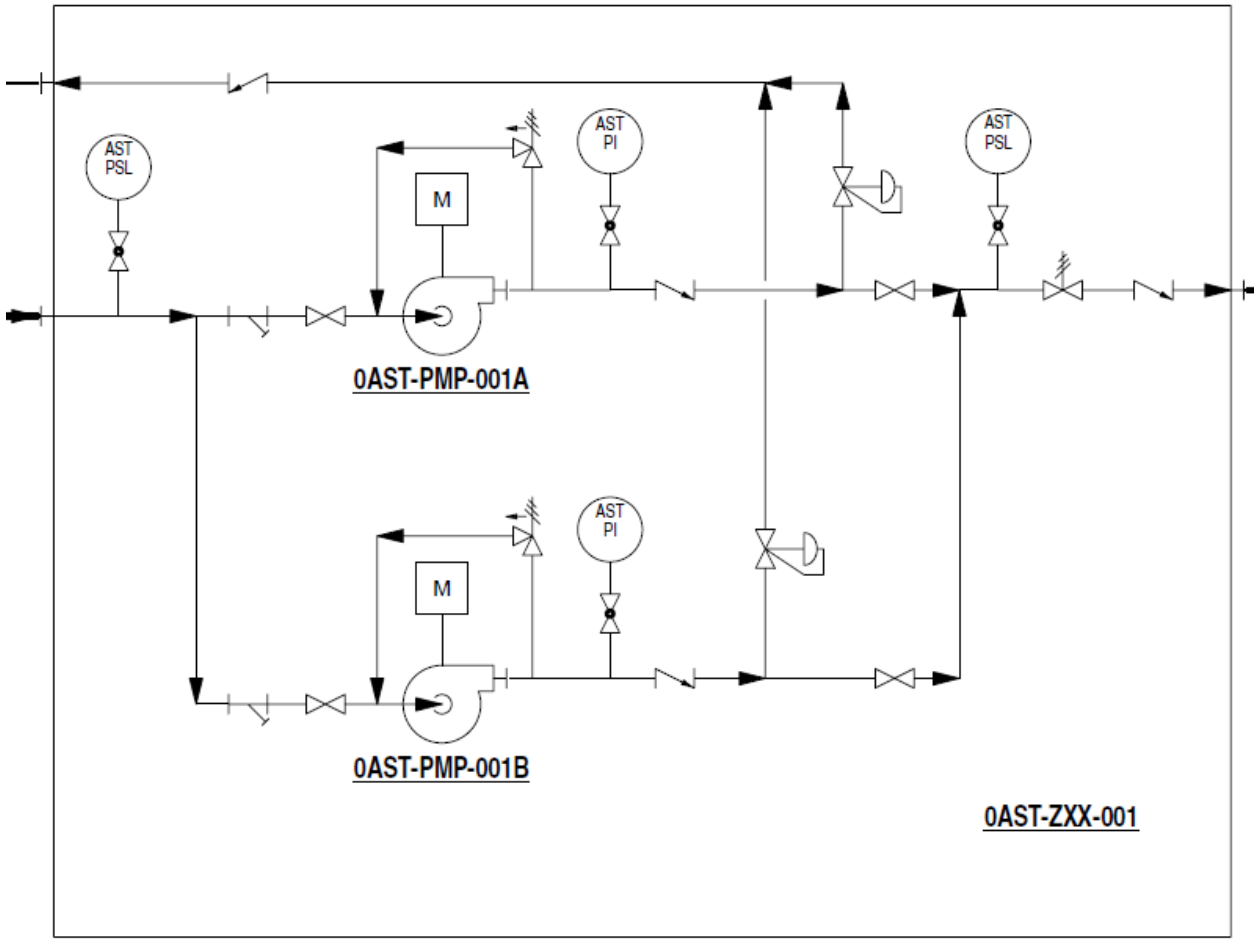
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR

Item	Description	Units	
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 pressure	psi	
	Pump speed	rpm	
	NPIP required	psia	
	NPIP available	psia	
	Pump efficiency	%	
	Shaft horsepower	hp	
	Motor Nameplate Rating	hp	
3.0	**OTHER PERFORMANCE DATA**		
	Total pressure @ shutoff	psig	
	Recommended min. recirculation	gpm	
	NPIP required @ 120% of rated flow	psia	
	Flow @ maximum pressure	gpm	
	Maximum pressure	psig	
	NPIP required @ runout	psia	
	Shaft horsepower @ runout	kW	
	For impeller diameter @ BEP		
	Flow	gpm	

Item	Description	Units	
	Total pressure	psia	
	Efficiency	%	
	Max. sound level @ 3', (dBA)	dBA	
	Shutoff pressure	psig	
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	

Item	Description	Units	
	Surface preparation		
	Item(s) or Section		
	Coating		
	Manufacturer & Designation		
	Final thickness	in	
	Surface preparation		

4.3 AMMONIA FORWARDING PUMP SKID PIPING ARRANGEMENT SKETCH



December 9, 2013

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT
(GT-5 Combined Cycle Installation)

Section 485422
Shell and Tube Heat Exchanger

PROJECT NUMBER:
123374

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Section 485422
Shell and Tube Heat Exchanger

Prepared for: *PASADENA WATER & POWER*
Prepared by: *SARAH GOLDSTEIN*

REVISION HISTORY		
DATE	REVISED BY	REVISION
9/11/13	T. Clark	A
12/09/13	S. Goldstein	B

SECTION 485422
SHELL AND TUBE HEAT EXCHANGER

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 2
1.5 DEFINITIONS 2
1.6 SYSTEM DESCRIPTION 3
1.7 SUBMITTALS 4
1.8 QUALITY ASSURANCE 5
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.10 SITE CONDITIONS 5
1.11 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 EQUIPMENT 6
2.3 COMPONENTS 7
2.4 INSTRUMENTATION AND CONTROLS 11
2.5 FABRICATION 11
2.6 SOURCE QUALITY CONTROL 12

PART 3 - EXECUTION 14

3.1 SPARE PARTS 14
3.2 FIELD QUALITY CONTROL 15
3.3 SCHEDULE 15

PART 4 - ATTACHMENTS 16

4.1 TECHNICAL DATASHEET 16

SECTION 485422
SHELL AND TUBE HEAT EXCHANGER

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of the shell and tube heat exchangers for liquid-to-liquid heat transfer. It is not the intent to specify completely herein all details of design and construction of the heat exchanger. 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 BOP Contractor's guarantee in a manner acceptable to the General Manager.

B. The BOP 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY BOP CONTRACTOR

A. The following equipment, materials and services shall be provided by the BOP Contractor for each shell and tube heat exchanger:

1. Fully assembled shell and tube heat exchanger designed and constructed to perform as required for each datasheet attached to this Section.
2. All seals, vessels, relief devices, instrumentation, isolation valves, nozzle connections, and other standard accessories or as specified herein.
3. Cleaning and finish painting prior to shipment
4. Startup spares and special tools
5. Pressure testing at factory and certificates of results
6. Drawings and design data to support facility design, construction and maintenance
7. Inspection certificates and quality control documentation listed in this Section
8. Complete set of component cut sheets
9. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
10. Priced list of recommended spare parts for two years of operation
11. 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.
12. Foundation, anchor bolts, and concrete embedments
13. Grout
14. Piping external to heat exchanger skids
15. Pipe insulation and lagging
16. Receipt and off-loading at site

17. Installation at site, material lay-down area defined by the owner
18. Plant Control System configuration and graphics programming
19. Electrical, instrumentation and controls wiring
20. Instrumentation
21. Field inspection and testing

1.3 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

1.4 CODES AND STANDARDS

A. Refer to Section 481200, Combined Cycle Balance of Plant 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. API 660 – Shell and Tube Heat Exchangers for General Refinery Services
2. American Society of Mechanical Engineers (ASME)
   a. BPVC Section VIII, Division 1 - Rules for Construction of Pressure Vessels
   b. B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24
   c. B31.1 - Power Piping
3. Heat Exchange Institute (HEI)
   a. Standards for Power Plant Heat Exchangers
4. International Standards Organization (ISO)
   a. ISO 10816 – Mechanical Vibration: Evaluation of machine vibration by measurements on non-rotating parts
5. Tubular Exchanger Manufacturers Association (TEMA)
   a. Standards of the Tubular Exchanger Manufacturers Association

1.5 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.

1.6 SYSTEM DESCRIPTION

A. Design Requirements

1. All heat exchangers shall conform to the ASME Code Section VIII as specified on the datasheets as well as pressure vessel laws having jurisdiction at the site.
2. All equipment shall be designed for a thirty (30) year life objective in outdoor service. 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. All equipment shall be designed and assembled to provide suitable access for operation and maintenance of the equipment.
4. All equipment shall be designed for continuous 24 hour per day operation with potential daily cycling from off-line to full load.
5. BOP Contractor shall supply shell side and tube side relief valves to protect shell and tubes from overpressure.
6. Heat exchangers shall be sized for ambient conditions with the maximum heating/cooling requirement with 15% margin for tube fouling.
7. Minimum design pressure for all heat exchangers shall be 75 psig unless stated on the datasheet. The minimum differential between maximum operating and design pressure shall generally be as follows. Actual design pressure shall be as specified on the datasheet.

Maximum Operating Pressure	**Minimum Differential Between Max Operating Pressure and Design Pressure**
50 - 250 psig	25 psi
251-1000 psig	10% of design
Over 1000 psig	7.5% of design

8. Equipment shall be designed in accordance with local building codes and seismic design information provided in Section 480020, Site Conditions.

9. Structural calculations shall be performed under the supervision of a professional engineer registered in the state where the site is located and stamped as required by local building codes.

B. Performance Requirements

1. The BOP Contractor shall guarantee the following:

   a. Capacity without negative tolerance.
   b. Fluid pressure drop at all operating cases.

C. Reliability: No single failure of an auxiliary component or system shall result in damage to the System. The BOP Contractor shall provide adequate redundancy to meet this requirement. BOP 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. BOP Contractor shall provide additives for redundancy for these systems and components.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:
1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:
a. A complete physical description of all quoted equipment.
b. List of warranties and guarantees.
c. Completed “Technical Datasheets by BOP Contractor” attached to this Section
d. Characteristic Curves
2. The BOP Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:
1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award including the following documentation:
a. Certified Manufacturer's drawings of shell-and-tube-type equipment, showing size, shape, and arrangement of equipment, including details of all piping connections, tube bundles, gasket details, anchor bolt size and patterns, empty weight, operating weight, and tube bundle weight (removable bundles).
b. Manufacturer's specifications for shell-and-tube-type equipment including ASME designation of materials and type of construction.
c. The bundle detail drawings shall be submitted at the earliest possible date after order. The Supplier shall show the following information with dimensions:
1) The maximum limiting tube circle.
2) Tubesheet, tube layout.
3) The locations of cross flow baffles and baffle cuts.
4) The location of bypass seal strips and tie-rods.
5) Gasket detail.
d. The General Manager reserves the right to request welding procedures, qualification test results, and the qualification test welds as examined. The procedures shall include a description of the weld equipment and any special fixtures to be used, as well as a sketch and definition of all essential variables.

C. Shop Drawings
1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

D. Operation and Maintenance Manuals
1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.
2. Maintenance instructions shall include as a minimum the following topics:
a. Data Sheets.
b. Special shipping, handling, and storage instructions.
c. Maintenance and repair instructions, including procedures, tolerances,
d. Special tool or facility needs, etc.
e. Bill of materials.
f. Descriptive literature.
g. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)

1.8 QUALITY ASSURANCE

A. Refer to Section 481200 Combined Cycle Balance of Plant 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 materials of construction for components (if required by the governing code).
b. Hydrostatic test reports
c. "As Built" heat exchanger data sheets

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general Packaging, Delivery, Storage, and Handling requirements.

1.10 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. 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.

B. Materials of Construction

1. The heat exchanger shell and tube bundles shall be manufactured using materials that meet or exceed the strength and corrosion-erosion resistance of the materials specified in the attached datasheet or by applicable related standards. Selection of materials for each heat exchanger application shall be subject to the approval of the General Manager.
2. Materials shall be identified with the applicable AISI, ASTM, ASME or SAE number, including material grade on data sheets and recommended spare parts lists supplied for the project.
3. If the BOP 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 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 18-8 stainless steel or of materials having similar galling tendencies shall be lubricated with an anti-seize compound.

C. Welding

1. All welding shall be in accordance with ASME Section IX. Welding procedures for stainless steels shall be designed to minimize sensitization for the heat affected zone. Piping supplied by the BOP Contractor shall be designed to conform to piping code ASME B31.1.

D. Castings

1. Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters, and other defects. Casting surfaces shall be cleaned by standard methods such as sandblasting, shot blasting, or pickling. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.
2. Castings shall not be repaired by peening, plugging, burning in or impregnating. If weld repairs to castings are authorized by the ASTM specification for the material, repair welding shall be in accordance with the applicable ASTM specification. Weld repairs shall be inspected according to the same quality standards as for inspection of the castings. Repairs not covered by an ASTM specification shall be subject to approval of the General Manager.

2.2 EQUIPMENT

A. General Requirements

1. The project is an outdoor installation. The heat exchangers shall be suitable for continuous operation in the ambient conditions exposed to the elements.
2. Manufacturer shall provide all connections for inlet, outlet, draining, venting, and maintenance/inspection. Piping shall be in accordance with ANSI B31.1. All piping furnished by the Manufacturer shall be provided in ANSI standard sizes in nominal English units (inch sizes). The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.

B. Heat Exchanger

1. Wetted components shall be suitable for the fluid service. BOP Contractor may propose alternate materials which in its own experience are more suited to the intended service. The alternate materials shall be subject to General Manager's approval.
2. When single-tube-pass design units are stacked in series, the external pipe loops for the tail pipe nozzles shall be provided by the BOP Contractor. The fit up of these loops shall be made in the shop and the exchangers shall be hydrotested as a unit.
3. Unless otherwise specified, carbon steel and low alloy pressure parts, except nozzles, shall have a minimum of 1/8-inch corrosion allowance. For specific allowance requirements, refer to the exchanger data sheets.
4. Floating head units shall be TEMA Type S or Type T design with removable shell covers, unless otherwise designated on the heat exchanger data sheet.

5. TEMA Type A or Type C channel design shall be used unless operating conditions indicate a leakage problem.
6. For TEMA Type C channels, the tubesheet shall be through-bolted to the shell flange and the channel cover flange shall be through-bolted to the channel cover.
7. When TEMA Type B cover is specified, the fixed tubesheet shall be full diameter with threaded bolt holes that permit testing of the shell side when the channel is removed.

2.3 COMPONENTS

A. Tube Bundle

1. The individual parts of a group of exchangers shall be designed for maximum interchangeability of the tube bundles so that spare bundles can be used in a greater number of exchangers.
2. All exchanger bundles shall be removable. Fixed tubesheet designs are not acceptable, unless specified on exchanger data sheets or approved by General Manager.
3. Floating-head bundles are the preferred design except for very large units.
4. The maximum tube bundle diameter is 54 inches. Larger sizes shall not be used unless approved by General Manager.
5. Cooling water shall be directed through the tubes on all water-cooled exchangers. Cooling water may be used on the shell side only if specified on the exchanger data sheet.
6. Cooling water flowing through the tubes shall have a minimum velocity of 4.0 feet per second (fps). The exchanger shall be designed for the highest water velocity through the tubes within the maximum allowable pressure drop and the following maximum velocities:
   a. Stainless Steel: 7 fps
   b. Admiralty Brass: 7 fps
   c. Copper-nickel: 10 fps
7. TEMA Type A or Type C channel design shall be used unless operating conditions indicate a leakage problem.
8. For TEMA Type C channels, the tubesheet shall be through-bolted to the shell flange and the channel cover flange shall be through-bolted to the channel cover.
9. When TEMA Type B cover is specified, the fixed tubesheet shall be full diameter with threaded bolt holes that permit testing of the shell side when the channel is removed.
10. The tubes shall be expanded securely into the tubesheet. Tubes shall be rolled for 80 percent of the thickness of the tubesheet for thicknesses up to 3 inches, with a maximum roll of 3 inches for thicker tubesheets. The rolling shall not extend beyond the shell side face. Tubes that are rolled only shall extend 1/8 inch beyond the outside face of the tubesheet with a tolerance of plus 0 inch, minus 1/16 inch, except that tubes shall be flush with the top tubesheet in vertical exchangers.
11. Tubes shall be welded to the tubesheets with austenitic, stainless steel tube and ferritic or martensitic steel tubesheet when specified on the data sheets. When welding is required, the tube side face of the tubesheet shall be clad or overlaid with deposited austenitic stainless steel weld metal.
12. Where surface requirements are less than a full bundle, only full bundles shall be considered. All surfaces shall be net.
13. The tube bundle shall contain the maximum number of tubes possible, consistent with the manufacturer's shell diameter standards, allowing for tie rods, impingement plates, channel and/or shell pass-ribs, vapor space under nozzles, etc.

14. The tube bundles shall be arranged so that the channel and floating head pass ribs are in a vertical and/or horizontal plane.
15. The inlet nozzle escape area shall be considered as the area of the segment circumscribed by the shell ID and the top tube row, the direction of flow being parallel to the tubes. The area of this segment shall equal one-half the area of the nozzle as a minimum.

B. U-Tube Bundles
1. U-Tube bundles may only be used for applications when specified on the heat exchanger datasheet. U-Tubes are not a suitable substitute when a single pass or double pass with return heads is specified.
2. The minimum bend radius shall be not less than 1.5 times the outside diameter of the tubes. Unless otherwise specified on the individual data sheets, U-bends in the two tube-pass U-tube bundles shall be in a vertical plane.
3. When maximum baffle cuts are required with U-tube construction having horizontal bends, consideration shall be given to the addition of extra tie-rods on the vertical centerline to increase rigidity to the two bundle halves.
4. U-tubes shall be made from one piece of tubing. Circumferential weld joints are prohibited.
5. 18-8 Stainless steel U-tubes shall be solution annealed at 1,900˚F minimum after forming U-bends by electric resistance methods.
6. U-tubes may be angled to reduce the row center-center dimension provided that the bending radius is not less than 1.5 times the outside diameter of the tube, and continuous cleaning lanes are maintained.

C. Tubesheets
1. Where provision for tubesheet pulling eyes are provided as per TEMA, the two tapped holes shall be oriented as near as possible to a horizontal axis. Each of the two holes shall accommodate a bolt size sufficient to withstand a pulling force of at least 50% of the bundle weight, based on a maximum bolt stress of 15,000 psi. The tapped holes shall not be smaller than 3/4 inch. Solid plugs of the same material as the tubesheet shall be provided.

D. Tubes
1. Tube sizes for exchangers shall be as follows:
   a. In clean services, 3/4-inch x 13 BWG average wall, or 14 BWG minimum wall, stainless steel tubes shall be used.
   b. In dirty services or where pressure drop is a consideration, 1-inch x 12 BWG minimum wall or 11 BWG average wall, stainless steel tubes may be used.
   c. High alloy or nonferrous tubes shall be 16 BWG minimum. The actual gage shall be as specified on the individual data sheet.
2. Low alloy tubes shall be the same gage as stainless steel.
3. Tube sizes for high-pressure exchangers shall be as specified on the individual data sheets.
4. Welded stainless steel tubes shall be manufactured in accordance with ASME SA249, or SA268 standards. Seamless stainless steel tubes shall be in accordance with ASME SA213.
5. Where welded tubing is used all welded tubes shall be 100% nondestructive-electric-tested in accordance with ASME SA450 standards.

E. Shell and Supports

1. The shells of all heat exchangers shall be of all welded construction. BOP Contractor's outline drawings shall show the pullout space required.
2. The axial straightness of the shell shall be such as not to exceed 1/8-inch clearance when measured with a 10-foot straightedge.
3. The completed shell shall be sufficiently circular to permit the passing of a template completely through the shell without binding. This template shall consist of two discs with an outside diameter equal to the transverse baffle outside diameter or the floating tubesheet outside diameter, whichever is larger, and shall be rigidly mounted perpendicular on a shaft and spaced 12 inches apart.
4. Shells shall not be stacked more than two high. Exception may be taken for small pipe size shells, which may be stacked three high with the General Manager's approval. The exchanger supports shall be designed to take the load of the top exchangers without distorting the shell of the bottom exchanger. A minimum of 12 inches shall be provided between shell body flanges of stacked exchangers to facilitate maintenance. The BOP Contractor shall provide complete structural steel supports required for stacking. Differential thermal expansion stresses between stacked shells shall be determined and shall not exceed the ASME Code allowable stresses.
5. Flange bolts 1 inch and larger in diameter, shall be designed to permit the use of a bolt tensioner.
6. Support pads shall be seal-welded to the shell and drained at the low point with a 1/4-inch hole.
7. The exchanger fixed support shall be designed for a horizontal frictional force of the bundle weight or 1/5 of the operating weight, whichever is greater. Sliding supports shall be designed likewise unless TFE slide plates are used.

F. Baffles

1. All baffle cuts shall be vertical, unless otherwise specified. The first baffle shall be located as close to the tubesheets as possible consistent with the specified baffle spacing. The floating head support shall be as close to the floating tubesheet as possible. Baffles shall not be located between the inlet or outlet nozzle and the respective tubesheet.
2. Longitudinal shell baffles (TEMA Type F) shall not be used unless specified on the individual data sheets. Two shell pass exchangers shall have longitudinal baffles designed with leaf seals to prevent bypassing from the first pass to the second. This leaf seal shall consist of a minimum of eight Type 304 stainless steel metal strips bolted to the longitudinal baffle. Packed or labyrinth-type longitudinal baffles are not acceptable. Across longitudinal baffles, the pressure drop shall not exceed 7 psi and the temperature differential shall not exceed 300 degrees F.

G. Flanges

1. Flange design shall be limited to the conventional bolted-type joints. Clamp-type joints shall not be used. The facing and drilling of joints in the shell, shell cover, channel, and channel cover shall conform to TEMA standards for confined joints, whenever practicable.
2. The design of end or body flanges shall be such that a nubbin on the flange face is not required for proper gasket seating.
3. Body flanges shall be provided with jackscrews. The minimum number of jackscrews shall be as follows:

Exchanger Diameter	Jack Screws (number @ diameter)
Up to 12 inches	2 @ 1/2 inch
14 to 24 inches	3 @ 5/8 inch
26 inches and larger	4 @ 3/4 inch

H. Nozzles and Connections

1. Nozzle reinforcing pads, or each segment thereof, shall have a 1/4-inch drilled and tapped tell-tale hole to permit testing of attaching welds with air and soap suds prior to final hydrostatic test. Drilled hole shall be deburred before attaching pad to heat exchanger. Segmented pads shall have seams oriented on Manufacturer's prints not less than 45 degrees from longitudinal axis of heat exchanger.
2. Where alloy protection is specified for either the shell and/or tube side, the nozzles through the flange gasket faces shall be similarly protected. Nozzles greater than 6 inches nominal size shall be fabricated from integrally clad plate or alloy protected with deposited weld metal, unless otherwise approved by General Manager.
3. Thermowell and pressure gauge connections, vents, and drains, where required, shall be as specified on the data sheet.
4. Flanged pipe connections and flanged nozzles shall conform to ASME B16.5.
5. All nozzles shall be ground flush with the inside of the channel and shell and shall be contoured to the inside diameter.
6. Bolts between connecting nozzles of stacked exchangers shall be removable without moving the exchanger or disturbing any insulation.
7. Threads shall not be used at all except for drain or vent connection plugs.

I. Lifting Lugs

1. Lifting lugs shall be provided on the channel cover, the channel section, the floating head, and the stationary tubesheet in order to facilitate handling and bundle removal. Each lifting lug shall have a hole with a minimum diameter of 1-1/4 inch.
2. Lifting lugs on stacked exchangers shall be given special attention.
3. Two or more lifting lugs located at 45 degrees from the top centerline shall be provided so that any of the exchangers can be dismantled without undue difficulty and interference with exchanger nozzles or piping.
4. Lifting lugs made from bent rods are not acceptable

J. Gaskets

1. Gaskets in hydrocarbon service shall be double-jacketed fiber-filled metal, solid metal, or spiral-wound fiber-filled metal.
2. Spiral-wound gaskets, when used, shall have a 1/8-inch thick integral compression ring, or a mechanical stop shall be provided on the flange to prevent over compression of the gasket. The gasket surface shall be smooth with a finish of 125 RMS.

K. Base Plate

1. When specified, a cast iron or welded steel equipment base plate shall be provided which is to be installed on a concrete base. Each base plate shall support the heat exchanger vessel and shall be of a neat design with pads for anchoring the units. Base plates shall be designed to adequately support the equipment under all conditions without 100 percent

grout fill inside the base plate frame. Equipment bases shall be designed to accept a connection to the plant grounding system. Anchor bolt pattern, number and diameter shall be determined by the Manufacturer, based on the assumption that anchor bolts shall be fabricated from ASTM A36 bar stock material.

L. Bypass Preventers
1. Bypass prevention seal strips shall be provided to prevent bypassing around the periphery of the bundle.
2. Additional bypass fins or shrouds shall be used where escape areas required by large nozzles create severe bypassing conditions.
3. Where the bypass lanes are not parallel to the baffle cut, seal strips, tie-rods, and/or tubes shall be strategically located to prevent channeling of fluid through the bypass area.

M. Accessories

1. Miscellaneous trim - All piping and valves required for air vent valves, level indicators, , and other miscellaneous accessories shall be furnished by the BOP Contractor. 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.

N. Identification
1. Stainless steel nameplates stainless steel shall be attached directly to the shell, by means of a bracket designed to clear insulation, in a visible location. Nameplates shall be stamped to include the following information:
   a. Service
   b. General Manager's purchase order number and item number
   c. Maximum temperature and pressure ratings of each stream
   d. Extent of heat treating and radiograph
   e. TEMA Type
   f. Codes to which built
   g. Date of manufacture
   h. Manufacturer's name, shop order, model number, and serial number
   i. Shell Side Operating / Design Conditions
   j. Tube Side Operating / Design Conditions
   k. Owner’s equipment tag number
   l. Hydrostatic test pressure
2. All instruments and control devices shall be properly tagged with Owner’s tag number prior to shipment.

2.4 INSTRUMENTATION AND CONTROLS

A. Refer to Section 481200, Combined Cycle Balance of Plant for general instrumentation and controls requirements.

2.5 FABRICATION

A. Shop Assembly

1. Exchanger shells shall be rounded up and properly supported before heat treatment to prevent deformation. Where necessary, machined surfaces shall be coated with a suitable compound for protection against scaling during heat treatment.
2. All heat exchangers shall be fully assembled for shipment.
3. The BOP Contractor shall provide only items that are of standard and current manufacturers' construction. Non-standard special items or any other difficult to replace items shall not be supplied without the General Manager's prior approval.

B. Shop/Factory Finishing

1. Cleaning

a. Internal Surfaces

1) All internal surfaces shall be free of gross contaminants, such as heavy deposits of mill or heat treating scale, oil, oxide films, slag, flux, weld splatter, dirt, metal chips, and abrasive particles. Visual inspection shall be performed to determine acceptability.
2) Manufacturer's cleaning plan shall ensure that cleaning materials do not adversely affect the surface or base metal in the cleaning, manufacturing, or operational environments and that, once obtained; the cleanliness will be maintained during subsequent manufacturing, shipping, storage and handling.
3) Abrasive blasting shall not be used on surfaces containing areas where grit can accumulate and not be readily removed by subsequent cleaning, rinsing or flushing.

b. External surfaces shall be smooth and free of gross contaminants such as heavy scale, rust, sand, blisters, weld splatter, metal chips, and heavy deposits of oil or grease.

2. Painting

a. Steel material furnished under this specification (excluding machined surfaces, surfaces to be bonded to concrete, aluminum, stainless steel, and special alloys) shall be blast cleaned and coated.
b. Surfaces to be painted shall be blast cleaned in accordance with SSPC-SP6, "Commercial Blast Cleaning", or the coating manufacturer's requirements if more stringent than SP6.
c. Cleaning of surfaces that are not to be coated or painted shall be done in accordance with the Supplier's best recommended practice. Only non-corrosion-resistant materials shall be coated.
d. Stainless steel shall not be painted.

2.6 SOURCE QUALITY CONTROL

A. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.

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.

B. Tests and Inspections

1. All welding, welding procedure qualifications and welder qualifications shall be in accordance with the BOP Contractors' ISO-9000 or equivalent qualified program.
2. Within 60 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent manufacture and inspection operations. The General Manager may, within 60 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection before the item concerned can be released for further manufacture or shipment.
3. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing. Unless the General Manager shall advise the BOP Contractor not to proceed with the inspection and testing prior to five days before the date which the BOP Contractor has stated in its notice, the BOP Contractor may proceed and any inspection and tests shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the inspection and test results.
4. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).
5. Major items supplied by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP Contractor or a third party. A test procedure shall be prepared for each such test which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be available for review by the General Manager. Successful completion of such test shall be a precondition to shipment of the tested item. The General Manager shall be notified in writing at least 14 days prior to any final factory test of any major components to be supplied.

C. Hydrostatic Tests

1. 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. The part limiting the hydrotest pressure shall be indicated on the Manufacturer's data report. The limiting part should not be nozzle reinforcement.
3. Tap water may be used for hydrotesting. However, immediately after completion of the hydrotest and draining, any exchanger with austenitic stainless steel exposed to this water shall be thoroughly rinsed with commercial distilled or demineralized water containing

less than 10 parts per million (ppm) total dissolved solids and less than 1 ppm chloride. Particular care shall be taken in rinsing areas containing austenitic surface discontinuities, such as nozzles, baffles, and both sides of tubesheets. As an alternate, water used for hydrotest of heat exchangers that are clad or overlaid with austenitic stainless steel shall contain not less than 5,000 ppm causticity, preferably in the form of ammoniated water. Commercial-grade soda ash, which has high chloride content, shall not be used to produce causticity.

4. The tube bundles shall be hydrostatically tested outside of the shell, or the Manufacturer may test the tube bundle in the shell with the shell full of water and 100 psi air pressure on the tube side, with the top nozzle flange being open to observe possible leads. With the tube bundle installed in the shell, the shell side shall be hydrostatically tested separately, after which the channel side shall be hydrostatically retested. Stacked exchangers shall be hydrostatically tested as a stacked unit.
5. Hydrotest pressure shall not be greater than 90 percent of the minimum yield strength, multiplied by the joint efficiency at the test temperature.

D. Shop Tests

1. 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.
2. The General Manager reserves the right to witness all shop tests. Two weeks advance notice of all tests shall be given to the General Manager.
3. The General Manager reserves the right to witness all equipment re-testing.
4. BOP Contractor shall submit certified copies of test and inspection reports within 14 days of completion of the inspection or test.

E. Acceptance Requirements

1. Heat exchangers that do not satisfy the requirements of this specification shall be subject to rejection.
2. Plate materials that are subjected to ultrasonic examination and that do not meet the requirements of ASME SA435, may be rejected by the General Manager or repaired with General Manager's approval if the repair is made before final post weld heat treatment. Repairs shall be made by welding using a repair technique that includes qualified welding procedures, heat treatment procedures, and inspection methods.

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Complete sets of spare gaskets shall be provided with each exchanger. Each set shall be individually boxed and tagged.

B. The BOP Contractor shall furnish a complete priced list of recommended spare parts for two years operation. Spare parts may be purchased separately by the Owner. A separate list shall identify any recommended spare parts for startup and commissioning. Startup and commissioning spares shall be included in the base bid.

3.2 FIELD QUALITY CONTROL

A. Field Testing

1. Following erection/installation of equipment, General Manager may 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.
2. BOP Contractor will be notified of this General Manager-performed performance testing, and shall be permitted to witness this testing, if desired.
3. In the event that the equipment does not meet the performance guarantees in the erected/installed conditions, the BOP Contractor shall make alterations and modifications as necessary to meet the performance guarantees, at the BOP Contractor's expense.

3.3 SCHEDULE

A. The BOP Contractor shall provide a schedule for the design, fabrication, shop testing, and preparation for shipment of the equipment furnished by the BOP Contractor. The schedule shall also provide anticipated durations for field erection and testing of the equipment furnished by the BOP Contractor.

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET

SECTION 485422
SHELL AND TUBE HEAT EXCHANGER

	Client Name:	Pasadena Water and Power										
	Project Name:	Glenarm Repowering Project (GT-5 Combined Cycle Installation)										
	Project Number:	123374										
	Equipment Tag	5ACW-HEX-020					**Name/Service:**	Auxiliary Cooling Water Heat Exchanger				
	Location	North side of OTSG					Total No.	1	No. Working	1	No. Spare	0
1	Manufacturer						Service Rating:	1 x 100%				
2	Size:		Type:	BEM	**Horizontal**/~~Vertical~~		No. Connected in:	1	Parallel	-	Series	-
3	Surface/Unit (ft^2):		Gross Eff:		Shells/ Unit		Surface/Shell (ft^2):			Gross Eff:		
4	**Performance of One Unit**											
5	Fluid Allocation				**Shell Side**			**Tube Side**				
6	Fluid Name				Bearing Cooling Water			Aux Cooling Water				
7	Fluid Quantity (Total)		lb/hr		1,122,390 *			1,346,706 (2700 gpm estimate)*				
8	Btu-ft/hr-ft^2-F				IN		OUT	IN			OUT	
9	Liquid		lb/hr									
10	Water *		lb/hr									
11	Temperature *		F				90		84			
12	Density		lb/ft^3									
13	Viscosity		cP									
14	Molecular Weight											
15	Specific Heat		Btu/lb-F									
16	Thermal Conductivity		Btu/hr-ft^2-F									
17	Latent Heat		Btu/lb @ F									
18	Inlet Pressure		psig									
19	Velocity		ft/sec									
20	Pressure Drop (Allow/Calc)		psi									
21	Fouling Resistance		hr-ft^2-F/Btu									
22	Heat Exchanged		15*		MMBtu/hr		LMDT Corrected				F	
23	Transfer Rate/Service				Btu/hr-ft^2-F		Clean				Btu/hr-ft^2-F	
24	Construction of One Shell						Bundle/Nozzle Orientation Sketch					
25			Shell Side		Tube Side							
26	Design Pressure	psig										
27	Design Temperature	F										
28	MDMT	F										
29	Passes per Shell		1 or 2		2							
30	Corrosion Allowance	in.	1/16”									
31		In										
32	Connections	Out										

SECTION 485422
SHELL AND TUBE HEAT EXCHANGER

33		Number		OD (in.)		Thickness (in.)		min avg		Length (ft)		
34	Tubes	Type		Material	316SS	Welded/ Seamless		Layout	30	60	90	45
35	Shell Material	Carbon Steel		Dia (in.)	ID	OD	Shell Cover Material	Carbon Steel		**Removable**/~~Integral~~		
36	Channel/Bonnet Material						Channel Cover Mat'l					
37	Stationary Tubesheet Material	316SS					Floating Tubesheet Cover Material			n/a		
38	Floating Head Cover Material						Impingement Protection			Yes/No		
39		Material	Carbon Steel				Type					
40	Cross Baffles	Carbon Steel	:%Cut		:Dia		Area	Spacing (in.):		Inlet (in.)		
41	Long Baffle	Material	Carbon Steel				Seal Type					
42	Tube Supports Material	Carbon Steel	~~U Bend~~				Type					
43	Bypass Seal	Yes/~~No~~		Tube-Tubesheet Joint:	~~Expanded~~	**Seal Weld**	~~Strength Weld~~					
44	Nozzle pV^2	Inlet:	lb/ft-s^2	Bundle Entrance:		lb/ft-s^2	Bundle Exit:		lb/ft-s^2			
45	Gaskets:	Shell Side	Spiral Wound	Tube Side	Spiral Wound		Floating Head	n/a				
46	Code:	Stamp	Yes/No	Nat'l Board Registered:			TEMA Class:	Liquid to liquid				
47	Weights (lbs)	Dry:		Filled w/ Water:			Bundle:					
48	Positive Metal Identification (PMI)					Yes	No					
49	Special Services					Yes	No					
50	Applicable Company Specifications											
51	Insulation Support Rings					~~Yes~~	**No**					
52	Protective Coating	Manufacturer's Standard:				Other: Carbozinc 11 Primer, Carbocrylic 3359 Finish						
53	Insulation Thickness (in)	Shell: none				Channel:	none					
54	Minimum Thickness Calculation:								Yes	~~No~~		
55	Threaded Connections Permitted:								~~Yes~~	No		
56	Continuous Tube Lanes Required:								Yes	No		
57	Connections Beveled for Welding:								~~Yes~~	No		
58	Chemical Cleaning Connections:					~~Yes~~	No	Size:				
59	PWHT of Carbon Steel and Bonnets:								Yes	No		
60	PWHT for Process Reasons:								Yes	No		
61	Special Flatness Requirements for Gasket Contact Services:								Yes	No		
62	Removal of Bonnet or Channel for Shell Side Hydrostatic Test:								Yes	No		
63	Test Rings:								Yes	No		
64	Supplemental Requirements:								Yes	No		
65	REMARKS											
66	* General Manager rating calculation estimate. BOP Contractor to verify or modify as required.											
67	Blank or ** Indicates data to be completed by BOP Contractor.											

December 9, 2013

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE *INSTALLATION)*

Section 485951.96
Potable Water Recirculation Skid

PROJECT NUMBER:
123374

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Section 485951.96
Potable Water Recirculation Skid

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
10/18/2013	T. Clark	A
12/09/2013	T. Clark	B

SECTION 485951.96
POTABLE WATER RECIRCULATION SKID

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 3
1.5 DEFINITIONS 3
1.6 SYSTEM DESCRIPTION 4
1.7 SUBMITTALS 5
1.8 QUALITY ASSURANCE 6
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 7
1.10 SITE CONDITIONS 7
1.11 WARRANTY 7

PART 2 - PRODUCTS 8

2.1 MATERIALS AND WELDING 8
2.2 MAJOR COMPONENTS 9
2.3 EQUIPMENT 11
2.4 COMPONENTS 12
2.5 FABRICATION 15
2.6 SOURCE QUALITY CONTROL 16

PART 3 - EXECUTION 18

3.1 SPARE PARTS 18
3.2 FIELD QUALITY CONTROL 18
3.3 SCHEDULE 18

PART 4 - ATTACHMENTS 19

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER 19
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR 22
4.3 M3-24-1: POTABLE WATER SYSTEM P&ID 24

SECTION 485951.96
POTABLE WATER RECIRCULATION SKID

PART 1 - GENERAL

1.1 SUMMARY

A. This section details the minimum technical requirements for the design, manufacture, testing, and furnishing of a potable water recirculation skid. It is not the intent to specify completely herein all details of design and construction of the recirculation skid. 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 BOP Contractor's guarantee in a manner acceptable to the General Manager.

B. The BOP 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

D. Section Includes:

1. Electric circulating water heater
2. Circulating pumps for potable water
3. Insulated expansion tank
4. On-skid instrumentation, controls, and associated interconnections

1.2 FURNISHED BY BOP CONTRACTOR

A. The following equipment, materials and services shall be provided by the BOP Contractor for each pump and driver set:

1. One Packaged Potable Water Recirculation Skid.
2. 1x100% Circulating electric water heater and controls
3. 2x100% capacity circulating pump for primary heated fluid (including motor starters mounted on skid). Base frame mounted pump with close coupled electric motor driver selected to perform as required for the pump datasheet attached to this Section.
4. 1x100% capacity booster pump (as needed) for primary heated fluid (including motor starters mounted on skid) if needed based on system pressure. Base frame mounted pump with close coupled electric motor driver selected to perform as required for the pump datasheet attached to this Section.
5. Skid control panel(s) with local PLC, HMI, and associated control components and devices
6. Skid base, framing, enclosure, painting, enclosure lighting, ventilation, electric space heater (if needed)

7. Stainless steel water piping to package boundaries and stainless steel valves and accessories within the package boundary.
8. Fluid Flow Controls
9. External instrumentation
10. Insulated expansion tank of appropriate capacity
11. All piping, accessories, and necessary instrumentation between the inlet and outlet tie points of the skid assembled prior to shipment to the site
12. ASME relief valves for ASME pressure vessels
13. Stand alone controls for the recirculation package
14. Plant Control System configuration and graphics programming
15. Startup spares and special tools
16. Initial charge of lubricants
17. Cleaning and factory finish painting prior to shipment
18. Performance testing at factory and certificates of results
19. Drawings and design data to support facility design, construction and maintenance
20. Inspection certificates and quality control documentation listed in this Section
21. Complete set of component cut sheets
22. Special tools, if required, for installation, operation, and maintenance of equipment supplied under this Section
23. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
24. Priced list of recommended spare parts for two years of operation
25. 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.
26. Services such as field support, startup support, and training as indicated in the purchase order
27. Drawings and design data to support facility design, construction and maintenance
28. Sun shade cover or awning over the skid
29. Insulation to maintain water temperature control
30. Foundation and anchor bolts
31. Piping external to pump skids
32. Motor starters and power wiring
33. Receipt and off-loading at site
34. Installation at site, material lay-down area defined by the General Manager
35. Electrical, instrumentation and controls wiring
36. Field inspection and testing

1.3 RELATED SECTIONS

A. Section 260000, Electrical - Mechanical Equipment

B. Section 262050, Specification for Low Voltage Motors

C. Section 480020, Site Conditions

D. Section 480031, Combined Cycle Power Island Noise Control Performance

E. Section 481200, Combined Cycle Balance of Plant

1.4 CODES AND STANDARDS

A. Refer to 481200 Combined Cycle Balance of Plant 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. ANSI/HI 1.3 – American National Standard for Centrifugal Pumps Design and Application

2. California Code of Regulations Title 8, Section 5162, Emergency Eyewash and Shower Equipment
3. Hydraulic Institute Standards (HI)
4. International Standards Organization (ISO)

   a. ISO 10816 – Mechanical Vibration: Evaluation of machine vibration by measurements on non-rotating parts

5. AISC 325 - Steel Construction Manual
6. ANSI Z358.1 - Emergency Eyewash and Shower Equipment
7. ASME B16.34 – Valves-Flanged, Threaded, and Welding End
8. ASME B16.5 – Pipe Flanges and Flanged Fittings
9. ASME B31.1 - Power Piping
10. ASME PTC 36 – Measurement of Industrial Sound
11. ASME Section VIII - Boiler and Pressure Vessel Code
12. ASME Section IX - Welding and Brazing Qualifications
13. ASTM - Standards for Materials
14. AWS D1.1 - Structural Welding Code
15. NFPA 70 - National Electrical Code

1.5 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.

1.6 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 and assembled to provide suitable access for operation and maintenance of the equipment.
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 pumps shall be suitable for continuous operation in the ambient conditions as detailed in Section 480020, Site Conditions.
5. Each pump shall be completely assembled, piped and mounted on a common base plate aligned with the electric driving motor.
6. When a standby pump is required it shall be designed to start automatically in an emergency situation when the failed operating pump shuts down.
7. The pump materials shall be suitable for the fluid being pumped. Refer to attachments for fluid description and recommended pump materials.
8. When multiple pumps are supplied, 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.
9. The characteristics of the motors shall be such that the pumps will not exceed the rated capacity and temperature rise under any operating conditions.
10. The Seller's control system shall monitor the heater discharge temperature, tank temperature & level, and pump discharge flow rate.
11. Skid shall be capable of supplying water of adequate temperature and flow to sustain two eyewash stations with continuous flow for a minimum of 15 minutes. The skid shall meet the requirements of the California Code of Regulations Title 8, Section 5162, Emergency Eyewash and Shower Equipment and the requirements of ANSI Z358.1, Emergency Eyewash and Shower Equipment.

B. Performance Requirements

1. The BOP 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 without positive tolerance above guarantee, minus 3%.
    f. Acceptable TDH deviation amongst identical units of 2% at design capacity.
    g. 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 BOP 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. 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.
6. The Suction Specific Speed shall not exceed 9,000 based upon Hydraulic Institute definitions.
7. 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.
8. BOP Contractor shall guarantee that the equipment supplied shall meet the specified noise criteria in Section 480031, Combined Cycle Power Island Noise Control Performance 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 BOP Contractor shall provide adequate redundancy to meet this requirement. BOP 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. BOP Contractor shall provide additives for redundancy for these systems and components.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:

1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:

   a. A complete physical description of all quoted skid equipment with a Piping and Instrumentation Diagram (P&ID) schematic arrangement of the tanks, pumps, piping, heater, piping specialties, tie points, and instrumentation provided on the skid.
   b. Exceptions and clarifications to the technical specification.
   c. List of warranties and guarantees.
   d. Equipment Bill of Materials
   e. Completed "Technical Datasheets by BOP Contractor" attached to this Section
   f. Complete list of electrical loads associated with the BOP Contractor's scope of supply. For all loads, the list shall contain description, location of the interconnect, voltage, ampere rating, phase, rated load, operating load, service factor, and whether operation is continuous, intermittent, or emergency only.
   g. Motor data including manufacturer, equipment tag number, horsepower (HP), voltage, ampere rating, phase, service factor, enclosure, insulation, rpm, efficiency, and accessories.
   h. Noise data including estimated sound power levels for the eight octave bands, corrections for silencers, ducts distance etc. and an estimated logarithmic summation for the driver and driven equipment.
   i. Characteristic Curves:

      1) Certified pump characteristic curves shall be submitted. Curves shall indicate total head, efficiency, brake horsepower, NPSH required, and

required submergence as ordinates, with capacity in gallons per minute as the abscissa.

2) Curves shall be submitted for maximum and minimum impeller designs which may be fitted to the pump casing and for the impeller design being provided.
3) The characteristic curves shall indicate pump performance from zero capacity to the pump runout capacity.
4) Speed-torque curves, including reverse rotation speed-torque characteristics and inertia (WR^2) values for the pump, shall also be submitted.

2. The BOP Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award including the following documentation:

a. Published pump performance curves showing pump capacity (gpm) vs. total developed pressure (psi), efficiency, brake horsepower, and required NPSH for maximum impeller diameter, proposed impeller diameter, and minimum impeller diameter at nominal pump speed. When variable speed or two speed drivers are specified, pump performance curves shall be submitted for rated impeller diameter at 10% speed increments from 60% - 100% speed.

C. Shop Drawings

1. Refer to Section 481200, Combined Cycle Balance of Plant for general shop drawing requirements.

D. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.
2. Maintenance instructions shall include as a minimum the following topics:

a. Data Sheets.
b. Special shipping, handling, and storage instructions.
c. Lubrication requirements.
d. Maintenance and repair instructions, including procedures, tolerances,
e. Special tool or facility needs, etc.
f. Bill of materials.
g. Descriptive literature.
h. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)

1.8 QUALITY ASSURANCE

A. Refer to Section 481200 Combined Cycle Balance of Plant 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

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general Packaging, Delivery, Storage, and Handling requirements.

1.10 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

B. The pumps shall be guaranteed to operate satisfactorily without damaging pitting, cavitations, or excessive vibration, when pumping against system head and when starting or stopping a pump with another pump in operation on the header.

1. The following shall be guaranteed:

a. Capacity at the design operating point.
b. Total developed head at the design operating point.
c. Pump efficiency at design operating point.
d. Horsepower required at the design operating point and maximum horsepower requirement.
e. Shutoff head.
f. Proper, stable operation with pumps in parallel over the range from recommended minimum flow to runout conditions, or 120 percent of design capacity, whichever capacity is greater.
g. Single pump operation from the recommended minimum flow to runout flow at minimum system resistance.
h. No critical speed at or near pump operating speed. All critical speeds shall be at least 25 percent greater than the highest operating speed.

2. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.

3. Pumps shall be designed to have a required NPSH at one pump run-out conditions of no more that 75% of the NPSH available. Reliability during all operation is a major consideration.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. 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.

B. Materials of Construction

1. The pump shall be manufactured using materials that meet or exceed the strength and corrosion-erosion resistance of the following listed materials. Selection of pump materials for each pump application shall be subject to the approval of the General Manager.
2. The construction materials for pumps identified as cast iron and bronze-fitted are as follows:

    a. Casing - Cast Iron ASTM A48 or General Manager approved equal.
    b. Impeller - Bronze ASTM B584, A48, C1 25B or 30B, or General Manager approved equal.
    c. Shaft - Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    d. Shaft sleeves - Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    e. Wear rings - Bronze ASTM B584 or General Manager approved equal.
    f. Base Plate – ASTM A283, A285 or General Manager approved equal.

3. The construction materials for pumps identified as all stainless steel are as follows:

    a. Casing – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    b. Impeller – Stainless steel ASTM A276 Type 316 or General Manager approved equal.
    c. Shaft - Stainless steel ASTM A276 Type 316 or General Manager equal.
    d. Base Plate – ASTM A283, A285, or General Manager approved equal.
    e. Wear Rings – ASTM A743 or General Manager approved equal.

4. Materials for manufacturing pumps shall be as specified on the individual pump data sheet. General material selections will follow API 610 guidelines for each fluid service. The BOP Contractor shall select suitable materials for pump wear rings and shaft sleeves based on the fluid analysis and technical requirements supplied for the project.
5. Austenitic stainless steel pump parts subject to welding shall be furnished in the “L” grade. Austenitic stainless steel shall be furnished in the solution-annealed condition. Stainless steel components shall not be cold worked by design to enhance mechanical properties. Internally wetted parts shall not utilize coatings.

6. Materials shall be identified with the applicable AISI, ASTM, ASME or SAE number, including material grade on pump data sheets and recommended spare parts lists supplied for the project.
7. If the BOP 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 BOP Contractor's proposal.
8. Minor parts not identified shall have corrosion resistance equal to that of specified parts in the same environment.
9. Mating parts, such as studs and nuts, constructed of 18-8 stainless steel or of materials having similar galling tendencies shall be lubricated with an anti-seize compound.

C. Welding

1. All welding shall be in accordance with ASME Section IX. Welding procedures for stainless steels shall be designed to minimize sensitization for the heat affected zone. Piping supplied by the pump manufacturer shall be designed to conform to piping code ASME B31.1.
2. 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.
3. 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.
4. Purchaser will provide the services of an independent testing laboratory for field nondestructive examination. Any defective weld shall be removed, rewelded, and retested at Seller's expense.
5. Nondestructive examination procedures shall be submitted. All nondestructive examinations shall be documented in accordance with the applicable code.
6.

D. Castings

1. Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters, and other defects. Casting surfaces shall be cleaned by standard methods such as sandblasting, shotblasting, or pickling. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.
2. Castings shall not be repaired by peening, plugging, burning in or impregnating. If weld repairs to castings are authorized by the ASTM specification for the material, repair welding shall be in accordance with the applicable ASTM specification. Weld repairs shall be inspected according to the same quality standards as for inspection of the castings. Repairs not covered by an ASTM specification shall be subject to approval of the General Manager.

2.2 MAJOR COMPONENTS

A. Electric Circulating Water Heater

1. The heater shall be a 1x100% flanged electric circulating water heater with immersion type heating elements.
2. The heater pressure vessel shall be designed and stamped in accordance with ASME B&PV Code, Section VIII, Division 1. The heater bundle head shall receive a partial Code stamp and hydrostatically tested to ASME Section VIII guidelines.

3. The heater vessel shall be carbon steel construction.
4. The heater enclosure and heater bundle electric terminal enclosure shall meet NEMA 4 requirements for a non-hazardous area. Heater elements shall have moisture tight seals at the terminal ends.

B. Recirculating Pump

1. 1x100% centrifugal recirculation pump and be provided and mounted as part of the main skid system. The pump may be either vertically or horizontally mounted.
2. The pump shall be sized by the Seller and include the water side pressure drop of the external piping system provided in the attached Data Sheet.
3. Pump shall meet ANSI design requirements or Purchaser approved equivalent. See Section 485311.10 and data sheet attached to this Section for details of pump construction and design requirements.
4. The pump shutoff head shall be between 20%-60% greater than the head at maximum design conditions.
5. Pump selection shall be based on maximum efficiency within 10% of design conditions but not greater than the point of maximum efficiency.
6. Lifting lugs or other attachment shall be provided to facilitate removal of pump motors and disassembly of the pump in place.
7. Shaft couplings between the motor and pump shall be flanged adjustable spacer type to allow for mechanical seal removal unless otherwise approved by the Purchaser. An OSHA approved coupling guard shall be provided for personnel protection.
8. Pump bearings shall be oil lubricated and designed for an AFBMA L-10 life of at least 50,000 hours.
9. Ball type thrust bearings shall be double row.

C. Booster Pump

1. 1x100% centrifugal recirculation pump and be provided and mounted as part of the main skid system. The pump may be either vertically or horizontally mounted.
2. The pump shall be sized by the Seller and include the water side pressure drop of the external piping system provided in the attached Data Sheet.
3. Pump shall meet ANSI design requirements or Purchaser approved equivalent. See Section 485311.10 and data sheet attached to this Section for details of pump construction and design requirements.
4. The pump shutoff head shall be between 20%-60% greater than the head at maximum design conditions.
5. Pump selection shall be based on maximum efficiency within 10% of design conditions but not greater than the point of maximum efficiency.
6. Lifting lugs or other attachment shall be provided to facilitate removal of pump motors and disassembly of the pump in place.
7. Shaft couplings between the motor and pump shall be flanged adjustable spacer type to allow for mechanical seal removal unless otherwise approved by the Purchaser. An OSHA approved coupling guard shall be provided for personnel protection.
8. Pump bearings shall be oil lubricated and designed for an AFBMA L-10 life of at least 50,000 hours.
9. Ball type thrust bearings shall be double row.

D. Expansion Tank

1. The tank shall be fabricated of carbon steel to ASME Section VIII construction and testing requirements.
2. Sizing of the tank shall take into consideration the entire volume of the potable water circulating system including external piping indicated in the data sheets.

2.3 EQUIPMENT

A. General Requirements

1. The project is an outdoor installation. The recirculation skid shall be suitable for continuous operation in the ambient conditions exposed to the elements.
2. Skid Components shall be designed for a continuous service life of 30 years. 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. Design of rotating elements shall be such that all critical speeds shall be at least 25 percent greater than the operating speed.
4. Manufacturer shall provide all connections for suction, discharge, sealing, and venting. Piping shall be in accordance with ASME B31.1. All piping furnished by the Manufacturer shall be provided in ASME standard sizes in nominal English units (inch sizes). The location, size, type, and quantity of all openings, connections, and fittings shall be shown on Manufacturer's drawings.
5. BOP 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. The pumps will be operated singly or in parallel. Each pump shall operate satisfactorily in two pump parallel operation, in single pump operation, and when bringing on or taking a pump out of service with any other pump, or pumps in service. The pumps shall deliver the head and capacity indicated in pump data sheets in this Section.
2. Each pump shall have a manual/auto/off selector switch for preference operation and have the ability to reset or lockout/tagout the pump motor breaker without affecting other equipment.
3. The pumps shall be capable of operating continuously at the minimum flow without damage to the pumping equipment.
4. Pump head curve shall rise continuously from design head point to shut-off. The pump shut-off head shall be a minimum of 120 percent of the total head at the design operating point and a maximum of 135 percent of the design head specified.
5. Pumps furnished for the same service shall be designed to operate continuously in parallel over the pump operating range without cavitations.
6. Where pumps are furnished for parallel operation, these pumps shall be "identical" as defined by the Hydraulic Institute standards, with all replacement parts being interchangeable.
7. The difference in flow for pumps operating in parallel shall not exceed 5 percent throughout the operating range.

8. Pumps shall be capable of both intermittent (start/stop) and continuous operation under flow conditions from minimum flow to runout conditions.
9. The horizontal pumps are centrifugal pumps of the horizontally or vertically split, single or double suction, single or multiple stage design, as specified in data sheets provided as Attachments.
10. Each pump submitted by the BOP Contractor shall be designed for operation as specified in data sheet.
11. Wetted pump parts shall be suitable for the fluid being pumped. Materials specified for the pumps are shown in the data sheets. BOP Contractor may propose alternate materials which in its own experience are more suited to the intended service. The alternate materials shall be subject to General Manager's approval.
12. Pumps shall be designed in accordance with Section 485311.10 - Pumps Horizontal Centrifugal-General Service.

C. Pump Characteristics

1. Pumps 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 the pumps have maximum efficiency at approximately design operating capacity and head.
3. Pumps shall be suitable for extended operation over the range from minimum flow to single pump runout flow at minimum system resistance, without damaging pitting, cavitations, excessive noise, or excessive vibration.

D. Skid Assembly

1. The heated tank, expansion tank, pumps, heater element, and accessory piping shall be mounted on a common skid. The 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.
2. 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.
3. 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.

E. Additional Technical Requirements

1. Noise requirements: Refer to Section 480033, Combined Cycle Balance of Plant Noise Control Performance.

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 BOP 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 BOP 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 BOP Contractor's warranty to include all direct costs to the General Manager that may result from the BOP Contractor's use of such procedures, components or assemblies.

B. Impellers

1. All impellers shall be statically and dynamically balanced.
2. Wear rings, as required, shall be replaceable.
3. Full size impellers shall not be used. An impeller diameter that is a least 10 percent larger than the minimum impeller diameter and at least 10 percent smaller than the maximum diameter for the pump casing is preferred.

C. Couplings

1. Shaft couplings, where applicable, shall be used between all drives and driven equipment. Couplings shall be attached to driver and driven shafts by press fits and keys.
2. Unless otherwise stated in the detailed equipment requirements, couplings shall be of the all metal lubricated gear flexible type.
3. Shaft couplings shall be sized to transmit the maximum brake horsepower requirements of the driven equipment with a service factor of not less than 2.
4. Couplings on pumps with mechanical seals shall be spacer type couplings to permit replacement of the mechanical shaft seals without disturbing the drive motor.

D. 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.
4. Safety guards for horizontal shafts, shaft couplings, belt sheaves, etc., shall be of the inverted "U" design with sides extending to the equipment base or base plate.

E. Base Plate

1. A cast iron or welded steel equipment base plate shall be provided which is to be installed on a concrete base. Each base plate shall support the unit and its drive assembly and shall be of a neat design with pads for anchoring the units. Motor mounting provisions shall be acceptable to the motor manufacturer. Base plates shall be designed to adequately support the equipment under all conditions without 100 percent grout fill inside the base plate frame. Equipment bases shall be designed to accept a connection to the plant grounding system. Anchor bolt pattern, number and diameter shall be determined by the Manufacturer, based on the assumption that anchor bolts shall be fabricated from ASTM A36 bar stock material.

F. Pump Seals

1. The mechanical seal of the pump specified shall comply with API 610 Seal Plan 14.
2. 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 the 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.

G. Bearings

1. Pumps shall be furnished with removable shaft sleeves as required by system design. Where required, the shaft shall be completely protected and isolated from the pumped fluid by incorporating gasketed or similarly sealed joints between the sleeve and the shaft. If the manufacturer's design does not include sealed joints, the pump shaft shall be constructed of a material equivalent to the material of the shaft sleeve.
2. Pump bearings shall be of the oil-lubricated sleeve or anti-friction type. Anti-friction bearing shall be designed for AFBMA L-10 life rating of not less than 130,000 hours. Pumps shall be provided with thrust bearings as required by the system designed to prevent thrust loads from being imposed on the drive motor bearings. Thrust bearings shall be of the Kingsbury type or double roll anti friction bearing as required by the pump service.

H. Casing

1. The pump casing, including suction connection, shall be rated for the design conditions of the pumping system. Suction and discharge connections shall be flanged. Each pump casing shall be furnished with tapped connections for casing drain and vent. Each connection shall be furnished with a solid, hex head, forged steel pipe plug. Casing pressure, drain, and vent connections shall be threaded.

I. Accessories

1. Miscellaneous trim - All piping and valves required for seal or stuffing box injection 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.

J. 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 or rivets. 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

K. Auxiliary Equipment Requirements

1. Electrical Requirements: Refer to Section 262050 - Low Voltage Motors.

2.5 FABRICATION

A. Shop Assembly

1. The pump assembly and motor shall be installed on a common base plate.
2. The pump shall be connected to the motor by a flexible coupling.
3. The BOP Contractor shall provide only items that are of standard and current manufacturers' construction. Non-standard special items or any other difficult to replace items shall not be supplied without the General Manager's prior approval.

B. Shop/Factory Finishing

1. Cleaning

a. Internal Surfaces

1) All internal surfaces shall be free of gross contaminants, such as heavy deposits of mill or heat treating scale, oil, oxide films, slag, flux, weld splatter, dirt, metal chips, and abrasive particles.
2) Manufacturer's cleaning plan shall ensure that cleaning materials do not adversely affect the surface or base metal in the cleaning, manufacturing, or operational environments and that, once obtained; the cleanliness will be maintained during subsequent manufacturing, shipping, storage and handling.
3) Abrasive blasting shall not be used on surfaces containing areas where grit can accumulate and not be readily removed by subsequent cleaning, rinsing or flushing.

b. External surfaces shall be smooth and free of gross contaminants such as heavy scale, rust, sand, blisters, weld splatter, metal chips, and heavy deposits of oil or grease.

2. Painting

a. Cleaning of surfaces that are not to be coated or painted shall be done in accordance with the Supplier's best recommended practice. Only non-corrosion-resistant materials shall be coated.
b. Insulated surfaces shall not be primed. Stainless steel shall not be painted.

2.6 SOURCE QUALITY CONTROL

A. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.
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.

B. Tests and Inspections

1. All rotating parts shall be statically and dynamically balanced. Impellers shall be dynamically balanced prior to assembly on the pump shaft. Motor rotors shall also be balanced.
2. Steps shall be taken in the fabrication and assembly to ensure that all mechanical fits are concentric and true to ensure alignment during installation.
3. All welding, welding procedure qualifications and welder qualifications shall be in accordance with the BOP Contractors' ISO-9000 or equivalent qualified program.
4. Within 60 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent manufacture and inspection operations. The General Manager may, within 60 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection before the item concerned can be released for further manufacture or shipment.
5. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing. Unless the General Manager shall advise the BOP Contractor not to proceed with the inspection and testing prior to five days before the date which the BOP Contractor has stated in its notice, the BOP Contractor may proceed and any inspection and tests shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the inspection and test results.
6. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).
7. Major items supplied by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP Contractor or a third party. A test procedure shall be prepared for each such test which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be available for review by the General Manager. Successful completion of such test shall be a precondition to shipment of the tested item. The General Manager shall be notified in writing at least 14 days prior to any final factory test of any major components to be supplied.

C. Hydrostatic Tests

1. Equipment, piping, 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.

D. Functional and Performance Tests

1. The equipment shall be subjected to functional and performance tests in the BOP Contractor's shop to the greatest extent possible to verify the BOP 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 BOP Contractor.

E. Shop Tests

1. 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.
2. If testing is specified one pump for each service shall be shop tested for capacity, NPSH required, power requirements, and efficiency at minimum flow recommended for continuous operation, maximum pressure, design point pressure, shutoff pressure, and at as many other points as necessary for plotting an accurate performance curve. Each pump shall be tested with its own motor.
3. Pumps shall be balanced so that peak to peak amplitude of rotor vibration in any plane measured at the pump bearing housing under design speed shall not exceed 1.5 mils over the pump operating range.
4. 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 article.
5. Any pump not meeting the guarantees shall receive all adjustments, repairs, additions or replacements as required for it to meet the guarantees.
6. 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.
7. 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.
8. If the pumps are not to be shop tested, then the results of prototype model pump shop tests, previously performed by the manufacturer, shall be used to develop performance curves for the miscellaneous pumps.
9. 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.
10. 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.
11. If pump suction test conditions (pressure and/or temperature) differ from the conditions listed, 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.

12. The General Manager reserves the right to witness all shop tests. Twenty (20) working days advance notice of all tests shall be given to the General Manager.
13. The General Manager reserves the right to witness all pumps re-testing.
14. BOP 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. The BOP Contractor shall furnish a complete priced list of recommended spare parts for two years operation. Spare parts may be purchased separately by the General Manager. A separate list shall identify any recommended spare parts for startup and commissioning. Startup and commissioning spares shall be included in the base bid.

3.2 FIELD QUALITY CONTROL

A. Field Testing

1. Following erection/installation of equipment, General Manager may require equipment to be tested by the BOP Contractor in the installed condition to verify the equipment's ability to operate under the specified conditions and to meet the specified performance guarantees.
2. In the event that the pumps do not meet the performance guarantees in the erected/installed conditions, the BOP Contractor shall make alterations and modifications as necessary to meet the performance guarantees, at the Manufacturer's expense.

3.3 SCHEDULE

A. The BOP Contractor shall provide a schedule for the design, fabrication, shop testing, and preparation for shipment of the equipment furnished by the BOP Contractor. The schedule shall also provide anticipated durations for field erection and testing of the equipment furnished by the BOP Contractor.

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEET BY GENERAL MANAGER

Client Name	Pasadena Water & Power
Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
Project Number	123374
System Name	Potable Water Recirculation Skid
Skid Equipment Tag Number	5PWS-ZXX-010

Item	Description	Units	Value
1.0	**Recirculation Pump**		
1.1	Pump Tag No.(s)		TBD
1.2	Type:		Centrifugal
1.3	Quantity Required		2
1.4	Capacity		100%
1.5	Location (Outdoor/Indoor)		Outdoor
1.6	Fluid Pumped		Potable Water
1.7	Pump Materials:		
	Casing		Stainless steel ASTM A276 Type 316
	Shaft		Stainless steel ASTM A276 Type 316
	Shaft Sleeve		Stainless steel ASTM A276 Type 316
	Wear Rings		ASTM A743
	Impeller		Stainless steel ASTM A276 Type 316
	Mechanical Seals		TBD by BOP Contractor
1.8	Speed	rpm	1800 max
1.9	Design Flow each (est.)	gpm	40
	Suction Pressure (est.)	psia	45
	Design Discharge Pressure (est.)	psia	85
	Design Temperature Range (est.)	°F	80
	Density of feed water at design temperature (est.)	lb/ft^3	62.2
	Pump Efficiency at Design flow	min %	80
1.10	Piping:		
	Size, inlet	in. NPS	TBD by BOP Contractor
	Size, discharge	in. NPS	TBD by BOP Contractor
	Design Pressure	psig	TBD by BOP Contractor
	Design Temperature	°F	TBD by BOP Contractor
1.11	Power, volts/ phase/ Hertz		Refer Section 262050
1.12	Shop Test Required, y / n		Y

Item	Description	Units	Value
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		Stainless steel
2.0	**Booster Pump**		(As required)
2.1	Pump Tag No.(s)		TBD
2.2	Type:		Centrifugal
2.3	Quantity Required		1
2.4	Capacity		100%
2.5	Location (Outdoor/Indoor)		Outdoor
2.6	Fluid Pumped		Potable Water
2.7	Pump Materials:		
	Casing		Stainless steel ASTM A276 Type 316
	Shaft		Stainless steel ASTM A276 Type 316
	Shaft Sleeve		Stainless steel ASTM A276 Type 316
	Wear Rings		ASTM A743
	Impeller		Stainless steel ASTM A276 Type 316
	Mechanical Seals		TBD by BOP Contractor
2.8	Speed	RPM	TBD by BOP Contractor
2.9	Design Flow each (est.)	gpm	20-40
	Suction Pressure (est.)	psia	60
	Design Discharge Pressure (est.)	psia	TBD
	Design Temperature Range (est.)	°F	75-100
	Density of feed water at design temperature (est.)	lb/ft^3	TBD
	Pump Efficiency at Design flow	min %	80
2.10	Piping:		
	Size, inlet	in. NPS	TBD by BOP Contractor
	Size, discharge	in. NPS	TBD by BOP Contractor
	Design Pressure	psig	TBD by BOP Contractor
	Design Temperature	°F	TBD by BOP Contractor
2.11	Power, volts/ phase/ Hertz		Refer Section 262050
2.12	Shop Test Required, y / n		Y
2.13	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

Item	Description	Units	Value
3.0	**Heated Water Tank**		
3.1	Tank Tag Number		TBD
3.2	Tank Size (estimate)	gal	325 gallons
4.0	**Expansion Tank**		(As required)
4.1	Tank Tag Number		TBD by BOP Contractor
4.2	Tank Size (estimate)	gal	TBD by BOP Contractor

4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR

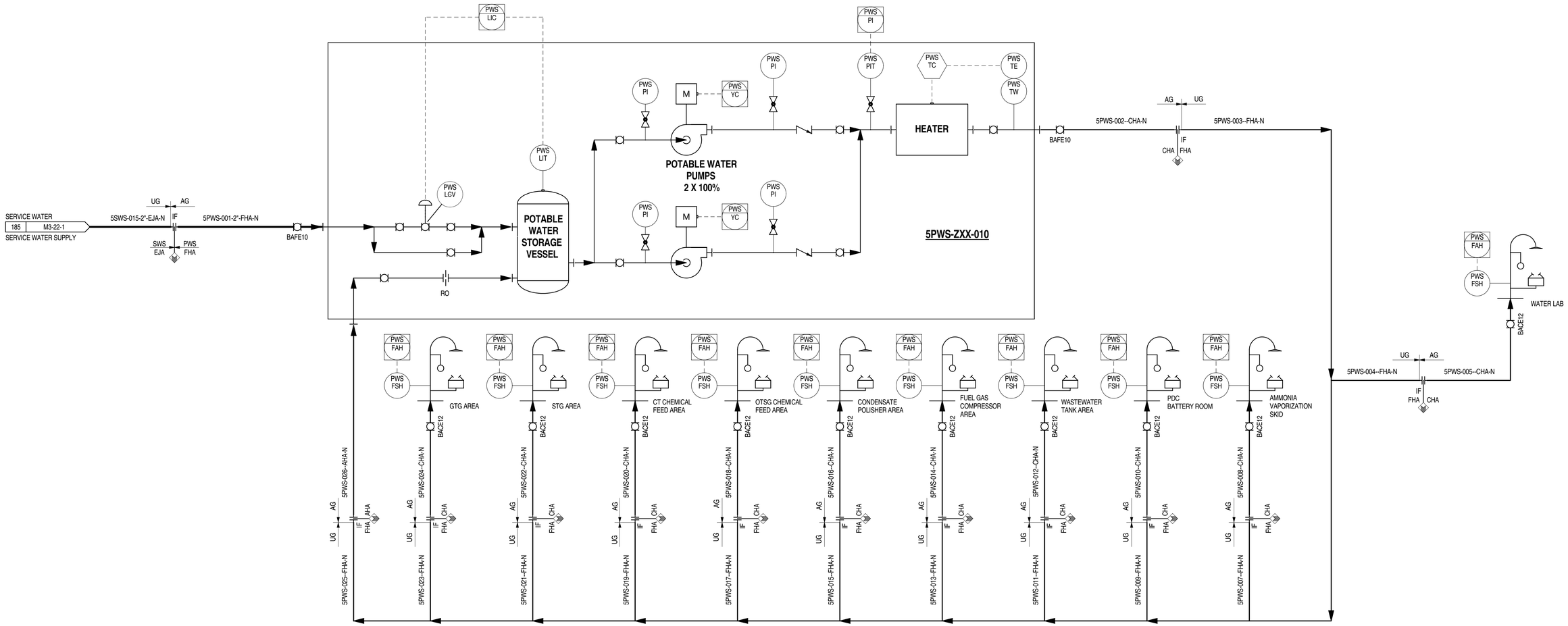
Item	Description	Units	
1.0	**GENERAL**		
	Pump Name		
	Tag No.		
	Number of pumps required		
	Pump type		
	Pump model		
	Manufacturer		
	Point of manufacture		
	Delivery, weeks ARO		
	Max. dimension (pumped solids)		
	Rotation direction (view from driver)		
	Number of stages		
	Suction conn. size/type/rating		
	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 pressure	psi	
	Pump speed	rpm	
	NPSH required	ft	
	NPSH available	ft	
	Pump efficiency	%	
	Shaft horsepower	hp	
	Motor Nameplate Rating	hp	
3.0	**OTHER PERFORMANCE DATA**		
	Total pressure @ shutoff	psig	
	Recommended min. recirculation	gpm	
	NPSH required @ 120% of rated flow	psia	
	Flow @ maximum pressure	gpm	
	Maximum pressure	psig	
	NPSH required @ runout	ft	
	Shaft horsepower @ runout	kW	
	For impeller diameter @ BEP		
	Flow	gpm	
	Total pressure	psia	

Item	Description	Units	
	Efficiency	%	
	Max. sound level @ 3', (dBA)	dBA	
	Shutoff pressure	psig	
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		
	Final thickness	in	
	Surface preparation		

4.3 M3-24-1: POTABLE WATER SYSTEM P&ID

5PWS-ZXX-010
POTABLE WATER RECIRCULATION SKID

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485951.96



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE EYEWASH STATION DRAINS TO THE EQUIPMENT DRAINS SUMP (5MDS-SMP-010).

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
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM POTABLE WATER SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-24-1

October 14, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Chemical Feed System: Cooling Tower
Section 485952.05

PROJECT NUMBER:
123374

PROJECT CONTACT:
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PHONE:
208-288-6408

Section 485952.05
Chemical Feed System: Cooling Tower

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
9/18/13	T. Clark	A
10/14/13	S. Goldstein	B

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 2
1.5 DEFINITIONS 3
1.6 SYSTEM DESCRIPTION 3
1.7 SUBMITTALS 3
1.8 QUALITY ASSURANCE 4
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.10 SITE CONDITIONS 5
1.11 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 EQUIPMENT 5
2.3 COMPONENTS 6
2.4 ACCESSORIES 7
2.5 ELECTRICAL 9
2.6 INSTRUMENTATION AND CONTROL 10
2.7 FABRICATION 13
2.8 SOURCE QUALITY CONTROL 13

PART 3 - EXECUTION 14

3.1 SPARE PARTS 14
3.2 FIELD QUALITY CONTROL 14

PART 4 - ATTACHMENTS 15

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER 15
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR 16

SECTION 485952.05
CHEMICAL FEED SYSTEM: COOLING TOWER

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 chemical feed system for use in cooling tower and circulating water systems. The chemical feed system shall be a complete package, including all controls, instruments, components, coatings, interconnecting piping, supports, vents, drains, and appurtenances as required per the referenced specifications including their attachments. 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 BOP Contractors guarantee in a manner acceptable to the General Manager.

B. 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

C. The BOP 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 BOP CONTRACTOR

A. The BOP Contractor will be responsible for the following activities, all in accordance with the requirement of the specification, the data sheets included as an attachment to the specification, and applicable codes and standards. The scope of work shall include design, manufacture, shop testing, packaging, shipping, along with technical direction of the installation and field testing.

1. All skid mounted equipment including automatic stroke or speed controlled injection pumps, strainers, mixers if required, calibration pots, pulsation dampeners, back pressure valves, external relief valves, contactors for 120 volt single phase motors, junction boxes, etc. to meet the performance guarantees.
2. Circulating water analyzer panel
3. Chemical pot feeder
4. Supply of motor drives and disconnect switches.
5. Control system consisting of a single, comprehensive, programmable logic controller (PLC) and flat screen control panel interface to operate the entire package.
6. Flow meters for the cooling tower makeup and blow down lines, with 4-20 mA signals to the PLC panel for control of chemical pumps.
7. One (1) complete set of any special tools required for installation and maintenance of all BOP Contractor supplied equipment.

8. Any lifting or support lugs required for lifting and handling of all BOP Contractor supplied equipment.
9. All local instrumentation necessary for control.
10. Wiring from instruments/devices on skids up to local common connection point at the control panel.
11. All piping, conduit, valves, supports, and instrumentation (i.e., items normally supplied on a pre-engineered package) required for operation are to be included. BOP Contractor shall give complete description of all items to be included and shall clearly indicate all items required to be supplied by General Manager to complete the system.
12. Finish painting
13. Factory testing and certificates of results
14. Site specific drawings and design data to support facility design, construction and maintenance
15. Inspection certificates and quality control documentation listed in this Section
16. Complete set of component cut sheets
17. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
18. Site installation supervision by BOP Contractor's personnel
19. Start-up supervision and training by BOP Contractor's personnel
20. Foundations, grouting and foundation bolts
21. Unloading at site, storage and installation
22. Power wiring to a single interconnection panel.
23. Control power to a single interconnection panel.
24. Tie-in of all piping, electrical power and control wiring at system interfaces.
25. Control and instrument cabling from equipment/skid junction boxes to the PLC and to the MCC, and between the PLC and Main Control Room.
26. Site civil design and grounding of equipment
27. Cable trays, supports, and accessories for all interconnecting cabling
28. Control power
29. Power wiring and starters in MCC to all electrical loads
30. Compressed air piping for instrumentation and control valves
31. Installation of shop assembled skids and erection & installation of equipment and components shipped loose

B. The requirements of this specification are the minimum for the equipment and are to be supplemented by the BOP Contractor's own requirements.

1.3 RELATED SECTIONS

A. Section 480020 - Site Conditions

B. Section 481200 - Combined Cycle Balance of Plant

C. Section 485491 - Cooling Tower

1.4 CODES AND STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1.5 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.

1.6 SYSTEM DESCRIPTION

A. Design Requirements:

1. Reference Section 481200 Combined Cycle Balance of Plant for general design requirements and expected operating profile.
2. The equipment shall be pre-engineered, pre-assembled units that minimize installation schedule and start-up costs. The system shall be fully tested at the factory and require simple utility connections, with minor set up and adjustment, and ready for immediate on-line service.
3. The equipment will be packaged (i.e., skid mounted) to the fullest extent practical to minimize labor required for field installation. Extent of skid assembly shall be as shown on BOP Contractor submitted P&IDs.

B. Performance Requirements:

1. The Cooling Tower Chemical Feed System shall continuously monitor and control water chemistry in the circulating water system.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:

1. Proposal shall be prepared in accordance with the Section 481200 Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and return the following documents:

a. Performance data based on conditions specified in Section 480020, Site Conditions.
b. Completed "Technical Datasheet by Contractor" attached to this Section

2. The Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:

1. Refer to Section 481100, Combined Cycle Power Island for general submittal requirements after contract award.
2. List of warranties and guarantees.
3. Complete list of electrical loads associated with the Contractor's scope of supply. For all loads, the list shall contain description, location of the interconnect, voltage, ampere rating, phase, rated load, operating load, service factor, and whether operation is continuous, intermittent, or emergency only.
4. Motor data including manufacturer, equipment tag number, horsepower (HP), voltage, ampere rating, phase, service factor, enclosure, insulation, rpm, efficiency, and accessories.
5. Noise data including estimated sound power levels for the eight octave bands, corrections for silencers, ducts distance etc. and an estimated logarithmic summation for the driver and driven equipment.

C. Shop Drawings

1. Refer to Section 481100, Combined Cycle Power Island for general shop drawing requirements.

D. 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 overhaul inspections
e. Tests, settings, and calibrations
f. Method of calculating effective operating hours

1.8 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.10 SITE CONDITIONS

A. Reference Section 480020, Site Design Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general material and welding requirements.

2.2 EQUIPMENT

A. General

1. The system shall be the BOP Contractor's standard design, modified as required to comply with this specification.
2. The skid shall be manufactured of material suited for the defined chemicals of service.
3. The equipment and materials specified are intended to be the minimum suitable for the intended service. They are not intended to limit the BOP Contractor's responsibility for proper design and selection of equipment. It is the BOP Contractor's responsibility to supply a complete system for the intended service and the specification is only for general guidelines. Any changes in proposed equipment or materials during design shall be approved by General Manager prior to incorporation into the design.
4. The equipment shall be designed to provide maximum practical operational reliability using standard, commercially available equipment, i.e. vessels, valves, pumps, PLC, etc.
5. The equipment shall be designed to provide trouble-free operation during start-up, shutdown, and system operating modes.
6. The design of equipment, arrangement of components, and routing of piping shall consider operational and maintenance accessibility of components. Equipment, piping, valves, and instruments shall be arranged so that when installed, components requiring manipulation, observation, or maintenance will be readily accessible and safe to operating and maintenance personnel.
7. BOP Contractor shall provide equipment and components Sub Contractor's list for General Manager's approval.

B. Cooling tower chemical feed and storage system will utilize portable containers for shipment, storage and feeding of the required chemicals. BOP Contractor shall provide containment, containment stand and quick connection to camlock fittings on the discharge of the connections.

C. Non-contacting type level indicating transmitters with local indication shall be provided to send tank level signals to the PLC. Drain and overflow piping and fittings shall be provided and installed by BOP Contractor.

D. The calibration column shall be a 1000 ml glass cylinder marked in 10 ml increments. A common calibration column shall be used for both pumps with the vent piped back to the chemical storage tote.

E. 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 with safe access for operating and maintenance personnel.

1. The Chemical Feed System shall consist of the following at a minimum and comply with data sheets included as attachment to the specification.

    a. Biocide diaphragm metering pumps with local and remote control.
    b. Scale/corrosion inhibitor diaphragm metering pumps with local and remote control.
    c. Sulfuric acid diaphragm metering pumps with local and remote control.
    d. Sample and Control Panel
    e. pH Analyzer
    f. Chemical Mixing Equipment

F. Skid Assembly

1. Components on a skid mounted assembly shall be installed properly and completely pre-piped and pre-wired. Electrical and control signal interface connections for all systems required to support both equipment specified in this specification and equipment in General Manager's systems shall be brought to a single distribution panel and terminal strip within the dry section. Alarm signals from individual analyzers are not used and therefore shall not be run to this location. Access to the panel by the General Manager for external wiring/signals shall be provided from the top of the dry section. The dry section shall be a NEMA 12 designed enclosure with the exception of the muffin fan required for condensation protection. BOP Contractor/General Manager piping and tubing interface connections shall terminate at the sampling/analyzer system plot boundary. Piping and tubing shall be supported from skid or equipment.

G. Structural Design

1. Refer to Section 481200, Combined Cycle Balance of Plant for general structural design requirements.

2.3 COMPONENTS

A. Pumps

1. The BOP Contractor shall provide all pumps, piping, valves, controls and instrumentation required to provide a complete transfer system. Each chemical injection set shall consist

of one calibration cylinder, two chemical metering pumps, and one pump suction strainer. Piping, valves, instruments, and supports for all cooling tower chemical injection sets shall be mounted on a common skid with one control panel. The pumps shall be provided the ability to receive a 4-20mA signal, local and remote on/off control by the plant control system (PCS).

B. Circulating Water System Analyzer Panel

1. The BOP Contractor shall provide a freestanding outdoor rated analyzer panel for monitoring circulating water system quality.
2. Alternately, the analyzer panel for the circulating water system may be integrated with the steam generator water and steam sample panel but must still meet the requirements of a standalone analyzer panel.
3. The analyzer shall contain the following components:

    a. One inch size sample piping with a strainer, pressure gauge, flow switch, sample valve and isolation valves for inlet and return connections.
    b. Provide pH/Conductivity dual channel analyzer of Rosemount model 1055 series, with 399 model pH probes and a 150 series conductivity probe or equivalent. On line monitoring of pH and Conductivity shall be made available.
    c. ORP analyzer shall be a Rosemount 1055 series analyzer and a series 399 probe or equivalent for on line ORP monitoring.
    d. Control Cabinet: NEMA 4X cabinet shall house the water analyzers. Analyzer panel interface signals (4 to 20mA) to PLC (CW system pH, conductivity, ORP). An analyzer Common Alarm and discrete Cooling Water Sample Flow (dry contact) shall be provided.

4. pH Analyzer

    a. The BOP Contractor shall provide one additional pH analyzer of Rosemount model 399 pH probes or equivalent.

C. Chemical Mixing Equipment

1. The BOP Contractor shall provide chemical mixing equipment, if required, for the addition of chemicals to the cooling water system such as a stainless steel chemical pot feeder with legs or a mixing trough. for the addition of chemicals to the cooling water system.

2.4 ACCESSORIES

A. Piping and Valves

1. All piping and valves required to take samples from the relevant sampling points to the chemical feed skid and from there to drain shall be furnished by the BOP Contractor.
2. Each system shall be supplied with all piping and valves as much as practical contained within the confines of its skid.
3. Each pump discharge line will have a check valve and a block valve, in addition to the relief valve and a back pressure valve.
4. Relief valves shall be piped back to the pump inlet line.

5. Instrumentation: Each pump shall be provided with a pressure gauge with isolation valve and snubber at the discharge. Chemical feed pumps shall also be equipped with a common calibration cylinder with isolation valve on the suction line. The calibration cylinders shall be sized appropriately for the specified operating capacities.
6. Each pressure indicator shall have a 4½" diameter face, with a type 316 stainless steel housing, and an operating range appropriate for the specified operation condition. Provide a diaphragm seal for pressure indicators in acid service.
7. Level gauges shall include gauge cocks constructed of 316 stainless steel materials with guard rod protectors and tubular glass constructed with red background target.
8. Level switches shall be double-pole, double throw. All wetted parts shall be constructed of 316 stainless steel materials. Top entry mounted conductance type with 316SS probes.

B. Utility

1. External Power/Control Connections

   a. Pumps speed signal 4-20 mA Analog Input
   b. Discrete pump status signals (Running/Not Running and Pump Trouble) for each pump
   c. 120V, single phase, 60 Hz, 30 Amp Power (one tie-in provided for each skid).
   d. Analyzer panel interface signals (4 to 20mA) to PLC (CW system pH, conductivity, ORP)

2. Piping and Tubing Connection Points (Terminal Points)

   a. Chemical Injection Pump Skid Discharge - One for each chemical service
   b. Chemical Storage Tank Fill Connection - One for each chemical service

C. Identification

1. Equipment shall be furnished with a permanently attached stainless steel nameplate having embossed or raised letters. The nameplate shall include, but is not limited to, the following:

   a. Manufacturer's name
   b. Model number
   c. Serial number
   d. Year built
   e. Design capacity or volume
   f. Design pressure and temperature
   g. Speeds – Rotating equipment
   h. Set pressure – Relief valves
   i. Equipment number
   j. Equipment contract number
   k. PO number

2. Nameplates shall conform to applicable requirements of Technical Specifications and Referenced Codes and Standards.
3. Each front of panel mounted instrument and control device shall have its tag number and service on a nameplate permanently mounted with stainless steel drive screws. A nameplate indicating the tag number shall be mounted inside the panel next to front-of-panel mounted instruments and devices. The same type of nameplate shall be installed

for tag numbered devices which are contained wholly within the panel. Nameplates shall be laminated plastic with black engraved characters on a white background.

4. Bulkhead fittings, panel piping, tubing, and wiring terminals shall be identified permanently with designations reviewed by General Manager. These designations shall correspond to those on the drawings.
5. A control cabinet nameplate that identifies the BOP Contractor may be furnished by the panel fabricator and mounted on the top center section of the control cabinet.
6. Field mounted instruments shall have an identifying nameplate attached permanently by stainless steel drive screws. The nameplate shall be made of stainless steel. The nameplate shall include the complete tag number stamped or engraved in characters ¼" high. For small items such as thermometers and pressure gages, characters may be smaller, and the nameplate shall be laminated plastic with black engraved characters on a white background.

2.5 ELECTRICAL

A. All circuits shall be factory wired and tested at operating voltage. The BOP Contractor shall complete all internal wiring between devices. All device terminals shall be connected to terminal blocks for field wiring. All wiring external to the skid shall enter and exit the panel from the top of the panel.

B. All terminal connections shall be plainly marked in accordance with the BOP Contractor's connection diagrams. The BOP Contractor shall provide all necessary internal panel wiring and branch circuit protection.

C. Terminal blocks provided for all circuit wiring shall be equipped with wire clamps and white fiber marking strips. Terminal blocks shall be of flame-retardant materials. No terminal block shall carry more than two conductors on either side of any terminal.

D. Electrical enclosures shall be NEMA 4X. Material of construction shall be FRP. Controls on the panel shall consist of, at a minimum, a HOA switch with running lights for each pump.

E. Wiring mounted to swing panels or subject to movement shall be grouped into bundles, have extra-flexible conductors, and have a plastic, wire loom over wire bundles.

F. Control panel power connections shall be permanently wired to power source. Local control and instrumentation shall provide, but not be limited to, on/off indication of pumps and local control to the extent of this specification. No local alarm is required on the panel. BOP Contractor supplied pumps shall be controllable via three discrete signals (one for on/off, one for pump trouble and one for pump running status) and one analog signal (for speed control) wherever required.

G. Motors for auxiliary services shall be in compliance with Section 482610, Low Voltage Motors. Motor power connections shall be permanently wired to power source.

H. All PLC's and/or controllers to have available connections for UPS power feeds.

I. Interface Boundaries: Electrical interface points shall be located in control panels. Control signals shall include appropriate segregation from 480V power.

J. 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.

2.6 INSTRUMENTATION AND CONTROL

A. General

1. Refer to Section 481200, Combined Cycle Balance of Plant for general instrumentation and control requirements and instrument calibration requirements.
2. All instrumentation required for automatic operation and monitoring of the equipment shall be provided by the BOP Contractor. This shall include necessary protective devices for alarm or alarm and shutdown, as required, for abnormal conditions of pumps, temperatures, flow, etc.
3. All gages and differential pressure transmitters shall be provided with root valves installed in the piping system. All meters and gages shall be supplied with scales utilizing imperial units.
4. The control system shall include a free standing NEMA 4X control enclosure, Programmable Logic Controller (PLC) with necessary I/O, and a Human Machine Interface (HMI) to operate and monitor all BOP Contractor supplied equipment.
5. The PLC shall provide an interface to the PCS via Modbus TCP protocol. Processor utilization shall not exceed 80%. The system shall be supplied with 20 percent spare "hot" pre-wired analog & digital I/O and 10 percent spare rack space. The capability to interface the PLC to the plant DCS via Ethernet/OPC interface shall be supplied.
6. All control components (hardware and software) shall be identified in the proposal. BOP Contractor shall also provide a list of all instrumentation to be furnished in the proposal.
7. All connections and interconnecting wiring to BOP Contractor supplied equipment shall be on numbered terminal strips.
8. BOP Contractor shall supply a hard wired digital out (dry contact) to BOP Contractor's PLC.
9. All BOP Contractor supplied equipment interfacing with control equipment shall be compatible with 4-20mA electronic signal ranges. Control power is available at 120 VAC.

B. Instrumentation and Control System

1. Chemical Feed Pumps: Local control and instrumentation shall provide, but not be limited to, on/off indication of pumps and local control to the extent of this specification. BOP Contractor shall ensure that each pump is compatible with discrete signals (for Run/Stop, pump trouble and pump running) and one analog signal (4-20mA for speed control).
2. A "fail-safe" system shall be furnished which protects the cooling water treatment system from a continuous chemical overfeed, will alarm the PLC in case of a loss of chemical flow, malfunctioning chemical feed pump, and other chemical treatment system failures.
3. Chemical Storage Tanks: A top mounted, non contacting type level indicating transmitter shall be provided for local indication. The PLC shall administer high level, low level and low-low level alarm status signals to the appropriate Operators Workstations.

4. BOP control system interface: The following Chemical Feed system I/O will be secured at the PLC. All discrete signals are 24v dry contacts unless otherwise stated and all analog signals are 4-20mA.

Description	Parameter	Type	Range
COOLING WATER PH	ANALYSIS	AI	4-20mA
COOLING WATER COND.	ANALYSIS	AI	4-20mA
COOLING WATER ORP	ANALYSIS	AI	4-20mA
CW ANALYZER PNL ALM	ALARM	DI	24v (Dry Contact)
COOLING WTR SAMPLE FLOW	FLOW	DI	24v (Dry Contact)
BIOCIDE A PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
BIOCIDE A PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
BIOCIDE A PMP#1 SPEED	CONTROL	AO	4-20mA
BIOCIDE A PMP#1 TBL	ALARM	DI	24v (Dry Contact)
BIOCIDE A PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
BIOCIDE A PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
BIOCIDE A PMP#2 SPEED	CONTROL	AO	4-20mA
BIOCIDE A PMP#2 TBL	ALARM	DI	24v (Dry Contact)
BIOCIDE A TNK LVL	LEVEL	AI	4-20mA
BIOCIDE B PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
BIOCIDE B PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
BIOCIDE B PMP#1 SPEED	CONTROL	AO	4-20mA
BIOCIDE B PMP#1 TBL	ALARM	DI	24v (Dry Contact)
BIOCIDE B PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
BIOCIDE B PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
BIOCIDE B PMP#2 SPEED	CONTROL	AO	4-20mA
BIOCIDE B PMP#2 TBL	ALARM	DI	24v (Dry Contact)

Description	Parameter	Type	Range
BIOCIDE B TNK LVL	LEVEL	AI	4-20mA
BROMINE BIOCIDE PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
BROMINE BIOCIDE PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
BROMINE BIOCIDE PMP#1 SPEED	CONTROL	AO	4-20mA
BROMINE BIOCIDE PMP#1 TBL	ALARM	DI	24v (Dry Contact)
BROMINE BIOCIDE PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
BROMINE BIOCIDE PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
BROMINE BIOCIDE PMP#2 SPEED	CONTROL	AO	4-20mA
BROMINE BIOCIDE PMP#2 TBL	ALARM	DI	24v (Dry Contact)
BROMINE BIOCIDE TNK LVL	LEVEL	AI	4-20mA
ACID PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
ACID PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
ACID PMP#1 SPEED	CONTROL	AO	4-20mA
ACID PMP#1 TBL	ALARM	DI	24v (Dry Contact)
ACID PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
ACID PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
ACID PMP#2 SPEED	CONTROL	AO	4-20mA
ACID PMP#2 TBL	ALARM	DI	24v (Dry Contact)
ACID TNK LVL	LEVEL	AI	4-20mA
SCALE/CORROSION PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
SCALE/CORROSION PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
SCALE/CORROSION PMP#1 SPEED	CONTROL	AO	4-20mA

Description	Parameter	Type	Range
SCALE/CORROSION PMP#1 TBL	ALARM	DI	24v (Dry Contact)
SCALE/CORROSION PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
SCALE/CORROSION PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
SCALE/CORROSION PMP#2 SPEED	CONTROL	AO	4-20mA
SCALE/CORROSION PMP#2 TBL	ALARM	DI	24v (Dry Contact)
SCALE/CORROSION TNK LVL	LEVEL	AI	4-20mA

2.7 FABRICATION

A. Shop/Factory Finishing

1. Cleaning
   a. Surfaces of the base shall be cleaned of all scale, rust, grease and other foreign matter. BOP 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 piping shall be primed and painted. Prior to shipment, the entire skid including the base, exposed piping, pre-painted BOP Contractor items, tubing and all other non-carbon steel items shall be primed and painted.
   b. Stainless steel surfaces shall not be painted. Standard components such as pumps, motors, valves, etc. shall be finish coated in accordance with the manufacturer's standards.
   c. BOP Contractor shall fully describe the color and proposed coating system for all BOP Contractor supplied equipment. Equivalent coating systems by other manufacturers must be submitted for approval to the General Manager prior to fabrication of the equipment.

3. Cleanliness and Workmanship: 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.

2.8 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. Inspection and testing shall be in accordance codes specified.
2. Instruments shall be protected during hydro testing.

3. Filters shall be removed for hydro test of filter housing.
4. Wiring shall be checked for continuity and insulation integrity.
5. Full information describing the tests which are included in the price quotation shall be included with the Proposal.
6. The BOP Contractor shall establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The BOP Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors.
7. Certified copies of test results shall be submitted for acceptance before shipment of the equipment is made.
8. Major items whether fabricated by the BOP Contractor or manufactured by a third party shall be given standard applicable tests during or at completion of the equipment fabrication.
9. A test procedure indicating the proposed test date shall be prepared. The test procedure for each such test shall describe the test to be performed, the applicable equipment item being tested, the method and standards for testing, and certification of the testing facility's capabilities. Successful completion of such test shall be a precondition to shipment.
10. All test procedures shall be available for review by the General Manager.
11. General Manager has the option to review and schedule inspection HOLD points.
12. General Manager shall be notified in writing at least 14 days prior to a shop test or independent inspection HOLD point. Notification shall include the date and place at which the equipment item shall reach the mandatory hold point.
13. Unless the General Manager advises the BOP Contractor not to proceed with the inspection and testing five working days in advance of the date at which the BOP Contractor has stated in the notice, the BOP Contractor may proceed with the activity. Any results shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the results.
14. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481200 Combined Cycle Balance of Plant for general spare parts requirements.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 481200 Combined Cycle Balance of Plant for general field acceptance test requirements

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER

PROJECT

Project Number	123374
Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
Client	Pasadena Water and Power
Location	Pasadena, CA
Service	Chemical Feed System: Cooling Tower

DESIGN DATA

Plant Configuration	1 x 1 Combined Cycle	
Equipment Location	☒ Indoor	☐ Outdoor
Design Life (years)	30	
Power Supply Available	120V/1PH/60Hz, 480V/3PH/60Hz	
System Flow rate	15,789 gpm (estimate)	
Total System Water Volume	TBD	
Cooling Tower Range	20˚F (estimate)	
Design Cycles of Concentration	6	
Circulating Water Temperature	107˚F (max)	
Circulating Water System Design Pressure	TBD	
Paint (Manufacturer's Std)	☒ Yes	☐ No
Remarks		

TESTING

Performance Test	☒ Yes	☐ No	Witnessed:	☐ Yes	☒ No
Remarks					

4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR

Item	Chemical Feed System Component Description/Data	
1.1	**Sample Inlet Bulkhead Connectors**	
	Quantity:	
	Size:	
	Material:	
	Connection Type: (Tube Connection/Socket Weld)	
1.2	**Sample Inlet Valves**	
	Quantity:	
	Manufacturer/Model:	
	Size:	
	Material:	
	Connection Type: (Tube Compression/Socket Weld)	
1.3	**Sample Blowdown Valves**	
	Quantity:	
	Manufacturer/Model:	
	Size:	
	Material:	
	Connections Type: (Tube Compression/Socket Weld)	
1.4	**Sample Blowdown Header**	
	Size:	
	Material:	
	Fitting Rating:	
	Connections:	
1.5	**Thermal/Pressure Relief Valves**	
	Quantity:	
	Manufacturer/Model:	
	Size:	
	Material:	
	Connections:	
	Relief Valve Setting:	
	Temperature Setting:	
1.6	**Water Supply Piping**	
	Size:	
	Material:	
	Connections:	
	Cooling Water Supply Max Design Temperature:	
	Special Features:	

Item	Chemical Feed System Component Description/Data	
1.7	**Return Piping**	
	Size:	
	Material:	
	Fittings:	
	Connections:	
	Special Features:	
1.7	**In-Line Sample Filters**	
	Quantity:	
	Manufacturer/Model:	
	Material:	
	Type:	
1.8	**Sample Pressure Relief Valves**	
	Quantity:	
	Manufacturer/Model:	
	Material:	
	Connections:	
	Relief Valve Setting:	
1.9	**Sample Temperature Indicators**	
	Quantity:	
	Manufacturer/Model:	
	Range:	
	Material:	
	Dial Size:	
	Thermowell (Yes/No)	
1.10	**Sample Sequencing Solenoid Valves**	
	Quantity:	
	Manufacturer/Model	
	Type: (Two or Three-way)	
	Size:	
	Pressure Rating:	
	Connections:	
	Material:	
	Voltage:	
	Coil NEMA Rating:	
	Coil Temperature Class: ("F" or "H")	
1.11	**Sample Sequencing Solenoid Isolation Valves**	
	Quantity:	
	Manufacturer/Model	

Item	Chemical Feed System Component Description/Data	
	Size:	
	Type:	
	Material:	
	Connections:	
1.12	**Sample Backpressure Valves**	
	Quantity:	
	Manufacturer/Model:	
	Material:	
	Connections:	
	Adjustable Handle (Yes/No)	
1.13	**Analyzer Rotameters**	
	Quantity:	
	Manufacturer/Model:	
	Flow Range:	
	Body Material:	
	End Connection Material:	
	Scale Size:	
	Integral Needle Valve (Yes/No)	
	Mounting Bezel (Yes/No)	
1.14	**Total Flow Sample Rotameters**	
	Quantity:	
	Manufacturer/Model:	
	Flow Range:	
	Body Material:	
	End Connection Material:	
	Scale Size:	
	Integral Needle Valve (Yes/No)	
	Mounting Bezel (Yes/No)	
1.15	**Grab Sample Valves**	
	Quantity:	
	Manufacturer/Model:	
	Size:	
	Material:	
	Connections:	
1.16	**Waste Drain Piping**	
	Size:	
	Material:	
	Fittings:	
	Connections:	

Item	Chemical Feed System Component Description/Data	
1.17	**Sample Tubing**	
	Size:	
	Material:	
	Wall Thickness:	
	Type:	
	Insulation (Yes/No)	
	Insulation Type:	
1.18	**Sample Tube Fittings**	
	Manufacturer:	
	Material:	
	Connections:	
1.19	**pH Sensors**	
	Quantity:	
	Manufacturer/Model:	
	Material:	
	Range:	
	Type:	
	Pre Amplifier (Yes/No)	
	Automatic Temperature Compensation (Yes/No)	
	Flow Through Housing Material:	
	High Purity Type: (Yes/No)	
1.20	**Specific Conductivity Sensors**	
	Quantity:	
	Manufacturer/Model:	
	Cell Constant:	
	Range:	
	Material:	
	Automatic Temperature Compensation (Yes/No)	
	Flow Through Housing Material:	
1.21	**pH Monitors**	
	Quantity:	
	Manufacturer/Model:	
	Channels:(Single or Dual)	
	Range:	
	Output:	
	Automatic Temperature Compensation (Yes/No)	
	Alarms (Yes/No)	
	Digital Indicator (Yes/No)	
	Display (LED or LCD)	

Item	Chemical Feed System Component Description/Data	
1.22	**Specific Conductivity Monitors**	
	Quantity:	
	Manufacturer/Model:	
	Channels: (Single or Dual)	
	Range:	
	Output:	
	Automatic Temperature Compensation (Yes/No)	
	Alarms (Yes/No)	
	Digital Indicator (Yes/No)	
	Display (LED or LCD)	
2.0	**Biocide Feed System**	
2.1	**Biocide A Storage Tote:**	
	Manufacturer:	
	Total Volume (gal):	
	Usable Volume (gal):	
	Dimensions (W x L x H, inches):	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
	Level Transmitter:	
	Transceiver Manufacturer/Model:	
2.2	**Biocide A Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
2.2.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
2.2.2	Speed Controllers:	
	Manufacturer/Model:	

Item	Chemical Feed System Component Description/Data	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
2.2.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
2.2.4	Pressure Gauges:	
	Manufacturer/Model:	
2.2.5	Pressure Switches:	
	Manufacturer/Model:	
2.2.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Set Pressure (psig):	
	Capacity (gph):	
2.3	**Biocide B Storage Tote:**	
	Manufacturer:	
	Total Volume (gal):	
	Usable Volume (gal):	
	Dimensions (W x L x H, inches):	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
d	Level Transmitter:	
	Transceiver Manufacturer/Model:	
2.4	**Biocide B Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
2.4.1	Motors:	
	Manufacturer/Model:	
	Type:	

Item	Chemical Feed System Component Description/Data	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
2.4.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
2.4.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
2.4.4	Pressure Gauges:	
	Manufacturer/Model:	
2.4.5	Pressure Switches:	
	Manufacturer/Model:	
2.4.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Set Pressure (psig):	
	Capacity (gph):	
2.5	**Bromine Biocide Storage Tote:**	
	Manufacturer:	
	Total Volume (gal):	
	Usable Volume (gal):	
	Dimensions (W x L x H, inches):	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
	Level Transmitter:	

Item	Chemical Feed System Component Description/Data	
	Transceiver Manufacturer/Model:	
2.6	**Bromine Biocide Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
2.6.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
2.6.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
2.6.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
2.6.4	Pressure Gauges:	
	Manufacturer/Model:	
2.6.5	Pressure Switches:	
	Manufacturer/Model:	
2.6.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Set Pressure (psig):	
	Capacity (gph):	
3.0	**Acid Feed System**	
3.1	**Acid Storage Tank**	
	Manufacturer	
	Total Volume (gal):	
	Usable Volume (gal):	60 (estimate)
	Dimensions (W x L x H, inches):	

Item	Chemical Feed System Component Description/Data	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
d	Level Transmitter:	
	Transceiver Manufacturer/Model:	
3.2	**Acid Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	0.5
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
3.2.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
3.2.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
3.2.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
3.2.4	Pressure Gauges:	
	Manufacturer/Model:	
3.2.5	Pressure Switches:	
	Manufacturer/Model:	
3.2.6	Pressure Relief Valves:	
	Manufacturer/Model:	

Item	Chemical Feed System Component Description/Data	
	Set Pressure (psig):	
	Capacity (gph):	
4.0	**Scale/Corrosion Inhibitor Feed System**	
4.1	**Scale/Corrosion Inhibitor Storage Tote:**	
	Manufacturer:	
	Total Volume (gal):	
	Usable Volume (gal):	60 (estimate)
	Dimensions (W x L x H, inches):	
	Materials of Construction:	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
	Level Transmitter:	
	Transceiver Manufacturer/Model:	
4.2	**Scale/Corrosion Inhibitor Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	0.5
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
4.2.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
4.2.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
4.2.3	Pulsation Dampeners:	

Item	Chemical Feed System Component Description/Data	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
4.2.4	Pressure Gauges:	
	Manufacturer/Model:	
4.2.5	Pressure Switches:	
	Manufacturer/Model:	
4.2.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Set Pressure (psig):	
	Capacity (gph):	
5.1	**Terminal Blocks**	
	Manufacturer/Model:	
5.2	**Control Wire**	
	Type:	
5.3	**Instrumentation/Sensor Wire**	
	Type:	
5.4	**Nameplates**	
	Mounting Method (Adhesive or SS Screws)	
5.5	**Wire Raceway**	
	Type:	
5.6	**Grounding Bus Bar**	
	Included (Yes/No)	
5.7	**Chemical Pot Feeder**	
	Manufacturer/Model:	
	Tank size/Design Temperature and Pressure:	

NOTES

Note 1: BOP Contractor to complete all missing information.

October 14, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Chemical Feed System: Steam Generator
Section 485952.06

PROJECT NUMBER:
123374

PROJECT CONTACT:
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Section 485952.06
Chemical Feed System: Steam Generator

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *TONY CLARK*

REVISION HISTORY		
DATE	REVISED BY	REVISION
9/18/13	T. Clark	A
10/14/13	S. Goldstein	B

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES AND STANDARDS 3
1.5 DEFINITIONS 3
1.6 SYSTEM DESCRIPTION 3
1.7 SUBMITTALS 3
1.8 QUALITY ASSURANCE 4
1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING 5
1.10 SITE CONDITIONS 5
1.11 WARRANTY 5

PART 2 - PRODUCTS 5

2.1 MATERIALS AND WELDING 5
2.2 EQUIPMENT 5
2.3 COMPONENTS 6
2.4 ACCESSORIES 8
2.5 ELECTRICAL 9
2.6 INSTRUMENTATION AND CONTROL 10
2.7 FABRICATION 12
2.8 SOURCE QUALITY CONTROL 12

PART 3 - EXECUTION 13

3.1 SPARE PARTS 13
3.2 FIELD QUALITY CONTROL 13

PART 4 - ATTACHMENTS 14

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER 14
4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR 15

SECTION 485952.06
CHEMICAL FEED SYSTEM: STEAM GENERATOR

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 chemical feed system for use in steam generator condensate systems. The chemical feed system shall be a complete package, including all controls, instruments, components, coatings, interconnecting piping, supports, vents, drains, and appurtenances as required per the referenced specifications including their attachments. 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 BOP Contractors guarantee in a manner acceptable to the General Manager.

B. 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

C. The BOP 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 BOP CONTRACTOR

A. The BOP Contractor will be responsible for the following activities, all in accordance with the requirement of the specification, the data sheets included as an attachment to the specification, and applicable codes and standards. The scope of work shall include design, manufacture, shop testing, packaging, shipping, along with technical direction of the installation and field testing.

1. All skid mounted equipment including automatic stroke or speed controlled injection pumps, strainers, mixers if required, calibration pots, pulsation dampeners, back pressure valves, external relief valves, contactors for 120 volt single phase motors, junction boxes, etc. to meet the performance guarantees.
2. Chemical injection quill
3. Control system consisting of a single, comprehensive, programmable logic controller (PLC) and flat screen control panel interface to operate the entire package.
4. Flow meters for the condensate makeup lines, with 4-20 mA signals to the PLC panel for control of chemical pumps.
5. Incoming 4-20 mA control signal from the Plant Control System (PCS) for the speed control of amine, and oxygen scavenger pumps. The stop/start signal will also be provided from the PCS.
6. Supply of motor drives and disconnect switches.

7. One (1) complete set of any special tools required for installation and maintenance of all BOP Contractor supplied equipment.
8. Any lifting or support lugs required for lifting and handling of all BOP Contractor supplied equipment.
9. All local instrumentation necessary for control.
10. Wiring from instruments/devices on skids up to local common connection point at the control panel.
11. All piping, conduit, valves, supports, and instrumentation (i.e., items normally supplied on a pre-engineered package) required for operation are to be included. BOP Contractor shall give complete description of all items to be included and shall clearly indicate all items required to be supplied by General Manager to complete the system.
12. Finish painting
13. Factory testing and certificates of results
14. Site specific drawings and design data to support facility design, construction and maintenance
15. Inspection certificates and quality control documentation listed in this Section
16. Complete set of component cut sheets
17. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
18. Site installation supervision by BOP Contractor's personnel
19. Start-up supervision and training by BOP Contractor's personnel
20. Foundations, grouting and foundation bolts
21. Unloading at site, storage and installation
22. Power wiring to a single interconnection panel.
23. Control power to a single interconnection panel.
24. Tie-in of all piping, electrical power and control wiring at system interfaces.
25. Control and instrument cabling from equipment/skid junction boxes to the PLC and to the MCC, and between the PLC and Main Control Room.
26. Site civil design and grounding of equipment
27. Cable trays, supports, and accessories for all interconnecting cabling
28. Control power
29. Power wiring and starters in MCC to all electrical loads
30. Compressed air piping for instrumentation and control valves
31. Installation of shop assembled skids and erection & installation of equipment and components shipped loose

B. The requirements of this specification are the minimum for the equipment and are to be supplemented by the BOP Contractor's own requirements.

1.3 RELATED SECTIONS

A. Section 480020 - Site Conditions

B. Section 481200 - Combined Cycle Balance of Plant

C. Section 482610 - Low Voltage Motors

D. Section 485951.80 - Steam Sample Panel

E. Section 485413 - Once Through Steam Generator

1.4 CODES AND STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1.5 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.

1.6 SYSTEM DESCRIPTION

A. Design Requirements:

1. Reference Section 481200 Combined Cycle Balance of Plant for general design requirements and expected operating profile.
2. The equipment shall be pre-engineered, pre-assembled units that minimize installation schedule and start-up costs. The system shall be fully tested at the factory and require simple utility connections, with minor set up and adjustment, and ready for immediate on-line service.
3. The equipment will be packaged (i.e., skid mounted) to the fullest extent practical to minimize labor required for field installation. Extent of skid assembly shall be as shown on BOP Contractor submitted P&IDs.

B. Performance Requirements:

1. The Steam Generator Chemical Feed System with the Steam Sample Panel shall continuously monitor and control boiler feedwater chemistry within the guidelines of the OTSG manufacturer.

1.7 SUBMITTALS

A. Information to be furnished with the Bid:

1. Proposal shall be prepared in accordance with the Section 481200 Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and return the following documents:

    a. Performance data based on conditions specified in Section 480020, Site Conditions.
    b. Completed "Technical Datasheet by Contractor" attached to this Section

2. The Contractor is encouraged to submit as many documents and drawings as necessary to define the supplied equipment.

B. Information required after Contract Award:

1. Refer to Section 481100, Combined Cycle Power Island for general submittal requirements after contract award.
2. List of warranties and guarantees.
3. Complete list of electrical loads associated with the Contractor's scope of supply. For all loads, the list shall contain description, location of the interconnect, voltage, ampere rating, phase, rated load, operating load, service factor, and whether operation is continuous, intermittent, or emergency only.
4. Motor data including manufacturer, equipment tag number, horsepower (HP), voltage, ampere rating, phase, service factor, enclosure, insulation, rpm, efficiency, and accessories.
5. Noise data including estimated sound power levels for the eight octave bands, corrections for silencers, ducts distance etc. and an estimated logarithmic summation for the driver and driven equipment.
6.

C. Shop Drawings

1. Refer to Section 481100, Combined Cycle Power Island for general shop drawing requirements.

D. 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 overhaul inspections
    e. Tests, settings, and calibrations
    f. Method of calculating effective operating hours

1.8 QUALITY ASSURANCE

A. Refer to Section 481100, Combined Cycle Power Island for general quality assurance requirements.

1.9 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.10 SITE CONDITIONS

A. Reference Section 480020, Site Design Conditions.

1.11 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND WELDING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general material and welding requirements.

2.2 EQUIPMENT

A. General

1. The system shall be the BOP Contractor's standard design, modified as required to comply with this specification.
2. The skid shall be manufactured of material suited for the defined chemicals of service.
3. The equipment and materials specified are intended to be the minimum suitable for the intended service. They are not intended to limit the BOP Contractor's responsibility for proper design and selection of equipment. It is the BOP Contractor's responsibility to supply a complete system for the intended service and the specification is only for general guidelines. Any changes in proposed equipment or materials during design shall be approved by General Manager prior to incorporation into the design.
4. The equipment shall be designed to provide maximum practical operational reliability using standard, commercially available equipment, i.e. vessels, valves, pumps, PLC, etc.
5. The equipment shall be designed to provide trouble-free operation during start-up, shutdown, and system operating modes.
6. The design of equipment, arrangement of components, and routing of piping shall consider operational and maintenance accessibility of components. Equipment, piping, valves, and instruments shall be arranged so that when installed, components requiring manipulation, observation, or maintenance will be readily accessible and safe to operating and maintenance personnel.
7. BOP Contractor shall provide equipment and components Sub-Contractor's list for General Manager's approval.

B. Steam generator chemical feed and storage system will utilize portable containers for shipment, storage and feeding of the required chemicals. BOP Contractor shall provide containment, containment stand and quick connection to camlock fittings on the discharge connections.

C. Non-contacting type level indicating transmitters with local indication shall be provided to send tank level signals to the PLC. Drain and overflow piping and fittings shall be provided and installed by BOP Contractor.

D. The calibration column shall be a 1000 ml glass cylinder marked in 10 ml increments. A common calibration column shall be used for both pumps with the vent piped back to the chemical storage tote.

E. 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 with safe access for operating and maintenance personnel.

1. The Chemical Feed System shall consist of the following at a minimum and comply with data sheets included as attachment to the specification.

    a. One pH control chemical feed system with all pumps, controls, and chemical storage which will be located close to the OTSG.
    b. One Oxygen Scavenger chemical feed system with all pumps, controls, and chemical storage which will be located close to the OTSG.
    c. One 3/4” size quill for pH control chemical injection.
    d. One 3/4” size quill for oxygen scavenger injection.

F. Skid Assembly

1. Components on a skid mounted assembly shall be installed properly and completely pre-piped and pre-wired. Electrical and control signal interface connections for all systems required to support both equipment specified in this specification and equipment in General Manager’s systems shall be brought to a single distribution panel and terminal strip within the dry section. Alarm signals from individual analyzers are not used and therefore shall not be run to this location. Access to the panel by the General Manager for external wiring/signals shall be provided from the top of the dry section. The dry section shall be a NEMA 12 designed enclosure with the exception of the muffin fan required for condensation protection. BOP Contractor/General Manager piping and tubing interface connections shall terminate at the sampling/analyzer system plot boundary. Piping and tubing shall be supported from skid or equipment.

G. Structural Design

1. Refer to Section 481200, Combined Cycle Balance of Plant for general structural design requirements.

2.3 COMPONENTS

A. pH Control Chemical Feed System

1. A pH control chemical shall be fed into the condensate pump discharge by metering injection pumps. The injection pumps are controlled on or off by the PCS and speed

controlled with 4-20mA signal and shall also have manual stroke adjustments capabilities.

2. The pH levels are continuously monitored by grab sample analysis. The levels of chemical and pH will determine the speed control or manual adjustments to be made to the stroke of the injection pumps to maintain the levels within specified ranges.
3. Chemical feed pumps shall be heavy-duty, piston or PTFE diaphragms. Seals manufactured by Durameter or Milton Roy XW series chemical pumps. The pumps shall be rated for 0.5gph.
4. Chemical Storage Drum/ Mini Porta Tote:

    a. Chemical totes of 150 gallons shall be provided. Construction shall be high density cross-linked polyethylene.

5. pH Control Chemical Feed System Skid

    a. BOP Contractor shall provide shop-assembled, skid-mounted unit. The skid assembly shall include injection pumps and interconnecting piping.
    b. The skid material shall be welded steel construction. The design of the skids shall include permanently attached lifting lugs. The design shall allow for the free flow of water out of the frame into the bermed containment area (for convenient housekeeping).
    c. The skid shall contain one control cabinet for power distribution and control wiring termination. The NEMA 4X fiberglass cabinet shall be mounted on a stainless steel frame.

B. Oxygen Scavenger Chemical Feed System

1. Oxygen scavenger will be fed into the boiler feed pumps suction piping by means of metering pumps. The injection pumps are controlled on or off by the PCS and speed controlled with 4-20mA signal and shall also have manual stroke adjustments capabilities. The feed rate of the scavenger is determined by the PCS and is proportional to the condensate flow rate, residual O_2 , conductivity, and the pH of the condensate before and after chemical injection. Independent verification of the oxygen level will be provided by grab sample analysis. The remote speed control or manual adjustment of the pump stroke is based on verification testing.
2. Oxygen Scavenger metering pumps: Two Milton Roy H Series / Bran-Luebbe or approved equivalent. The pumps shall be rated for 0.5gph.

3. Oxygen Scavenger Chemical Storage Drums/ Mini Porta Totes

    a. Chemical totes of 60 gallons shall be provided. Construction shall be high density cross-linked polyethylene, with suction taken from the low point of the tank.
    b.

4. Oxygen Scavenger Chemical Feed System Skid

    a. BOP Contractor shall provide shop-assembled, skid-mounted unit. The skid assembly shall include oxygen scavenger injection pumps and interconnecting piping.
    b. The skid material shall be welded steel construction. The design of the skids shall include permanently attached lifting lugs. The design shall allow for the free flow

of water out of the frame into the bermed containment area (for convenient housekeeping).

c. The skid shall contain one control cabinet for power distribution and control wiring termination. The NEMA 4X fiberglass cabinet shall be mounted on a stainless steel frame.

C. Pumps

1. Pump speed control will be a 4-20mA control signal from the PCS.

2.4 ACCESSORIES

A. Piping and Valves

1. All piping and valves required to take samples from the relevant sampling points to the chemical feed skid and from there to drain shall be furnished by the BOP Contractor.
2. Each system shall be supplied with all piping and valves as much as practical contained within the confines of its skid.
3. Each pump discharge line will have a check valve and a block valve, in addition to the relief valve and a back pressure valve.
4. Relief valves shall be piped back to the pump inlet line.
5. Instrumentation: Each pump shall be provided with a pressure gauge with isolation valve and snubber at the discharge. Chemical feed pumps shall also be equipped with a common calibration cylinder with isolation valve on the suction line. The calibration cylinders shall be sized appropriately for the specified operating capacities.
6. Each pressure indicator shall have a 4½" diameter face, with a type 316 stainless steel housing, and an operating range appropriate for the specified operation condition. Provide a diaphragm seal for pressure indicators in acid service.
7. Level gauges shall include gauge cocks constructed of 316 stainless steel materials with guard rod protectors and tubular glass constructed with red background target.
8. Level switches shall be double-pole, double throw. All wetted parts shall be constructed of 316 stainless steel materials. Top entry mounted conductance type with 316SS probes.

B. Utility

1. External Power/Control Connections

a. Pumps speed signal 4-20 mA Analog Input
b. Discrete pump status signals (Running/Not Running and Pump Trouble) for each pump
c. 120V, single phase, 60 Hz, 30 Amp Power (one tie-in provided for each skid).
d. Analyzer panel interface signals (4 to 20mA) to PLC (steam cycle system pH, conductivity, etc)

2. Piping and Tubing Connection Points (Terminal Points)

a. Chemical Injection Pump Skid Discharge - One each chemical service
b. Chemical Storage Tank Fill Connection - One each chemical service

C. Identification

1. Equipment shall be furnished with a permanently attached stainless steel nameplate having embossed or raised letters. The nameplate shall include, but is not limited to, the following:

    a. Manufacturer's name
    b. Model number
    c. Serial number
    d. Year built
    e. Design capacity or volume
    f. Design pressure and temperature
    g. Speeds – Rotating equipment
    h. Set pressure – Relief valves
    i. Equipment number
    j. Equipment contract number
    k. PO number

2. Nameplates shall conform to applicable requirements of Technical Specifications and Referenced Codes and Standards.
3. Each front of panel mounted instrument and control device shall have its tag number and service on a nameplate permanently mounted with stainless steel drive screws. A nameplate indicating the tag number shall be mounted inside the panel next to front-of-panel mounted instruments and devices. The same type of nameplate shall be installed for tag numbered devices which are contained wholly within the panel. Nameplates shall be laminated plastic with black engraved characters on a white background.
4. Bulkhead fittings, panel piping, tubing, and wiring terminals shall be identified permanently with designations reviewed by General Manager. These designations shall correspond to those on the drawings.
5. A control cabinet nameplate that identifies the BOP Contractor may be furnished by the panel fabricator and mounted on the top center section of the control cabinet.
6. Field mounted instruments shall have an identifying nameplate attached permanently by stainless steel drive screws. The nameplate shall be made of stainless steel. The nameplate shall include the complete tag number stamped or engraved in characters ¼" high. For small items such as thermometers and pressure gages, characters may be smaller, and the nameplate shall be laminated plastic with black engraved characters on a white background.

2.5 ELECTRICAL

A. All circuits shall be factory wired and tested at operating voltage. The BOP Contractor shall complete all internal wiring between devices. All device terminals shall be connected to terminal blocks for field wiring. All wiring external to the skid shall enter and exit the panel from the top of the panel.

B. All terminal connections shall be plainly marked in accordance with the BOP Contractor's connection diagrams. The BOP Contractor shall provide all necessary internal panel wiring and branch circuit protection.

C. Terminal blocks provided for all circuit wiring shall be equipped with wire clamps and white fiber marking strips. Terminal blocks shall be of flame-retardant materials. No terminal block shall carry more than two conductors on either side of any terminal.

D. Electrical enclosures shall be NEMA 4X. Material of construction shall be fiberglass. Controls on the panel shall consist of, at a minimum, a HOA switch with running lights for each pump.

E. Wiring mounted to swing panels or subject to movement shall be grouped into bundles, have extra-flexible conductors, and have a plastic, wire loom over wire bundles.

F. Control panel power connections shall be permanently wired to power source. Local control and instrumentation shall provide, but not be limited to, on/off indication of pumps and local control to the extent of this specification. No local alarm is required on the panel. BOP Contractor supplied pumps shall be controllable via three discrete signals (one for on/off, one for pump trouble and one for pump running status) and one analog signal (for speed control) wherever required.

G. Motors for auxiliary services shall be in compliance with Section 482610, Low Voltage Motors. Motor power connections shall be permanently wired to power source.

H. All PLC's and/or controllers to have available connections for UPS power feeds.

I. Interface Boundaries: Electrical interface points shall be located in control panels. Control signals shall include appropriate segregation from 480V power.

J. 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.

2.6 INSTRUMENTATION AND CONTROL

A. General

1. Refer to Section 481200, Combined Cycle Balance of Plant for general instrumentation and control requirements and instrument calibration requirements.
2. All instrumentation required for automatic operation and monitoring of the equipment shall be provided by the BOP Contractor. This shall include necessary protective devices for alarm or alarm and shutdown, as required, for abnormal conditions of pumps, temperatures, flow, etc.
3. All gages and differential pressure transmitters shall be provided with root valves installed in the piping system. All meters and gages shall be supplied with scales utilizing imperial units.
4. The control system shall include a free standing NEMA 4X control enclosure, Programmable Logic Controller (PLC) with necessary I/O, and a Human Machine Interface (HMI) to operate and monitor all BOP Contractor supplied equipment.
5. The PLC shall provide an interface to the PCS via Modbus TCP protocol. Processor utilization shall not exceed 80%. The system shall be supplied with 20 percent spare "hot" pre-wired analog & digital I/O and 10 percent spare rack space. The capability to interface the PLC to the plant DCS via Ethernet/OPC interface shall be supplied.
6. All control components (hardware and software) shall be identified in the proposal. BOP Contractor shall also provide a list of all instrumentation to be furnished in the proposal.
7. All connections and interconnecting wiring to BOP Contractor supplied equipment shall be on numbered terminal strips.
8. BOP Contractor will supply a hard wired digital out (dry contact) to the supplied PLC.

9. All BOP Contractor supplied equipment interfacing with General Manager's control equipment shall be compatible with 4-20mA electronic signal ranges. Control power is available at 120 VAC.

B. Instrumentation and Control System

1. Chemical Feed Pumps: Local control and instrumentation shall provide, but not be limited to, on/off indication of pumps and local control to the extent of this specification. BOP Contractor shall ensure that each pump is compatible with discrete signals (for Run/Stop, pump trouble and pump running) and one analog signal (4-20mA for speed control).
2. A "fail-safe" system shall be furnished which protects the cooling water treatment system from a continuous chemical overfeed, will alarm the PLC in case of a loss of chemical flow, malfunctioning chemical feed pump, and other chemical treatment system failures.
3. Chemical Storage Tanks: A top mounted, non contacting type level indicating transmitter shall be provided for local indication and to send low, and low-low control signals to the PCS. Level loop shall be power displayed to facilitate the filling of the storage tank.
4. BOP control system interface: The following Chemical Feed system I/O will be secured at the PLC. All discrete signals are 24v dry contacts unless otherwise stated and all analog signals are 4-20mA.

Description	**Parameter**	**Type**	**Range**
PH CONTROL PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
PH CONTROL PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
PH CONTROL PMP#1 SPEED	CONTROL	AO	4-20mA
PH CONTROL PMP#1 TBL	ALARM	DI	24v (Dry Contact)
PH CONTROL PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
PH CONTROL PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
PH CONTROL PMP#2 SPEED	CONTROL	AO	4-20mA
PH CONTROL PMP#2 TBL	ALARM	DI	24v (Dry Contact)
PH CONTROL TNK LVL	LEVEL	AI	4-20mA
OXYGEN SCAVENGER PMP#1 RUNNING	STATUS	DI	24v (Dry Contact)
OXYGEN SCAVENGER PMP#1 RUN	COMMAND	DO	24v (Dry Contact)
OXYGEN SCAVENGER PMP#1 SPEED	CONTROL	AO	4-20mA

Description	Parameter	Type	Range
OXYGEN SCAVENGER PMP#1 TBL	ALARM	DI	24v (Dry Contact)
OXYGEN SCAVENGER PMP#2 RUNNING	STATUS	DI	24v (Dry Contact)
OXYGEN SCAVENGER PMP#2 RUN	COMMAND	DO	24v (Dry Contact)
OXYGEN SCAVENGER PMP#2 SPEED	CONTROL	AO	4-20mA
OXYGEN SCAVENGER PMP#2 TBL	ALARM	DI	24v (Dry Contact)
OXYGEN SCAVENGER TNK LVL	LEVEL	AI	4-20mA

2.7 FABRICATION

A. Shop/Factory Finishing

1. Cleaning
   a. Surfaces of the base shall be cleaned of all scale, rust, grease and other foreign matter. BOP 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 piping shall be primed and painted. Prior to shipment, the entire skid including the base, exposed piping, pre-painted BOP Contractor items, tubing and all other non-carbon steel items shall be primed and painted.
   b. Stainless steel surfaces shall not be painted. Standard components such as pumps, motors, valves, etc. shall be finish coated in accordance with the manufacturer's standards.
   c. BOP Contractor shall fully describe the color and proposed coating system for all BOP Contractor supplied equipment. Equivalent coating systems by other manufacturers must be submitted for approval to the General Manager prior to fabrication of the equipment.

3. Cleanliness and Workmanship: 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.

2.8 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. Inspection and testing shall be in accordance codes specified.
2. Instruments shall be protected during hydro testing.

3. Wiring shall be checked for continuity and insulation integrity.
4. Full information describing the tests which are included in the price quotation shall be included with the Proposal.
5. The BOP Contractor shall establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The BOP Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors.
6. Certified copies of test results shall be submitted for acceptance before shipment of the equipment is made.
7. Major items whether fabricated by the BOP Contractor or manufactured by a third party shall be given standard applicable tests during or at completion of the equipment fabrication.
8. A test procedure indicating the proposed test date shall be prepared. The test procedure for each such test shall describe the test to be performed, the applicable equipment item being tested, the method and standards for testing, and certification of the testing facility's capabilities. Successful completion of such test shall be a precondition to shipment.
9. All test procedures shall be available for review by the General Manager.
10. General Manager has the option to review and schedule inspection HOLD points.
11. General Manager shall be notified in writing at least 14 days prior to a shop test or independent inspection HOLD point. Notification shall include the date and place at which the equipment item shall reach the mandatory hold point.
12. Unless the General Manager advises the BOP Contractor not to proceed with the inspection and testing five working days in advance of the date at which the BOP Contractor has stated in the notice, the BOP Contractor may proceed with the activity. Any results shall be deemed to have been made in the General Manager's presence, and the BOP Contractor shall forthwith forward to the General Manager duly certified copies of the results.
13. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any factory inspection at the premises of BOP Contractor or any other place of manufacture of items supplied hereunder (or components thereof).

PART 3 - EXECUTION

3.1 SPARE PARTS

A. Refer to Section 481200 Combined Cycle Balance of Plant for general spare parts requirements.

3.2 FIELD QUALITY CONTROL

A. Field Acceptance Tests

1. Refer to Section 481200 Combined Cycle Balance of Plant for general field acceptance test requirements

PART 4 - ATTACHMENTS

4.1 TECHNICAL DATASHEETS BY GENERAL MANAGER

PROJECT

Project Number	123374
Project Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)
Client	Pasadena Water and Power
Location	Pasadena, CA
Service	Chemical Feed System: Steam Generator

DESIGN DATA

Plant Configuration	1 x 1 Combined Cycle	
Equipment Location	☒ Indoor	☐ Outdoor
Design Life (years)	30	
Power Supply Available	120V/1PH/60Hz, 480V/3PH/60Hz	
System Flow rate	TBD	
Condensate Temperature	77-117˚F	
Condensate System Design Pressure	TBD	
Paint (Manufacturer's Std)	☒ Yes	☐ No
Remarks		

TESTING

Performance Test	☒ Yes	☐ No	Witnessed:	☐ Yes	☒ No
Remarks					

4.2 TECHNICAL DATASHEETS BY BOP CONTRACTOR

Item	Description	Data
1.0	**pH Control Chemical Feed System**	
1.1	**pH Control Storage Tote:**	
	Manufacturer:	
	Volume (gallons):	150
	Dimensions (W x L x H, inches):	
	Materials of Construction:	High density cross-linked polyethylene
	Wall Thickness:	
	Connection Number/Size/Type:	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
	Level Switches:	
	Manufacturer/Model:	
	Materials of Construction:	
	Process Connections Size/Type:	
1.2	**pH Control Chemical Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	0.5
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Check Valve Materials:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
1.2.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	

Item	Description	Data
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	
1.2.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
1.2.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Materials of Construction:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
1.2.4	Pressure Gauges:	
	Manufacturer/Model:	
1.2.5	Pressure Switches:	
	Manufacturer/Model:	
1.2.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Capacity (gph):	
1.2.7	Backpressure Valves:	
	Manufacturer/Model:	
	Capacity (gph):	
1.2.8	Check Valves:	
	Manufacturer/Model:	
1.3	**Electrical and Instrumentation & Controls**	
	Control Panel Enclosure Manufacturer/Model:	
	Selector Switch Manufacturer/Model:	
	Indicating Light Manufacturer/Model:	
	Main Power Disconnect Manufacturer/Model:	
	Branch Power Disconnect Manufacturer/Model:	
	Transformer Manufacturer/Model:	
	Storage Tank Level Indicator Manufacturer/Model	

Item	Description	Data
2.0	**Oxygen Scavenger Feed System**	
2.1	**Oxygen Scavenger Storage Tote:**	
	Manufacturer:	
	Total Volume (gal):	
	Usable Volume (gal):	
	Dimensions (W x L x H, inches):	
	Materials of Construction:	
	Wall Thickness:	
	Connection Number/Size/Type:	
	Measuring Cylinders Numbers/Capacity	
	Vent (if closed top):	
	Overflow (if closed top):	
	Level switch (if closed top):	
	Level Transmitter:	
	Transceiver Manufacturer/Model:	
2.2	**Oxygen Scavenger Metering Pumps:**	
	Manufacturer/Model:	
	Rated Capacity (gph):	0.5
	Rated Discharge Pressure (psig):	
	Maximum Stokes per Minute:	
	Strokes per Minute at Specified Pump Flow:	
	Head Material:	
	Check Valve Type:	
	Diaphragm Material:	
	Pump Horsepower at Rated Capacity/Pressure (hp):	
2.2.1	Motors:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Service Factor:	
	Enclosure:	
	Voltage/Phase(s)/Frequency:	
	Speed (rpm):	

Item	Description	Data
2.2.2	Speed Controllers:	
	Manufacturer/Model:	
	Type:	
	Rated Horsepower (hp):	
	Enclosure:	
	Inlet Voltage/Phase(s)/Frequency:	
2.2.3	Pulsation Dampeners:	
	Manufacturer/Model:	
	Volume (cubic inches):	
	Pressure Fluctuation (%):	
2.2.4	Pressure Gauges:	
	Manufacturer/Model:	
2.2.5	Pressure Switches:	
	Manufacturer/Model:	
2.2.6	Pressure Relief Valves:	
	Manufacturer/Model:	
	Set Pressure (psig):	
	Capacity (gph):	
2.3	**Misc. Valves and Piping Specialties:**	
2.3.1	Basket Strainer:	
	Manufacturer/Model:	
	Strainer Mesh:	
2.3.2	Calibration Column:	
	Manufacturer/Model:	
	Materials of Construction:	
	Volume:	
	Graduations (Primary/Secondary):	
	End Connection Type/Size:	
2.4	**Injection Quill:**	
	Manufacturer/Model:	
	Materials of Construction:	
	Body:	
	Check Valve:	
	Rated Temperature/Pressure	

Item	Description	Data
	Connection Size/Type:	
3.0	**Electrical and Instrumentation & Controls**	
	Control Panel Enclosure Manufacturer/Model:	
	Selector Switch Manufacturer/Model:	
	Indicating Light Manufacturer/Model:	
	Main Power Disconnect Manufacturer/Model:	
	Branch Power Disconnect Manufacturer/Model:	
	Transformer Manufacturer/Model:	
	Grounding Bus Bar included (yes/no)	

NOTES

Note 1: BOP Contractor to complete all missing information.

END OF SECTION 485952.06

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 260000

Electrical-Mechanical Equipment

PROJECT NUMBER:
123374

PROJECT CONTACT:
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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

September 6, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 260533
Nonsegregated-Phase Bus

PROJECT NUMBER:
123374

PROJECT CONTACT:
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POWER ENGINEERS

Section 260533
Nonsegregated-Phase Bus

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
09/06/2013	F. De Guzman	R. Barklund	G. Harwood	A

SECTION 260533
NONSEGREGATED-PHASE BUS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 UNIT PRICING 2

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT 2

2.1 NONSEGREGATED BUS DUCT 2

PART 3 - EXECUTION 4

3.1 QUALITY CONTROL 4

APPENDIX A – VENDOR DATA COMMITMENTS 5

APPENDIX B – NON-SEG BUS DATA SHEET 6

APPENDIX C – REFERENCE DRAWINGS 8

SECTION 260533
NONSEGREGATED-PHASE BUS

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. A nonsegregated-phase bus duct shall be provided and installed for connection between switchgear and the respective transformers.

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 262600 PDC Specification
4. 480020 Pasadena Site Conditions

1.2 SCOPE

A. This specification covers furnishing a nonsegregated bus duct complete for connection between the associated (a) 480 V switchgear/MCC (b) 15kV Switchgear-GTG Bus and (c) 15kV Switchgear-STG Bus, and their respective transformers. The equipment required shall be installed outdoors. Refer to Drawing E1-1A Electrical Overall One Lines for details on bus and transformer connections.

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

C. The nonsegregated-phase bus and all associated equipment shall be designed and tested in accordance to the latest revision of the following standards and codes:

1. IEEE C37.23 - IEEE Standard for Metal-Enclosed Bus
2. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
3. NEC – National Electrical Code

D. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentation shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Dimensional drawings
3. Brochures/literature
4. Complete description of all equipment to be furnished
5. Unit Pricing
6. Commercial terms and conditions of sale
7. Include calculated results of predicted performance of the Nonsegregated-Phase Bus while operating under the specified environmental conditions.

D. Manufacturer Seismic Qualification Certification: Submit certification that the nonsegregated-phase bus, accessories, and related components will withstand seismic forces defined in 480020 Pasadena Site Conditions:

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 UNIT PRICING

A. Bidder shall furnish add/delete pricing required by filling in all blanks for 3 phase Bus duct.

1. Outdoor straight section per foot

a. Add Price _____
b. Delete Price _____

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT

2.1 NONSEGREGATED BUS DUCT

A. Equipment Ratings:

1. 600V, 4000A
2. 600V, 4000A

3. 15kV, 3000A
4. 15kV, 1200A

B. The Nonsegregated phase duct shall be electrically continuous, self-cooled design.

C. Bus sections shall be constructed in sections as long as practical for installation to reduce installation time.

D. Nonsegregated phase bus shall include removable gasketed covers and heating to prevent condensation, unless the vendors design negates this requirement.

E. A continuous ground conductor should be installed in parallel with the bus enclosure, and each gasketed section shall be bonded to the conductor. The ground conductor should be connected to the station ground at one point only, although more connection points are satisfactory if induced current loops have been avoided. The ground bus shall be capable of carrying the rated short-circuit current of the bus.

F. Induced voltage across insulated joints in the enclosure should be kept as low as possible, and preferably below 2 V, during rated current operation.

G. Ventilation with filtered breathers can be provided. Filtered drains should be provided at the low point in vertical sections to prevent accumulation of condensation if required.

H. Where bus duct penetrates fire barriers (fire rated walls and floors), the integrity of the fire barrier shall not be impaired by the bus duct system.

I. Tinned copper bus conductors shall be supplied.

J. The conductors shall be insulated.

K. Welded or bolted flexible connectors should be provided at terminations and along the length of the conductor to accommodate conductor expansion/contraction over the expected temperature range.

L. All bolted contact surfaces should be tin or nickel plated.

M. The bus supports may be polyester glass or porcelain insulators for standard ratings.

N. Enclosures should be of the totally enclosed type, formed of sheet aluminum or steel and should be weatherproof /dust tight

O. Space Heaters shall be provided to prevent condensation in accordance with the attached data sheets, unless the vendors design negates the need for these heaters.

P. The enclosed bus assembly should be designed so that the maximum conductor temperature rise above an outside ambient temperature should not exceed the allowable hot spot temperature while continuously operating at rated full load capacity

Q. The enclosure interior shall be painted the vendor’s standard color.

R. The bus manufacturer shall coordinate all bus connections shown in equipment drawings to be supplied by the Purchaser. Vendor equipment drawings shall be provided as they become available.

S. All elbows shall be constructed to eliminate any field welding of the diagonal joints.

T. All bus bolting hardwire shall be zinc dichromate plated steel. All conductor bolted joints shall be tin or nickel-plated and incorporate spring washers. All connections shall be appropriately torqued.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Design tests shall consist of Basic Impulse Level Test, Temperature Rise test and Momentary Short Circuit test. Should the bus manufacturer have existing test reports on the bus of a design similar to the bus as covered by these specifications, and where interpolations may be used to justify the design submitted by the bus manufacturer, it shall be the General Manager's option to waiver actual test on this specific design. Design test on the specific bus as covered by these specifications shall be quoted as an option.

B. Production test shall consist of factory Power Frequency Withstand test and shall be performed on each and every section of bus manufactured under these specifications.

END OF SPECIFICATION

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	FOR APPROVAL		CERTIFIED		AS-BUILT
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

SECTION 260533
NONSEGREGATED-PHASE BUS

APPENDIX B – NON-SEG BUS DATA SHEET

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number:
Service/Application: (2) 480V Non-seg Bus

		SPECIFICATION REQUIREMENTS	DATA BY VENDOR
1. BUS SYSTEM VOLTAGE			
Bus System Rated Voltage	V	600	
Bus System Operating Voltage	V	480	
Bus System Frequency	Hz	60	
Basic Impulse Level	kV	45	
Bus Material		Copper	
Bus Plating		Tin	
2. BUS AMPACITY			
Continuous	Amps	4000	
3. SHORT CIRCUIT CURRENT			
Main Bus (rms symmetrical)	kA	65	
4. ACCESSORIES			
Heaters	W		

Service/Application: 13.8kV Non-seg GTG Bus

		SPECIFICATION REQUIREMENTS	DATA BY VENDOR
1. BUS SYSTEM VOLTAGE			
Bus System Rated Voltage	kV	15	
Bus System Operating Voltage	kV	13.8	
Bus System Frequency	Hz	60	
Basic Impulse Level	kV	95	
Bus Material		Copper	
Bus Plating		Tin	
2. BUS AMPACITY			
Continuous	Amps	3000	
3. SHORT CIRCUIT CURRENT			
Main Bus (rms symmetrical)	kA	50	
4. ACCESSORIES			
Heaters	W		

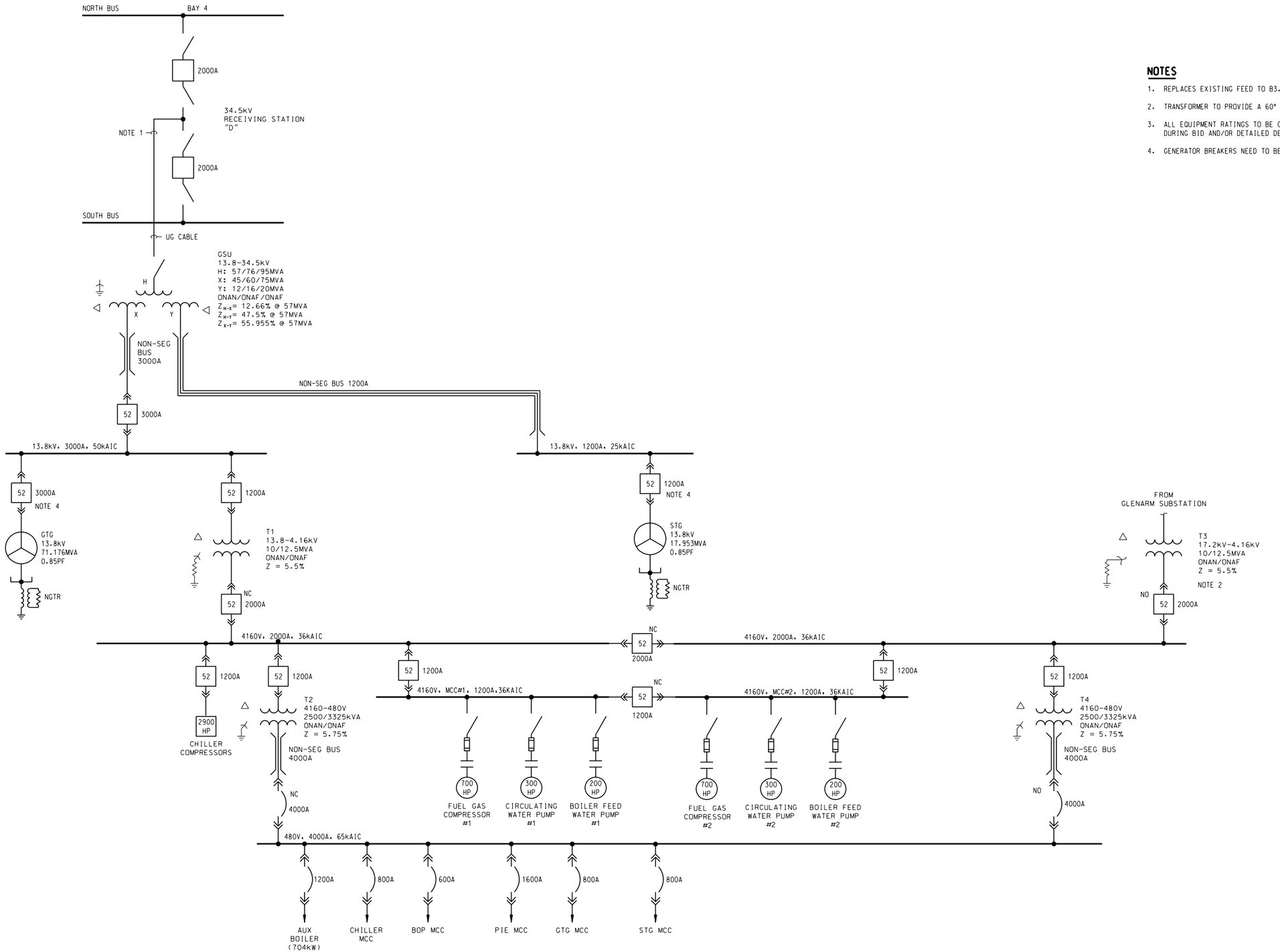
Service/Application: 13.8kV Non-seg STG Bus

SECTION 260533
NONSEGREGATED-PHASE BUS

		SPECIFICATION REQUIREMENTS	DATA BY VENDOR
1. BUS SYSTEM VOLTAGE			
Bus System Rated Voltage	kV	15	
Bus System Operating Voltage	kV	13.8	
Bus System Frequency	Hz	60	
Basic Impulse Level	kV	95	
Bus Material		Copper	
Bus Plating		Tin	
2. BUS AMPACITY			
Continuous	Amps	1200	
3. SHORT CIRCUIT CURRENT			
Main Bus (rms symmetrical)	kA	25	
4. ACCESSORIES			
Heaters	W		

APPENDIX C – REFERENCE DRAWINGS

E1-1A Electrical Overall One-Lines (LM6000)
E1-2 Conceptual PDC Layout



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

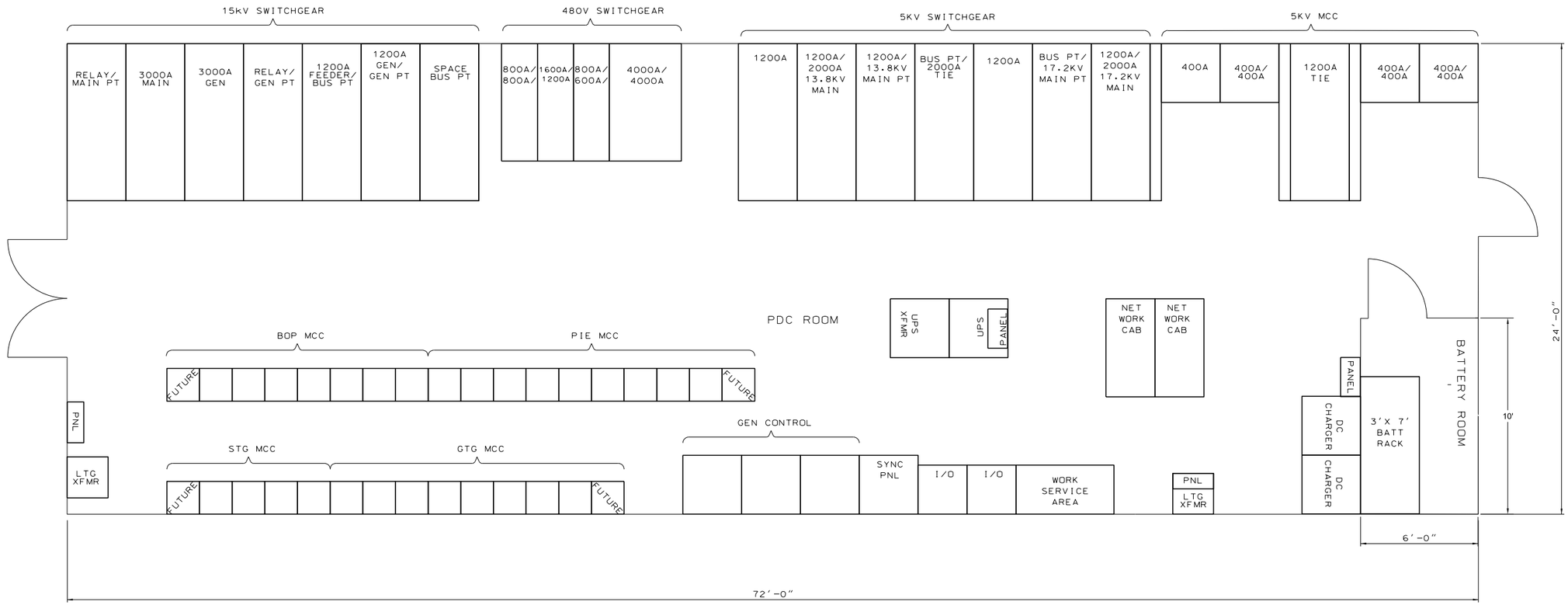
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

ralexander 09/06/2013 03:33 PM W:\123374\DD\CAD\dwg\elec\54pase1_1A.dgn



0 1 2 3 4 5 10 FEET

1/4"= 1'- 0"

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INTER-DISCIPLINE REVIEW							
DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

SCALE: * *
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CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2

September 9, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 261200-2
Medium Voltage Auxiliary Transformers

PROJECT NUMBER:
123374

PROJECT CONTACT:
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POWER ENGINEERS

Section 261200-2
Medium Voltage Auxiliary Transformers

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
07/15/2013	F. De Guzman	J. Rippee	G. Harwood	A
09/09/2013	F. De Guzman	R. Barklund	G. Harwood	B

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 MAINTENANCE MATERIALS 4

PART 2 - DESIGN REQUIREMENTS FOR LIQUID FILLED TRANSFORMERS 4

2.1 GENERAL 4
2.2 PRIMARY SIDE INCOMING SECTION 4
2.3 TRANSFORMER SECTION 5
2.4 LOW VOLTAGE SECTION 6
2.5 WIRING AND COMPONENTS 7
2.6 CLEANING AND PAINTING 7
2.7 EQUIPMENT MARKING 8

PART 3 - EXECUTION 8

3.1 QUALITY CONTROL 8
3.2 FIELD TEST 8

APPENDIX A – VENDOR DATA COMMITMENTS 9

APPENDIX B – TRANSFORMER DATA SHEETS 10

APPENDIX C – REFERENCE DRAWINGS 19

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. Auxiliary transformers and accessories shall be provided.

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. 480020 Pasadena Site Conditions

1.2 SCOPE

A. This specification covers the design, fabrication, testing, and delivery of medium voltage auxiliary transformers. Equipment tagging shall be provided as listed below:

1. T1 13800-4160V Transformer
2. T2 4160-480V Transformer
3. T3 17200-4160V Transformer
4. T4 4160-480V Transformer

B. BOP Contractor shall provide:

1. Concrete foundation and any items embedded in foundation.
2. Erection labor, also crane(s) and all required standard tools.
3. External power supplies
4. All wiring external to Vendor’s equipment.

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. No deviation shall be made from this specification and standards unless particular requirements are waived or modified in writing by General Manager. Vendor shall provide or obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions these shall be described in detail and included in Vendor's proposal. Vendor shall add a statement that no other exceptions are taken to this specification.

C. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

D. The design of the equipment and accessories, shall be as recommended by Vendor and shall comply with all applicable Federal, State and Local statutes, in addition to the regulations, specifications and requirements in effect at time of purchase order of the following standards, as applicable:

1.	ANSI	American National Standards Institute
2.	ASTM	American Society of Testing and Materials
3.	ICEA	Insulated Cable Engineers Association
4.	IEEE	Institute of Electrical & Electronics Engineers
5.	NEC	National Electrical Code
6.	NEMA	National Electrical Manufacturers Association
7.	NFPA	National Fire Protection Association and City Fire standards
8.	UL	Underwriters Laboratories, Inc.

E. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentations shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Completed data sheets
3. Dimensional drawing with weights for each transformer
4. Brochures/literature
5. Experience List
6. Preliminary arrangement, foundation requirements, plan drawing, estimated weights and descriptive literature

D. Approval drawings shall include the following for each respective transformer:

1. Outline Drawings: Outline/ dimensions with all parts identified by item numbers referenced to the bill of material.
2. Bushing Details: Drawing showing bushing arrangements and dimensions, bus duct flange sizes, height, separations, and drilling pattern dimensions.
3. Foundation Requirement Drawings: weights, dimensions and details required for foundation design
4. Miscellaneous Detailed Drawings: all details of components. Drawings shall include space requirements for all equipment specified and field assembly requirements.
5. Nameplate data. The nameplate shall be ANSI-C57.12 Nameplate C.

6. Elementary schematics.
7. Internal wiring diagram.
8. Connection diagram.
9. Phasing diagram showing primary-to–secondary vector relationship.
10. Bill of Material.
11. Recommended spare parts list with itemized pricing.
12. Commissioning procedures
13. Testing procedures
14. Shipping Data: shipping dimensions and weights, including identification of all parts to be removed for shipment.

E. Operations, Information and Maintenance Data:

1. Submit "as-built" drawings, instruction books, and manuals in accordance to document requirements in this specification. The instruction books shall include, but not limited to:

    a. Instruction and operation manuals including all installation instructions.
    b. Complete service and repair manuals.
    c. Complete parts list with vendor part numbers and a recommended spare parts list.
    d. Core & Coil Assembly Photographs
    e. Manufacturer's Certificate: The manufacturer shall certify that the transformer shall perform in accordance with these specifications and all applicable standards. The following minimum standard tests shall be guaranteed and included:

        1) No-load losses and excitation Current
        2) Load Loss and Impedance Voltage Test
        3) Ratio Tests on the rated voltage and on all tap connections
        4) Polarity and Phase Relation Test
        5) Winding Resistance Test
        6) HIPOT
        7) Induced Voltage and Dielectric Test
        8) Temperature Rise Test
        9) Resistance measurement of all windings
        10) Pressure leak tests
        11) Impulse test

F. Manufacturer Seismic Qualification Certification: Submit certification that the transformer, accessories, and components will withstand seismic forces defined in 480020 Pasadena Site Conditions.

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 MAINTENANCE MATERIALS

A. Provide special tools and manufacturer's standard spare parts required for installations and normal operation and maintenance.

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 - DESIGN REQUIREMENTS FOR LIQUID FILLED TRANSFORMERS

2.1 GENERAL

A. The transformers shall be suitable for continuous operation at rated kVA in an unsheltered outdoor installation. Ratings shall be as follows:

1. T1: 10/12.5 MVA
2. T2: 2500/3325 kVA
3. T3: 10/12.5 MVA
4. T4: 2500/3325 kVA

B. The termination points for all cable connections, including equipment ground connection points, shall be tin-plated copper. Bus connection points shall also be tin-plated copper.

C. All lugs furnished by the manufacturer shall be heavy-duty, tin-plated, long-barrel compression type with NEMA two-hole tongues for installation on copper conductors. All lugs shall be rated for 90°C conductor operating temperature. The manufacturer shall furnish complete hardware for the installation, including all required lugs, bolts, vibration-proof washers and nuts. All nuts, bolts and washers shall have a zinc-chromate or stainless steel finish. All lugs shall be installed on the buses for which they are intended. Lugs shall not be shipped loose.

D. The main equipment nameplates shall be stainless steel and shall be attached with stainless steel screws.

E. In all respects, equipment shall incorporate the highest quality of modern engineering, design, and workmanship. It is not the intent to specify all details of design and construction; therefore, equipment shall be fabricated and equipped with accessories in accordance with Vendor's standard practices when such practices do not conflict with this specification.

2.2 PRIMARY SIDE INCOMING SECTION

A. The primary side incoming line section shall be an outdoor, weatherproof, self-supporting, steel enclosure flange or throat connected, with appropriate gaskets, to the primary side of the transformer. The enclosure shall be a non-walk-in design, with a bottom plate and an extended top cover that provides a drip-proof shield. The enclosure shall be fabricated from not less than 11-gauge sheet steel. To facilitate installation and maintenance, the top and front covers shall be removable. Removable covers and panels shall be furnished with appropriate gaskets.

B. The design of the connection between the primary side incoming line section and the transformer shall be such that it will be possible to remove the transformer without moving the incoming line section.

C. All cables will enter the incoming line section from the bottom. At least forty-eight (48) inches from the point of cable entry to the termination point shall be provided for stress cones, cable bending and terminations. Three (3) lugs shall be furnished for terminating the incoming line conductors.

D. The power bus in each section shall be tin-plated copper and shall be insulated. All insulation supporting current carrying parts shall be porcelain or cycloaliphatic epoxy resin.

E. The incoming enclosure shall be furnished with a tin-plated copper ground bus. Lugs and hardware are required.

F. The incoming line enclosure shall be furnished with a nameplate engraved with the equipment number. The nameplate shall be laminated plastic with a white background engraved to expose a black core. The engraving shall be 1" high.

G. The enclosure shall be furnished with a "DANGER-HIGH VOLTAGE-KEEP OUT" sign. Signs shall have white backgrounds with red letters. Signs shall be attached with stainless steel screws.

2.3 TRANSFORMER SECTION

A. The transformer shall be liquid immersed type and suitable for outdoor installation. The transformer insulating fluid shall be Envirotemp FR3 dielectric fluid.

B. Insulation Temperature Rise: Per data sheets.

C. Insulating Liquid: Per data sheets.

D. Full Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

E. Cooling System: ONAN/ONAF. The transformer shall include all required radiators and auxiliary equipment.

F. Sound level may not exceed sound levels listed in NEMA TR 1.

G. Impedance: Per data sheets.

H. Efficiency: Per data sheets.

I. Basic Impulse Level: Comply with UL 1062 and associated requirements represented on Data Sheets.

J. Each transformer shall have the following features: (Refer to the attached data sheets for transformer specific information)

1. Primary voltage no-load tap changer with external manual operator mechanism suitable for padlocking and a visible indication of position.
2. Tap changer warning plate.
3. Dial type liquid temperature indicator with contacts for alarm and future cooling fan control and an indicator (26Q) for maximum temperature experienced.
4. Transformer winding temperature gauge with alarm contacts (26T).
5. Liquid level gauge with alarm contacts (71Q).
6. Vacuum pressure gauge without alarm contacts (63V).
7. Pressure relief device, self-resetting. Alarm contacts shall be provided for the General Manager's use (63PR)
8. Rate-of-rise pressure relay (Device No. 63PT), and auxiliary relay (63PTX).
9. Drain valve and sampling device.
10. Upper and lower filter press connections.
11. Dial type thermometer
12. Liquid temperature indicator w/ alarm contacts
13. Stainless steel diagrammatic instruction nameplate attached with stainless steel screws.
14. All bus or cable connection points shall be tin-plated copper.
15. All contacts shall be wired to terminals in a NEMA 4 enclosure mounted on the transformer tank.
16. All other standard features offered by the manufacturer.

K. The transformer shall have a sealed tank construction to prevent breathing. Adequate gas space shall be provided to limit internal pressure due to load cycle operation. The transformer tanks shall be designed to withstand an internal pressure of 15 psi.

L. The transformer shall be furnished filled with insulating fluid. Before shipment, the upper air space shall be purged and filled with dry nitrogen to a pressure to be specified by the manufacturer. This nitrogen padding shall not contain more than 2% oxygen.

M. The transformer shall be furnished with lifting lugs at each corner of the tank for lifting the entire unit. Loops or pad eyes shall be furnished for lifting the cover. Provisions shall be made at each corner of the base for jacking the complete transformer. The base shall be suitable for rolling and skidding in the directions parallel to the transformer centerlines.

N. Two (2) tin-plated copper ground pads shall be furnished on the transformer base. Provisions shall be made for terminating one 4/0 AWG copper equipment-grounding conductors at each pad. Grounding pads shall be standard two-hole bolt pattern and shall be on diagonally opposite corners.

O. The transformer shall be furnished with primary and secondary side bushings. All bushings shall be individually removable and shall have copper stud terminals. Each transformer shall have a neutral bushing with a current rating equal to that of the phase bushings.

2.4 LOW VOLTAGE SECTION

A. The low voltage bushings of each transformer shall be enclosed in a weatherproof, air filled terminal transition compartment.

B. Transformer T2 and T4: The terminal compartment shall be suitable for Non-Segregated Phase Bus Duct (NSPBD) connection from the 480V low voltage switchgear. Removable, gasketed access panels shall be provided.

C. The low voltage secondary side air terminal compartment shall be furnished with a tin-plated copper phase buses. The phase buses shall be used to connect the secondary of the transformer. All termination hardware, buses, etc. shall be provided for a complete connection between the transformer and the outgoing section.

2.5 WIRING AND COMPONENTS

A. Control wiring shall be 600V, 14 AWG minimum, 7 strand SIS, copper wire with heat, moisture and flame resistant cross-linked polyethylene insulation in accordance with ICEA S-66-524 or alternate acceptable to General Manager or Representative. Where flexibility is required, l9 strand wire shall be used. The wiring shall pass the flame test conducted in accordance with UL 44, Section 85. Wire markers shall be used on both ends of all wires.

B. All wiring shall be protected against contact with sharp edges neatly bundled and secured with wire ties. Wires shall be continuous, no splicing is permitted.

C. Terminal lugs shall be compression type with insulated sleeves and shall have ring-type or locking fork-type tongue. Terminal blocks shall be screw type. Terminal blocks for external connections shall be rated 600 Volt, 10 Amp (minimum).

D. In Vendor's internal wiring, not more than two wires shall be connected to one terminal block point. Not more than one wire shall be in any terminal lug.

E. Adequate space shall be provided on both sides of the terminal blocks for connecting wires and for wire markers. To allow for stripping and bending of incoming cables, terminal blocks for external connections shall be located a minimum of 8 inches away from external cable entrances.

F. A minimum number of spare 10% terminal points shall be available for General Manager’s use.

2.6 CLEANING AND PAINTING

A. All manufacturing waste, such as metal chips and filings, welding rods and stubs, waste, rags, debris, etc., shall be removed from the interior of each enclosure. All loose mills scale, rust, oil, grease, chalk, crayon, paint marks and other deleterious material shall be removed from interior and exterior surfaces. At time of shipment, product shall be clean inside and out. Each component shall be properly packed and protected before shipment so that it shall reach the site with all surfaces clean inside and out.

B. Equipment and materials shall be painted in accordance with Manufacturer's standard primer and paint. Finish color shall be ANSI No. 61, Light Gray.

2.7 EQUIPMENT MARKING

A. All packaged equipment and other separate components that are match marked for field assembly shall be clearly marked by letters and number so that they can be identified and cross-checked with shipping papers and applicable erection drawings.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Factory Tests: Perform routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90.

1. The General Manager or Representative reserves the right to inspect the transformer at manufacturer's factory prior to packaging for shipment.
2. The Vendor shall notify the General Manager or Representative not less than two weeks before inspection is allowed.

B. All transformers shall be tested in accordance with the latest revision of ANSI Standard Test Code for transformers C57.12.90. Refer to Section 1.4

3.2 FIELD TEST

A. Field-tests and acceptance tests shall be performed by General Manager or Representative.

END OF SPECIFICATION

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	FOR APPROVAL		CERTIFIED		AS-BUILT
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

APPENDIX B – TRANSFORMER DATA SHEETS

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: T1
Service/Application: Outdoor Auxiliary Transformers

1. TRANSFORMER	UNIT	REQUIRED	BY VENDOR
Quantity	Ea	1	
Type		Oil-Filled, Outdoor, Station Type, Power Transformer	
Continuous Rating	MVA	10/12.5	
Cooling Class		ONAN/ONAF	
Temperature Rise	^{o}C	55/65	
Voltage, HV-LV	KV	13.8-4.16	
HV Configuration		Delta	
LV Configuration		Wye	
Phases		3	
Frequency	Hz	60	
Insulation Liquid		Envirotemp FR3 dielectric fluid	
Taps Available	%	(2) 2.5% above and (2) 2.5% below rated voltage	
Tap Changer Type		De-Energized	
BIL, High Voltage	KV	110	
BIL, Low Voltage	KV	75	
HV Bushings		Side wall in air-insulated cable box	
LV Bushings		Side wall in air-insulated cable box	
Neutral Bushing		Cover Mount	
Neutral Connection		HRG	
Efficiency at ONAF rating	%	Not less than 99.5%	
Load Losses @ ONAF Rating	KW		
Load Losses @ ONAN Rating	KW		
No Load Losses	KW		
Auxiliary Losses	KW		
Percent Impedance Voltage	%Z	5.5%	
Max. Audible Noise, ONAF Rating	dB.A	Per NEMA TR-1	
Winding Material HV/LV		Copper/Copper	
Enclosure		NEMA 4	

	UNIT	REQUIRED	BY VENDOR
2. INSTRUMENT TRANSFORMERS			
Not Required			
3. ARRESTERS			
Not Required			
4. 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		
5. ACCESSORIES			
ANSI C57.12.10 Standard		Yes	
No Load Tap-Changer		Yes	
Liquid-Level Indicator		Yes	
Liquid-Temperature Indicator		Yes	
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	

	UNIT	REQUIRED	BY VENDOR
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		No	
6. COMMERCIAL			
Warranty	M		
Drawings after Order	Wk		
Approval	Wk		
Shipment after Approval	Wk		

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: T2, T4
Service/Application: Outdoor Auxiliary Transformers

1. TRANSFORMER	UNIT	REQUIRED	BY VENDOR
Quantity	Ea	2	
Type		Oil-Filled, Outdoor, Station Type, Power Transformer	
Continuous Rating	kVA	2500/3325	
Cooling Class		ONAN/ONAF	
Temperature Rise	^{o}C	55/65	
Voltage, HV-LV	KV	4.16-.480	
HV Configuration		Delta	
LV Configuration		Wye	
Phases		3	
Frequency	Hz	60	
Insulation Liquid		Envirotemp FR3 dielectric fluid	
Taps Available	%	(2) 2.5% above and (2) 2.5% below rated voltage	
Tap Changer Type		De-Energized	
BIL, High Voltage	KV	75	
BIL, Low Voltage	KV	45	
HV Bushings		Side wall in air-insulated cable box	
LV Bushings		Side wall designed for non-seg bus duct connection	
Neutral Bushing		Cover Mount	
Neutral Connection		HRG	
Efficiency at ONAF rating	%	Not less than 99.5%	
Load Losses @ ONAF Rating	KW		
Load Losses @ ONAN Rating	KW		
No Load Losses	KW		
Auxiliary Losses	KW		
Percent Impedance Voltage	%Z	5.75%	
Max. Audible Noise, ONAF Rating	dB.A	Per NEMA TR-1	
Winding Material HV/LV		Copper/Copper	
Enclosure		NEMA 4	
2. INSTRUMENT TRANSFORMERS			
Not Required			
3. ARRESTERS			
Not Required			

	UNIT	REQUIRED	BY VENDOR
4. 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		
5. ACCESSORIES			
ANSI C57.12.10 Standard		Yes	
No Load Tap-Changer		Yes	
Liquid-Level Indicator		Yes	
Liquid-Temperature Indicator		Yes	
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	

	UNIT	REQUIRED	BY VENDOR
Controls for Auxiliary Cooling Equipment		Yes	
Fans for Auxiliary Cooling Equipment		Yes	
Removable Radiators and Isolation Valves		No	
6. COMMERCIAL			
Warranty	M		
Drawings after Order	Wk		
Approval	Wk		
Shipment after Approval	Wk		

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: T3
Service/Application: Outdoor Auxiliary Transformers

1. TRANSFORMER	UNIT	REQUIRED	BY VENDOR
Quantity	Ea	1	
Type		Oil-Filled, Outdoor, Station Type, Power Transformer	
Continuous Rating	MVA	10/12.5	
Cooling Class		ONAN/ONAF	
Temperature Rise	^{o}C	55/65	
Voltage, HV-LV	KV	17.2-4.16	
HV Configuration		Delta	
LV Configuration		Zig zag	
Vector Group arrangement		Dzn2	
Phases		3	
Frequency	Hz	60	
Insulation Liquid		Envirotemp FR3 dielectric fluid	
Taps Available	%	(2) 2.5% above and (2) 2.5% below rated voltage	
Tap Changer Type		De-Energized	
BIL, High Voltage	KV	125	
BIL, Low Voltage	KV	75	
HV Bushings		Side wall in air-insulated cable box	
LV Bushings		Side wall in air-insulated cable box	
Neutral Bushing		Cover Mount	
Neutral Connection		HRG	
Efficiency at ONAF rating	%	Not less than 99.5%	
Load Losses @ ONAF Rating	KW		
Load Losses @ ONAN Rating	KW		
No Load Losses	KW		
Auxiliary Losses	KW		
Percent Impedance Voltage	%Z	5.5%	
Max. Audible Noise, ONAF Rating	dB.A	Per NEMA TR-1	
Winding Material HV/LV		Copper/Copper	
Enclosure		NEMA 4	
2. INSTRUMENT TRANSFORMERS			
Not Required			
3. ARRESTERS			
Not Required			

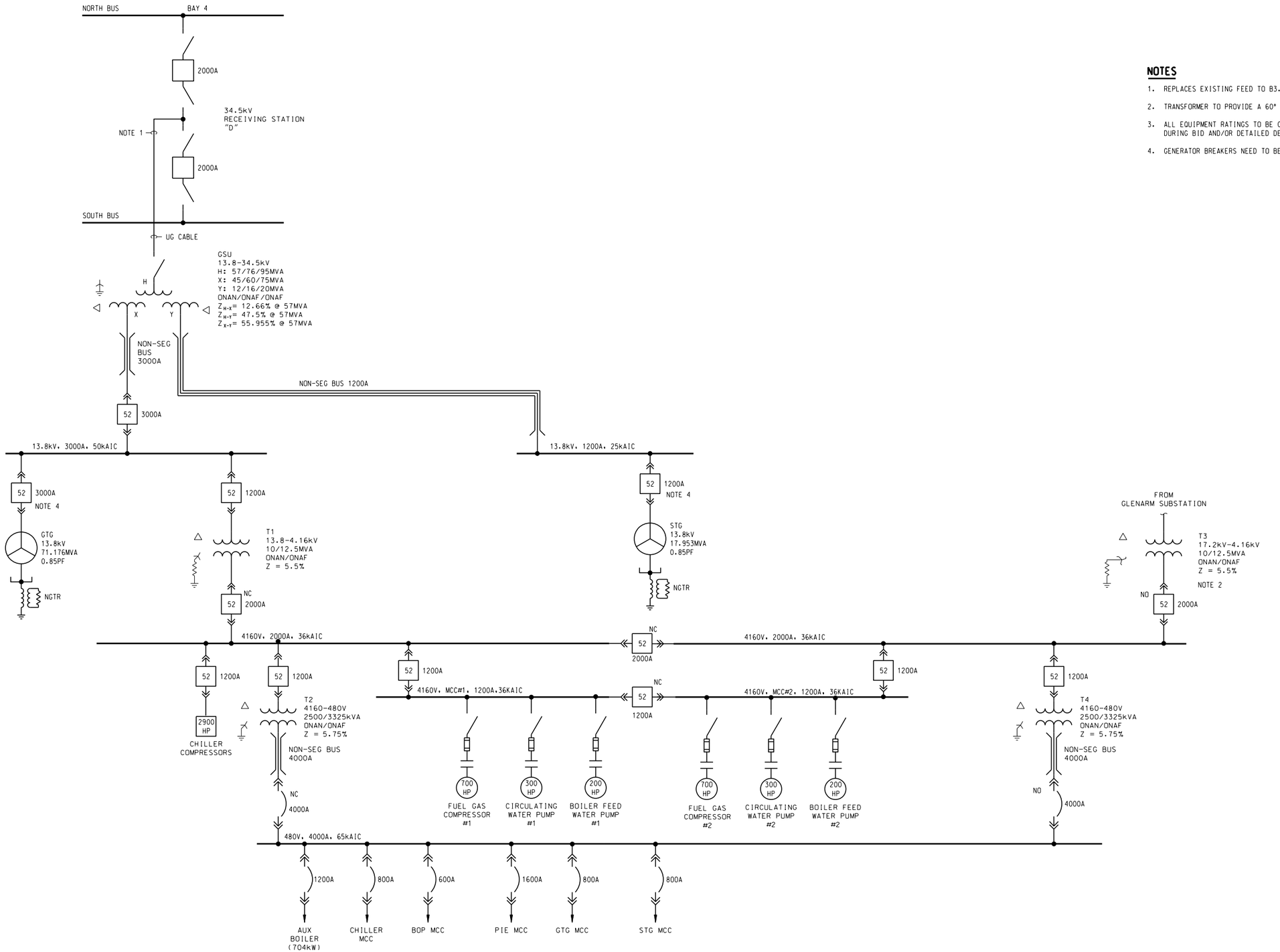
	UNIT	REQUIRED	BY VENDOR
4. PHYSICAL DATA			
Dimensions (Approximate)			
1. Height	In		
2. Width	In		
3. Depth	In		
4. Height over Cover	In		
5. Untanking Height (Plus Slings)	In		
Weights (Approximate)			
1. Core and Coils	Lb		
2. Tank and Fittings	Lb		
3. Bushings	Lb		
4. Oil	Lb		
5. Total Weight	Lb		
6. Shipping Weight	Lb		
Oil Volume	gallons		
5. ACCESSORIES			
ANSI C57.12.10 Standard		Yes	
No Load Tap-Changer		Yes	
Liquid-Level Indicator		Yes	
Liquid-Temperature Indicator		Yes	
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	

	UNIT	REQUIRED	BY VENDOR
Controls for Auxiliary Cooling Equipment		Yes	
Fans for Auxiliary Cooling Equipment		Yes	
Removable Radiators and Isolation Valves		No	
6. COMMERCIAL			
Warranty	M		
Drawings after Order	Wk		
Approval	Wk		
Shipment after Approval	Wk		

SECTION 261200-2
MEDIUM VOLTAGE AUXILIARY TRANSFORMERS

APPENDIX C – REFERENCE DRAWINGS

E1-1A Electrical Overall One-Lines (LM6000)



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

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October 10, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 261300-1
15kV Switchgear

PROJECT NUMBER:
123374

PROJECT CONTACT:
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208-288-6360

Section 261300-1
15kV Switchgear

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
09/06/2013	F. De Guzman	R. Barklund	G. Harwood	A
10/10/2013	F. De Guzman	R. Laughy	G. Harwood	B

SECTION 261300-1
15kV SWITCHGEAR

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 MAINTENANCE MATERIALS 3
1.6 DELIVERY, STORAGE AND HANDLING 3

PART 2 - PRODUCTS 4

2.1 MANUFACTURED UNITS 4
2.2 METAL-CLAD, CIRCUIT BREAKER SWITCHGEAR 4
2.3 FABRICATION 5
2.4 COMPONENTS 5

PART 3 - EXECUTION 7

3.1 QUALITY CONTROL 7

APPENDIX A – VENDOR DATA COMMITMENTS 8

APPENDIX B – SWITCHGEAR DATA SHEETS 9

APPENDIX C – REFERENCE DRAWINGS 16

SECTION 261300-1
15kV SWITCHGEAR

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. Medium voltage switchgear and accessories shall be provided and installed inside a Power Distribution Center (PDC).

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 262600 Power Distribution Center
4. 261300-2 5kV Switchgear/MCC
5. 480020 Pasadena Site Conditions
6. SKE16-1 Typical Electrical Schematic Diagram, MV Generator Breaker
7. SKE16-2 Typical Electrical Schematic Diagram, MV Feeder Breaker

1.2 SCOPE

A. This specification covers furnishing one (1) lineup of metal clad, circuit-breaker medium voltage switchgear rated for 15kV. The lineup consists of two separate buses.

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. No deviation shall be made from this specification and standards unless particular requirements are waived or modified in writing by General Manager. Vendor shall provide or obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions these shall be described in detail and included in Vendor's proposal. Vendor shall add a statement that no other exceptions are taken to this specification.

C. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

D. The design of the equipment and accessories, shall be as recommended by Vendor and shall comply with all applicable Federal, State and Local statutes, in addition to the regulations, specifications and requirements in effect at time of purchase order of the following standards, as applicable:

1. ANSI American National Standards Institute
2. ASTM American Society of Testing and Materials
3. IEEE Institute of Electrical & Electronics Engineers

4.	NEC	National Electrical Code
5.	NEMA	National Electrical Manufacturers Association
6.	NFPA	National Fire Protection Association
7.	UL	Underwriters Laboratories, Inc.

E. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentations shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project. Drawing format shall be compatible with AutoCAD 2010. Four (4) sets of hard copies shall be furnished.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Completed data sheets
3. Brochures/literature
4. Experience List
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes
6. Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipes and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support

D. Approval drawings shall include the following for each type of switchgear and related equipment:

1. Dimensioned plans, elevations, sections and details, including required clearances and service space around equipment
2. Tabulation of installed devices with features and ratings
3. Enclosure types and details
4. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
5. Bus configuration with size and number of conductors in each bus run, including phase, and ground conductors of main and branch buses
6. Current rating of buses
7. Short-time and short-circuit current rating of switchgear assembly
8. Nameplate legends
9. UL listing for series rating of installed devices
10. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

11. Wiring and Schematic Diagrams: Power, signal and control wiring

E. Operations, Information and Maintenance Data:

1. Submit "as-built" drawings, instruction books, and manuals in accordance to document requirements in this specification. The instruction books shall include, but not limited to:

   a. Instruction and operation manuals including all installation instructions.
   b. Complete service and repair manuals.
   c. Complete parts list with vendor part numbers and a recommended spare parts list.
   d. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   e. Time-current curves, including selectable ranges for each type of overcurrent protective device.

F. Manufacturer Seismic Qualification Certification: Submit certification that the switchgear, accessories, and components will withstand seismic forces defined in 480020 Pasadena Site Conditions:

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 MAINTENANCE MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Six of each type and rating used. Include spares for potential transformer fuses, control power fuses, and fuses and fusible devices for fused circuit breakers,
2. Indicating Lights: Six of each type installed.
3. Touchup Paint: 2 containers of paint matching enclosure finish, each 0.5 pint.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver switchgear in sections of lengths (maximum of 6ft in width) that can be moved past obstructions in delivery path.

B. Prior to shipment store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Factory assembled and tested, and complying with IEEE C37.20.*2 IEEE Standard for Metal-Clad Switchgear* and IEEE C37.20.7 *IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Fault.*

B. Ratings: Suitable for application in 3-phase, 60 Hz.

C. System voltage: 13.8kV nominal

2.2 METAL-CLAD, CIRCUIT BREAKER SWITCHGEAR

A. Comply with IEEE C37.20.2 *IEEE Standard for Metal-Clad Switchgear.*

B. Comply with IEEE C37.20.7 *IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Fault.*

C. Provide arc-resistant switchgear.

D. Nominal Interrupting Capacity Class:

1. GTG Bus – 50 kAIC
2. STG Bus – 26 kAIC

E. Ratings: Comply with IEEE C37.04 IEEE Standard Rating Structure For AC High Voltage Circuit Breakers.

1. GTG Main Bus Rating: 3000A continuous
2. STG Main Bus Rating: 1200A continuous

F. Circuit Breakers: Three-pole, single-throw electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within three cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to-ground voltage of the system.
2. Contact-Wear Indicator: Readily accessible to field maintenance personnel.
3. Minimum of six Type A and six Type B spare contacts.
4. Minimum of six Type A and six Type B TOC contacts
5. Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.

    a. Continuous Current Rating of Main Incoming Circuit Breaker: 3000A
    b. Continuous Current Rating of GTG Circuit Breaker: 3000A.
    c. Continuous Current Rating of STG Circuit Breaker: 1200A
    d. Continuous Current Rating of Feeder Circuit Breaker: 1200 A.

6. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated. Generator Circuit breaker shall be provided with two trip coils.

a. Closing speed of moving contacts to be independent of both control voltage and operator action.
b. Design mechanism to permit manual closing of contacts for inspection or adjustment.

1) Control Power: 125V DC for closing and tripping.

c. Provide shunt trip capability independent of overcurrent trip

7. Any necessary removal tools, racking drive handles, etc. shall be provided with equipment.

G. Test Accessories: Relay and meter plugs

H. Low-DC Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.

2.3 FABRICATION

A. Indoor Enclosure: Steel

B. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

C. Bus Transition Unit: If required, arranged to suit bus and adjacent units.

D. Incoming Line Unit: Arranged to suit bottom entry from underground power cables. Control cables to be top entry.

E. Outgoing Feeder Units: Arranged to suit bottom entry from underground cables. Control cables to be top entry.

F. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.

2.4 COMPONENTS

A. Main Bus: Copper, full length of each bus.

B. Ground Bus: Tinned Copper, minimum size ¼ by 2 inches, full length of switchgear.

C. Bus Insulation: Covered with flame-retardant insulation.

D. Mimic Diagram

1. Red mimic diagram and symbols showing the exact representation of the system shall be provided in the front of the switchgear.
2. Mimic diagram shall be made preferably of anodized aluminum or plastic, which shall be screwed to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable.

The width of the mimic bus shall be ½ inch for bus bars and ¼ inch for other connections.

E. Instrument Transformers: Comply with IEEE C57.13 *IEEE Standard Requirements for Instrument Transformers.*

1. Potential Transformers
2. Current Transformers

F. Relays: Comply with IEEE C37.90 *IEEE Standard for Relays and Relay Systems Associated With Electric Power Apparatus*, integrated digital type; with test blocks and plugs. Test blocks shall be ABB-FT-1 test switches with clear cover.

G. The following relays are provided for reference only. The Vendor shall be responsible for the design of the electrical system per the Electrical Overall One-Line Diagram during detailed design:

1. Generator Protection Relay 11G: SEL-300G with SEL-2600D and SEL-2664 modules

H. Functions: 21, 24, 25, 27, 32R, 36, 50, 50BF, 51V, 59N, 81O/U, 87

1. Transformer Differential Relay 11T: SEL-787

I. Functions: 87, 87N, 50/51P, 50N

1. Unit Differential Relay 87U: SEL-387

J. Functions: 87, 50/51P

1. Bus Differential Relay 87B: SEL-587Z

K. Functions: 87, 50/51P

1. Unit Overcurrent Relay 11U: SEL-751A

L. Functions: 50/51P, 27, 59, 81O/U, 25, 59G

1. Transformer Overcurrent Relay 51T: SEL-751A

M. Functions: 50/51P, 50/51N, 59G

1. Auto-Synchronization Relay 25A
2. Generator Revenue Meter: SEL-734
3. Lockout Relay 86U: Manufacturers Standard: Minimum of 4 Decks

N. Lockout Relay 86G: Manufacturers Standard: Minimum of 4 Decks

1. Lockout Relay 86T: Manufacturers Standard: Minimum of 4 Decks
2. Communication RTU: SEL-3530

O. Manual Synchronization: Provide manual synchronization provisions for GTG breaker and STG breaker.

P. Control Power Supply: Control power transformer, dry type, supplying 120V control circuits through secondary disconnect devices. DC battery system as backup. Include the following features:

1. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.

Q. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Flexible tinned copper conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units. SIS wiring is acceptable for this application.
2. Conductors sized according to NFPA 70 for duty required.

R. Communications:

1. All relays shall be networked to the communications RTU. All communications between the Plant Control System (PCS) and the switchgear relays shall be via the RTU using DNP3. No wiring or other communications between the PCS and individual relays shall be required.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Before shipment of equipment, perform the following tests and prepare reports:

1. Production tests on circuit breakers according to IEEE C37.09 IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
2. Production tests on completed switchgear assembly according to IEEE C37.20.2 IEEE Standard for Metal-Clad Switchgear.

B. Assemble switchgear and equipment in manufacturer's plant and perform the following:

1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay indicators.

C. Prepare equipment for shipment:

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

END OF SPECIFICATION

SECTION 261300-1
15kV SWITCHGEAR

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	**FOR APPROVAL**		**CERTIFIED**		**AS-BUILT**
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

APPENDIX B – SWITCHGEAR DATA SHEETS

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: GTG/STG Bus
Service/Application: 15kV Switchgear

1. SWITCHGEAR	**UNIT**	**SPECIFICATION REQUIREMENTS**	**DATA BY VENDOR**
Manufacturer			
Manufacturer's Type Designation			
Quantity		One Assembly	
Design Standards		NEMA/ANSI	
Switchgear Type		Metal-Clad, Air Insulated Arc-Resistant	
Switchgear Rating			
Rated Volts	kV	15	
Service Volts	kV	13.8	
Phase		3	
Wire		3	
Frequency		60	
Main Bus Amps		3000	
Short Time Withstand Rating	kA	50	
	sec		
Peak Withstand	kA		
Lightning Impulse BIL Voltage	KV		
System Configuration			
Delta		☑ No neutral in SWGR	
System Fault Current	kA rms sym	25	
X/R Ratio			
Arc-Resistant Construction			
Required		☑ IEEE C37.20.7, Type 2B	
Arc Fault Vent Plenum			
Required		☑	
Switchgear Arrangement			
Two-High		☑	
Front Doors			
Latch		☑ Single Handle Multi-Point Latch	
Interlock		☑	

	UNIT	REQUIRED	BY VENDOR
Rear Doors			
Latch		☑ If applicable to the switchgear design – a Single Handle Multi-Point Latch	
Interlock		☑ If applicable to the switchgear design	
Construction			
Indoor		☑ NEMA Type 1	
Closed Door Racking for Circuit Breakers and Transformers			
Required		☑	
Safety Shutters			
Grounded Metal		☑	
Lockable		☑	
Ventilation			
Non Filtered Louvers		☑	
Forced Cooling			
Not Required		☑	
Bus Insulators			
Epoxy		☑	
Bus Pass Through and Barrier Insulation			
Glass Poly		☑	
Bus Insulation			
Insulated		☑	
Primary Bus Joint Plating			
Tin		☑	
Joint Covers			
Reusable Boots		☑	
Cable Entry Plates			
Aluminum		☐	
Steel		☐	
Stainless Steel		☐	
Heat Output Data (For complete switchgear line-up)	BTU/Hr		

2. POWER CIRCUIT BREAKERS	**UNIT**	**REQUIRED**	**BY VENDOR**
Type		3-pole, draw out, vacuum circuit breaker with stored energy operating mechanism	
Rated Voltage	kV	15	
Service Voltage	kV	13.8	
Symmetrical Interrupting Rating	kA_{rms}	50	
%DC Interrupting	%	50	
Rated Interrupting Time	Cycle	3	
Dual Trip Coils Required		Yes	
Voltage	VDC	Primary trip coil voltage shall be 125 VDC	
	VDC	Secondary trip coil voltage shall be 125 VDC	
Closing Coil Voltage	VDC	125	
Charging Motor Voltage	VDC	125	
Capacitive Trip Device		☐	
Under voltage Trip		☐	
Breaker Auxiliary Contacts (52 a/b)		6-NO and 6-NC	
Breaker Auxiliary Contacts (52S a/b)		6-NO and 6-NC	
Breaker Truck Position (TOC) Contacts		6a/6b	
Control Power Disconnects		Common Charge and Close, Separate Trip	
Breaker Secondary Disconnect			
Incoming Main Breaker Rating	A	3000	
GTG Breaker Rating	A	3000	
Distribution Breaker Rating	A	1200	
STG Breaker Rating	A	1200	
3. SURGE PROTECTION			
Arresters & Capacitors			
Not Required		☑	
4. TERMINATIONS			
Entry			
Power Cable		Bottom	
Minimum space for cable Termination	in		
Control Cable		Top	

	UNIT	REQUIRED	BY VENDOR
Termination Boots			
Required		☑	
Cable Supports			
Required		☑	
Power Cable Lugs and Termination Kits			
By Supplier		☐	
Type			
Cable Size			
5. INSTRUMENT TRANSFORMERS			
Current Transformers		☑ As shown on the one-line drawings	
Voltage Transformers		☑ As shown on the one-line drawings	
6. PROTECTIVE RELAYING			
Protective Relaying		☑ As shown on the one-line drawings	
7. METERING			
GTG Meter			
STG Meter			
8. SYNCHRONIZING			
Sync between GTG and STG		☑	
9. PARTIAL DISCHARGE MONITORING			
Not Required		☑	
10. INTERNAL WIRING			
Lugs			
CT		Insulated Ring Tongue	
Other		Insulated Ring Tongue	
Wire Larger than #10		Manufacturers Standard	
11. ACCESSORIES			
Control Switches			
Trip/Close		ElectroSwitch, Series 24, Pistol-Grip Handle	
Indicating Lights			
LED		☑	
Red – Closed		☑	
Green – Open		☑	
Amber – Fault		☑	
Other			

	UNIT	REQUIRED	BY VENDOR
Wire Markers			
Sleeve-Type Both Ends		☑	
Not Heat Shrunk		☑	
Terminal Blocks			
		☑ STATES type NT, Catalog No. M-250, sliding link, front-connected open type terminal block with white marker strip	
CT		Shorting Type	
Spare Points	%	20	
Wire All Spare Contacts to Terminal Blocks			
Required		☑	
Nameplates			
Stainless Steel		☑	
White Plastic with Black Letters		☑	
Stainless Steel Screws		☑	
Mimic Bus			
Required		☑	
Space Heaters			
Required		☑	
Load	W		
Rated Voltage	VAC	120	
Operating Voltage	VAC	110	
Thermostat			
One per switchgear		☑ One Per Structure	
Ground and Test Device			
Required		☑	
6-pole Manual or Electrically Operable (Options?)		☑	
Electrical Remote Racking Device			
Not Required		☑	
Lift Truck			
Required		☑ Recommended for breaker removal	
Test Jumper			
Not Required		☑	
Test Cabinet			
Not Required		☑	
Packing Requirements		☑ Standard	

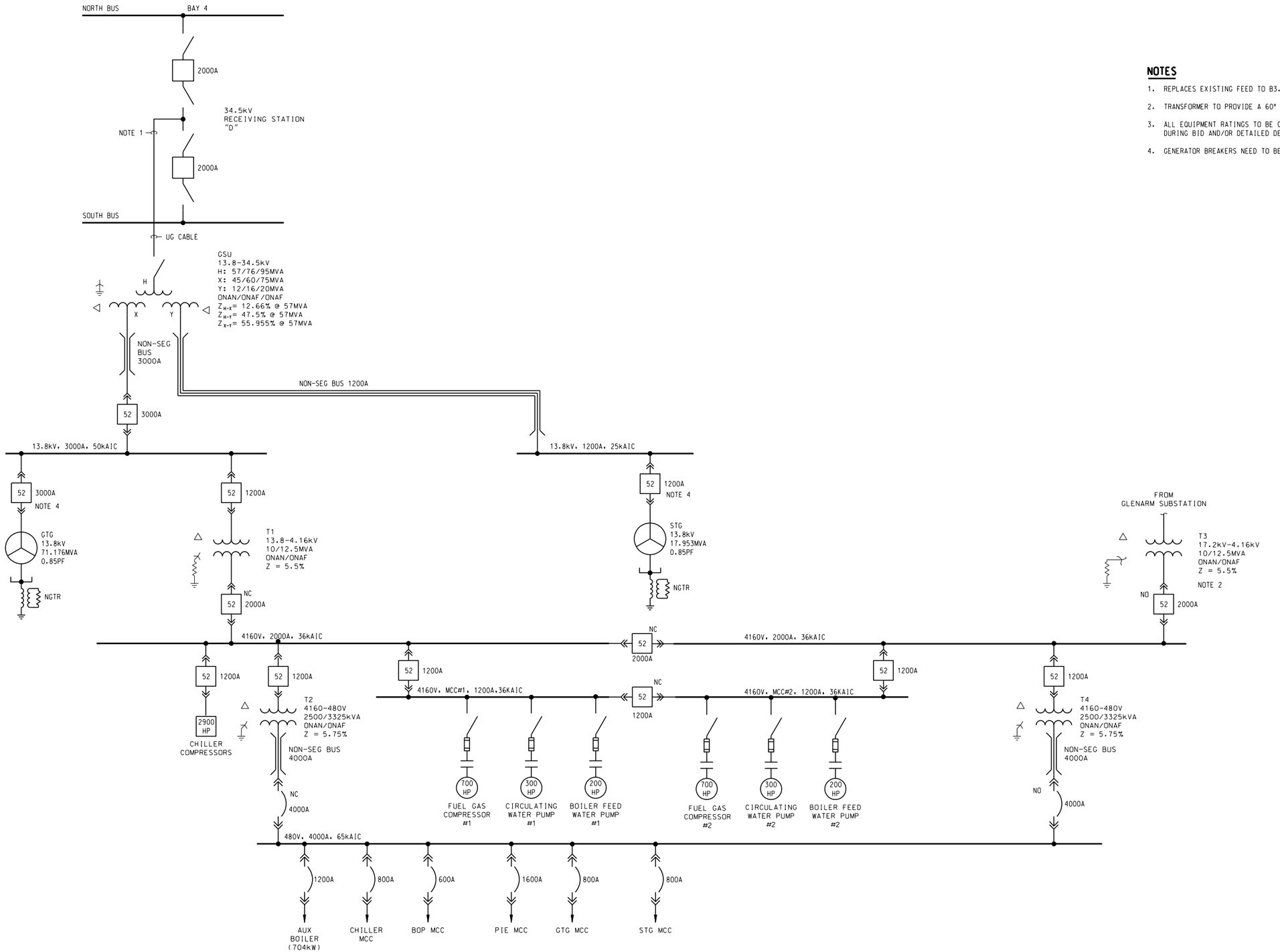
12. NOTES	**UNIT**	**REQUIRED**	**BY VENDOR**
A. Circuit breakers shall be capable of being locked with up to three padlocks, in either the test or the disconnected positions.			
B. CT secondary leads shall be landed on shorting terminal blocks with the common side grounded at the first shorting terminal block in the control compartment.			
C. All VT and CT secondary leads shall be wired to terminal blocks in control compartment then to circuit devices.			
13. INSPECTION AND TESTS			
Factory Inspection and Tests			
Mfr./ANSI/CSA Standard Tests		☑	
Other Tests as Described		☐	
Factory Acceptance Test Witnessed		☑ With Circuit Breakers	
Certified Test Reports		☑	
Test Reports Prior to Shipment		☑	
On-Site Mechanical Inspection		☑	
14. DOCUMENTATION			
One Line		☑	
Front View		☑	
Plan View		☑	
Nameplate Schedule		☑	
Bill of Materials		☑	
Three Line		☑	
Schematic Diagrams		☑	
Interconnection Wiring Diagrams		☑	
Connection Wiring Diagrams		☑	
RTU Parameter List			
15. SERVICE CONDITIONS			
Installation Location			
Indoors		☑	
Temperature		Refer to 262600 PDC Specification	
16. PHYSICAL DATA			
Dimensions (Approximate)			
1. Height	in		
2. Width	in		
3. Depth	in		
4. Shipping Height	in		
5. Shipping Width	in		
6. Shipping Depth	in		

	UNIT	REQUIRED	BY VENDOR
Weights (Approximate)			
1. Weight	lb		
2. Shipping Weight	lb		
17. COMMERCIAL			
Warranty	M		
Approval Drawings after Order	Wk		
Approval Period	Wk		
Shipment after Approval	Wk		

SECTION 261300-1
15kV SWITCHGEAR

APPENDIX C – REFERENCE DRAWINGS

E1-1A Electrical Overall One-Lines (LM6000)
E1-2 Preliminary PDC Layout
SKE16-1 Typical Electrical Schematic Diagram, MV Generator Breaker
SKE16-2 Typical Electrical Schematic Diagram, MV Feeder Breaker



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

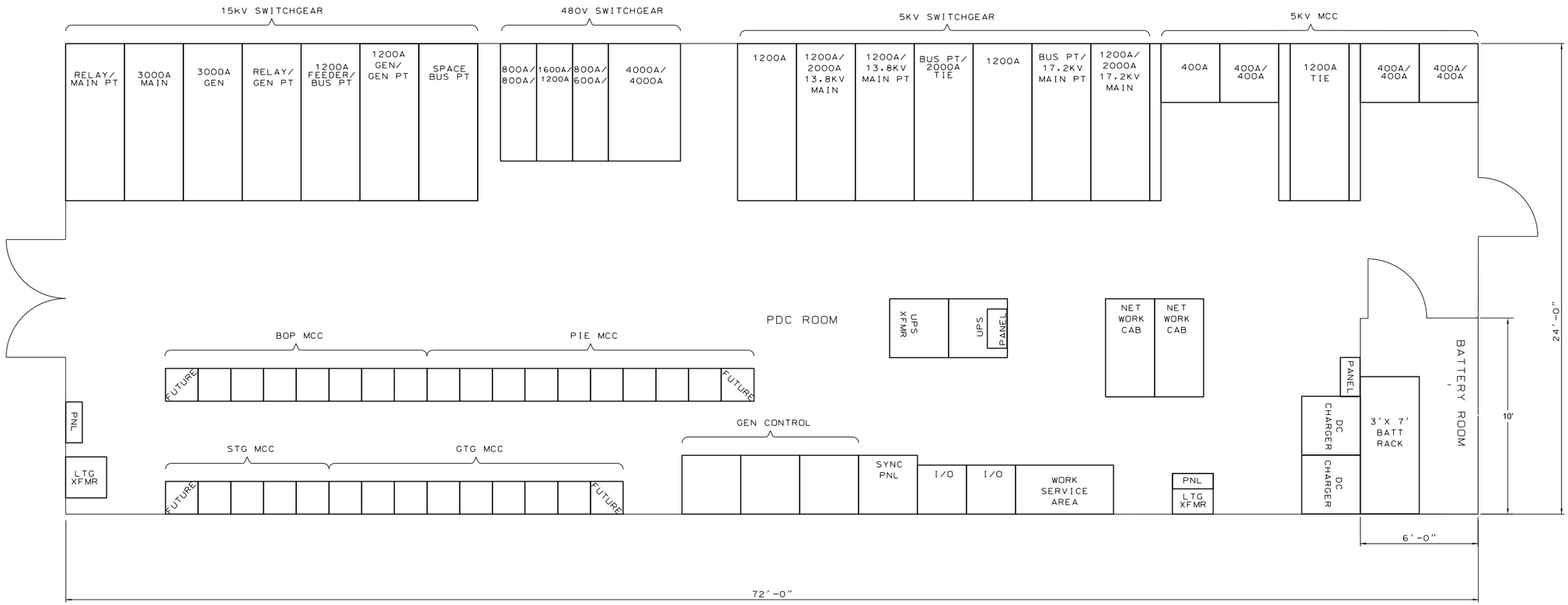
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
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C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

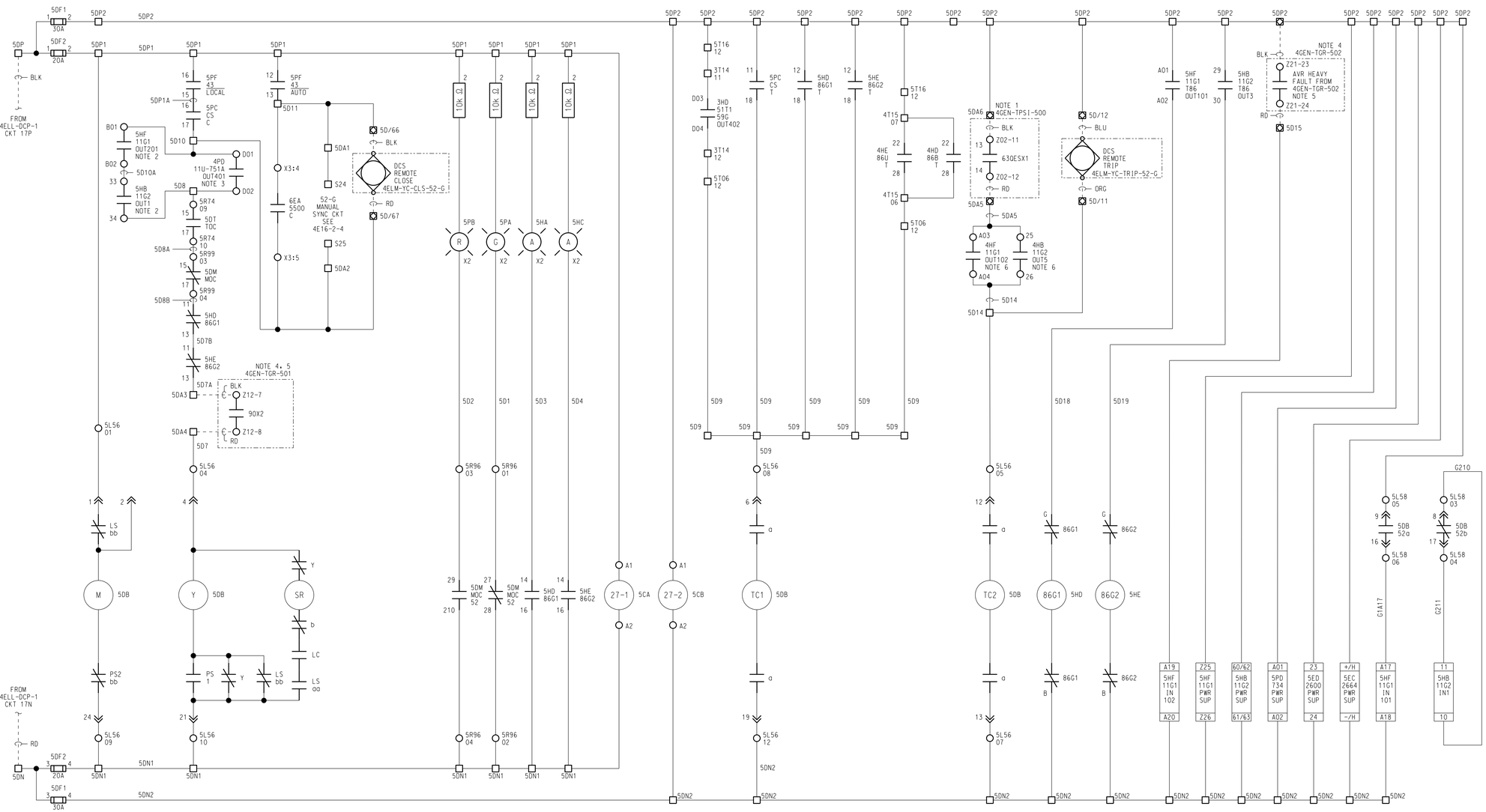
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POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2



LEGEND

- FACTORY WIRING
- FIELD WIRING
- VENDOR LV TERMINAL
- CUSTOMER LV TERMINAL
- BREAKER COMPARTMENT TERMINAL

NOTES

1. REFER TO VENDOR DRAWING FOR DETAILS.
2. OUTPUT PROGRAMMED TO BE HIGH WHEN 4HPS-GEN-500 AND 4ELM-SWGR-1 ARE SYNCHRONIZED.
3. OUTPUT PROGRAMMED TO BE HIGH WHEN 4ELM-SWGR-1 IS DEAD BUS.
4. REFER TO VENDOR DRAWING FOR MORE DETAILS.
5. REMOVE INTERLOCK JUMPER AND FIELD WIRE AS SHOWN.
6. OUTPUT PROGRAMMED FOR 3 SECOND DELAY ON REVERSE POWER.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	**/**	RDQ	FD	JR	RL

DSGN	FD	09/07/12
DRN	RDQ	09/10/12
CKD	JR	09/11/12

SCALE: NONE

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POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TYPICAL ELECTRICAL SCHEMATIC DIAGRAM MV GENERATOR BREAKER

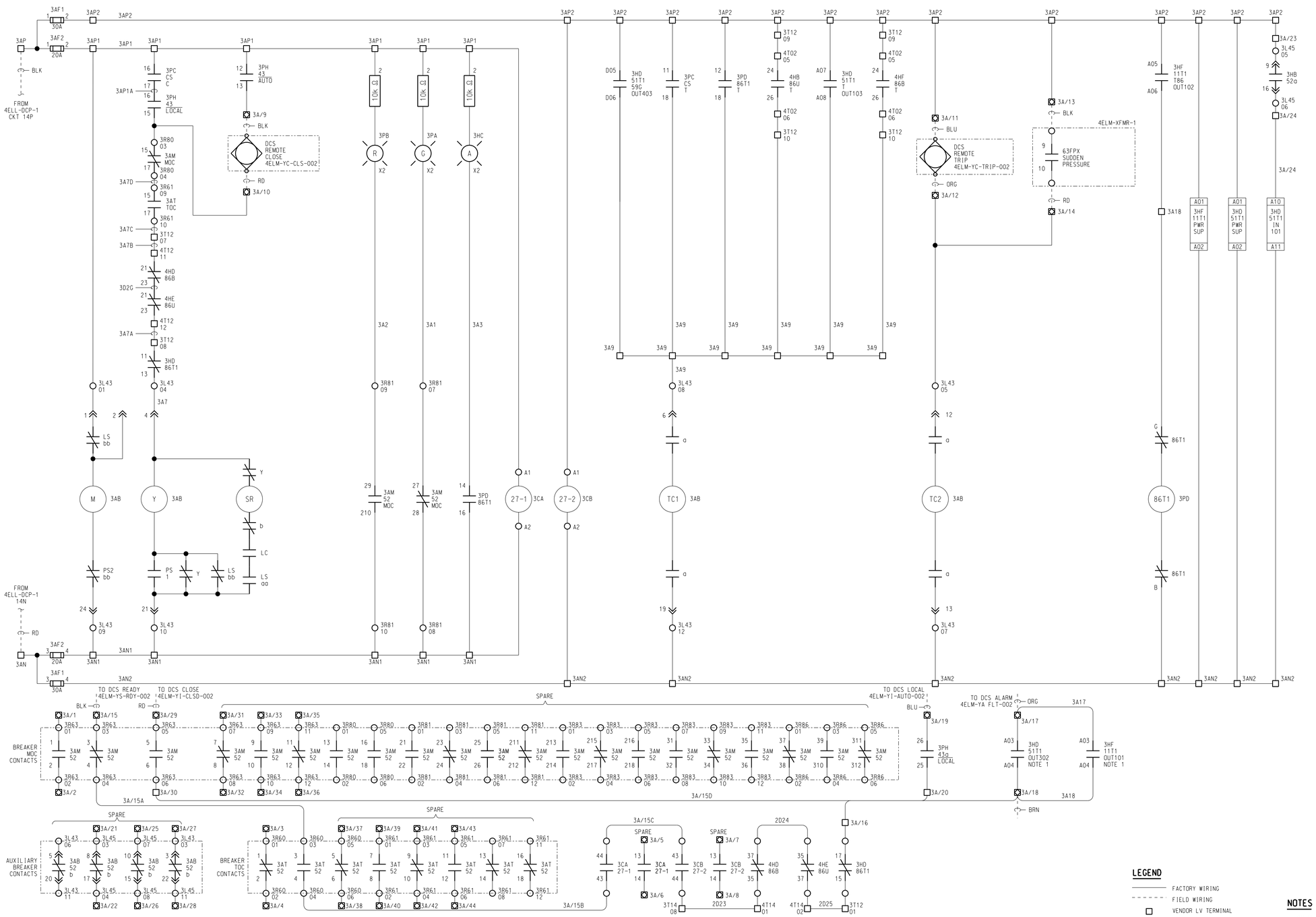
JOB NUMBER 123374

REV A

DRAWING NUMBER SKE16-1

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LEGEND

- FACTORY WIRING
- FIELD WIRING
- VENDOR LV TERMINAL
- CUSTOMER LV TERMINAL
- BREAKER COMPARTMENT TERMINAL

NOTES

1. OUTPUT PROGRAMMED TO CLOSE ON ALARM.
2. TYPICAL WIRING, TERMINALS AND CONFIGURATION WILL CHANGE BASED ON VENDOR SELECTED.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	–	–	–	–	–	–	–
INIT	–	–	–	–	–	–	–

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	**/**	RDQ	FD	JR	RL

DSGN	FD	09/07/12
DRN	RDQ	09/10/12
CKD	JR	09/11/12

SCALE: NONE

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CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TYPICAL ELECTRICAL SCHEMATIC DIAGRAM MV FEEDER BREAKER

JOB NUMBER 123374

REV A

DRAWING NUMBER SKE16-2

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October 10, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 261300-2
5kV Switchgear/MCC

PROJECT NUMBER:
123374

PROJECT CONTACT:
GREGG HARWOOD
EMAIL:
GREGG.HARWOOD@POWERENG.COM
PHONE:
208-288-6360

Section 261300-2
5kV Switchgear/MCC

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
09/06/2013	J. Clark	R. Barklund	G. Harwood	A
10/10/2013	F. De Guzman	R. Laughy	G. Harwood	B

SECTION 261300-2
5kV SWITCHGEAR/MCC

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 MAINTENANCE MATERIALS 3
1.6 DELIVERY, STORAGE AND HANDLING 4

PART 2 - PRODUCTS 4

2.1 MANUFACTURED UNITS 4
2.2 METAL-CLAD, CIRCUIT BREAKER SWITCHGEAR 4
2.3 MEDIUM VOLTAGE MOTOR CONTROL CENTER 5
2.4 FABRICATION 6
2.5 COMPONENTS 7

PART 3 - EXECUTION 8

3.1 QUALITY CONTROL 8

APPENDIX A – VENDOR DATA COMMITMENTS 10

APPENDIX B – SWITCHGEAR DATA SHEETS 11

APPENDIX C – REFERENCE DRAWINGS 18

SECTION 261300-2
5kV SWITCHGEAR/MCC

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. Medium voltage switchgear and accessories shall be provided and installed inside a Power Distribution Center (PDC). The PDC will be mounted on concrete piers to provide space beneath the PDC for field installation of a cable tray system and associated field installed cables.

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 262600 Power Distribution Center
4. 261300-1 15kV Switchgear
5. 480020 Pasadena Site Conditions
6. SKE16-2 Typical Electrical Schematic Diagram, MV Feeder Breaker
7. SKE17-1 Typical MCC Schematic, Size 1, 2, 3, 4, 5, and 6, FVNR
8. SKE17-2 Typical MCC Schematic, MV Motor

1.2 SCOPE

A. This specification covers furnishing and installing one (1) lineup of metal clad, circuit-breaker medium voltage switchgear rated for 5kV.

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. No deviation shall be made from this specification and standards unless particular requirements are waived or modified in writing by General Manager. Vendor shall provide or obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions these shall be described in detail and included in Vendor's proposal. Vendor shall add a statement that no other exceptions are taken to this specification.

C. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

D. The design of the equipment and accessories, shall be as recommended by Vendor and shall comply with all applicable Federal, State and Local statutes, in addition to the regulations, specifications and requirements in effect at time of purchase order of the following standards, as applicable:

1. National Electrical Manufacturer's Association (NEMA)

2. Institute of Electrical and Electronic Engineers (IEEE)
3. American National Standards Institute (ANSI)
4. National Electrical Code (NEC)
5. Occupational Safety and Health Administration Standards (OSHA) and CalOSHA
6. American Society of Testing Materials (ASTM)
7. National Fire Protection Association (NFPA)
8. International Building Code (IBC)
9. American Institute of Steel Construction (AISC)
10. Insulated Cable Engineers Association, Inc. (ICEA)
11. Structural Welding Code (AWS D1.1)
12. Metal Building Manufacturers Association (MBMA)
13. California Fire Code (CFC)
14. City of Pasadena Fire Prevention Code
15. California Building Code 2007 (CBC)
16. Applicable Local Codes and Ordinances

E. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentations shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project. Drawing format shall be compatible with AutoCAD 2010. Four (4) sets of hard copies shall be furnished.

C. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated, include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

D. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Completed data sheets
3. Brochures/literature
4. Experience List
5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes
6. Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipes and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support

B. Approval drawings shall include the following for each type of switchgear and related equipment:

1. Dimensioned plans, elevations, sections and details, including required clearances and service space around equipment
2. Tabulation of installed devices with features and ratings
3. Enclosure types and details
4. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
5. Bus configuration with size and number of conductors in each bus run, including phase, and ground conductors of main and branch buses
6. Current rating of buses
7. Short-time and short-circuit current rating of switchgear assembly
8. Nameplate legends
9. UL listing for series rating of installed devices
10. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
11. Wiring and Schematic Diagrams: Power, signal and control wiring

C. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, accessories, and components will withstand seismic forces defined in 480020 Pasadena Site Conditions.

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
1. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operations Information and Maintenance Data:

1. Submit “as-built” drawings, instruction books, and manuals for switchgear and components in accordance to document requirements in this specification. The instruction books shall include, but not limited to:

    1. Instruction and operation manuals including all installation instructions.
    2. Complete service and repair manuals.
    3. Complete parts list with vendor part numbers and a recommended spare parts list.
    4. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
    5. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 MAINTENANCE MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Six of each type and rating used. Include spares for potential transformer fuses, control power fuses, and fuses and fusible devices for fused circuit breakers,

2. Indicating Lights: Six of each type installed.
3. Touchup Paint: 2 containers of paint matching enclosure finish, each 0.5 pint.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver switchgear in sections of lengths (maximum of 6ft in width) that can be moved past obstructions in delivery path.

B. Prior to shipment store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Factory assembled and tested, and complying with IEEE C37.20.2 *IEEE Standard for Metal-Clad Switchgear* and IEEE C37.20.7 *IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Fault.*

B. Ratings: Suitable for application in 3-phase, 60 Hz, resistance grounded-neutral system.

C. System voltage: 4.16kV nominal

2.2 METAL-CLAD, CIRCUIT BREAKER SWITCHGEAR

A. Comply with IEEE C37.20.2 *IEEE Standard for Metal-Clad Switchgear*.

B. Comply with IEEE C37.20.7 *IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Fault*.

C. Provide arc-resistant switchgear.

D. Nominal Interrupting Capacity Class: 36kAIC

E. Ratings: Comply with IEEE C37.04 *IEEE Standard Rating Structure For AC High Voltage Circuit Breakers*.

1. Main Bus Rating: 2000A continuous

F. Circuit Breakers: Three-pole, single-throw electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within three cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to-ground voltage of the system.
2. Contact-Wear Indicator: Readily accessible to field maintenance personnel.
3. Minimum of six Type A and six Type B spare contacts.

4. Minimum of six Type A and six Type B TOC contacts
5. Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.

    1. Continuous Current Rating of Main Incoming Circuit Breaker from T1: 2000A
    2. Continuous Current Rating of Main Incoming Circuit Breaker from T3: 2000A
    3. Continuous Current Rating of Feeder Circuit Breaker: 1200 A
    4. Continuous Current Rating of Feeder Circuit Breaker: 1200 A

6. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated. Generator Circuit breaker shall be provided with a trip coil.

    1. Closing speed of moving contacts to be independent of both control voltage and operator action.
    2. Design mechanism to permit manual closing of contacts for inspection or adjustment.
        1) Control Power: 125V DC for closing and tripping.
    3. Provide shunt trip capability independent of overcurrent trip

7. Any necessary removal tools, racking drive handles, etc. shall be provided with equipment.

G. Test Accessories: Relay and meter plugs

H. Low-DC Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage.

2.3 MEDIUM VOLTAGE MOTOR CONTROL CENTER

A. Description: NEMA Class E2 high-voltage control for 4.16kV, 3 phase, 60 Hz. factory assembled and tested, and complying with NEMA ICS-3 *Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC*.

B. Comply with IEEE C37.20.7 *IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Fault.*

C. Provide arc-resistant switchgear.

D. All controllers shall be fused type employing current-limiting power fuses that are coordinated with the powered equipment as well as providing the controller with an interrupting rating associated with the MCC.

E. Contactors shall be drawout where available and stationary where not available per the contactor rating. The coils shall be removable without removing the contactor from the enclosure. The vacuum interrupter wear checks shall not require removal of the contactor.

F. For safety to personnel, enclosure(s) shall be compartmented into low-voltage control compartment with separate door, AC bus compartment with protective barriers and cable entrance compartment.

G. The controller shall be isolated by a quick-make quick-break switch operated by an externally mounted operating handle. The isolating device shall disconnect the secondary of the control power transformer before opening the main circuit contacts. Auxiliary contacts shall be provided for indication of the switch position.

H. Mechanical interlocks shall be provided to prevent the following:

1. Closing the isolation switch with the high-voltage door open
2. Operation of the isolation switch while under load.
3. Opening of the high-voltage door when isolation switch is closed.
4. Operation of the contactor when the isolation switch is in an intermediate position.

I. For overload protection, one motor protection relay type SEL-710 shall be included with each motor starter.

J. Controllers rated 400 and 800 amperes shall be rated 60kV BIL.

K. The following options shall be provided:

1. Each controller shall contain protection against single-phasing due to a blown fuse and shall have blown fuse indication (provided via an SEL-710 relay).
2. Solid-state relay protection as required.
3. Unlatched contactors shall be provided for motors.
4. Control power at 120 volts shall be provided from a control power transformer in each controller. The transformer shall be protected by current-limiting fuses.
5. Controllers shall provide instantaneous undervoltage protection when momentary contact push button is used, undervoltage release when maintained contact push button is used.

L. Each starter/contactor shall be top feed with appropriate cable connections as required by load.

2.4 FABRICATION

A. Indoor Enclosure: Steel

B. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.

C. Bus Transition Unit: If required, arranged to suit bus and adjacent units.

D. Incoming Line Unit: Arranged to suit bottom entry from underground power cables. Control cables to be top entry.

E. Outgoing Feeder Units: Arranged to suit bottom entry from underground cables. Control cables to be top entry.

F. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components.

2.5 COMPONENTS

A. Main Bus: Copper, full length of MCC and switchgear

B. Ground Bus: Tinned Copper, minimum size ¼ by 2 inches, full length of switchgear.

C. Bus Insulation: Covered with flame-retardant insulation.

D. Mimic Diagram

1. Red mimic diagram and symbols showing the exact representation of the system shall be provided in the front of the switchgear.
2. Mimic diagram shall be made preferably of anodized aluminum or plastic, which shall be screwed to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The width of the mimic bus shall be ½ inch for bus bars and ¼ inch for other connections.

E. Instrument Transformers: Comply with IEEE C57.13 *IEEE Standard Requirements for Instrument Transformers*.

1. Potential Transformers
2. Current Transformers

F. Relays: Comply with IEEE C37.90 *IEEE Standard for Relays and Relay Systems Associated With Electric Power Apparatus*, integrated digital type; with test blocks and plugs. Test blocks shall be ABB FT-1 test switches with clear cover.

G. The following relays are provided for reference only. The Vendor shall be responsible for the design of the electrical system per the Electrical Overall One-Line Diagram during detailed design:

1. MCC: Motor Protection Relay: SEL-710 with RTD inputs
2. Transformer Differential Relay 11T: SEL-787

    1. Functions: 87, 87N, 50/51P, 50N

3. Unit Differential Relay 87U: SEL-387

    1. Functions: 87, 50/51P

4. Bus Differential Relay 87B: SEL-587Z

    1. Functions: 87, 50/51P

5. Unit Overcurrent Relay 11U: SEL-751A

    1. Functions: 50/51P, 27, 59, 81O/U, 59G

6. Transformer Overcurrent Relay 51T: SEL-751A

    1. Functions: 50/51P, 50/51N, 59G

7. Lockout Relay 86U: Manufacturers Standard: Minimum of 4 Decks
8. Lockout Relay 86T: Manufacturers Standard: Minimum of 4 Decks
9. Communication RTU: SEL-3530

H. Control Power Supply: Control power transformer, dry type, supplying 120V control circuits through secondary disconnect devices. DC battery system as backup. Include the following features:

1. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.

I. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Flexible tinned copper conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units. SIS wiring is acceptable for this application.
2. Conductors sized according to NFPA 70 for duty required.

J. Communications:

1. All relays with the exception of the 86 Lockout Relays shall be networked to the communications RTU. All communications between the Plant Control System (PCS) and the switchgear relays shall be via the RTU using DNP3. No wiring or other communications between the PCS and individual relays shall be required.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Before shipment of equipment, perform the following tests and prepare reports:

1. Production tests on circuit breakers according to IEEE C37.09 *IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*.
2. Production tests on completed switchgear assembly according to IEEE C37.20.2 *IEEE Standard for Metal-Clad Switchgear*.

B. Assemble switchgear and equipment in manufacturer's plant and perform the following:

1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay indication means.

C. Prepare equipment for shipment:

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.

2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

END OF SPECIFICATION

SECTION 261300-2
5kV SWITCHGEAR/MCC

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	**FOR APPROVAL**		**CERTIFIED**		**AS-BUILT**
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

APPENDIX B – SWITCHGEAR DATA SHEETS

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number:
Service/Application: 5kV Switchgear

1. SWITCHGEAR	**UNIT**	**SPECIFICATION REQUIREMENTS**	**DATA BY VENDOR**
Manufacturer			
Manufacturer's Type Designation			
Quantity		One Assembly	
Design Standards		NEMA/ANSI	
Switchgear Type		Metal-Clad, Air Insulated Arc-Resistant	
Switchgear Rating			
Rated Volts	kV	5	
Service Volts	kV	4.160	
Phase		3	
Wire		3	
Frequency		60	
Main Bus Amps		2000	
Short Time Withstand Rating	kA	36	
	sec		
Peak Withstand	kA		
Lightning Impulse BIL Voltage	KV		
System Configuration			
Wye		☑ No neutral in SWGR	
System Fault Current	kA rms sym	36	
X/R Ratio			
System Grounding			
High Resistance		☑ When either switchgear main breaker is CLOSED	
Ungrounded		☑ When both main breakers are OPEN	
System Ground Fault Current	A	5	
Arc-Resistant Construction			
Required		☑ IEEE C37.20.7, Type 2B	
Arc Fault Vent Plenum			
Required		☑	

	UNIT	REQUIRED	BY VENDOR
Switchgear Arrangement			
Two-High		☑	
Front Doors			
Latch		☑ Single Handle Multi-Point Latch	
Interlock		☑	
Rear Doors			
Latch		☑ If applicable to the switchgear design – a Single Handle Multi-Point Latch	
Interlock		☑ If applicable to the switchgear design	
Construction			
Indoor		☑ NEMA Type 1	
Closed Door Racking for Circuit Breakers and Transformers			
Required		☑	
Safety Shutters			
Grounded Metal		☑	
Lockable		☑	
Ventilation			
Non Filtered Louvers		☑	
Forced Cooling			
Not Required		☑	
Bus Insulators			
Epoxy		☑	
Bus Pass Through and Barrier Insulation			
Glass Poly		☑	
Bus Insulation			
Insulated		☑	
Primary Bus Joint Plating			
Tin		☑	
Joint Covers			
Reusable Boots		☑	
Cable Entry Plates			
Aluminum		☐	
Steel		☐	
Stainless Steel		☐	
Heat Output Data (For complete switchgear line-up)	BTU/Hr		

2. POWER CIRCUIT BREAKERS	**UNIT**	**REQUIRED**	**BY VENDOR**
Type		3-pole, draw out, vacuum circuit breaker with stored energy operating mechanism	
Rated Voltage	kV	5	
Service Voltage	kV	4.160	
Symmetrical Interrupting Rating	kA_{rms}	36	
%DC Interrupting	%	50	
Rated Interrupting Time	Cycle	3	
Dual Trip Coils Required		Yes	
Voltage	VDC	Primary trip coil voltage shall be 125 VDC	
Closing Coil Voltage	VDC	125	
Charging Motor Voltage	VDC	125	
Capacitive Trip Device		☐	
Under voltage Trip		☐	
Breaker Auxiliary Contacts (52 a/b)		6-NO and 6-NC	
Breaker Auxiliary Contacts (52S a/b)		6-NO and 6-NC	
Breaker Truck Position (TOC) Contacts		6a/6b	
Control Power Disconnects		Common Charge and Close, Separate Trip	
Breaker Secondary Disconnect			
Incoming T1 Main Breaker Rating	A	2000	
Incoming T3 Main Breaker Rating	A	2000	
Distribution Breaker Rating	A	1200	
Chiller Compressors Breaker Rating	A	1200	
3. SURGE PROTECTION			
Arresters & Capacitors			
Not Required		☑	
4. TERMINATIONS			
Entry			
Power Cable		Bottom	
Minimum space for cable Termination	mm		
Control Cable		Top	

	UNIT	REQUIRED	BY VENDOR
Termination Boots			
Required		☑	
Cable Supports			
Required		☑	
Power Cable Lugs and Termination Kits			
By Supplier		☐	
Type			
Cable Size			
5. INSTRUMENT TRANSFORMERS			
Current Transformers		☑ As shown on the one-line drawings	
Voltage Transformers		☑ As shown on the one-line drawings	
6. PROTECTIVE RELAYING			
Protective Relaying		☑ As shown on the one-line drawings	
7. METERING			
Metering		☑ Not Required	
8. SYNCHRONIZING			
Synchronizing		☑ Not Required	
9. PARTIAL DISCHARGE MONITORING			
Not Required		☑	
10. INTERNAL WIRING			
Lugs			
CT		Insulated Ring Tongue	
Other		Insulated Ring Tongue	
Wire Larger than #10		Manufacturers Standard	
11. ACCESSORIES			
Control Switches			
Trip/Close		ElectroSwitch, Series 24, Pistol-Grip Handle	
Indicating Lights			
LED		☑	
Red – Closed		☑	
Green – Open		☑	
Amber – Fault		☑	
Other			

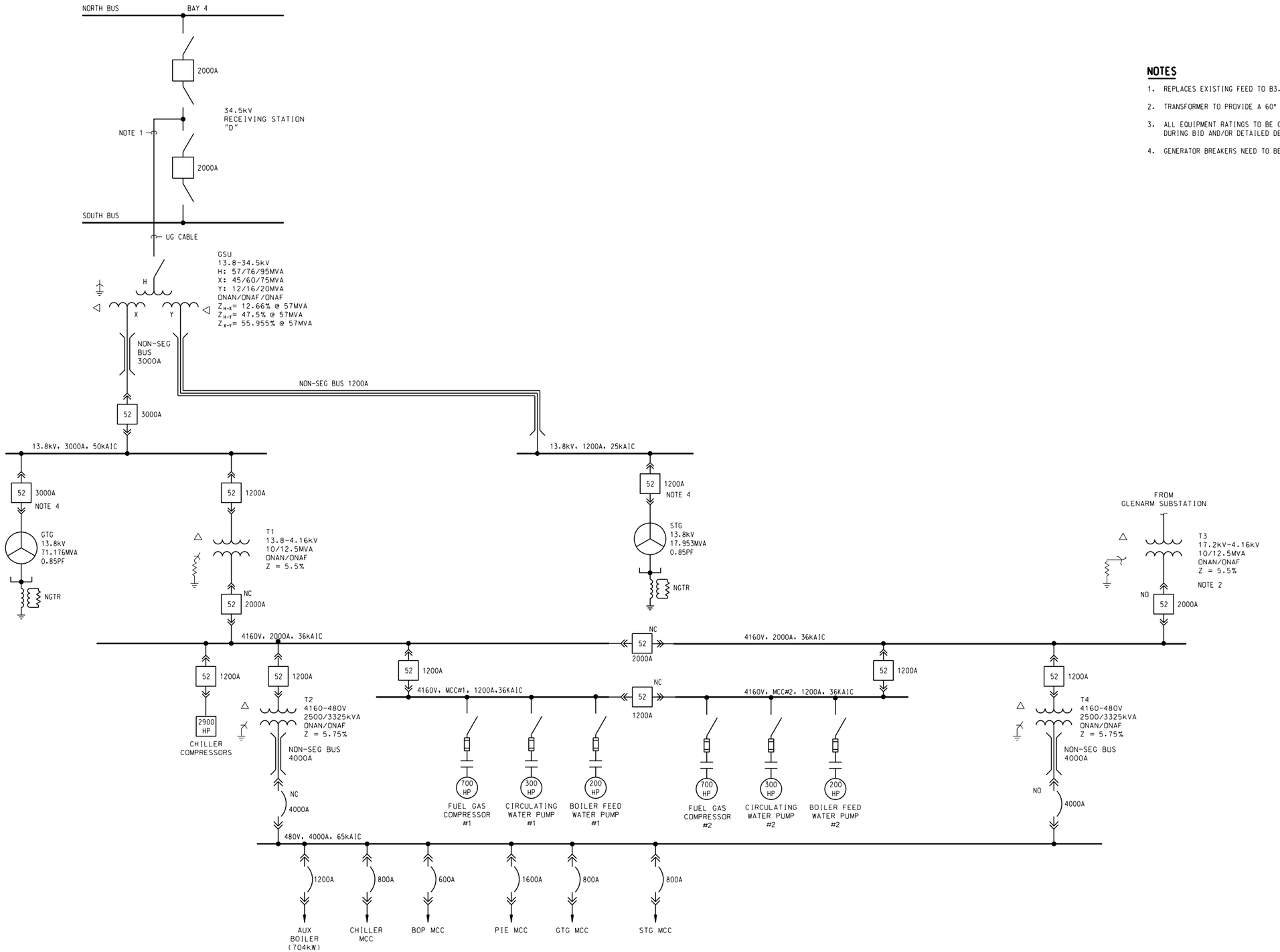
	UNIT	REQUIRED	BY VENDOR
Wire Markers			
Sleeve-Type Both Ends		☑	
Not Heat Shrunk		☑	
Terminal Blocks			
		☑ STATES type NT, catalog No. M-250, sliding link, front-connected open type terminal block with white marker strip	
CT		Shorting Type	
Spare Points	%	20	
Wire All Spare Contacts to Terminal Blocks			
Required		☑	
Nameplates			
Stainless Steel		☑	
White Plastic with Black Letters		☑	
Stainless Steel Screws		☑	
Mimic Bus			
Required		☑	
Space Heaters			
Required		☑	
Load	W		
Rated Voltage	VAC	120	
Operating Voltage	VAC	110	
Thermostat			
One per switchgear		☑ One Per Structure	
Ground and Test Device			
Required		☑	
6-pole Manual or Electrically Operable (Options?)		☑	
Electrical Remote Racking Device			
Not Required		☑	
Lift Truck			
Required		☑ Recommended for breaker removal	
Test Jumper			
Not Required		☑	
Test Cabinet			
Not Required		☑	
Packing Requirements		☑ Standard	

12. NOTES	**UNIT**	**REQUIRED**	**BY VENDOR**
A. Circuit breakers shall be capable of being locked with up to three padlocks, in either the test or the disconnected positions.			
B. CT secondary leads shall be landed on shorting terminal blocks with the common side grounded at the first shorting terminal block in the control compartment.			
C. All VT and CT secondary leads shall be wired to terminal blocks in control compartment then to circuit devices.			
13. INSPECTION AND TESTS			
Factory Inspection and Tests			
Mfr./ANSI/CSA Standard Tests		☑	
Other Tests as Described		☐	
Factory Acceptance Test Witnessed		☑ With Circuit Breakers	
Certified Test Reports		☑	
Test Reports Prior to Shipment		☑	
On-Site Mechanical Inspection		☑	
14. DOCUMENTATION			
One Line		☑	
Front View		☑	
Plan View		☑	
Nameplate Schedule		☑	
Bill of Materials		☑	
Three Line		☑	
Schematic Diagrams		☑	
Interconnection Wiring Diagrams		☑	
Connection Wiring Diagrams		☑	
RTU Parameter List			
15. SERVICE CONDITIONS			
Installation Location			
Indoors		☑	
Temperature		Refer to 262600 PDC Specification	
16. PHYSICAL DATA			
Dimensions (Approximate)			
1. Height	in		
2. Width	in		
3. Depth	in		
4. Shipping Height	in		
5. Shipping Width	in		
6. Shipping Depth	in		

	UNIT	REQUIRED	BY VENDOR
Weights (Approximate)			
1. Weight	lb		
2. Shipping Weight	lb		
17. COMMERCIAL			
Warranty	M		
Approval Drawings after Order	Wk		
Approval Period	Wk		
Shipment after Approval	Wk		

APPENDIX C – REFERENCE DRAWINGS

E1-1A Electrical Overall One-Lines (LM6000)
E1-2 Preliminary PDC Layout
SKE16-2 Typical Electrical Schematic Diagram, MV Feeder Breaker
SKE17-1 Typical MCC Schematic, Size 1, 2, 3, 4, 5, and 6, FVNR
SKE17-2 Typical MCC Schematic, MV Motor



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

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CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

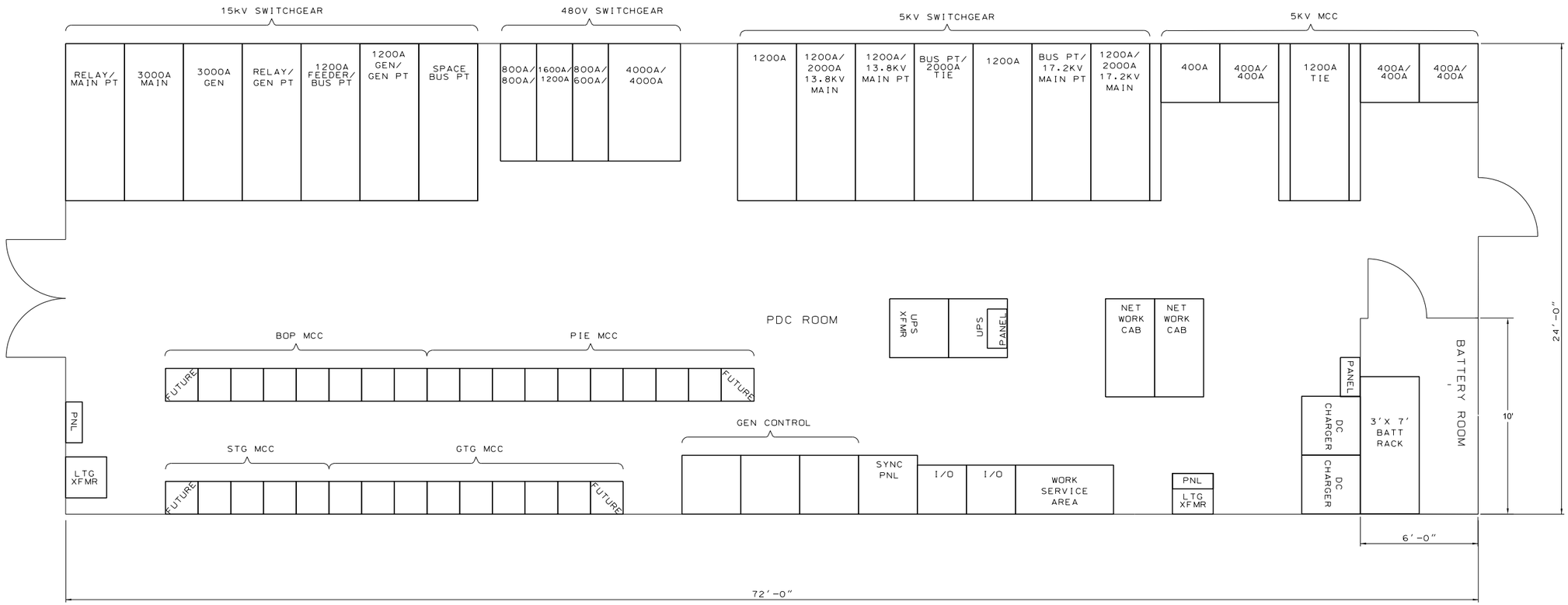
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

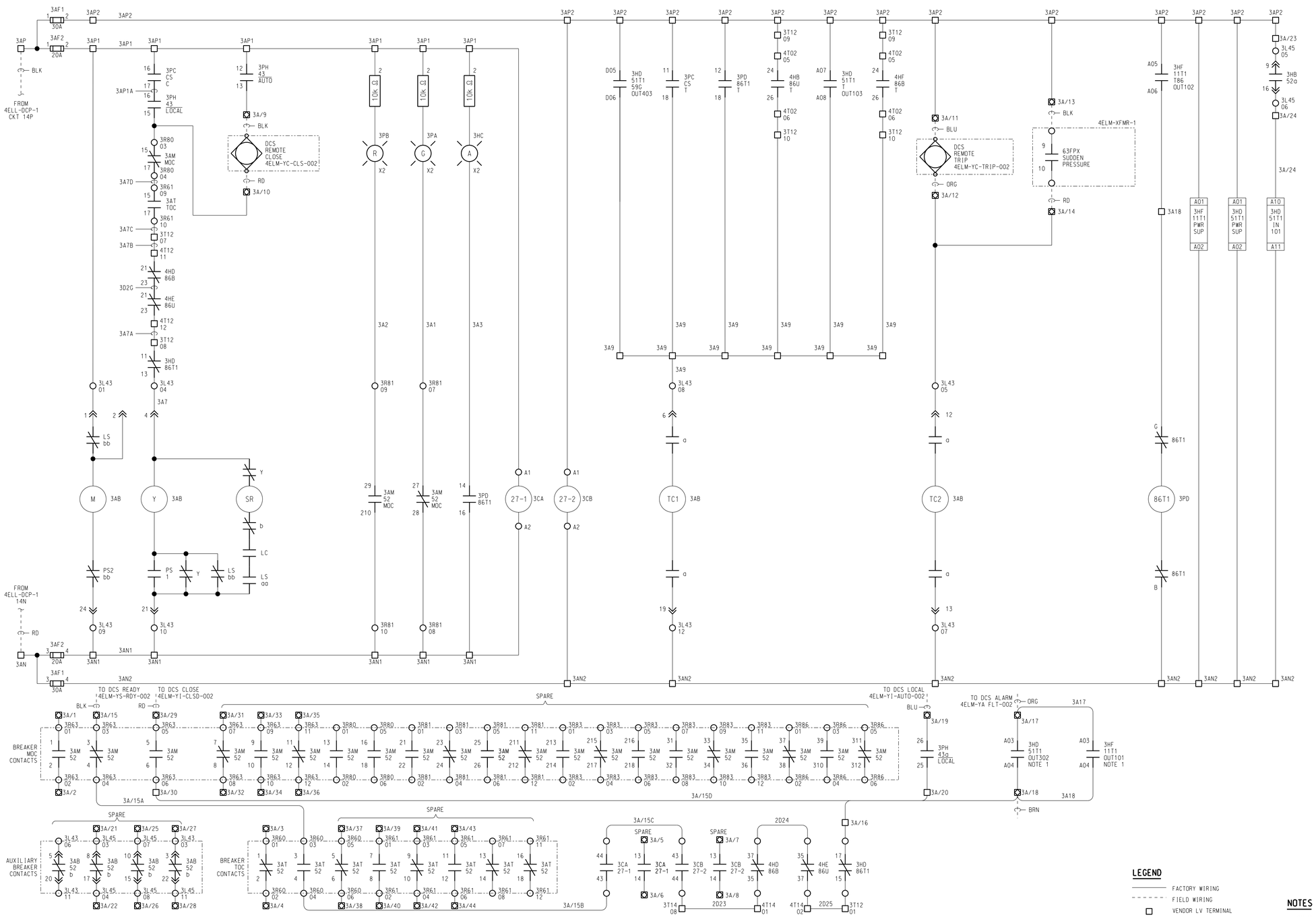
SCALE: * *
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POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2



LEGEND

- FACTORY WIRING
- FIELD WIRING
- VENDOR LV TERMINAL
- CUSTOMER LV TERMINAL
- BREAKER COMPARTMENT TERMINAL

NOTES

1. OUTPUT PROGRAMMED TO CLOSE ON ALARM.
2. TYPICAL WIRING, TERMINALS AND CONFIGURATION WILL CHANGE BASED ON VENDOR SELECTED.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	–	–	–	–	–	–	–
INIT	–	–	–	–	–	–	–

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	**/**	RDQ	FD	JR	RL

DSGN	FD	09/07/12
DRN	RDQ	09/10/12
CKD	JR	09/11/12

SCALE: NONE

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GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TYPICAL ELECTRICAL SCHEMATIC DIAGRAM MV FEEDER BREAKER

JOB NUMBER 123374

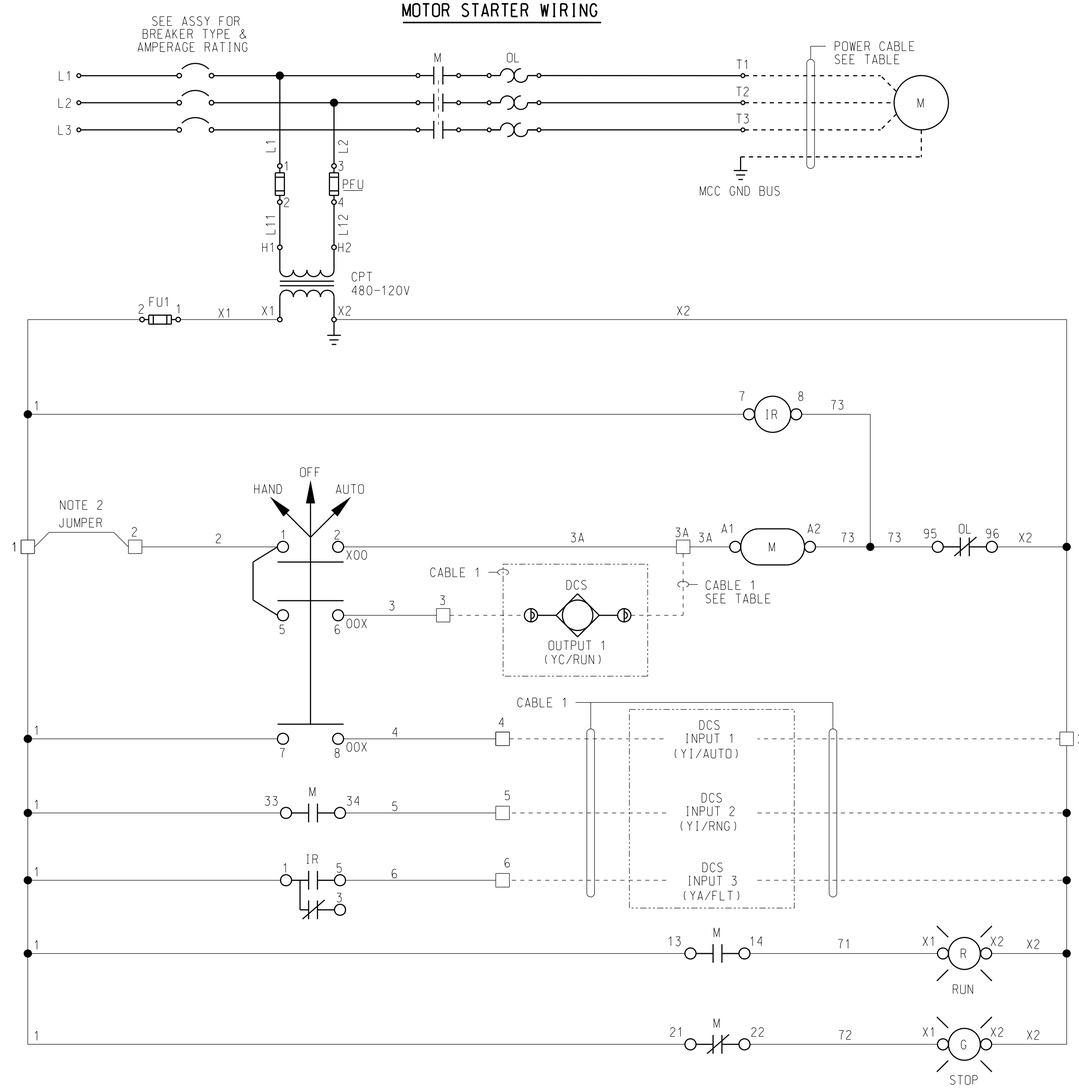
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DRAWING NUMBER SKE16-2

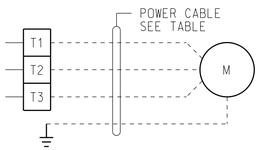
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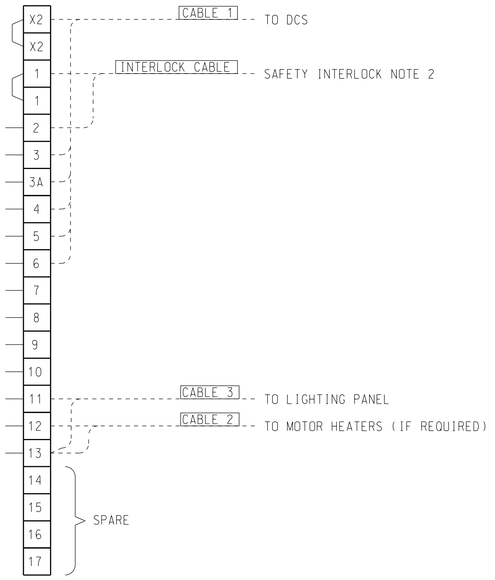
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MOTOR STARTER WIRING



EXTERNAL WIRING





NOTES

1. TYPICAL WIRING. TERMINALS AND CONFIGURATION WILL CHANGE BASED ON MCC VENDOR SELECTED.
2. REMOVE JUMPER AND CONNECT INTERLOCK CABLE WHERE INTERLOCKS ARE REQUIRED.
3. MOTOR SPACE HEATERS (IF REQUIRED) ARE POWERED BY CIRCUITS TO MCC VERTICAL SECTIONS.

———— INTERNAL STARTER WIRING

- - - - - - - - - - - - - - - EXTERNAL WIRING

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DISC							
DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	**/**	RDQ	FD	JR	RL

DSGN	FD	09/07/12
DRN	RDQ	09/10/12
CKD	JR	09/11/12

SCALE: NONE

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PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

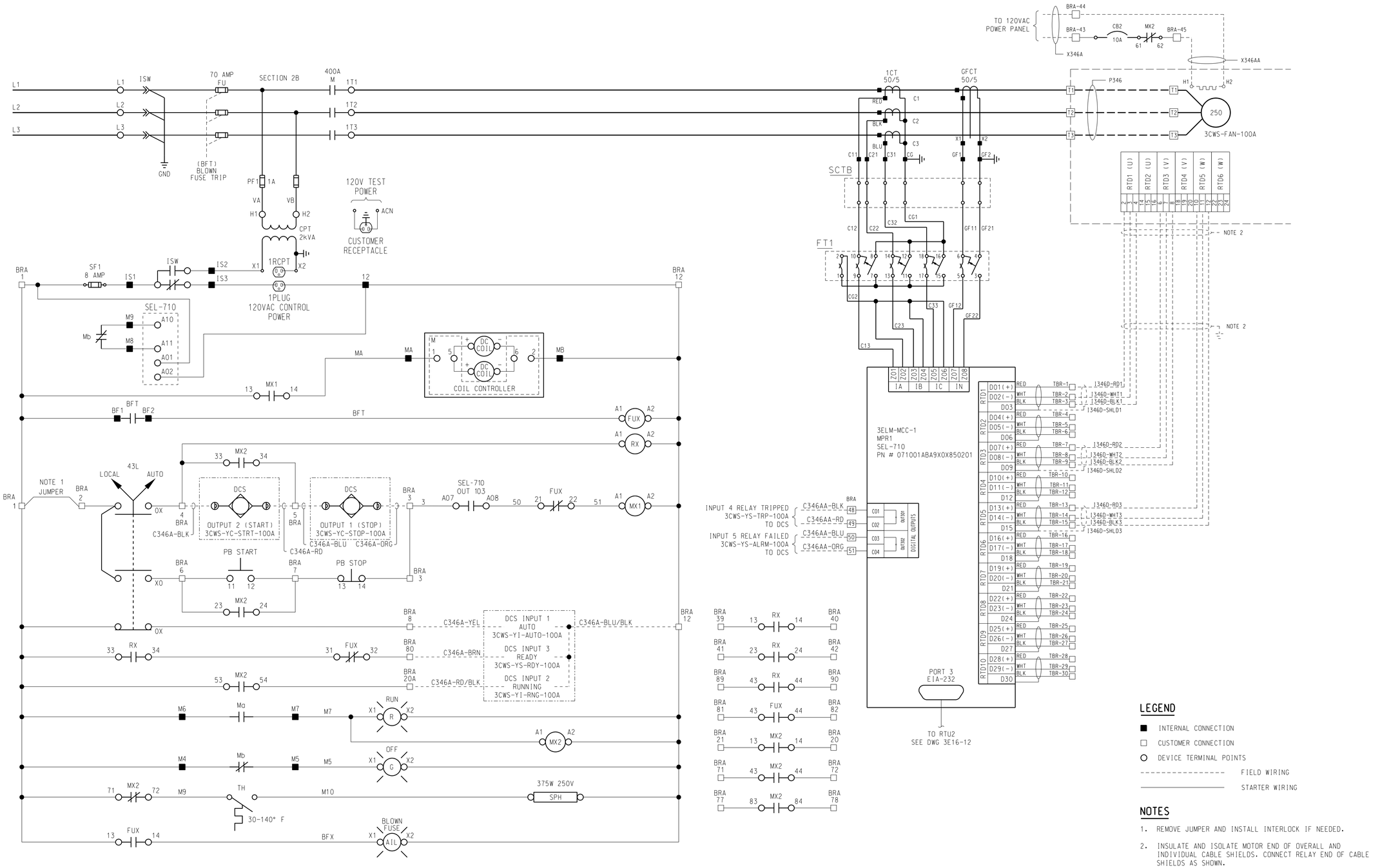
TYPICAL MCC SCHEMATIC SIZE 1, 2, 3, 4, 5, AND 6 FVNR

JOB NUMBER 123374 | REV A

DRAWING NUMBER SKE17-1

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tmarrichus07/10/2013



LEGEND

- ■ INTERNAL CONNECTION
- □ CUSTOMER CONNECTION
- ○ DEVICE TERMINAL POINTS
- ---------- FIELD WIRING
- ———— STARTER WIRING

NOTES

1. REMOVE JUMPER AND INSTALL INTERLOCK IF NEEDED.
2. INSULATE AND ISOLATE MOTOR END OF OVERALL AND INDIVIDUAL CABLE SHIELDS. CONNECT RELAY END OF CABLE SHIELDS AS SHOWN.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	–	–	–	–	–	–	–
INIT	–	–	–	–	–	–	–

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	**/**	TLM	FD	RL	GH

DSGN	FD	07/10/13
DRN	TLM	07/10/13
CKD	RL	07/10/13

SCALE: NONE

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CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TYPICAL MCC SCHEMATIC MV MOTOR

JOB NUMBER 123374

REV A

DRAWING NUMBER SKE17-2

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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

G
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

September 9, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 262600
Power Distribution Center (PDC)

PROJECT NUMBER:
123374

PROJECT CONTACT:
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POWER ENGINEERS

Section 262600
Power Distribution Center (PDC)

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
07/15/2013	F. De Guzman	J. Rippee	G. Harwood	A
09/09/2013	F. De Guzman	R. Barklund	G. Harwood	B

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 2
1.4 DOCUMENTATION 3

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT 4

2.1 GENERAL 4
2.2 MEDIUM VOLTAGE SWITCHGEAR 4
2.3 LOW VOLTAGE SWITCHGEAR 4
2.4 120 VAC UNINTERRUPTIBLE POWER SUPPLY 5
2.5 125 VDC BATTERY AND CHARGERS (OTHERS) 5
2.6 24 VDC BATTERY AND CHARGERS (OTHERS) 5
2.7 480 VOLT MOTOR CONTROL CENTERS (OTHERS) 5
2.8 MISCELLANEOUS DISTRIBUTION TRANSFORMERS AND PANELS 5
2.9 POWER DISTRIBUTION CENTER 6

PART 3 - EXECUTION 9

3.1 QUALITY CONTROL 9

APPENDIX A – VENDOR DATA COMMITMENTS 10

APPENDIX B – REFERENCE DRAWINGS 11

SECTION 262600
POWER DISTRIBUTION CENTER

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. A Power Distribution Center (PDC) shall be provided for electrical power distribution equipment, control systems associated with power generation equipment, auxiliary transformers, 125 VDC battery system, 24VDC battery system, and 120 VAC UPS. The PDC will be mounted on concrete piers to provide space beneath the PDC for field installation of a cable tray system and associated field installed cables.

B. Related Documents:

1. E1-1 A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 263323-1 125VDC Battery System
4. 263323-2 24VDC Battery System
5. 263353 UPS
6. 261300-1 15kV Switchgear
7. 261300-2 5kV Switchgear/MCC
8. 262300 480V Switchgear/MCC
9. 260533 Non Seg Bus
10. 480020 Pasadena Site Conditions

1.2 SCOPE

A. This specification details the technical and quality assurance requirements for furnishing, delivering and installing a modular, weatherproof, electrical equipment enclosure and cubicle containing electrical distribution and control equipment for a fully functional operation. The project consists of a single (1) PDC.

B. The electrical equipment housed in the enclosure will consist of, but is not limited to MV and LV metal-enclosed draw-out switchgear, 4160V motor starters, 480V motor control centers, miscellaneous low voltage distribution equipment, the 125 VDC and 24 VDC battery system, miscellaneous LV auxiliary and lighting transformers, and panels and the 120 VAC uninterruptible power supply (UPS) systems.

C. The physical size and electric capacity information and quantities (if given) throughout these documents are provided for reference only. The Vendor shall be responsible for the design of the electrical system within the PDC. The final PDC layout and electrical design shall be mutually agreed upon by the Vendor and Owner or Owner's Representative.

D. Based on the equipment furnished, the Vendor shall provide equipment arrangement drawings with the bid Proposal, keeping in view shipping requirements, site spacing constraints (do not exceed space allotted without prior approval from the Owner), equipment operation, and maintenance, including equipment replacement. All interconnects and terminations of all

equipment within the PDC shall be the scope of the Vendor. To the maximum extent possible, all termination and interconnections shall be performed and tested at the factory.

E. The equipment outlined below and as depicted in the Electrical Overall One-Line Diagram shall be provided and installed in the PDC:

1. Medium Voltage Switchgear
2. Medium Voltage Motor Starters
3. Low Voltage Switchgear
4. Uninterruptible Power Supply
5. 125VDC Battery , chargers, DC Panel and accessories
6. 24VDC Battery and accessories for GTG
7. 480V Motor Control Centers
8. Miscellaneous Low Voltage Power Distribution Equipment
9. PDC Enclosure
10. PDC HVAC Systems (ducted)
11. PDC Lighting and Receptacles
12. Fire and Smoke Detection System
13. Fire protection system compliant with all relevant Local, State and Federal requirements and satisfactory to the Authority Having Jurisdiction
14. Grounding System

F. The following equipment shall be shipped to the PDC vendor for installation and interconnect wiring (by others):

1. Miscellaneous control panels for GTG and STG
2. PCS

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. No deviation shall be made from this specification and the standards cited herein unless particular requirements are waived or modified in writing by General Manager. Vendor shall provide or obtain from its subcontractors a statement as to compliance with this specification without exception and/or if there are any exceptions these shall be described in detail and included in Vendor's proposal. Vendor shall add a statement that no other exceptions are taken to this specification.

C. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

D. The PDC shall be constructed, wired and tested in accordance with Applicable Laws, including the conditions in this specification and applicable portions of the latest edition of the following standards and codes:

1. National Electrical Manufacturer's Association (NEMA)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. American National Standards Institute (ANSI)
4. National Electrical Code (NEC)
5. Occupational Safety and Health Administration Standards (OSHA) and CalOSHA
6. American Society of Testing Materials (ASTM)
7. National Fire Protection Association (NFPA)
8. International Building Code (IBC)
9. American Institute of Steel Construction (AISC)
10. Insulated Cable Engineers Association, Inc. (ICEA)
11. Structural Welding Code (AWS D1.1)
12. Metal Building Manufacturers Association (MBMA)
13. Applicable Local Codes and Ordinances
14. California Fire Code (CFC)
15. City of Pasadena Fire Prevention Code
16. California Building Code 2007 (CBC)

E. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his sole resolution.

1.4 DOCUMENTATION

A. The Vendor shall submit any data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentation shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Dimensional drawings including weights, capacities, design loadings
3. Brochures/literature
4. Experience list
5. Preliminary arrangement, plan drawing and descriptive literature

D. Operation, Information and Maintenance Data

1. Vendor shall submit to General Manager spare parts recommendation for operation and maintenance, which includes all the spare parts that the Vendor recommends that should be stocked at the site to enable prompt repair due to any outage of the furnished equipment that can reasonably be expected after start of commercial operation. The Vendor shall take into account the length of time required to obtain replacement parts. This list shall be separately priced and the option to include these parts as part of the contract may be exercised by the General Manager at the time of contract placement.

E. Manufacturer Seismic Qualification Certification: Submit certification that the PDC, accessories, and related components will withstand seismic forces defined in 480020 Pasadena Site Conditions

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT

2.1 GENERAL

A. Electrical equipment modular enclosure shall be provided by the Vendor to house the electrical distribution and control equipment defined in this specification. This module shall be self-contained, outdoor, weatherproof, and shall include the equipment, lighting, heating, air-conditioning, filtration, grounding, 120 VAC convenience receptacles, fire and smoke detection and alarm equipment, fire protection system, fire extinguishers and all equipment interconnections and wiring. The Vendor shall determine the number of enclosures required and provide a recommended layout of these enclosures with their Proposal to obtain the most cost effective design to manufacture ship and install. PDC layout shall be similar to the attached drawing, E1-2 Conceptual PDC layout.

B. All power bus and cable connections to these cubicles and from the cubicles to their loads will be provided by the Vendor in accordance with the project One-Line Diagram and specifications. The Vendor shall be responsible for all power sources and associated feeders necessary for a complete installation of the PDC's power needs such as: HVAC, lighting, receptacles, etc. based on the detailed design.

2.2 MEDIUM VOLTAGE SWITCHGEAR

A. One (1) lineup of 15kV arc-resistant Switchgear and one (1) lineup of 5kV arc-resistant Switchgear/MCC consistent with Drawing E1-1A (Electrical Overall One-Line Diagram), shall be furnished and installed. Generator breakers will be appropriately equipped for generator breaker service.

2.3 LOW VOLTAGE SWITCHGEAR

A. One (1) lineup of 600V Switchgear consistent with Drawing E1-1A (Electrical Overall One-Line Diagram) shall be furnished and installed.

2.4 120 VAC UNINTERRUPTIBLE POWER SUPPLY

A. One UPS shall be furnished and installed. UPS shall use the 125 VDC battery as source of DC power.

B. UPS shall be sized for a two (2) hour plant outage.

2.5 125 VDC BATTERY AND CHARGERS (OTHERS)

A. One 125 VDC battery and redundant chargers shall be included. Refer to 263323-1 125VDC Battery System Specification for additional details.

2.6 24 VDC BATTERY AND CHARGERS (OTHERS)

A. One 24 VDC battery and redundant chargers shall be included. Refer to 263323-2 24VDC Battery System Specification for additional details.

2.7 480 VOLT MOTOR CONTROL CENTERS (OTHERS)

A. Two (2) lineups of 600V Motor Control Centers. Refer to E1-1A (Electrical Overall One-Line Diagram).

2.8 MISCELLANEOUS DISTRIBUTION TRANSFORMERS AND PANELS

A. The following distribution transformers and panels shall be furnished in each PDC:

1. 2 – 100 ampere, 120/208V, 3 phase, 4-wire distribution panel board with 100 ampere main breaker
2. 2 – 30 kVA 480/208-120V, 3-phase, 60 Hz dry type 150°C rise transformer.
3. 1 – 400 ampere, 125 VDC distribution panel board with main breaker (by others)
4. 1 – system of power distribution equipments provided for all PDC, HVAC, lighting and receptacle load requirements, to include items mentioned above

B. Miscellaneous Distribution:

1. Panels will consist of a standard panel board assembly of AC molded-case air circuit breakers or DC fused switches or breakers contained in metal enclosures designed for surface mounting.
2. Each 208/120V distribution panel shall be furnished with adequate capacity and circuit breakers to satisfy the Vendor's installed electrical module service requirements and provide the General Manager with no less than 30 percent remaining capacity and single pole circuit breaker positions.
3. The panels and breakers shall withstand and interrupt the maximum fault current they may be exposed to.
4. The Vendor shall provide wireways between the bottom of the distribution panels and the floor of the modules. All conduit and wiring between module lighting, heating and other devices and the panels shall be furnished by the Vendor. The Vendor shall

provide nameplates for each panel labeled in accordance with titles provided by the General Manager.

5. Reference the one-line diagram and PDC Layout for required dry-type transformers and distribution panel boards.

2.9 POWER DISTRIBUTION CENTER

A. PDC equipment layouts shall be in accordance with the attached sketches showing arrangement and spaces around the equipment.

B. Structural Design

1. The PDC shall be a completely self-contained housing built on a structural steel framework. The base of the structure shall be designed to be supported by foundation piers. The area under the base and between the foundation walls will be free for a height of five feet (minimum) for incoming and outgoing cable. Enclosure shall be secured to its perimeter wall foundation with an anchor bolt system that meets the seismic requirements for the project. Walls, roof and floor shall be insulated as required to meet or exceed the temperature requirements.
2. Sections of the PDC floor shall be removable at locations in front of and behind electrical equipment for access to areas below the base. Two entrances, providing access and egress for the PDC shall be furnished. The doors shall be self-closing and shall be furnished with emergency exit type panic bar latches. Installation of equipment and components shall comply with the clearances required by the National Electrical Code and other applicable Local, State and Federal agencies.
3. Interior wall material and finish shall be manufacturers standard.
4. The base of the PDC shall be designed for lifting the PDC as a unit by crane or by other means without any distortion of the framework.
5. The structural steel design for each module shall be in accordance with the AISC Specification, Code and Manual.
6. Door landings, access platforms and stairs shall be provided by the vendor. To assist with breaker servicing, one set of access platforms and stairs shall be removable to provide for easy access with plant equipment such as forklift.

C. Environmental Design

1. The PDC shall be provided with pressurization, ventilating, and air conditioning equipment. The PDC shall be weatherproof. All joints shall be gasketed or sealed to prevent outside air from entering the PDC.
2. Skirting of suitable material with access panels suitable for the outdoor environment shall be installed from the base of the PDC to the top of the PDC foundation base, on all four sides, to minimize the incursion of dirt, dust, debris and rodents into the plenum beneath the PDC.

D. Fire Protection

1. The PDC requires a fire alarm panel with smoke/heat detectors. In addition, an audible alarm shall sound on activation of a detector. The fire panel shall have alarm and fault dry contacts for interface with the overall plant fire protection system. Sufficient hand held fire extinguishers shall be furnished to meet the requirements of NFPA 10.

2. A dry agent fire suppression system such as FM-200 shall be provided by the vendor. Fire suppression system controls shall be capable of integration with the overall plant fire protection system and communications network. A door fan test shall be performed in the field by the installation contractor, in lieu of a concentration test, to demonstrate building integrity.

E. Electrical Distribution

1. Adequate lighting and electrical convenience receptacles shall be furnished. Interior overhead lighting shall be fluorescent, providing at least 35 foot candles at 30 inches above the floor. Exterior lighting shall be furnished near each door.
2. The PDC distribution panels shall have circuits for power outlets at 120V, single phase. Two (2), minimum, outlets shall be supplied on each wall of the PDC.
3. The PDC shall also be provided with combination emergency/exit lighting fixtures above each door and emergency lighting fixtures as necessary throughout the building to create an illuminated egress path.

F. Grounding

1. The PDC shall be provided with a tin-plated copper grounding system. This system shall be connected to the enclosures of all electrical equipment, and to the ground points of distribution power and lighting circuits. The grounding system shall be provided with two tin-plated copper pads, one at each end of the module, for connection to the underground grounding system. All aboveground exposed copper shall be tinned. The pads shall be drilled and tapped for NEMA two-hole cable terminals. An underground ground loop shall encircle each PDC enclosure and in turn be tied to the station ground.

G. Raceways

1. Wiring within the PDC shall be completely contained in metallic raceways (conduit/cable tray). Power cables and control wiring shall be run in separate raceways, separated by a suitable distance. Conduit shall be galvanized, rigid steel type. Any required conduit on the outside of the PDC shall be rigid galvanized. EMT conduit is not acceptable and shall not be used under any circumstance.
2. All incoming and outgoing wiring shall be from below. Openings below all equipment shall be furnished for the entry of wiring. These openings shall be furnished with removable, gasketed drill plates for the entry of rigid conduit.
3. Metallic wireways shall be furnished above, and shall run the entire length of such equipment and lineups. These wireways will be used for the interconnection of all wiring between electrical components within the PDC.

H. Wiring

1. All equipment shall be furnished completely wired, with the exception of control and AC power buses, all other alarm and control wiring for extension to General Manager's remote equipment or for interconnection between equipment shall terminate at terminal blocks.
2. All spare auxiliary switches shall be connected to the terminal blocks.

3. Equipment shall be wired with 600V flame-retardant insulated No. 14 stranded copper switchboard wire with 600-volt cross-linked polyethylene insulation. All wiring shall be tinned copper.
4. The Vendor shall provide insulated copper power cable and connections between units of electrical equipment within the module, as required.
5. Conductor insulation shall be 90°C thermosetting type ethylene propylene rubber (EPR) in accordance with NEMA WC-3 or cross-linked polyethylene (XLPE), in accordance with NEMA WC-7. The insulation thickness shall be in accordance with the above applicable standards for the rated voltage of the connected equipment.
6. Power cables connected between components within the modules shall be enclosed completely in metallic raceways, preferably overhead. All secondary circuit wiring shall be no smaller than No. 14 AWG.
7. Wiring shall be neatly arranged and clamped securely to panels to prevent movement and breaking and should be provided with the appropriate markers. Wiring clamps and supports at door hinge transition points shall be properly sized to prevent chafing of insulation when a cubicle door is opened and closed. Metal clamps must have insulating inserts between the clamps and wiring.
8. Wiring leads shall be terminated by the use of ring-tongue lugs. Wiring splices of any kind are not acceptable.

I. Welding

1. All welding of the module and the electrical equipment therein shall be in accordance with the Vendor's standard welding procedures. As a minimum, all production fillet and butt welds shall satisfy the following visual acceptance criteria:

    a. No cracks or lack of fusion shall be acceptable.
    b. The sum of weld porosity diameters shall not exceed 3/8 inch in any linear inch of weld and shall not exceed 3/4 inch in any 12 inch length of weld.
    c. All weld craters shall be filled to the full cross-section of the weld.
    d. Undercut shall not exceed 1/32 inch. The Vendor shall establish a lesser value of undercut if required to satisfy design requirements.
    e. Weld filler material reinforcement shall be 0 inch to 1/8 inch maximum between abutting surfaces and shall have a gradual transition (30deg maximum) to the plane of the base metal surfaces.

2. All materials provided by the Vendor requiring field welding shall be identified by specification, type, and grade.

J. Painting

1. The exterior of the PDCs shall be painted with manufacturer’s standard paint. Paint color shall be subject to approval by the General Manager.
2. The bottom of the base of the PDC shall be undercoated and treated to prevent rust and corrosion.
3. The inside steel floors of the PDC shall be painted ANSI-61 light gray that includes a material that provides for a non-skid safety. (note: installation contractor needs to protect the floors during construction or re-paint the floors after installation.

4. The inside walls shall be manufacturers standard white gloss.

K. Nameplates

1. Permanent engraved lamacoid nameplates shall be provided for all panels.
2. Nameplates shall be attached with stainless steel screws.

L. Tests

1. Before shipping, the Vendor shall test the complete unit. Required testing shall include:

   a. Megger of all power circuits.
   b. Continuity checks of all wiring installed.
   c. Control check for all switchgear breaker operations, aux relays, heaters and miscellaneous protective relays.
   d. Metering check for all CTs/PTs, verifying turns ratio and polarity.
   e. Testing of all MV and LV circuit breakers and buses.
   f. Operational check of all furnished and installed electrical apparatuses.

2. Testing shall include a full witness operation test by the General Manager or General Manager's representative.

3. Vendor shall submit as-built PDC electrical drawings, which reflect test records and any modifications made to the equipment following witnessed operation testing, within 4 weeks of PDC shipment. These drawings shall be supplied in the latest version of AutoCAD as well as PDF format.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Factory Inspections:

1. The General Manager reserves the right to inspect the switchgear equipment at manufacturer's factory prior to packaging for shipment.
2. The Vendor shall notify General Manager not less than two weeks before inspection is allowed.
3. The Vendor shall be responsible for making any repairs or changes to the switchgear, PDC or equipment that is not in compliance with contract specification requirements, contract drawings or shop drawings.

B. Test Results

1. Three (3) copies of the certified test report shall be delivered to the General Manager not later than five (5) days after completion of all factory tests.
2. A copy of the test report shall also be included in each copy of the switchgear instruction manual.

END OF SPECIFICATION

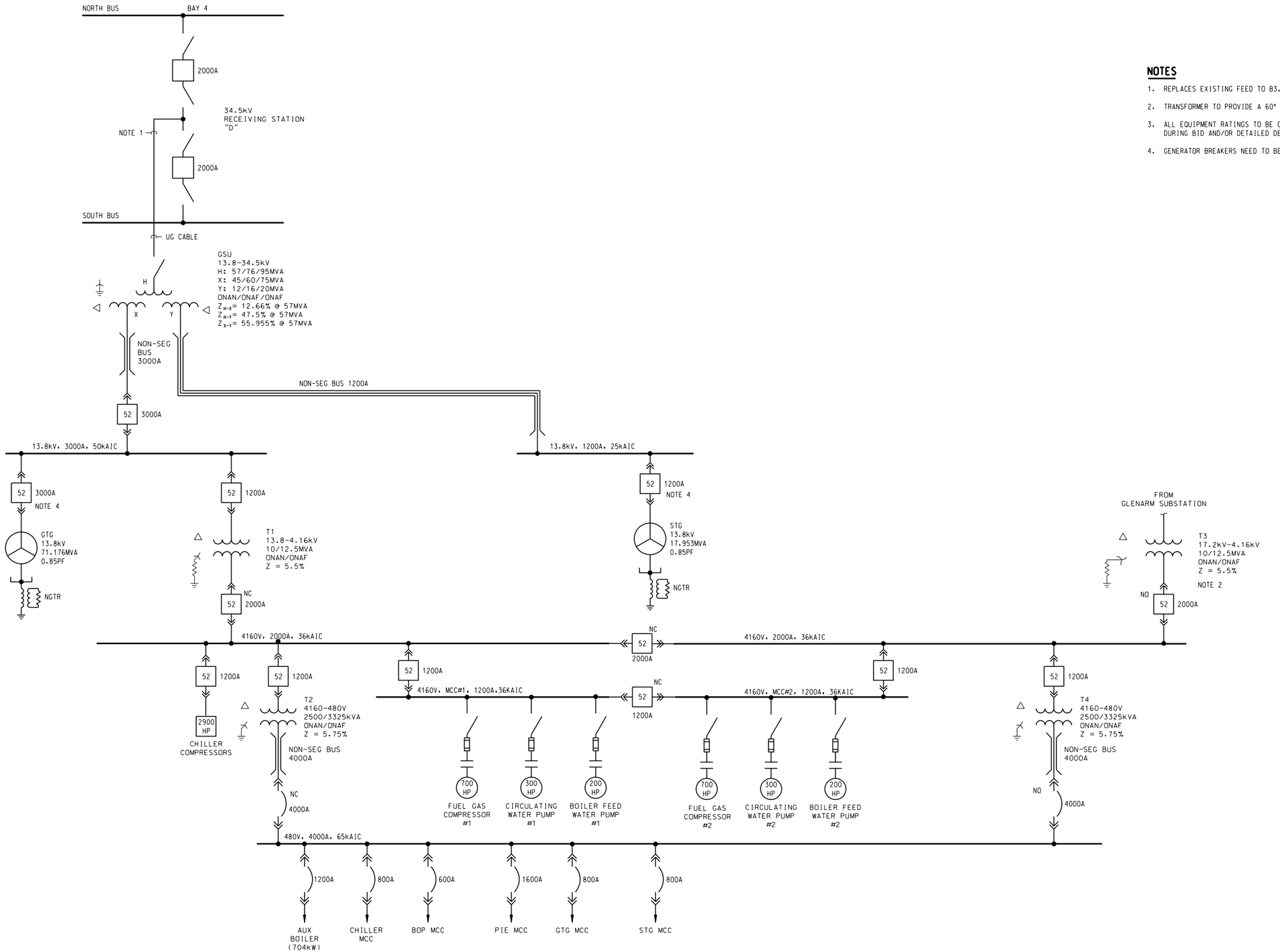
APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	**FOR APPROVAL**		**CERTIFIED**		**AS-BUILT**
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

APPENDIX B – REFERENCE DRAWINGS

E1-1A Electrical Overall One-Lines (LM6000)
E1-2 Preliminary PDC Layout



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

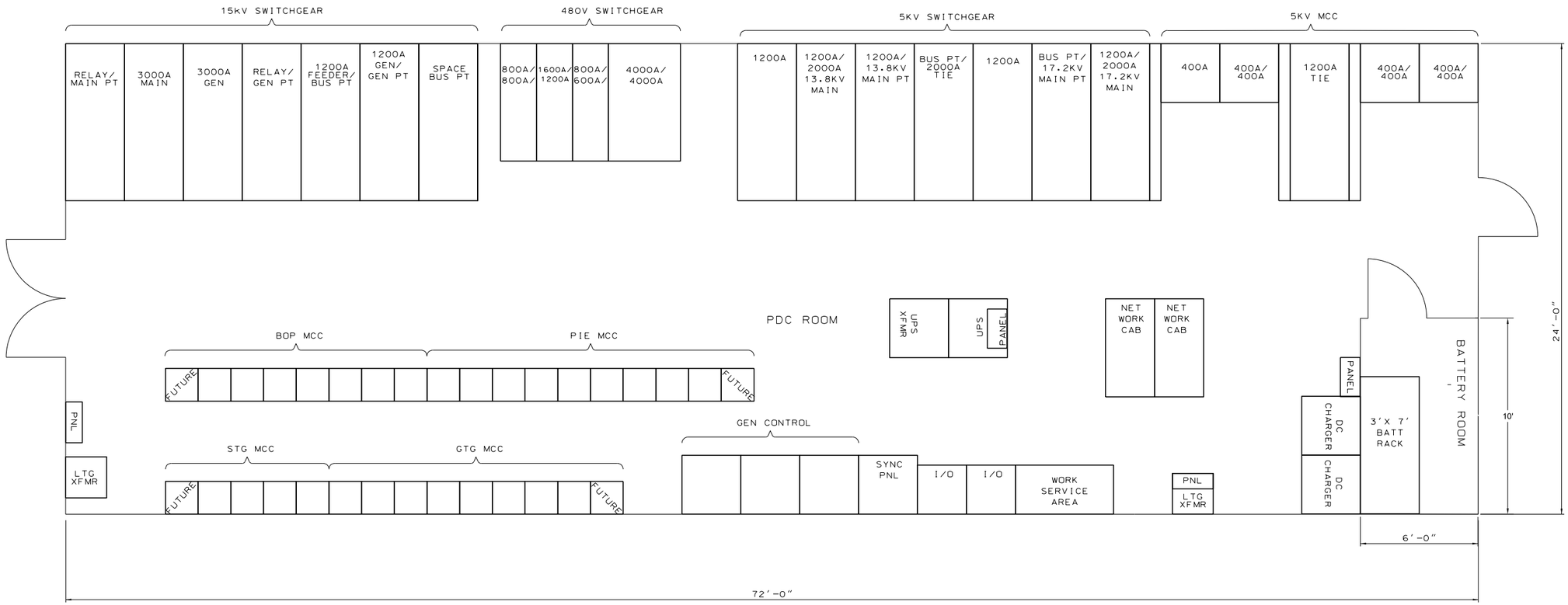
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

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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
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

SCALE: * *
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2

September 6, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 263323-1
125VDC Battery System

PROJECT NUMBER:
123374

PROJECT CONTACT:
GREGG HARWOOD
EMAIL:
GREGG.HARWOOD@POWERENG.COM
PHONE:
208-288-6360

POWER ENGINEERS

Section 263323-1
125VDC Battery System

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
07/15/2013	F. De Guzman	J. Rippee	G. Harwood	A
09/06/2013	F. De Guzman	R. Barklund	G. Harwood	B

SECTION 263323
125 VDC BATTERY SYSTEM

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 MAINTENANCE MATERIALS 3

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT 3

2.1 APPROVED MANUFACTURERS 3
2.2 STATION BATTERY 3
2.3 BATTERY RACKS 4
2.4 BATTERY ACCESSORIES 4
2.5 BATTERY CHARGERS 4
2.6 DC DISTRIBUTION PANEL 6

PART 3 - EXECUTION 6

3.1 QUALITY CONTROL 6

APPENDIX A – VENDOR DATA COMMITMENTS 7

APPENDIX B - BATTERY SYSTEM DATA SHEET 8

APPENDIX C – BATTERY LOAD PROFILE 9

APPENDIX D – REFERENCE DRAWINGS 10

SECTION 263323
125 VDC BATTERY SYSTEM

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. 125volt DC Station Battery, Battery Rack, two Battery chargers, Battery Accessories, DC Distribution panel and all associated cabling shall be installed inside an electrical equipment enclosure, PDC.

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 262600 PDC Specification
4. 263353 Uninterruptible Power Supply
5. 480020 Pasadena Site Conditions

1.2 SCOPE

A. Equipment tagging shall be provided as listed below.

1. ELL-BATT-1 125 Volt DC Battery
2. ELL-CHGR-1 Battery Charger
3. ELL-CHGR-2 Battery Charger

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

C. The battery and all associated equipment shall be designed and tested in accordance to the latest revision of the following standards and codes:

1. ANSI – American National Standards Institute
2. IEEE 484 - IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
3. IEEE 485 – Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
4. IEEE 946 – Recommended Practice for the Design of DC Auxiliary Power Systems
5. NEMA – National Electrical Manufacturers Association
6. UBC – Uniform Building Code

7. NETA – National Electrical Testing Agency
8. UL – Underwriters Laboratory

D. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentations shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Dimensional drawings
3. Brochures/literature
4. Battery capacity calculations and battery ampacity curves used for sizing the battery. Provide information on rated cycles to 80% depth of discharge.
5. Battery charger ratings, including performance characteristics with efficiency curves, regulation characteristics, output ripple content, ambient temperature ranges, power supply input requirements, and charger accessories description.
6. **Optional Pricing** for onsite installation inspection and equipment commissioning.

D. Operations, Information and Maintenance Data

1. Submit "as-built" drawings, instruction books, and manuals in accordance to document requirements in this specification. The instruction books shall include, but not limited to:

   a. Instruction and operation manuals including all installation instructions.
   b. Complete service and repair manuals.
   c. Complete parts list with vendor part numbers and a recommended spare parts list.
   d. Certified test reports for factory tests.

E. Manufacturer Seismic Qualification Certification: Submit certification that the battery, accessories, and related components will withstand seismic forces defined in 480020 Pasadena Site Conditions:

1. Basis of Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 MAINTENANCE MATERIALS

A. Provide special tools and manufacturer's standard spare parts required for installation and normal operation and maintenance.

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT

2.1 APPROVED MANUFACTURERS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

2.2 STATION BATTERY

A. The station battery shall be rated for service under the following conditions:

Battery Type: Base Bid **Optional Price**	 VRLA, Gel Lead-Calcium **Optional Price: Flooded Cell Lead-Calcium**
System Description:	2 wire, ungrounded
Nominal System Voltage:	125 Vdc
Maximum System Voltage:	140 Vdc
Minimum System Voltage(Final):	105 Vdc
Number of cells	Vendor to size appropriately per specifications

B. Station battery will be installed in a climate-controlled room, located inside the PDC. Batteries shall have a useful service life of at least 20 years based on float service operation at 77 ºF, with the equivalent of not more than two full load three-hour discharges per year.

C. Battery shall have deep cycle capacity performance characteristics: rated with a minimum of 1200 cycles at 77 ºF to 80% depth of discharge.

D. The battery capacity shall be determined in accordance with IEEE 485 and these specifications. The battery shall be sized with an age compensation factor of 125% and a design margin of 15%.

E. The attached DC duty cycle (Appendix C) shall be used to size the battery. The battery voltage throughout the duty cycle shall not be less than the final voltage specified. Size shall be based on the battery initially fully charged (at float voltage) at the start of the discharge duty cycle.

F. Battery terminal plates shall be furnished for reducing stress to the battery terminals at each battery positive and negative cable connection to associated equipment. Terminal plates shall be designed and installed for incoming cables.

G. Battery shall be sized for a two (2) hour outage.

2.3 BATTERY RACKS

A. A modular steel tray rack with the following description shall be furnished:

1. Number of steps: 2 steps
2. Max. length per step: 9 ft. per step
3. Max. width per step: 2 ft. 6 in. max

B. The rack shall allow horizontal or vertical arrangement of the battery cells. Horizontal stacking of the cells is preferred. Battery stacking height shall not exceed 5 ft. Refer to E1-2 Conceptual PDC layout, Appendix D, for available arrangement space.

C. The battery arrangement shall permit individual cell removal and reconnection of the remaining battery cells on either side of the removed cell.

D. All steel shall have not less than two uniform finish coats of acid resistant ANSI #61 gray paint or electrostatically applied epoxy coating finish.

E. Battery supporting rails shall be covered with a protective vinyl or plastic runner plate not less than 1/16 inches thick.

2.4 BATTERY ACCESSORIES

A. Each battery shall be furnished with the following accessories:

1. Hydrometer
2. Hydrometer holder with drip cup for all wall mounting
3. Thermometer of size suitable for use with specified batteries
4. Lead coated and insulated intercell connectors.
5. Interrack connectors for each battery (if necessary).
6. Connector bolts with acid resistant nuts.
7. Vinyl coated assembly wrenches.
8. No-Ox-Id grease.
9. One set of numerals (one numeral per cell) suitable for permanent attachment to cells.
10. Solderless terminal lugs for incoming cables.
11. Cell lifting device (optional price)

2.5 BATTERY CHARGERS

A. Two redundant, self-regulating, solid-state, full wave rectified, filtered output, battery chargers shall be provided.

B. Each battery charger shall be sized to re-charge the batteries in less than 12 hours while simultaneously powering all normal DC loads.

C. The chargers shall be capable of parallel operation but need not be designed for automatic load sharing during parallel operation.

D. The battery chargers shall be capable of continuous operation from no-load to full-load with the batteries disconnected for maintenance purposes.

E. Control circuits shall have AC and DC transient voltage protection, output short-circuit protection, and shall be designed to recharge a fully discharged battery without overloading and without tripping the AC input or DC output circuit breakers or fuses.

F. The battery chargers shall provide float and equalizing charges to all required multi-cell, lead calcium, flat plate batteries.

G. Charger ratings shall be as follows:

1. AC Input Voltage: 480 volt AC, 3-phase, +/- 10%
2. Frequency: 60 Hz, +/- 5%
3. DC Output Voltage: 115-140 Volts Float, 2.20 vpc
4. 124-150 Volts Equalize, 2.33 vpc
5. Regulation, DC output: +/- ½% at any load
6. Ambient Temperature Range: 77°F ±35°F
7. Conversion Efficiency: 90% minimum
8. Charging mode: Switch selectable – float or equalize
9. Output Current Limiting: 125% of rated full load current

H. Each battery charger shall be enclosed in a self-ventilated, floor mounted NEMA 1 cabinet with the following minimum accessories furnished, mounted and wired on the front enclosure panel:

1. Input Voltmeter (AC): Analog (2% accuracy)
2. Output Voltmeter (DC): Analog (2% accuracy)
3. Output Ammeter (DC): Analog (2% accuracy)
4. Connection Terminals: AC and DC
5. Input Circuit Breaker: 600 V molded case, 42kA interrupting capacity
6. Charger Output: 2-pole fast-acting current limiting fuses, DC output blocking and protection diodes
7. Potentiometers: Float voltage and Equalizing voltage adjustments +5% min; Current limit adjust
8. Equalize Timer: Manual set, 0-72 hours.
9. Charge Failure Alarm: Two (2) – Form C contacts wired to terminal block for external circuit connection.
10. High/Low DC Voltage: Relays with form C alarm contacts wired to terminal block
11. Lamps: Local status and alarm indications.
12. Ground Detection: Local indication, test switch, relay alarm, and Form C contact wired to terminal block for external circuit connection.

I. Each accessory mounted on the charger control panel shall be identified with an engraved nameplate permanently attached to the charger control panel.

J. Factory Tests: All batteries and chargers shall be inspected and tested prior to shipment. Tests and inspections shall conform to applicable ANSI, IEEE, and NEMA requirements. Certified test reports of Manufacturer's factory tests shall be provided.

K. Each battery charger shall be designed for top cable entry. All components shall be accessible from the front, with no side or back clearance required.

L. Each battery charger shall provide temperature compensated voltage charging as well as current-limited charging protection.

2.6 DC DISTRIBUTION PANEL

A. A DC Distribution Panel with the following features shall be provided:

1. Surface Mount, NEMA 1
2. Bus Size: Suitably sized for battery bank and DC Charger combination as sized by vendor
3. Breakers: See Appendix C, Battery Load Profile and Appendix D, Reference Drawings

   a. Qty 1: Sized for Battery Bank
   b. Qty 2: Sized for Battery Charger requirements
   c. Qty 13: Sized for Load requirements

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for all components, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Vendor shall perform as a minimum the following tests and inspections and prepare test reports:

1. Perform NETA tests and inspections for each of the following NETA categories:

   a. Circuit breakers.
   b. Protective relays including Ground-Fault systems.
   c. Instrument transformers.
   d. Metering and instrumentation.
   e. Panelboards
   f. Battery systems.

END OF SPECIFICATION

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	FOR APPROVAL		CERTIFIED		AS-BUILT
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

SECTION 263323
125 VDC BATTERY SYSTEM

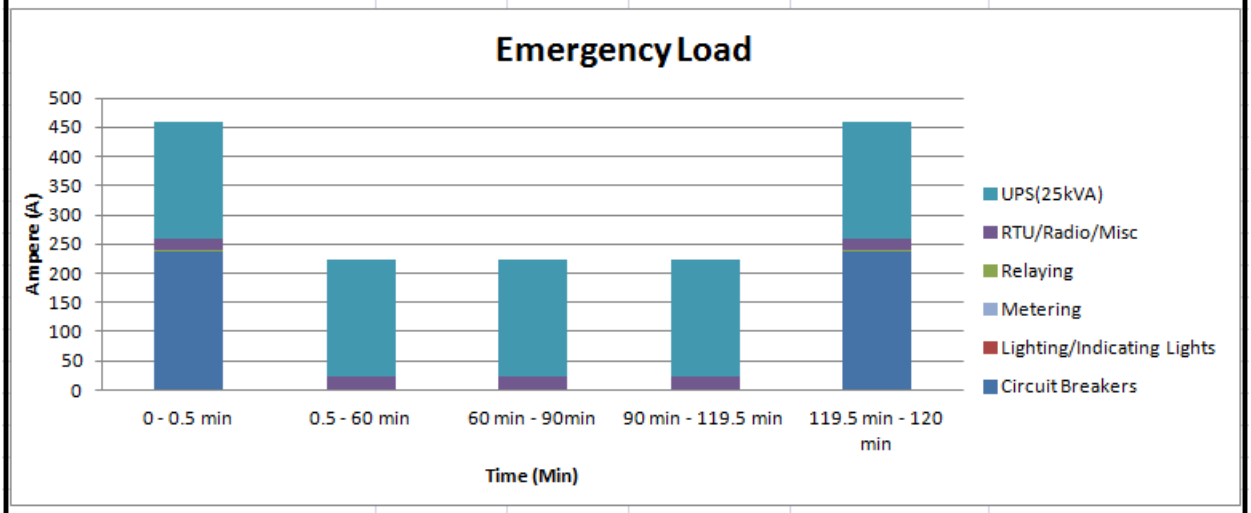
APPENDIX B - BATTERY SYSTEM DATA SHEET

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: ELL-BATT-1
Service/Application: 125VDC System

		SPECIFICATION REQUIREMENTS	DATA BY VENDOR
1. 125VDC SYSTEM			
Station Battery Information			
Equipment Tag		ELL-BATT-1	
Manufacturer			
Manufacturers Type Designation			
Quantity		One Assembly	
Size	mAH		
Nominal Voltage	VDC	125	
Float Volts	VDC	135	
Final Volts	VDC	105	
Maximum Volts	VDC	140	
# of cycles to 80% Depth of Discharge			
Dimensions	mm		
Mounting Arrangement			
Total Weight	kg		
Cell Resistance	Ω		
Short Circuit Amps	kA	42	
Battery Charger Information			
Equipment Tag		ELL-CHGR-1 ELL-CHGR-2	
Manufacturer			
Manufacturers Type Designation			
Quantity		Two Units	
Size	A		
DC Breaker Rating			
Nominal Voltage	VDC	125	
Voltage Ripple	mVDC	30	
Dimensions	mm		
Mounting Arrangement			
Total Weight	kg		
Alarms			
Short Circuit Amps	kA		

APPENDIX C – BATTERY LOAD PROFILE

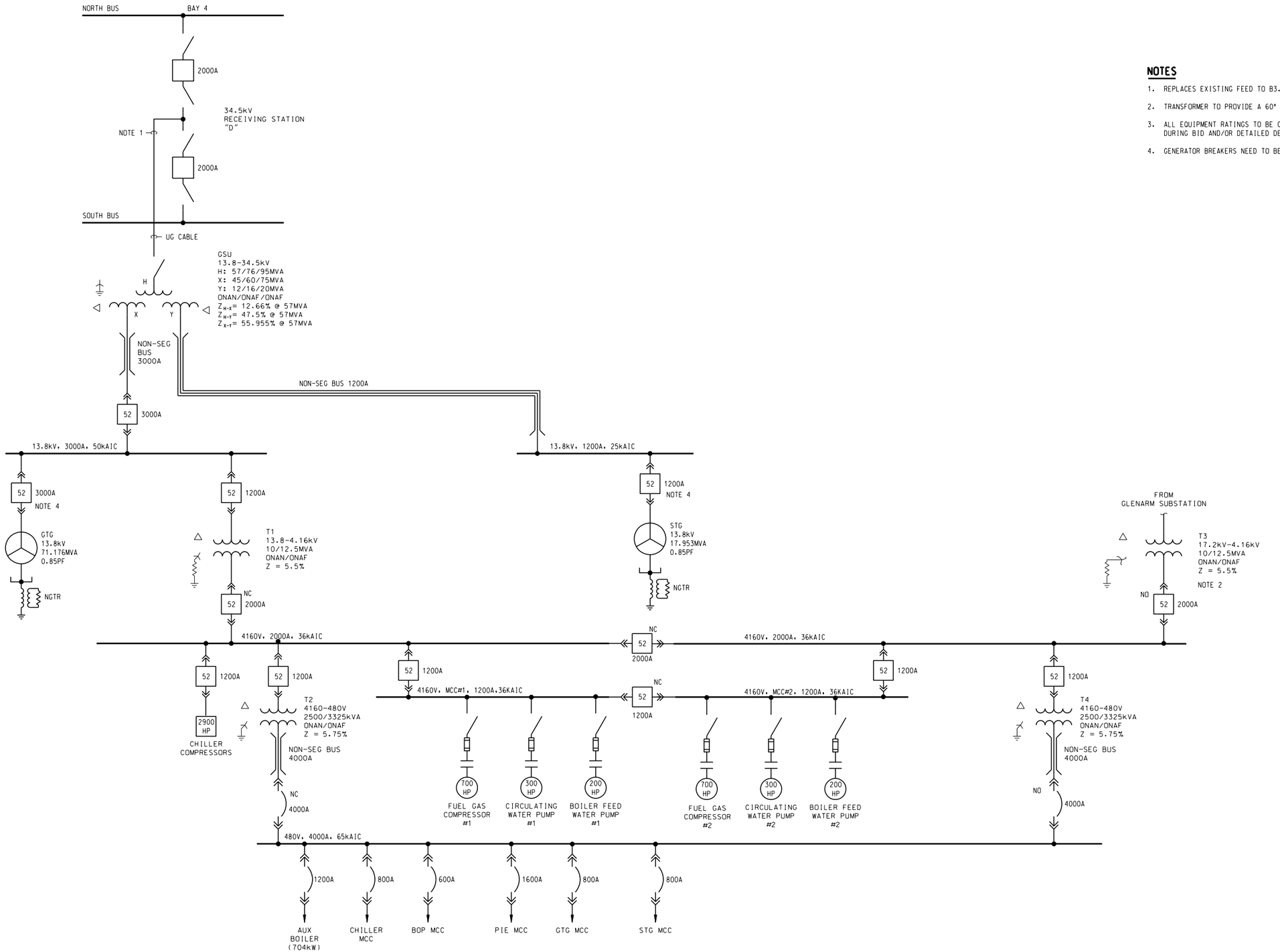
Load Description	***Load Profile (Amps)***				
Non Continuous/Momentary Loads					
Circuit Breakers	237	0	0	0	237
Continuous Loads					
Lighting/Indicating Lights	0.40	0.40	0.40	0.40	0.40
Metering	0.28	0.28	0.28	0.28	0.28
Relaying	1.60	1.60	1.60	1.60	1.60
RTU/Radio/Misc	20.00	20.00	20.00	20.00	20.00
UPS(25kVA)	200.00	200.00	200.00	200.00	200.00
Total Amps	**458.88**	**222.28**	**222.28**	**222.28**	**458.88**
Time (Min)	0 - 0.5 min	0.5 - 60 min	60 min - 90min	90 min - 119.5 min	119.5 min - 120 min



SECTION 263323
125 VDC BATTERY SYSTEM

APPENDIX D – REFERENCE DRAWINGS

E1-1A Electrical Overall One Lines (LM6000)
E1-2 Conceptual PDC Layout



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

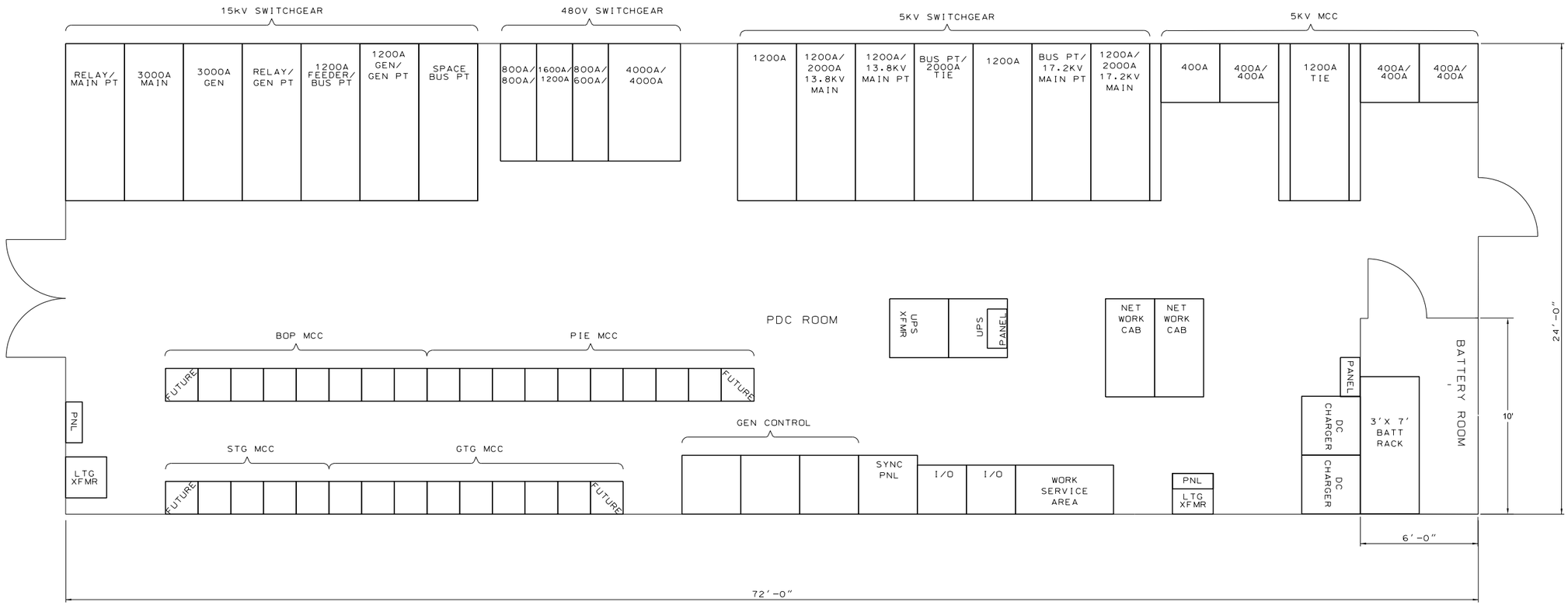
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

ralexander 09/06/2013 03:33 PM W:\123374\DD\CAD\dwg\elec\54pase1_1A.dgn



0 1 2 3 4 5 10 FEET

1/4"= 1'- 0"

ralexander 09/09/2013 06:45 AM W:\123374\DD\CAD\dwg\elec\54pose1_2.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
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

SCALE: * *
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2

September 6, 2013

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 263323-2

24VDC Battery System

PROJECT NUMBER:
123374

PROJECT CONTACT:
GREGG HARWOOD
EMAIL:
GREGG.HARWOOD@POWERENG.COM
PHONE:
208-288-6360

POWER ENGINEERS

Section 263323-2
24VDC Battery System

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *POWER ENGINEERS*

REVISION HISTORY				
DATE	PREPARED BY	CHECKED BY	APPROVED BY	REVISION
09/06/2013	F. De Guzman	R. Barklund	G. Harwood	A

SECTION 263323-2
24 VDC BATTERY SYSTEM

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 PROJECT 1
1.2 SCOPE 1
1.3 CODES, STANDARDS & REGULATIONS 1
1.4 DOCUMENTATION 2
1.5 MAINTENANCE MATERIALS 3

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT 3

2.1 APPROVED MANUFACTURERS 3
2.2 STATION BATTERY 3
2.3 BATTERY RACKS 4
2.4 BATTERY ACCESSORIES 4
2.5 BATTERY CHARGERS 4
2.6 DC DISTRIBUTION PANEL 6

PART 3 - EXECUTION 6

3.1 QUALITY CONTROL 6

APPENDIX A – VENDOR DATA COMMITMENTS 8

APPENDIX B - BATTERY SYSTEM DATA SHEET 9

APPENDIX C – BATTERY LOAD PROFILE 10

APPENDIX D – REFERENCE DRAWINGS 11

SECTION 263323-2
24 VDC BATTERY SYSTEM

PART 1 - GENERAL

1.1 PROJECT

A. The project is an outdoor installation of combined cycle turbine generators. 24volt DC Station Battery, Battery Rack, two Battery chargers, Battery Accessories, DC Distribution panel and all associated cabling shall be installed inside an electrical equipment enclosure, PDC.

B. Related Documents:

1. E1-1A Electrical Overall One Lines (LM6000)
2. E1-2 Conceptual PDC Layout
3. 262600 PDC Specification
4. 263323-1 125VDC Battery System
5. 480020 Pasadena Site Conditions

1.2 SCOPE

A. Equipment tagging shall be provided as listed below.

1. ELL-BATT-2 24 Volt DC Battery
2. ELL-CHGR-3 Battery Charger
3. ELL-CHGR-4 Battery Charger

1.3 CODES, STANDARDS & REGULATIONS

A. Vendor shall bear the responsibility that the equipment has been designed, fabricated and tested in accordance with all codes, standards, and governmental regulations applicable and performs under the conditions and to the standards specified herein.

B. It is not the General Manager's intent to specify all details of construction, but the installed equipment shall in all respects conform to highest standards of engineering, design, materials, construction and workmanship and shall be capable of operating reliably, efficiently, satisfactorily, and without excessive wear or maintenance under the service conditions stated in this specification.

C. The battery and all associated equipment shall be designed and tested in accordance to the latest revision of the following standards and codes:

1. ANSI – American National Standards Institute
2. IEEE 484 - IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
3. IEEE 485 – Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
4. IEEE 946 – Recommended Practice for the Design of DC Auxiliary Power Systems
5. NEMA – National Electrical Manufacturers Association

6. UBC – Uniform Building Code
7. NETA – National Electrical Testing Agency
8. UL – Underwriters Laboratory

D. If there is an apparent discrepancy between any of the requirements of this Specification and the standards and requirements stipulated above, or of any applicable statute, ordinance or code, then the most stringent requirements shall apply. The General Manager shall be apprised of all apparent discrepancies for his sole resolution.

1.4 DOCUMENTATION

A. The Vendor shall complete all data sheets and shall submit any other data and drawings necessary to completely describe the equipment being furnished. All documentation shall be provided in accordance with Vendor Data Commitments – Appendix A.

B. All documentations shall be in electronic and hard copy formats and shall reference the Vendor purchase order number, the equipment tag number, the Vendor's job number, the project name, and the location of the project.

C. Proposal Requirements shall include the following items:

1. Complete list of exceptions/clarifications
2. Dimensional drawings
3. Brochures/literature
4. Battery capacity calculations and battery ampacity curves used for sizing the battery. Provide information on rated cycles to 80% depth of discharge.
5. Battery charger ratings, including performance characteristics with efficiency curves, regulation characteristics, output ripple content, ambient temperature ranges, power supply input requirements, and charger accessories description.
6. **Optional Pricing** for onsite installation inspection and equipment commissioning.

D. Operations, Information and Maintenance Data

1. Submit "as-built" drawings, instruction books, and manuals in accordance to document requirements in this specification. The instruction books shall include, but not limited to:

   a. Instruction and operation manuals including all installation instructions.
   b. Complete service and repair manuals.
   c. Complete parts list with vendor part numbers and a recommended spare parts list.
   d. Certified test reports for factory tests.

E. Manufacturer Seismic Qualification Certification: Submit certification that the battery, accessories, and related components will withstand seismic forces defined in 480020 Pasadena Site Conditions.

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 MAINTENANCE MATERIALS

A. Provide special tools and manufacturer's standard spare parts required for installation and normal operation and maintenance.

PART 2 - DESIGN REQUIREMENTS FOR PRODUCT

2.1 APPROVED MANUFACTURERS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

2.2 STATION BATTERY

A. The station battery shall be rated for service under the following conditions:

Battery Type: Base Bid **Optional Price**	 VRLA, Gel Lead-Calcium **Optional Price: Flooded Cell Lead-Calcium**
System Description:	2 wire, ungrounded
Nominal System Voltage:	24 Vdc
Maximum System Voltage:	27 Vdc
Minimum System Voltage(Final):	21 Vdc
Number of cells	Vendor to size appropriately per specifications

B. Station battery will be installed in a climate-controlled room, located inside the PDC. Batteries shall have a useful service life of at least 20 years based on float service operation at 77 ºF, with the equivalent of not more than two full load three-hour discharges per year.

C. Battery shall have deep cycle capacity performance characteristics: rated with a minimum of 1200 cycles at 77 ºF to 80% depth of discharge.

D. The battery capacity shall be determined in accordance with IEEE 485 and these specifications. The battery shall be sized with an age compensation factor of 125% and a design margin of 15%.

E. The attached DC duty cycle (Appendix C) shall be used to size the battery. The battery voltage throughout the duty cycle shall not be less than the final voltage specified. Size shall be based on the battery initially fully charged (at float voltage) at the start of the discharge duty cycle.

F. Battery terminal plates shall be furnished for reducing stress to the battery terminals at each battery positive and negative cable connection to associated equipment. Terminal plates shall be designed and installed for incoming cables.

G. Battery shall be sized for a two (2) hour outage.

2.3 BATTERY RACKS

A. A modular steel tray rack shall be furnished.

B. The rack shall allow horizontal or vertical arrangement of the battery cells. Horizontal stacking of the cells is preferred. Battery stacking height shall not exceed 5 ft. Refer to E1-2 Conceptual PDC layout, Appendix D, for available arrangement space.

C. The battery arrangement shall permit individual cell removal and reconnection of the remaining battery cells on either side of the removed cell.

D. All steel shall have not less than two uniform finish coats of acid resistant ANSI #61 gray paint or electrostatically applied epoxy coating finish.

E. Battery supporting rails shall be covered with a protective vinyl or plastic runner plate not less than 1/16 inches thick.

2.4 BATTERY ACCESSORIES

A. Each battery shall be furnished with the following accessories:

1. Hydrometer
2. Hydrometer holder with drip cup for all wall mounting
3. Thermometer of size suitable for use with specified batteries
4. Lead coated and insulated intercell connectors.
5. Interrack connectors for each battery (if necessary).
6. Connector bolts with acid resistant nuts.
7. Vinyl coated assembly wrenches.
8. No-Ox-Id grease.
9. One set of numerals (one numeral per cell) suitable for permanent attachment to cells.
10. Solderless terminal lugs for incoming cables.
11. Cell lifting device (optional price)

2.5 BATTERY CHARGERS

A. Two redundant, self-regulating, solid-state, full wave rectified, filtered output, battery chargers shall be provided.

B. Each battery charger shall be sized to re-charge the batteries in less than 12 hours while simultaneously powering all normal DC loads.

C. The chargers shall be capable of parallel operation but need not be designed for automatic load sharing during parallel operation.

D. The battery chargers shall be capable of continuous operation from no-load to full-load with the batteries disconnected for maintenance purposes.

E. Control circuits shall have AC and DC transient voltage protection, output short-circuit protection, and shall be designed to recharge a fully discharged battery without overloading and without tripping the AC input or DC output circuit breakers or fuses.

F. The battery chargers shall provide float and equalizing charges to all required multi-cell, lead calcium, flat plate batteries.

G. Charger ratings shall be as follows:

1. AC Input Voltage: 480 volt AC, 3-phase, +/- 10%
2. Frequency: 60 Hz, +/- 5%
3. DC Output Voltage: 26.4-26.8 Volts Float, 2.20 vpc
4. 28-32 Volts Equalize, 2.33 vpc
5. Regulation, DC output: +/- ½% at any load
6. Ambient Temperature Range: 77°F ±35°F
7. Conversion Efficiency: 90% minimum
8. Charging mode: Switch selectable – float or equalize
9. Output Current Limiting: 125% of rated full load current

H. Each battery charger shall be enclosed in a self-ventilated, floor mounted NEMA 1 cabinet with the following minimum accessories furnished, mounted and wired on the front enclosure panel:

1. Input Voltmeter (AC): Analog (2% accuracy)
2. Output Voltmeter (DC): Analog (2% accuracy)
3. Output Ammeter (DC): Analog (2% accuracy)
4. Connection Terminals: AC and DC
5. Input Circuit Breaker: 600 V molded case, 42kA interrupting capacity
6. Charger Output: 2-pole fast-acting current limiting fuses, DC output blocking and protection diodes
7. Potentiometers: Float voltage and Equalizing voltage adjustments +5% min; Current limit adjust
8. Equalize Timer: Manual set, 0-72 hours.
9. Charge Failure Alarm: Two (2) – Form C contacts wired to terminal block for external circuit connection.
10. High/Low DC Voltage: Relays with form C alarm contacts wired to terminal block
11. Lamps: Local status and alarm indications.
12. Ground Detection: Local indication, test switch, relay alarm, and Form C contact wired to terminal block for external circuit connection.

I. Each accessory mounted on the charger control panel shall be identified with an engraved nameplate permanently attached to the charger control panel.

J. Factory Tests: All batteries and chargers shall be inspected and tested prior to shipment. Tests and inspections shall conform to applicable ANSI, IEEE, and NEMA requirements. Certified test reports of Manufacturer's factory tests shall be provided.

K. Each battery charger shall be designed for top cable entry. All components shall be accessible from the front, with no side or back clearance required.

L. Each battery charger shall provide temperature compensated voltage charging as well as current-limited charging protection.

2.6 DC DISTRIBUTION PANEL

A. A DC Distribution Panel with the following features shall be provided:

1. Surface Mount, NEMA 1
2. Bus Size: Suitably sized for battery bank and DC Charger combination as sized by vendor
3. Breakers: See Appendix C, Battery Load Profile and Appendix D, Reference Drawings

    a. Qty 1: Sized for Battery Bank
    b. Qty 2: Sized for Battery Charger requirements
    c. Qty 6: 30A branch breakers
    d. Qty 5: 20A branch breakers
    e. Qty 8: 15A branch breakers
    f. Qty 15: 10 A branch breakers
    g. Qty 6: 5A branch breakers

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for all components, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Vendor shall perform as a minimum the following tests and inspections and prepare test reports:

1. Perform NETA tests and inspections for each of the following NETA categories:

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    d. Metering and instrumentation.
    e. Panelboards
    f. Battery systems.

SECTION 263323-2
24 VDC BATTERY SYSTEM

END OF SPECIFICATION

APPENDIX A – VENDOR DATA COMMITMENTS

	DESCRIPTION	COPIES REQ	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ	WEEKS AFTER AWARD	COPIES REQ
		TENDER	FOR APPROVAL		CERTIFIED		AS-BUILT
01	**DRAWING INDEX**		4P	**4**	4P	**8**	8PB
02	ENGINEERING AND MANUFACTURING PROGRAM	**2**	4P	4	4P	8	
03	STATEMENT OF CONFORMANCE	**2**					
04	COMPLETED DATA SHEET	**2**	4P	**4**			8PB
05	TYPE TEST CERTIFICATE						
06	DESCRIPTIVE LITERATURE CATALOG INFORMATION	**2**					8PB
07	ANCHOR BOLT AND FOUNDATION LOADINGS PLAN		4P	**4**	4PF	8	8PBF
08	GENERAL ARRANGEMENT DIAGRAM	**2**	4P	**4**	4PF	8	8PBF
09	NAMEPLATE		4P	**4**	4PF	8	8PBF
10	ELECTRICAL SCHEMATIC DIAGRAM		4P	**8**	4PF	12	8PBF
11	ELECTRICAL WIRING DIAGRAM		4P	**8**	4PF	12	8PBF
12	LIST OF SPECIAL TOOLS WITH PRICES	2					
13	RECOMMENDED SPARE PARTS - LIST WITH PRICES	2					
14	TEST REPORT				4P	On Deliv	8PB
15	INSTALLATION MANUALS		4P	6	4P	12	8PB
16	OPERATING AND MAINTENANCE MANUAL						8PB
17	(SHALL INCLUDE ALL AS-BUILT DRAWINGS AND SHALL BE ISSUED TWO (2) WEEKS AFTER DELIVERY)						

The above data shall be furnished in the number of copies indicated and in the number of weeks indicated following receipt of purchase order. All drawings and other documents specified are considered part of the order - The order shall not be considered complete for payment until all such items are received.
Operating and Maintenance Manuals shall contain all "As-Built" drawings.
All drawings shall be produced on the Engineer's standard sheets and on AutoCad
P-Prints F-Full Size B-As Built

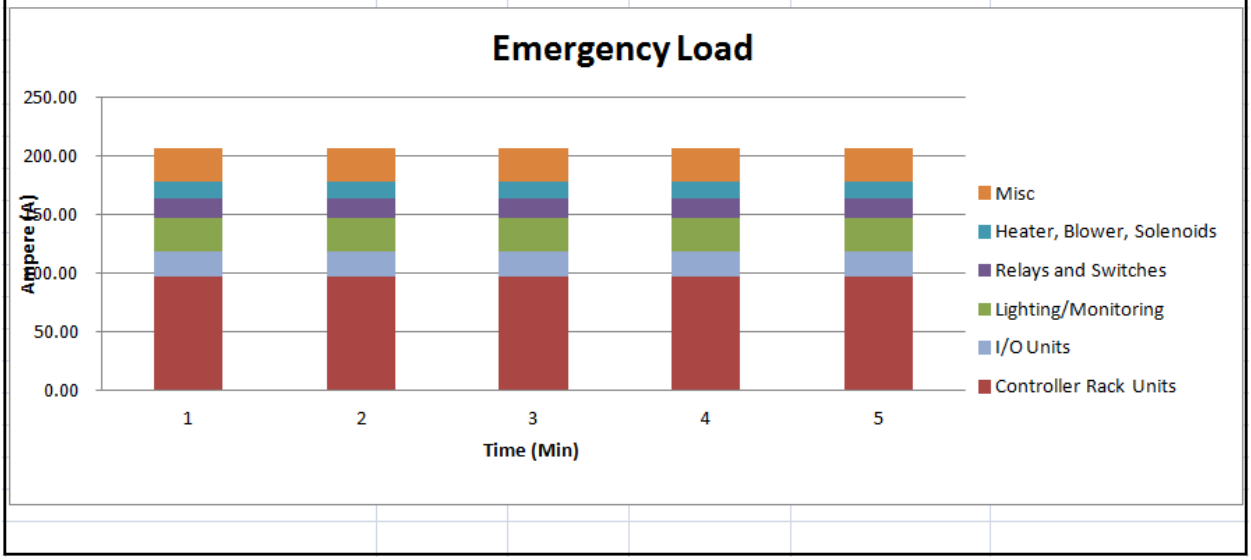
APPENDIX B - BATTERY SYSTEM DATA SHEET

PROJECT: Glenarm Repowering Project Project Number: 123374
Equipment Number: ELL-BATT-1
Service/Application: 125VDC System

		SPECIFICATION REQUIREMENTS	DATA BY VENDOR
1. 125VDC SYSTEM			
Station Battery Information			
Equipment Tag		ELL-BATT-2	
Manufacturer			
Manufacturers Type Designation			
Quantity		One Assembly	
Size	mAH		
Nominal Voltage	VDC	24	
Float Volts	VDC	26	
Final Volts	VDC	21	
Maximum Volts	VDC	27	
# of cycles to 80% Depth of Discharge			
Dimensions	mm		
Mounting Arrangement			
Total Weight	kg		
Cell Resistance	Ω		
Short Circuit Amps	kA	42	
Battery Charger Information			
Equipment Tag		ELL-CHGR-3 ELL-CHGR-4	
Manufacturer			
Manufacturers Type Designation			
Quantity		Two Units	
Size	A		
DC Breaker Rating			
Nominal Voltage	VDC	24	
Voltage Ripple	mVDC	30	
Dimensions	mm		
Mounting Arrangement			
Total Weight	kg		
Alarms			
Short Circuit Amps	kA		

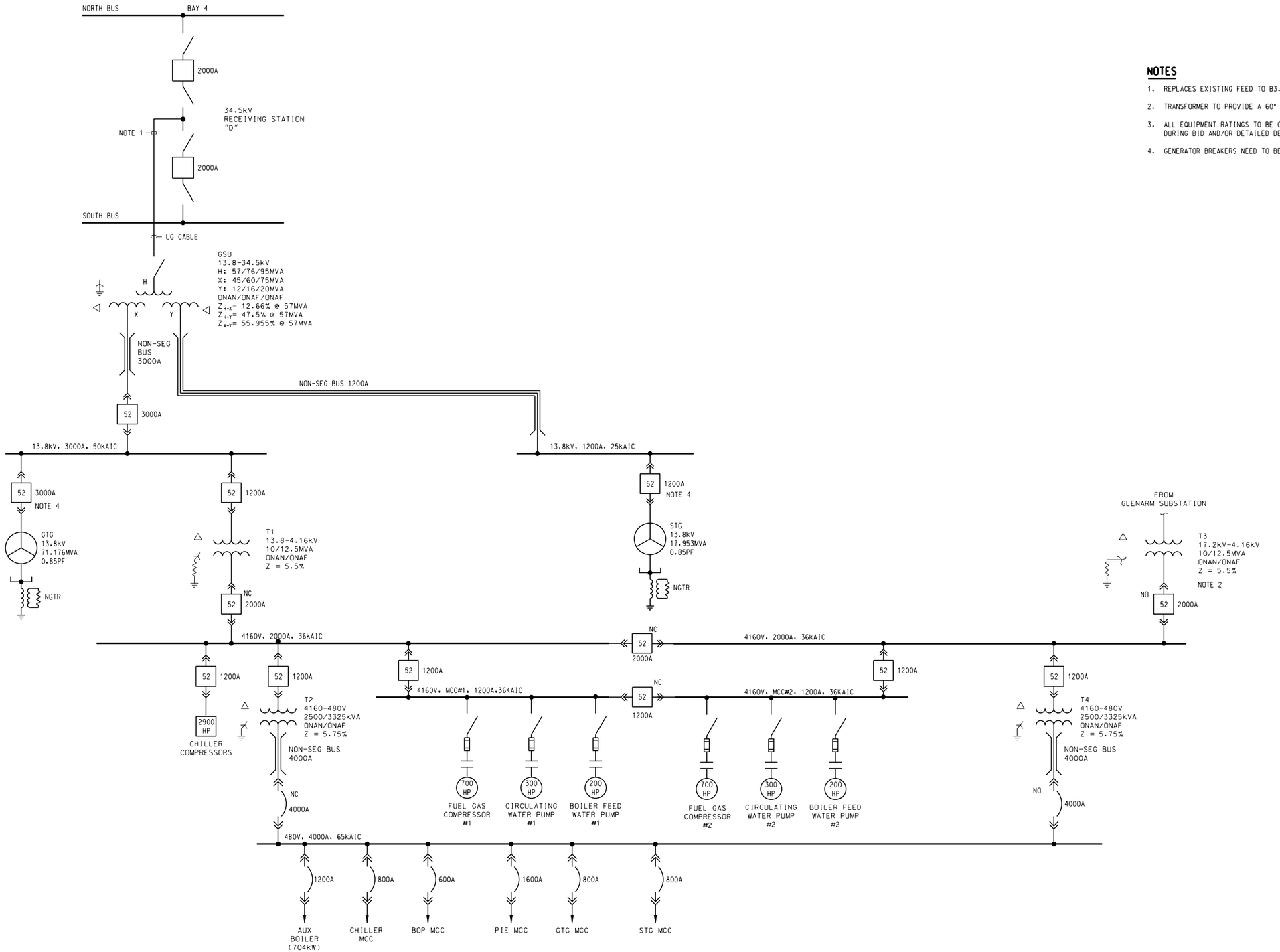
APPENDIX C – BATTERY LOAD PROFILE

Load Description	***Load Profile (Amps)***				
Continuous Loads					
Controller Rack Units	97.22	97.22	97.22	97.22	97.22
I/O Units	20.51	20.51	20.51	20.51	20.51
Lighting/Monitoring	29.46	29.46	29.46	29.46	29.46
Relays and Switches	16.46	16.46	16.46	16.46	16.46
Heater, Blower, Solenoids	13.67	13.67	13.67	13.67	13.67
Misc	28.64	28.64	28.64	28.64	28.64
Total Amps	**205.96**	**205.96**	**205.96**	**205.96**	**205.96**
Time (Min)	0 - 0.5 min	0.5 - 60 min	60 min - 90min	90 min - 119.5 min	119.5 min - 120 min



APPENDIX D – REFERENCE DRAWINGS

E1-1A Electrical Overall One Lines (LM6000)
E1-2 Conceptual PDC Layout



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY EPC CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.

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
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH
A	ISSUED FOR REVIEW	05/25/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

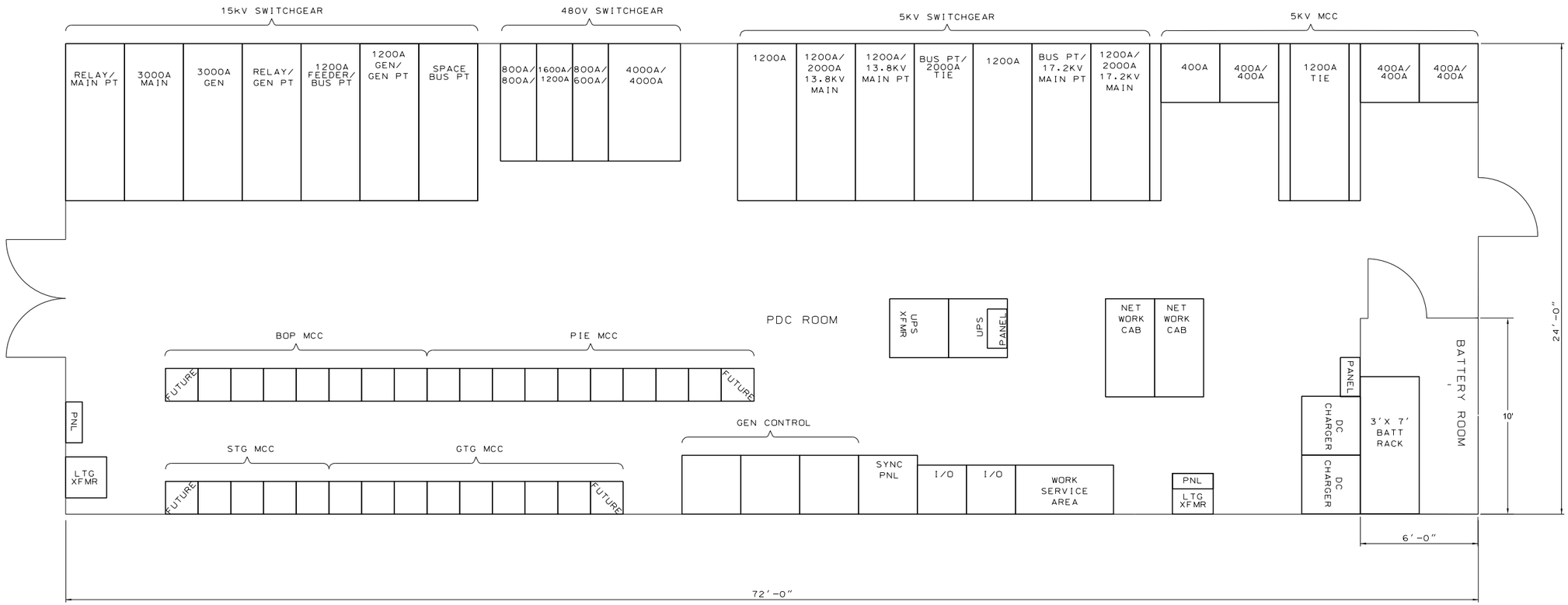
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV E

DRAWING NUMBER E1-1A

ralexander 09/06/2013 03:33 PM W:\123374\DD\CAD\dwg\elec\54pase1_1A.dgn



0 1 2 3 4 5 10 FEET

1/4"= 1'- 0"

ralexander 09/09/2013 06:45 AM W:\123374\DD\CAD\dwg\elec\54pose1_2.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
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

SCALE: * *
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CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV D
DRAWING NUMBER E1-2

December 9, 2013

CITY OF PASADENA WATER & POWER

GLENARM REPOWERING PROJECT
(GT-5 Combined Cycle Installation)
PCS/CONTROL SYSTEM SPECIFICATION

PROJECT NUMBER:
123374

PROJECT CONTACT:
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PHONE:
208-288-6100

POWER ENGINEERS

GLENARM REPOWERING PROJECT
(GT-5 Combined Cycle Installation)
PCS/Control System Specification

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *DAVE THOMAS*
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REVISION HISTORY			
DATE	REVISION	REVISED BY	DESCRIPTION
7/26/2013	A	DT	Issued for Review
12/9/13	B	DT	General Philosophy Section Added

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 OVERVIEW 1
1.2 RESPONSIBILITIES 1
1.3 SCOPE 1
1.4 SYSTEM DESCRIPTION 4
1.5 PERFORMANCE REQUIREMENTS 7
1.6 CODES AND STANDARDS 8
1.7 SCHEDULE 9
1.8 GENERAL BOP PCS DESIGN PHILOSOPHIES EMPLOYED 10

PART 2 - PRODUCTS 15

2.1 CONTROL PROCESSORS 15
2.2 SYSTEM HARDWARE 15
2.3 I/O HARDWARE 19
2.4 OPERATOR WORKSTATIONS 22
2.5 ENGINEERING WORKSTATION 23
2.6 REMOTE WORKSTATIONS 24
2.7 DATABASE SERVER 24
2.8 PCS SOFTWARE AND FUNCTIONALITY 25

PART 3 - EXECUTION 31

3.1 TESTING AND INSPECTION 31
3.2 SITE COMMISSIONING 32
3.3 TRANSFER OF OWNERSHIP 33
3.4 DOCUMENTATION 33
3.5 TRAINING 34
3.6 SHIPMENT AND STORAGE 34

APPENDIX A – HARDWIRED I/O ESTIMATE 35

APPENDIX B – DOCUMENT SCHEDULE 36

APPENDIX C – REFERENCED DOCUMENTS 37

PART 1 - GENERAL

1.1 OVERVIEW

A. This specification details the requirements for the supply of a plant control system (PCS), related controls equipment, and vendor services for the City of Pasadena Municipal Water & Power's proposed Glenarm Repowering Project.

B. The City of Pasadena Municipal Water & Power's proposed Glenarm Repowering Project consists of the addition of a nominal 71 MW of generating capacity through the installation of a 1x1 combustion turbine combined cycle generating station adjacent to PWP's existing plants 3&4 to supply reliable electric power to the PWP grid. The project shall use one (1) Contractor-supplied GE LM6000-PG-SPRINT gas turbine; one (1) Contractor-supplied, un-fired, once through steam generator (OTSG); and one (1) Contractor-supplied steam turbine generator (STG).

C. The Project shall be designed for not less than a thirty (30) year expected life operating base load with an expected availability of 95%. All equipment will be designed and selected for continuous duty service and maximum reliability.

1.2 RESPONSIBILITIES

A. The purpose of this specification is to define the scope of work and supply requirements for the Plant Control System (PCS) Supplier. The PCS Supplier shall be responsible for manufacture, assembly, hardware factory testing, software configuration, operator training, and delivery to site of a Balance of Plant (BOP) control system for the Glenarm Repowering Project.

B. The PCS Supplier shall be responsible for project specific logic development, software configuration, software factory acceptance testing (project specific logic, HMIs screens, historian, alarm development, etc), and on-site commissioning support of the PCS. Personnel involved in the configuration shall also be involved in the onsite commissioning.

C. The Detailed EPC engineer shall be responsible for project specific logic diagrams and control narratives that will be provided to the PCS vendor for detailed configuration guidance.

D. The PCS Supplier shall be responsible for the supply of the workstations, servers, network switches, firewalls, servers and other required control system equipment as defined in this specification and the Control System Architecture drawing. These workstations/servers and other rack mountable equipment shall be furnished by the PCS Supplier in 19" rack mount cabinets.

1.3 SCOPE

A. The PCS functional scope shall include, but is not limited to:

1. Balance of Plant Controls, including:

    a. Once Through Steam Generator system
    b. Steam Turbine Generator (STG) Steam Condenser system

c. Gland Steam Condenser system
d. Water Treatment system
e. High Pressure Feedwater Pumps systems
f. Circulating Water system
g. Closed Cooling Water system
h. Demineralized Water system
i. Gas Turbine Generators (GTG) Inlet Air system
j. Potable and Fire Water systems
k. STG Drain Tank systems
l. Ammonia system
m. GTG supervisory control
n. STG supervisory control
o. Water Treatment system supervisory control
p. Air Compressor system supervisory control
q. Fuel Gas Compressor Package supervisory control
r. Continuous Emissions Monitoring Systems (CEMS) supervisory monitoring
s. PWP Video Monitoring / Security System

2. The following subsystems will have a standalone control system that will interface with the PCS through Ethernet or other industrial standard communication backbone. The PCS will provide a graphical user interface for supervisory control and monitoring of these subsystems including historical archiving of data, alarming, and process monitoring with associated graphical operator displays.

   a. Combustion Turbine Generator Controls – The GE GTG will be provided complete with a packaged and integrated control system that provides for automatic and manual startup, synchronizing, loading and unloading, protection and shutdown of the GTG systems from the GTG control panels. Each GTG panel includes analog meters for key parameters, control switches and pushbuttons for operator commands, a programmable microprocessor based sequencer, and a stand-alone desktop monitor, as well as a remote desktop monitor for installation in the control room.

      The GTG, OTSG and STG Turbine Control Panels (TCPs) shall be installed in the pre-engineered and pre-fabricated 13.8 kV switchgear modules. The one switchgear module containing GTG, OTSG and STG switchgear shall also contain both the GTG and STG TCPs.

   b. Steam Turbine Generator Controls – The STG shall be provided complete with a packaged and integrated control system that will be designed to completely control and protect the STG and its auxiliary systems. During abnormal operating conditions, the objective will be to keep the STG synchronized, and at some partial load until the cause of the transient has been remedied. Transients that shall be considered for automatic runback of the STG include GTG runback and high condenser pressure. The STG controls shall be capable automatically controlling the STG through startup, shutdown, normal and abnormal operation independent of operator involvement
   c. Water Treatment System – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover, but not be limited to network connection, HMI interface

and communication interface to other sub-systems. The PCS Supplier shall collaborate with the Water Treatment system provider and the EPC engineer to produce HMI graphics.

d. Air Compressor System – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover, but not be limited to network connection, HMI interface and communication interface to other sub-systems. The PCS Supplier shall collaborate with the Air Compressor provider and the EPC engineer to produce HMI graphics.

e. Fuel Gas Compressor System – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover, but not be limited to network connection, HMI interface and communication interface to other sub-systems. The PCS Supplier shall collaborate with the Fuel Gas Compressor provider and the EPC engineer to produce HMI graphics.

f. SCR with Ammonia dosing System – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover, but not be limited to network connection, HMI interface and communication interface to other sub-systems. The PCS Supplier shall collaborate with the equipment provider and the EPC engineer to produce HMI graphics.

g. CEMS (Continuous Emissions Monitoring System) – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover but not be limited to network connection, HMI interface and communication interface to other sub-systems. The PCS Supplier shall collaborate with the CEMS provider and the EPC engineer to produce HMI graphics.

h. Condensate Polisher System – Programmable Logic Controller (PLC) based system provided by the system vendor. PLC shall be pre-programmed and configured by the vendor. The PCS Supplier will be responsible for its integration to the PCS. The integration will cover but not be limited to network connection, HMI interface and communication interface to other sub-systems. The PCS supplier shall collaborate with the equipment provider and the EPC engineer to produce HMI graphics.

3. Ethernet based communications to the following subsystems (data only):
   a. GTG Units 1,2,3,4. Approximately 400 points. (240 digital, 160 analog)
   b. GTG Unit 5. Approximately 200 points (120 digital, 80 analog)
   c. STG Unit 5. Approximately 100 points. (60 digital, 40 analog)
   d. Water treatment system PLC. Approximately 60 points. (50 digital, 10 analog)
   e. Air compressor and dryers PLC. Approximately 40 points. (30 digital, 10 analog)
   f. Fuel Gas compressor PLC. Approximately 60 points. (40 digital, 20 analog)
   g. Inlet Air Cooler Unit PLC. Approximately 40 points. (30 digital, 10 analog)
   h. CEMS. Approximately 50 points. (30 digital, 20 analog)
   i. Weather Station. Approximately 20 points. (5 digital, 15 analog)
   j. Fire Alarm and Control Panel. Approximately 30 points. (30 digital)

k. PWP Remote Interface Gateway (RIG) (Modbus TCP)

4. The following functions and applications

a. Alarm management and event recording system
b. ESD (emergency shutdown)
c. On line trending
d. Historical storage and retrieval system
e. Operation and production reporting

B. PCS Overview

1. The PCS servers and PCS IO cabinets will be mounted in an air conditioned PCS/PCU room. The PCS cabinets shall have bottom cable entry but shall be capable of top entry if required.
2. A minimum of four (4) high resolution 24-inch (minimum) color monitors and keyboards at each of the two (2) operator workstations (OWS). Operator workstations will be completely interchangeable with full process access for each, identical in appearance and capability.
3. Two (2) engineering workstations (EWS) comprised of two (2) high resolution monitor for each station, keyboards, mice, 11”x17” black and white laser printer, 11”x17” color laser page printer, and programming software to provide the engineering interface with the plant processes and equipment for control system tuning and control strategy modifications.
4. Three (3) remote workstations with capability to view operations and generate reports.
5. Three system printers are required near the OWS consoles. These one (1) 11”x17” color laser page printer and two (2) 11”x17” black and white laser printers shall be networked to the various PCS workstations and servers to facilitate printing all reports, screen shots, configuration changes, plant alarm events, logs, and other events determined by the operator.
6. The PCS shall be provided with two (2) levels of historians for storage and retrieval of historical I/O and process data. These historians shall consist of short-term and long-term data storage. The short-term historian shall be as offered by the PCS manufacturer. The long-term data storage system shall be capable of trending analysis, report generation, and archiving to portable media. The long term system shall be capable of logging all PCS data points for a period of not less than three (3) years and keep them in local storage for instant analysis, trending, and reporting access. Provide licenses for three (3) viewers for each system.
7. Interactive graphic displays shall be provided with a minimum of 50 pages of user defined interactive graphic displays.
8. A sequence of events (SOE) recorder shall be provided with the capability to monitor 100 points. All points shall be time tagged and shall have a 1 ms resolution. The SOE shall be integral with the PCS.
9. A GPS time clock shall be provided with the PCS. GPS time stamping (IRIG-B) of all system clocks shall be performed. The IRIG-B system shall have several additional outputs for use within all applicable plant systems.

1.4 SYSTEM DESCRIPTION

A. General Principles

1. The PCS is a modular microprocessor-based distributed control system, providing both analog and sequential logic control, advanced control computations, data acquisition, overall performance calculations, operator interface and computer interface capabilities. The PCS will provide overall control and operator interface to the generating facility. The PCS will incorporate state-of-the-art digital technology in a redundant microprocessor based system. It will consist of a real time functionally distributed computer control system equipped with adequate memory, I/O hardware, termination cabinets, redundant data highway, operator interface consoles, engineer's workstation, and peripherals such as printers, mass storage, etc. The PCS system shall be suitable for continuous operation. The PCS shall be on a Project network (also called Plant Data Highway or PDH) and provide no connections to Owner's business network or to the internet. Outside communication shall be to the Owner's dispatch system only.
2. The control system shall be designed to allow a single operator to effectively control and monitor the plant from a central location. The Operator Workstations (OWS) shall be capable of supervising and monitoring the entire plant, including the startup, normal operation, and shutdown of the plant. The PCS shall provide a unified operator interface to all separate vendor-supplied control systems.
3. The PCS will serve as the central interface for all process controllers. This system will be connected to the various instrumentation and control devices throughout the plant and will be linked via Ethernet to the Plant Data Highway (PDH). The system shall have functionally and physically distributed architecture comprised of processing units and operator stations linked by a highly reliable data highway. The PDH will be redundant and this document will define the minimum requirements for such a network design. However, it shall be the PCS Supplier's responsibility to determine the optimum network based on their expertise and knowledge. The control system shall be capable of adding hardware while the system is in operation, i.e. controlling the unit, including but not limited to; CPUs, I/O modules, HMI stations, servers, and peripherals.
4. The system architecture is to be proposed by the PCS Supplier for approval by EPC engineer. The minimum requirement for the system structure is that any failure of any component must not influence the normal operation of the remainder of the plant. In order to maximize system availability, communication modules, controllers and power supplies must be capable of being replaced on line (i.e., under power) with no adverse effects to the operation of the plant. The PCS Suppliers shall submit their preliminary proposed architecture with their proposal.
5. The PCS architecture shall be open to interface with other systems and equipment as required by this section and related sections. The PCS shall have the capability of network interfaces with the major brands of programmable logic controllers. The following list is an example of the PLCs and microprocessor based control system components that could be expected on site:
    a. Allen-Bradley PLC
    b. Bently Nevada 3300 Vibration Monitor
    c. Woodward MicroNet Governor
    d. Multi-Function Power Meters, (MFM)
    e. Protective Relays (SEL)
    f. Smart MCCs
    g. PWP's dispatch SCADA system (DNP 3.0)

6. Grounding of control systems and instrumentation equipment shall follow good industry practice and the PCS Suppliers recommendations and be such as to ensure that equipment operates reliably, safely and without damage in the presence of large electrical disturbances such as occur in a power generation plant. A separate grounding system for

control and instrumentation systems shall be established within the PCS Suppliers cabinets. This shall be isolated from the power system ground except for a single point connection to the main plant ground.

B. Redundancy

1. Electronic equipment offered shall be of a type having proven record of reliability under power station service conditions. The PCS shall be a microprocessor based system and shall provide highly reliable process plant control. No single failure of any system component (above the I/O level) or power source shall interrupt or disrupt any system function, nor shall any single system failure cause any controlled equipment to change status except as specifically described in this specification.
2. The PCS system controllers shall be provided with sufficient redundancy such that a loss of a processor, primary power feed, or data highway will not cause a loss of logic processing or display capability.
3. Non-redundant I/O cards are allowed, however, loss of a single I/O card shall not cause a trip of the unit.
4. To permit removal of I/O modules without removing field wiring, all I/O field terminations shall be terminated on separate field termination blocks in I/O cabinets.
5. Changeover to any backup or redundant component will be “bumpless” and not cause any data or function to be lost.
6. PCS controller cards shall be hot swappable.
7. A single component failure shall not cause loss of a data highway or loss of operator interface and operator stations.
8. No component in the system shall require rebooting in the event of a single failure to become fully functional.
9. Fault checking will be included and will cause appropriate loop response, change over and/or alarm. Points of “bad” quality will not be used and will be appropriately tagged, alarmed, and displayed.
10. No fault in any distributed processor shall cause a shutdown or miss-operation of any other distributed processor or the data highway.
11. A fault in one of the data highways shall not cause any fault in a distributed processor or other data highway.
12. The system shall not miss-operate or sustain damage from the influence of radiated or cable-conducted radio frequency fields typically found in an electric power generation facility or from the use of Walkie-talkie transceivers in the immediate vicinity of the modules and cabinets.
13. Remote I/O bus connections shall be fully redundant.
14. Triple redundant instrumentation shall be used for critical applications as follows:

    a. Critical I/O shall be implemented with triple redundant inputs. Analog signals shall utilize a select feature, and the ability to switch to a primary controlling signal. An alarm shall be generated if redundant analog signals deviate by more than 10% of span.
    b. On a failure of all three triple redundant sensors, the loop shall fail to manual and control to a safe output value and a high priority alarm shall be generated.
    c. Redundant Inputs and Outputs shall be located on different I/O modules so that replacement of any one I/O module will not disable more than one I/O point.

15. The following PCS components shall be redundant:

a. Power Supplies
b. Control Processors
c. PCS system communications switches and communications paths
d. Operator Workstations (OWS)

C. Failure Modes

1. The PCS system controllers shall react in a predictable manner to system, equipment, and component failures.
2. The control loop shall transfer to manual control and alarm upon loss of valid process data.
3. Upon processor failure, as detected by system diagnostics, a processor shall transfer to its backup. Transfer to the backup controller shall be bumpless on all control signals. If the backup processor is unavailable, the processor outputs shall fail to a predictable status. Generally, outputs shall hold the status existing prior to the failure.

D. Diagnostics

1. Self-diagnostic programs shall be provided to identify component degradation, failure and faults to the card level.
2. The PCS system controllers shall include extensive self-checking to detect malfunction of the input/output equipment, memory parity errors, lost or spurious communication interrupts, program hang-ups (control and data acquisition) and other feasibility checks that indicate erroneous operation. When such checks show a problem from which the system can recover without intervention by plant personnel or interruption to plant control; a system error shall be alarmed and operation shall resume. If the check reveals a non-recoverable error; an orderly shutdown shall be performed, leaving in memory whenever possible such information as will enable plant personnel to readily locate and correct the problem.
3. Random (recoverable) errors on the data highway or any sub-network shall be continuously counted and available to the EWS. Each data highway or sub-network of the system shall be continuously monitored for errors in transmission or absence of distributed processors.
4. All distributed processors shall perform on-line diagnostics at least once every second and report any faults, as well as recoverable software errors.
5. Each distributed processor shall monitor its own operation on an on-line basis and provide alarm notification in the event of faults plus take action to modify the automatic status of the associated controls if warranted by the seriousness of the alarmed item.
6. Any diagnostic that detects a failure or abnormal operation shall be alarmed and displayed.
7. Any failure of a processor, card, or system level component shall be alarmed and displayed.

1.5 PERFORMANCE REQUIREMENTS

A. Response Times

1. The response time of the system shall be sufficient to maintain control over the plant processes under all system operating conditions including extreme plant upset conditions

with all points in alarm. The response time is the total elapsed time for transmission of data through the system communication path from input point to displays or outputs as applicable. This time shall include all communication time from processor to processor, I/O scans, gateways, operator stations, and other equipment internal to the system.

2. The system shall be able to achieve the following response times for the system:

Function	Response Time, ms
Modulating Control Loops	250
Operator Control (keyboard to output)	1000
Logic (input to output)	250
New Display/faceplate Call up	< 2000
Display Update (input to display)	1000
Alarm Update	1000
Data links	1000

The system shall be sized to meet these requirements for all analog and digital loops without exceeding the defined capacity with spare of each node/drop. Exceeding the stated capacity limits of a processor or slowing down of individual loops or functions shall not be permitted unless approved on a case by case basis by the Owner.

B. System Performance Requirements
1. All performance values are listed as deviations from setpoint.
2. If during system startup these performance requirements are not met, the PCS Supplier shall tune and/or modify the control strategies as required to meet these performance requirements within the control limits of the field control equipment or systems.
3. The control system shall not be the limiting factor in meeting the performance requirements.

C. Reliability

1. PCS Supplier shall guaranty that the overall PCS system availability shall be greater than 99.7% for the first year of service after final system acceptance. Availability is defined as the control system not being the limiting factor in unit production.

1.6 CODES AND STANDARDS

A. The latest edition and published addenda of the following publications are part of this Specification and, where referred to by title or basic designation only, are applicable to the extent indicated by the specific references or equivalent national standards.

B. Institute of Electrical and Electronics Engineers (IEEE/ANSI):

1. ISO 10861-1994 ISO/IEC 10861:1994: Information Technology High-performance synchronous 32-bit bus: MULTIBUS II
2. 1143-1994 IEEE Guide on Shielding Practice for Low Voltage Cables
3. 1050, “Guide for Instrumentation and Control Equipment Grounding in Generating Stations”

4. C 37.1-1994 “Standard Definition, Specification and Analysis used for Supervisory Control, Data Acquisition, and Automatic Control”.
5. C 37.2-2001 – “Standard Electric Power System Device Function Numbers and Contact Designations”
6. C37.90.1, "Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems."
7. 122-1991 IEEE Recommended Practice for Functional and Performance Characteristics of Control Systems for Steam Turbine-Generator Units

C. National Electrical Manufacturers Association (NEMA):

1. ICS 1 - General Standards for Industrial Controls and Systems.
2. ICS 4, “Terminal Blocks
3. ICS 6, “Enclosures for Industrial Control Systems

D. North American Electric Reliability Council (NERC):

1. CIP-002-1 – Critical Cyber Asset Identification
2. CIP-003-1 – Security Management Controls
3. CIP-004-1 – Personnel and Training
4. CIP-005-1 – Electronic Security Perimeter(s)
5. CIP-006-1 – Physical Security of Critical Cyber Assets
6. CIP-007-1 – Systems Security Management
7. CIP-008-1 – Incident Reporting and Response Planning
8. CIP-009-1 – Recovery Plans for Critical Cyber Assets

E. National Fire Protection Association (NFPA):

1. NFPA70 National Electrical Code.

F. Open DeviceNet Vendors Association (ODVA)

1. CIP Common Specification Edition 2.1 (PUB00001R2)
2. DeviceNet Adaptation of CIP Specification Edition 1.1 (PUB00003R1)
3. DeviceNet Planning and Installation Manual for DeviceNet Cable System(PUB00027R1)

G. HART Communication Foundation:

1. HART Field Communication Protocol Specifications, Revision 7.0
2. Wireless WiHart standard HCF_SPEC-290 Revision 1.1

H. Where above referenced codes and standards contain recommendations in addition to requirements, the recommendations shall be considered requirements and shall be followed unless stated otherwise by this Technical Specification. In the event of any conflict between codes, or the Technical Specifications and codes, the more stringent regulation, code or requirement shall apply.

1.7 SCHEDULE

A. Within 60 days after the date of issuance of a purchase order to the PCS Supplier or 60 days before start of fabrication, whichever is earlier, the PCS Supplier shall submit to the EPC

contractor for review an inspection and test plan which shall include pertinent manufacture and inspection operations. The EPC contractor may, in consultation with the PCS Supplier, select a range of points as a Hold Points for inspection before the item concerned can be released for further manufacture or shipment.

B. PCS Supplier shall give the EPC contractor at least 14 days prior notice in writing of the date on and the place at which any Works shall reach a Hold Point or shall be ready for the EPC contractor's inspection.

1.8 GENERAL BOP PCS DESIGN PHILOSOPHIES EMPLOYED

A. The PCS configuration and implementation to the Plant Control System will be based on an established Design Criteria document and a Control Philosophy document. The PCS shall be capable of supporting the functions described in the several key features of the Control Philosophy outlined in this section.

1. General-

   The BOP Control system will consist of the equipment, software and design required to operate both the Balance of Plant equipment and interface the primary Power Island component controllers on a common network. Operator workstations will be the primary interface to the control system by operators who will execute plant operations from the primary control room. The PCS will provide a great deal of automatic functionality however operators will always have the capability to place an automatic control loop in manual. The details of these design features are outlined in the Control system Narratives and are provided for PCS configuration and commissioning.

2. Interfaces

   Control signals between the BOP PCS and the MKVI will be individually hardwired between the two devices and will use standard 4-20mA analog signals or discrete logic signals of either 24VDC (indication) or 120VAC (control). Balance of Plant instruments will be hard-wired through the I/O cabinet in the Power Distribution Center where the PCS controllers are located.

   The PCS includes two OWS's and one EWS though a server cabinet located in the New Control Room.

   There are several subsystems that are supported by the PCS Network through Ethernet/Modbus TCP interface in the network cabinet. These systems are:

   a. Air Inlet Chiller/Heater
   b. NH3 Flow Control system
   c. Condensate Polisher System
   d. Selective Catalytic Reduction System (SCR)
   e. Water Treatment System
   f. Fuel Gas Compressor System
   g. Air Compressor System (Modbus)
   h. Station Weather System (Modbus)

   These serial communications are supported by Multi-mode fiber optic cable where distances between the BOP PCS network cabinet and the local controllers exceed 100m (~328ft.). Media converters in the network cabinet and local control panels are employed to ensure signal quality between points.

   The City of Pasadena has an interface with the PCS via a server known as the Remote

Interface Gateway (RIG). Via this gateway, information from the Unit 5 Electrical switchyard SCADA system, the fuel gas meter supplied by the fuel vendor and the California ISO. The RIG runs Wonderware software and communicates to the BOP PCS network via Ethernet IP protocol.

3. Plant Control –
   a. Control Valves
      i. Automatic/Manual
      Process control valves shall have the capability of being operated in either Automatic or Manual mode. The transition to automatic shall be by way of a two-step execution process by the operator to avoid accidental transitions to automatic. Transitions to Manual can be either the result of approved logic or by a similar two-step process initiated by the operator.

      Transition from Manual-Auto and Auto-Manual shall be made "bumpless" by the PCS.

      ii. Fail State
      Control valves will be identified as either FO (Fail Open), FC (Fail Closed), or FL (Fail to Last position) on the P&IDs and the Valve Datasheets.
      Control signals to actuators shall be configured to support proper valve fail state.

      iii. Signal type
      Modulating Control valves will utilize 4-20mA current loops from the PCS I/O cards for the command signal or "control variable" (CV).
      Feedback of actual valve position may also utilize 4-20mA current loops to analog input cards but may also utilize HART protocol.

      iv. Error detection
      Modulating valve logic shall be configured to provide an alarm to the operator if the valve position deviates from the commanded position by a predetermined value after a reasonable time delay to allow for travel. This value will be established during commissioning and agreed upon by operations so it will not contribute to nuisance alarms.

   b. Emergency Stops
   The plant emergency stops will be located on the new control console at a location central to both the BOP and Unit OWS's. Each E-stop will consist of a mushroom style switch that will remain depressed when pressed by the operator. Typically the switch contacts will result in an open circuit when the switch is depressed and there will be a minimum of four (4) contacts available per switch. Additional contacts may be added to provide closed circuit switching if desired. The E-stops used will be:
      1. Master Fuel Trip
      2. OTSG Trip
      3. GT 5 Trip
      4. GT 1 Trip (future)
      5. GT 2 Trip (future)
      6. GT 3 Trip (future)
      7. GT 4 Trip (future)

   c. Alarms

i. When an analog point passes an alarm threshold, a colored and numbered shape will appear next to the process value. This is intended to quickly draw the attention of the operator to the important parameter. The use of alarm priority numbers and shapes enhances the ability of operators, even if color blind, to quickly identify that a point is in alarm, and its priority.
ii. Alarm priority is assigned to each point as it is added to the I/O list and Alarm list. The Priority assigned is based on the urgency of immediate operator response to the process condition being reported. There are 4 identified priorities; each is affiliated with a unique and easily recognizable color, shape and audible tone.
iii. HMI design is carried out with Alarm depiction in mind. The colors and shapes associated with alarms shall remain unique to alarm conditions and not used in the general operator screen imagery. Alarm colors are the only bright colors used on screens and should stand out boldly against the normal screen images.
iv. Upon transition of a parameter to its alarm state, the appropriate icon will appear flashing on the screen in close proximity of the equipment in alarm until it is acknowledged. The Icon shall not block from view any numerical value, trend or title on the screen.
v. Along with the visual indication, an audible tone will sound for priority 1-3 alarms. Each alarm priority will have a unique tone assigned that is easily distinguishable from the other two tones.
vi. When an operator recognizes an alarm the next step will be to acknowledge and address the condition. With the mouse the operator will select the parameter in the alarm banner window and proceed to the acknowledge command

d. Plant Protection

Protection schemes are integrated into plant design by both Hardware redundancy and software backup when necessary. Both personnel safety and equipment protection are the primary factors behind automatic plant protection features. Protective trips and control signals for critical equipment will always utilize hardwired control signals between instruments, controlled devices and the PCS. Safety trips will utilize direct hardwired circuits between the sensor and protective device. Indication will typically be brought to the PCS on a parallel circuit utilizing an independent set of contacts of the switching device.
Control of non-critical equipment and systems may utilize signals passed between intelligent devices over an industrial data highway (serial communications).

In General, the PCS will be configured to provide the following automatic protections:

i. Triple instrumentation will be utilized for critical plant control loops. The PCS will use 2/3 voting to initiate plant trips per approved logic upon loss of instruments or low level readings for the following parameters:
    1. Instrument Air Pressure
    2. Condenser Level
ii. Hardwired trips provided by approved logic. Several systems will be protected from unsafe/out of range conditions with Hardwired trips followed by software trips as backups. Examples of this are:
    1. High fuel gas pressure – hardwired switch to safety valve will close valve without PCS action. DPDT switch will also provide indication to PCS to issue close command to same valve.
iii. Automatic to Manual Failover. Some devices normally controlled in Automatic Mode will automatically failover to Manual mode following a system trip,

typically in conjunction with fail-safe automatic measures to place the device in the safest state. Examples are:

1. Condenser Low Level trip: Outlet valve(s) normally in Automatic will be driven closed by PCS Command until fully shut, and Automatic control will transition to Manual control at OWS.

iv. Failover to Redundant equipment: provided by approved logic. Some plant conditions may warrant protective actions by the PCS to prevent equipment damage or maintain equipment running. An example of this is Automatic Failover to redundant feed pumps and Tempering fans:

1. The Boiler feed system employs 2x100% pumps for redundancy. Upon loss of one pump the second (standby) pump will be issued a start signal from the PCS.
    a. In the case that the standby pump fails to start the GTG may still be permitted to run without feedwater if the Tempering Air fans are utilized to maintain OTSG duct temperatures within the ranges allowed by the Manufacturer.

4. Operator Interface

a. OWS
The system architecture includes two (2) OWS. The OWS consist of workstations running Microsoft's Windows OS and are PCS Client nodes or drops. The Clients are the primary means for Plant Operators to view plant data, alarms, sequence of events data, trending, and system network health. Each OWS includes Microsoft's Office Professional business applications for creating reports in Excel, etc. Each OWS supports two NIC ports for redundant Ethernet communications to the Process Control Bus. These workstations reside on an Ethernet ring network isolated from the Process Controllers

b. EWS
The architecture includes one (1) EWS. The EWS is a desk mounted server running current Microsoft's Windows Server OS and PCS development software. It enables the Engineer to perform modification to most PCS system configuration associated with the in plant controls, steam delivery, and steam generation controls

3. Graphics

a. Plant and Unit Displays:
These displays provide a big picture at-a-glance broadest available overview of the Plant and Units. There will be one overview display for the GTG#5 unit and one overview display for the Plant (all Units & Switchyard). These displays will include bar charts or timeline graphical summaries of key Level 2 displays parameters (such as Condenser Level) High level Key Performance Indicators will be displayed such as the Net and Gross MW output (both raw and corrected to design conditions), highest priority alarms, key process controllers (condenser level, steam pressure), and major equipment status. The Level 1 displays will be configured after the Level 2 and 3 displays.

b. Functional Group Displays:
Each level 2 display will contain all the information and controls required to perform most operator tasks associated with that Functional Group. The Functional Groups include:

1) Plant Auxiliaries
2) Automatic Voltage Regulator (AVR)
3) Component Cooling Water (CCW)
4) Condensate
5) Cooling Tower
6) Electro Hydraulic Governor (EHG)
7) Electrical System
8) Generators
9) Main Steam
10) Oil
11) Turbine/Generator Mechanical
12) Turbine (process)
13) Vacuum

c. Device Level (detailed) Displays

Level 3 displays provide drill down detailed views of:

1) Individual equipment and their related controls and indications
2) Custom pre-build trends
3) Plant startup and shutdown sequence lists
4) Interlock and permissive checklists

d. HMI Colors and Line weights

HMI colors will be selected using best practices intended to minimize operator eye strain and minimize distractions. The background color for HMI displays will be light grey. The number of foreground colors will be minimized. Process lines and the outlines for vessels and equipment will be dark grey or black. Bright, saturated colors will only be used to quickly draw the operator's attention to abnormal situations. Main process lines will be three pixels wide and secondary lines one pixel wide. There will be no more than three line types (solid, dashed, dotted) and line weights (one, three, five pixels) used. In general, flows will always go from left to right with a minimal use of arrows to indicate flow direction

5. External Interface Management of Packaged Control Systems

Many skid-mounted or Packaged control systems are utilized in the Plant design and it is necessary to provide an operator interface to each for purposes of monitoring and in some cases control. In general, most will communicate to the process control bus over an approved industrial network connection and utilize an approved protocol such as Ethernet IP or Modbus TCP. Where a microprocessor based controller is not provided for the system the following parameters shall be the minimum indication provided to the operator via Hardwired I/O to the BOP controller:

a. System availability (Ready)
b. System in Operation (Running)
c. System Trouble or System has Tripped
d. Other critical alarms unique to the system.

Plant Maintenance personnel shall be granted access and authorization by the vendors to execute software upgrades and limited configuration changes as deemed necessary by the plant maintenance supervisor.

PART 2 - PRODUCTS

2.1 CONTROL PROCESSORS

A. Each system controller's processor shall be microprocessor based. The processor shall interface with the network system to communicate with other processors within the system.

B. Memory shall be programmable to allow modification to existing control and/or monitoring programs or the addition or deletion of new control and/or monitoring programs.

C. The equipment shall be programmable both off-line and on-line.

D. A hard disk, battery backed RAM, or flash memory shall be used to quickly restore memory/program contents to the last documented design in cases when processor or operating station reboot is required. Battery backed RAM shall provide alarm indication of back-up battery low voltage

E. PCS Controllers shall be loaded to no more than 60% upon completion of Factory Acceptance Testing and 75% upon completion of commissioning.

F. Each processor shall be provided with a hardware or software key lock for run and program modes.

G. All system controllers and processors shall be redundant in a hot back-up; lock-step approach. That allows replacement of the Standby controller and processor cards without shutdown of the PCS controller.

H. Analog and digital loops shall be capable of being processed at a tunable rate of ten (10) times per second or faster

2.2 SYSTEM HARDWARE

A. Control System Cabinets

1. Cabinets shall be capable of both bottom and top entry, although only top entry is anticipated at this point.
2. Cabinets shall provide front and rear access to minimize the use of space for the given IO quantities.
3. For each analog input and output, two terminals plus shield shall be provided.
4. Digital inputs and outputs shall be individually fused with blown fuse indications and with discrimination against any upstream fuses to ensure that an individual circuit fault does not blow more than the individual circuit fuse.
5. All system level processor and I/O termination cabinets will be located in air-conditioned rooms.

6. The cabinet sections shall be equipped with removable lifting eyes or standard lifting straps and pallets. Cabinets shall be fabricated, tested, and shipped as multibay units to the maximum extent possible.
7. Cabinets/enclosures located in air conditioned spaces shall be NEMA 1 rated or equivalent.
8. All cabinets shall be key lockable and furnished with a handle. When unlocked, the cabinet shall be capable of being opened without the key.
9. Cabinets shall be provided with base plate holes for attaching to the floor.
10. All internal PCS cabinet wiring and interconnecting cables shall be detailed on drawings. These drawings shall be submitted during the engineering phase of the Project.
11. Processor cabinets shall be provided for processors, communication cards, and associated equipment. I/O cabinets shall be provided for I/O cards, termination assemblies, relays, and associated components. Processor cabinets may also include I/O card assemblies.
12. I/O cabinets shall have an equipment, power (safety), and isolated instrument ground. A ground bar shall be provided for termination of shields on all I/O cards.
13. A minimum of six inches of blank space at the top of top entry cabinets and six inches of blank space at the bottom of bottom entry cabinets shall be provided.
14. A minimum of one inch shall be provided between terminal block assemblies and all grounding points.
15. AC power and signal wiring shall be separated by a minimum spacing of 4 inches in all cases, and shall not under any circumstance be run in the same wire way.
16. Terminal blocks for power and utility circuits shall be grouped in one section of the cabinet.
17. Control wiring shall be stranded, tinned copper wire with 90°C, 600 volt, flame-retardant with self-extinguishing insulation that will not support combustion.
18. Terminal blocks shall be of a material that neither support combustion nor propagate flame.
19. Polyvinyl chloride shall not be used in any equipment, components, or insulations.

B. Emergency Plant Shutdown

Individual package shutdown signals will be available from the PCS. A separate screen will be provided that will allow the operator to select a skid or package system and provide a shutdown signal.

The following emergency alarm signals will be transmitted to PWP's SCADA system:

1. Fire alarm or trouble
2. Loss of grid power
3. Ammonia leakage detection
4. Natural Gas Emergency Stop Valve (ESV) closed
5. High hydrogen level alarm (Battery rooms, Generator house)
6. High containment tank alarm
7. Low building temperature (all heated buildings)
8. Ten (10) additional alarms points to be identified by the Owner during the design process.

C. Server and Network Cabinets

1. System cabinets shall be provided for servers, domain controllers, network switches, network routers, time servers, network hubs, and all other system level components.

2. All cabinets for system and network devices shall be fully enclosed on all sides and key lockable, furnished with a handle. Expanded metal, other screen and louvered doors are acceptable, all six sides must be enclosed to meet NERC access requirements.
3. All components shall be rack mounted with extendable slide rails, if available for that component.
4. Network cable wire ways shall be provided under each switch, hub, or router. The wire way shall be large enough so that booted network cables can be installed without kinking or straining the cables.
5. A minimum of three separate vertical wire ways shall be provided for power, train "A" network cables, and train "B" network cables.
6. A minimum of two power strips shall be provided one for Primary and one for Backup Power. Maximum rating of each power strip shall be 30 amps.
7. Cable management hardware shall be provided to enable components to be slid out of the cable and returned without manually manipulating any cables attached to the rear of the components.
8. Cabinet shall be provided with 20% spare space.
9. Cable entry shall be from the top or bottom. Adequate space for cable spreading and facilities for cable support shall be provided
10. System cabinets shall be provided with a KVM with remote access including a keyboard, mouse, and LCD monitor. Distance between the cabinet and remote access shall be determined by the PCS Supplier.
11. The PCS Supplier shall include in their proposal a listing of their recommended servers and workstations and their anticipated heat load for the review and use of the EPC engineer in designing the HVAC system.

D. Printers

1. Industry standard non-impact printers shall be provided by the PCS Supplier, except as noted otherwise in this specification. The printers shall generate very little noise such that they do not need to be enclosed within a sound proofing enclosure. The PCS Supplier shall provide noise specifications for their proposed printers for the EPC engineer's review.
2. Engineering Work Station (EWS) printers shall include one (1) black and white laser type printer capable of printing 11 x 17 inch drawings and one (1) color printer capable of printing 11 x 17 inch drawings.
3. Three system printers are required near the OWS consoles. These one (1) 11"x17" color laser page printer and two (2) 11"x17" black and white laser printers shall be networked to the various PCS workstations and servers to facilitate printing all reports, screen shots, configuration changes, plant alarm events, logs, and other events determined by the operator.
4. Consumables, spare parts and service for the printer shall be off the shelf and readily available in local stores.

E. Power Supplies and System Power Feeds

1. Each control processor, remote I/O cabinet, server, and other critical components of the PCS shall be capable of accepting two power sources. The PCS shall be capable of automatic auctioneering should one of the feeds be lost.
2. Operator stations, engineering work stations, and accessories can be supplied that accept only one power feed.
3. Circuit breakers shall be included in each PCS cabinet.

4. Power supply shall be from either two UPS feeds or one UPS and one 125 VDC feed for the control processor and I/O cabinets
5. Dual redundant instrument power supplies shall be provided and have the capability of being replaced on-line without affecting the operation of the instruments. The output of the instrument power supplies shall be 24 VDC
6. The PCS Supplier shall provide redundant power supplies to energize all of the processing, communication, and I/O equipment connected to the system.
7. The system shall provide transmitter loop power supplies, RTD power supplies, and contact interrogation voltages for dry contact inputs.
8. Transmitter power supplies shall be 24V dc and shall have 25 percent spare capacity per node/drop.
9. The PCS Supplier shall provide power distribution and fuses inside the I/O cabinets for distributing power to PCS contact outputs for operating field solenoid valves (assume 40 solenoids). Power for the solenoid valves will from external sources of power provided by others. The power supply voltage will be as defined in the Project by the PCS Supplier.
10. Failure of one of a redundant pair of power supplies shall be alarmed to the operator.

F. PCS Network

1. The PCS controllers, stand alone equipment, unit control PLCs and all other network devices shall be connected together with a highly reliable redundant control network system which is separate from the plant LAN/WAN system. The LAN shall be Gigabit Ethernet based (TCP/IP) and configured in a redundant star utilizing Ethernet switches or other topology as approved by Owner. It is anticipated that the data highway will be a fault tolerant redundant and this document will define the minimum requirements for such a network design. However, it shall be the PCS Supplier's responsibility to determine the optimum network (redundant, mesh, ring, star, etc.) structure to utilize for the described system based on these requirements and the PCS Supplier's expertise and knowledge. The following features shall be provided as a minimum for the control network system:

    a. Network component or communication failure in one unit shall not impact the operation of the other units.
    b. Operator stations in the control room and remote operating area are common equipment; any plant system or component may be controlled from any of the control room operator stations.
    c. Both redundant network systems are to be active at all times. All system controllers will fail over to the backup network automatically upon primary network failure. The fail over shall be alarmed. It shall also be bumpless and not affect any processes.
    d. Communications diagnostics are to be continuous such that a failure is alarmed in the minimum time. The diagnostics shall identify the specific component that has failed.
    e. Each node shall provide message checking.
    f. There shall be no single point of failure.
    g. Control data highway shall operate at 1 Gbps, minimum.
    h. Networking to Unit 5 Control/Communications Room will be via fiber optics.
2. The network shall be sized so that a given processor can supply information to all other processors simultaneously and at the same time receive information from all other

processors simultaneously plus have 40% spare base system capacity without exceeding the performance limits.

3. Data protocol shall be used to safeguard against false data transmission, allow for error detection, failure detection/recovery as well as automatic switchover to the redundant network.
4. Only one physical connection shall be permitted to any other network. Outside communication shall be to the Owner's dispatch system only.
5. All network switches shall be of the managed type.
6. The PCS network shall be provided with a domain controller.

2.3 I/O HARDWARE

A. General

1. Inputs shall be fully optically isolated and shall be able to withstand test voltages between the inputs and the internal electronics and between the inputs and the earth of 1500 V rms 60 Hz for one (1) minute (ANSI/IEEE Standard C37.90).
2. The system shall be equipped to withstand lightning surge by atmospheric electrical disturbances without damage or disruption when normally installed and operating.
3. Each I/O card within the system shall be monitored for proper operation. The system shall generate an alarm indicating the specific type of card failure.
4. Signal conditioning including linearization and scaling to engineering units shall be provided with a minimum of 14 bit analog to digital (A/D) converter, and a minimum of 12 bit digital to analog (D/A) converter.
5. Surge, overcurrent and reverse polarity protection shall be provided.

B. I/O Quantity - A minimum of 30% spare I/O of each type in each functional partition or remote I/O rack shall be provided at time of shipment to the site and 20% spare I/O of each type in each functional partition or remote I/O rack after commissioning, as a minimum. Appendix A is provided as an estimate only of the I/O and data links required.

C. I/O Power

1. The PCS Supplier is required to fuse and distribute all I/O power from cabinets or I/O card assemblies for wetting digital I/O and powering analog loops.
2. The PCS shall provide a blown fuse alarm for the contact wetting power for each I/O card. These points are not included in the database or I/O count and shall be added to the database and I/O count by the PCS Supplier.
3. The PCS shall fuse and distribute all solenoid valve power.

D. Digital I/O

1. The PCS shall be capable of the following voltage signals:

    a. 24 & 125 VDC
    b. 120 VAC

2. Single Ended Digital Input: Capable of receiving 24 VDC powered from the PCS with individually fused inputs. Inputs shall be high impedance type. Digital inputs shall be fully optically isolated from each other.
3. Differential Ended Digital Input Externally Powered: Capable of receiving 120VAC powered from the individual MCC (motor control center) bucket control power

transformers with individually fused inputs. Inputs shall be high impedance type. Digital inputs shall be fully optically isolated from each other.

4. All digital inputs shall be available with selectable filtering from 2 to 20 milliseconds.
5. Inputs shall be high impedance type.
6. Digital inputs shall be optically isolated between field contacts and internal logic voltages.
7. Digital outputs shall be either Triac or interposing relay type as defined by the I/O list. All interposing type digital outputs shall have 24V dc interposing relays with plug in bases. Wiring and power between the output card and relay shall be by the PCS Supplier. Each relay shall be provided with one form C, isolated dry contacts rated for 6 amps at 120V ac or 0.5 amps at 125V dc unless specified otherwise in the Project design criteria.
8. All Triac outputs shall be individually fused and be rated for 2 amps at 120V.
9. Digital input/output modules shall have status lights to indicate when each point is active.
10. All digital outputs that drive valves shall be fused.

E. Analog Input

1. The PCS shall be capable of accepting HART compliant 4 to 20 mA analog inputs with individual A/D conversion. The system shall be capable of reading HART secondary, tertiary, and quaternary HART variables at a rate of approximately once per second. The system shall be capable of supplying the 24 VDC to power the 4 to 20 mA loop and drive a load of at least 500 ohms of total loop resistance. The system shall also be able to provide 24VDC or 120VAC power for 4-wire transmitters. Common mode noise rejection shall be a minimum of 110 dB at 60 Hz. Accuracy will be 0.2% of full span or better. Each loop powered circuit shall be individually fused. Inputs shall be via a low-pass filter to reject high frequency interference. Common mode noise rejection shall be a minimum of 110 dB at 60 Hz. Normal mode rejection shall be a minimum 60 dB at 60 Hz. Accuracy shall be ±0.2% of full span or better.

F. Analog Output:

1. HART compliant 4-20 mA capable of driving up to 500 ohms total loop resistance. The system shall be capable of reading HART secondary, tertiary, and quaternary HART variables at a rate of approximately once per second (note: HART valve positioners will not be multi-dropped). The system shall be capable of supplying the 24 VDC loop power. Accuracy shall be 0.1 % of full span or better. Note: In general, all modulating control valves will incorporate HART smart positioners operating in burst mode. These positioners will transmit the valve position feedback via the superimposed HART signal. The PCS will read on the analog output channel and display the valve position feedback at the OWS and process historian utilizing this HART signal.

G. Temperature I/O

The PCS shall be capable of receiving the following temperature detector inputs:

1. RTD Input: Capable of receiving 100-ohm platinum resistance temperature detectors (RTDs) inputs directly. Lead length compensation for 3-wire RTDs shall be provided.
2. T/C Inputs: Capable of receiving all types of thermocouple inputs directly. Thermocouples, in general, shall be type E (chromel-constantan), with dual elements. Cold junction reference compensation and open circuit detection shall be provided.

Millivolt input ranges of -100 to +100 mV and 0 to +100 mV shall also be provided. Thermocouple reference junction temperature compensation shall be provided. The thermocouple reference junction temperature compensation value shall be available for display to the operator and shall have alarm limits.

H. In addition, cabinets shall be furnished with at least 10% spare card slots in every card and 20% extra space in each cabinet for future use.

I. I/O Database and Partitioning Requirements

1. I/O shall be functionally partitioned to minimize disruption of plant operations upon a failure of an I/O card, communication gateways or a loss of communications between processors.
2. I/O shall be partitioned such that control logic and I/O modules are contained in the same processor to minimize the I/O signals that are transmitted across the highway.
3. Process variables that are redundant shall not be terminated on a common card.
4. I/O of the same type associated with a specific component shall be grouped on a common card.
5. I/O layout between redundant cards shall be identical.

J. Bussed I/O Requirements

1. General

a. The PCS Supplier is responsible to provide all hardware (gateways, power supplies, power conditioners, etc.) software, and engineering for the I/O bus interface down to the interface to the I/O bus segment.
b. The functional requirements identified in this specification for digital and analog devices apply to all bussed I/O except for the physical interface.
c. Redundant control processors shall be able to interface with all I/O bus segments associated with that control processor.
d. All I/O busses shall be provided with redundant communications from the process controllers to the interface of the bus segment so that a failure of anyone component shall not result in the loss of communications to devices on more than one segment.
e. No control shall be performed in field devices. All control logic will be performed in the control processors.
f. The system shall provide the capability of being wired in such a manner that removal or disconnection of a field device will not interrupt other communication on any other field device on that I/O bus segment or any other I/O bus segment.
g. The system shall automatically isolate a segment from any connected spur on which a short circuit has occurred.
h. The PCS Supplier shall be responsible for providing/obtaining any files required to communicate with field devices. The Owner will provide to the PCS Supplier a list of the field devices that are being used.

2. Partitioning

a. I/O bus segments shall be engineered (with redundancy) so that process control and/or safety functions are not compromised on a loss of a segment.

b. The PCS Supplier shall be responsible to provide sufficient hardware so that each bus segment can meet the following performance criteria for the specified number of field devices

1) Analog Devices
   a) Process data including up to four variables from each device shall be updated no longer than once every 500 msec
   b) The quantity of process data points that need to be updated at a faster rate than once every 500 msec and the data rate required for those points is identified in Attachment C.
   c) Diagnostic data for each field device shall be updated no longer than once every 2 seconds.
2) Digital Devices
   a) Process data including up to four variables from each device shall be updated no longer than once every 250 msec
   b) Diagnostic data (if available for that bus protocol) for each field device shall be updated no longer than once every 2 seconds.
3) Temperature Instruments
   a) Process data for each temperature instrument shall be updated no longer than once every second.
   b) Diagnostic data (if available for that bus protocol) for each field device shall be updated no longer than once every 2 seconds.

c. The PCS Supplier shall provide the analysis with his bid for each type of bus that determined the number of segments required for each functional area.

d. If the performance criteria are not met it is the PCS Supplier's responsibility to provide the extra hardware to meet the performance criteria even if the deficiency is determined by field testing.

2.4 OPERATOR WORKSTATIONS

A. Two Operator workstations (OWS) shall be table top mounted quad (4) screens 24" LCD screens (the resolution shall be 1024 x 768 or greater) displays with keyboards and an optical mouse. A third Operator work stations (OWS), physically identical to the first two, shall have the capability to project displays on the training room screens. This OWS shall be able to pull report data, but with no operational control.

B. A single display system component failure shall not result in a loss of more than one operator control station. An operator control station may consist of multiple displays. At no time shall a display system component result in the loss of displays from a different set of electronics.

C. Keyboard security shall be provided to ensure that plant processes or system software is only accessible to authorized personnel. A single logon shall provide the login access to all authorized functions.

D. Any screen saver function shall be disabled unless otherwise specified by the Owner.

E. Control station display call-ups shall occur in 2 second or less.

F. Data Display on called graphics shall refresh and update every 1 second or less.

G. Each OWS shall perform all plant control functions and shall serve as backup to other operator stations. Displays shall be able to be selected either through the keyboard or via the cursor positioning device.

H. All critical plant control actions shall require a two step confirmatory operator entry sequence prior to transmission of a control command.

I. The OWS processing units shall be PC IBM-compatible based units which shall be able to provide all regular system functions while achieving the above performance requirements with at least 50% spare processing capacity. Each OWS shall be equipped with adequate Random Access Memory (RAM) to achieve all the required system functions together with at least 30% spare RAM capacity.

2.5 ENGINEERING WORKSTATION

A. All of the basic EWS applications, including the system domain configuration, will be factory installed and configured by the PCS Supplier.

B. The PCS Supplier shall supply two Engineering Work Stations (EWS) with a operator interface capabilities which will provide the following functions:

1. Configure, maintain and trouble-shoot PCS logic algorithms.
2. Protection from unauthorized access by means of logon access with password protection.

C. The EWS shall have the following minimal requirements:

1. The EWS shall include a 64bit Dual Core microprocessor based PC based computer, a high-density disk drive for storing and loading programs, dual screen 21” LCD display and a full function QWERTY keyboard. The PCS Supplier will provide a minimum of two EWS dual screen workstations.
2. The EWS shall be interfaced directly to a communications network using redundant NIC cards and be capable of entering, altering, and monitoring programs, logics, tags, displays, and databases in all processors interfaced to the communications network.
3. The PCS Supplier shall provide all hardware and software required to backup all system software while the unit is on-line without disrupting any functions. The backup process shall not require physical relocating or re-cabling of hard drives, DVD or CDR/W drive or processors to perform backups.
4. The EWS shall include provisions to insure that unauthorized program entry and alteration cannot occur. Access to the Engineer/programmer functions shall be through key lock or password access.

D. The EWS software supplied shall include but not be limited to:

1. Control algorithm configuration software shall be provided for interactive graphics that allows PCS logic and configuration drawings to be created. The package shall use a graphically oriented objects-based approach to process design, which allows the user to link function blocks together to configure the control strategy and create the drawings that will serve as the as configured documentation. Configuration shall be possible either on-line, in real time, or off-line.
2. OWS configuration software to allow graphics configuration and editing, tag data base maintenance, trends and reports development, historical logging tasks, etc. The standard

software shall provide a large library of standard symbols and displays, and shall include the ability to create customized process displays, symbols and face-plates. Configuration shall be possible either on-line, in real time, or off-line.

3. The EWS shall also have the functional capability of an operator's workstation allowing trending and process tuning.

2.6 REMOTE WORKSTATIONS

A. Three remote workstations shall be table top mounted 21" screens (the resolution shall be 1024 x 768 or greater) displays with keyboards and an optical mouse.

B. These remote workstations shall only have the capability to view operations and generate reports. No control functions shall be available at the remote workstations.

C. Control station display call-ups shall occur in 2 second or less.

D. Data Display on called graphics shall refresh and update every 1 second or less.

E. Displays shall be able to be selected either through the keyboard or via the cursor positioning device.

F. The remote workstations processing units shall be PC IBM-compatible based units which shall be able to provide all allowed system functions while achieving the above performance requirements with at least 50% spare processing capacity. Each remote workstation shall be equipped with adequate Random Access Memory (RAM) to achieve all the required system functions together with at least 30% spare RAM capacity.

2.7 DATABASE SERVER

A. Each server shall be microprocessor based. All servers will be a minimum of 64-bit, multi-speed standard software design (server class computer with RAID 5 controller). The server shall interface with the network system to communicate with other servers and processors within the system.

B. The equipment shall be configurable both off-line and on-line without adversely affecting system performance.

C. A hard disk or battery backed RAM shall be used to quickly restore memory/program contents to the last documented design in cases when server reboot is required.

D. Each server shall have a spare capacity of 25 percent of its base memory, server utilization, addressable points, and any other factor that affects server utilization. Each server shall be sized to perform properly under worse-case conditions.

E. All servers critical to operation of the process unit shall be redundant or fault tolerant.

F. All servers shall be rack mounted in a common cabinet

G. All of the basic server applications, including the system domain configuration, will be factory installed and configured by the PCS Supplier.

2.8 PCS SOFTWARE AND FUNCTIONALITY

A. Control Algorithms

1. The selection of control functions on the active modules shall be accomplished by configuring "function blocks". These function blocks are generic software control algorithms that can be used to perform specific tasks.
2. Control Logic Macros for motors and valves shall be developed by the PCS Supplier to offer consistent functionality throughout the plant. Likewise, the operator interface for such logic shall also be consistent. Permissive displays shall be provided for applicable motors and valves identifying all system interlock. Permissive displays shall be developed either as a paged display associated with a given graphic or a pop-up display. These control logic macros shall be reviewed by the Owner prior to releasing them to the PCS Supplier for programming. After review and approval of the control logic macros and faceplates by the Owner, the PCS Supplier shall program each of the standard logic and operator display faceplates, then load and test each of them on a test control system comprised of hardware and software similar to the PCS plant control system equipment supplied for this Project. The Owner and Owner's Engineer will witness and approve the results of these tests at the PCS Supplier or PCS system integrator's facility.
3. As a minimum, the standard function library shall support the following functions:

    a. PID loop control
    b. Controller reset anti-wind-up
    c. Direct and reverse controller output selection
    d. Cascade, ratio and bias control
    e. Automatic adjustment of tunable parameters based on an external input signal
    f. Ability for setpoint to track a process variable based on an external input or internal logic signal
    g. Ability for controller output to track a specified input, based on an external input or internal logic signal
    h. Ability for controller to be selected to manual, automatic, cascade, or remote cascade modes.
    i. Provide a bumpless transfer when switching between modes
    j. Ability to combine function blocks into a macro (i.e. motor control, valve control) function block which can be reused as needed.

B. Alarm & Event Recording System

1. The detailed alarm handling features shall include but not be limited to the following:

    a. Display of alarm limits at the operator's work station
    b. Digital storage and management of alarms
    c. Storage of alarm limits for all inputs
    d. Comparison of the inputs against the stored information
    e. Initiation of the following alarms:

        1) Measured over-range and measured under-range
        2) Deviation
        3) Rate of change
        4) Change of state
        5) Transmitter failure.

2. Time stamping of all events to 100 msec. All trip initiating signals and events are to be time stamped to 1 msec.
3. Comprehensive alarm and event notification shall be provided by:

    a. Alarm and events printer
    b. Visual annunciation on screen
    c. Audible annunciation

4. The system shall electronically log each plant and system alarm, operator actions and tag state changes. The events shall be time-stamped and include month, day of the week, hour, minute, second and millisecond. All alarms shall be recorded in the unit data historian for later evaluation.
5. The five most recent unacknowledged alarms shall be displayed in a "most recent alarm window" located in a dedicated area of each display or use a drop down window.
6. Alarms shall be able to be sorted by various criteria on a per OWS basis (Unit, Priority, Time, unacknowledged, etc).

C. Alarm Management

1. Automatic inhibit of alarms may be appropriate based on process conditions; however, intentional inhibiting of alarms through configuration shall be avoided.
2. Duplicate alarming shall be avoided. For example, if for a given control loop it is possible to alarm both the output of an analog input block and the input of its associated controller on the same process variable, ONLY configure the alarm in the controller. Control loop alarming on inputs and outputs shall be configured in the controller block.
3. Notwithstanding other guidance contained herein, alarm set points are to be chosen based on equipment manufacturer’s recommendations and good engineering practice. Alarms or a sequence of alarms that cause trips shall provide some time between receipt of the alarm and actual trip action if possible. Non-trip alarms shall occur early enough to allow operators to take corrective action before personnel hazards or major equipment damage results. Alarm dead bands are to be used to avoid unnecessary alarming when operating near an alarm set point and configured based upon the accuracy of the instrument supplying the process variable signal.
4. Conditional alarming is defined as automatic inhibition of a configured alarm based upon a process condition where the alarm becomes non-meaningful. For example, a flow transmitter providing a process flow indication downstream of a pump may be configured to alarm on a low flow condition; however, if the pump is not running, the low flow alarm is not meaningful. Conditional alarming shall be used as applicable to avoid unnecessary alarming. Time delays are often applicable when using conditional alarming to prevent inadvertent alarms and shall be employed accordingly.
5. Alarms indicating hardware related problems, such as loss of signal (BAD I/O), an out of range condition, or hardware failure (PCS or instrument) shall be configured.
6. Unacknowledged alarms will be configured to automatically clear when the alarm clears.
7. Alarm priorities are to be configured using the guidance below. The goal of alarm prioritization is to ensure operators are presented with process variable alarms that have the greatest impact on plant reliability. Consequently, the number of process variables configured at the highest priorities is to be minimized to the greatest extent. The following table assumes selection of alarm priorities from 1 (highest priority) to 5 (lowest priority).

    a. PRIORITY DEFINITION

1) Any alarm which:

   a) Indicates a plant trip has occurred or is imminent (Example: turbine trip), or
   b) Requires immediate operator action to prevent major equipment damage requiring plant shutdown (Example: Loss of all turbine lube oil pumps while operating), or
   c) Indicates a personnel safety hazard exists or possible personnel injury has occurred (Example: safety shower actuation).

2) Any alarm which:
   a) Can lead to a plant trip if situation is not corrected
   b) Requires operator action to prevent damage to equipment which may lead to a reduction in plant capacity
   c) Informs operators that a safety protective action (equipment trip) has occurred.

3) Any alarm which:
   a) Indicates equipment is not operating within normal parameters, or May result in equipment damage not affecting plant capacity.
   b) Any alarm which indicates a hardware failure, I/O failure, Smart field device or PCS system trouble condition.
   c) Any alarm, which provides notification of a routine process event

4) Operator notification (no audible alarm).

8. In order to assist in operator recognition of alarms, Priority 1 and 2 alarms are to be segregated for display on a pre-selected OWS. Priority 3 and 4 alarms are to be segregated for display on a different pre-selected OWS. The remaining OWS's will be configured to display all alarms.
9. Audible alarms tones (horns) will be configured based on the priority of the alarm.
10. The alarm system will display time, point tag, description, and alarm value for each point in alarm. Alarm displays will be colored to correspond to the alarm priority. An audible alarm and flashing of the point on the display shall continue until acknowledged by the operator. Alarms shall be capable of being displayed in a sequential listing or by alarm groups. Current alarms will be display at the top of the list. Alarm text messages shall be simply worded and descriptive of the alarming condition in all cases. Avoid use of abbreviations unless necessary, ASME abbreviations are preferred if deemed necessary.
11. The HMI will include the ability to link directly to the display for the point that is in alarm.
12. The 1,000 most recent alarms shall be available to the operator. The operator shall have the ability to sort and/or query the alarms by time intervals.
13. Each point shall be capable of having its alarm condition masked by any digital value without logic configuration. It shall be capable of being done through the system database.
14. System shall include the capability to inhibit alarms on a per point basis from the Engineering Workstation. The capability to inhibit groups of alarms or all system alarms shall be provided.

D. Graphics and Displays

1. The EPC Engineer will provide conceptual typical screen design diagrams for the PCS vendor to implement in the HMI.

2. The PCS Supplier shall be responsible for providing a complete and effective set of graphics and displays for the unit. Static graphics developed for the PCS shall be reviewed and approved by the Owner before making dynamic by the PCS Supplier. Graphics and displays shall include the following as a minimum:

   a. Overview graphics for large processes
   b. Main plant overview
   c. P&ID/process type graphics for all systems
   d. Detail graphics/displays of equipment such as GTG, STG, OTSGs and any other complex piece of equipment where it is impractical to show all process parameters for a piece of equipment on the P&ID graphic.
   e. Control displays with numerous control permanently placed faceplates can be located for coordinating complex processes such as the unit front end controls.
   f. Mixed displays that include control faceplates, trends, and P&IDs/process graphics to control the system/equipment in an efficient manner.
   g. The PCS Supplier shall supply a graphic and display configuration standard to be used for all displays which will be reviewed and accepted by the Owner.
   h. Dynamic permissive and interlock lists accessible directly from control faceplates shall be provided for each device to allow the operator to quickly determine why the device does not have an operational permissive. First-out trip indication shall be provided for all devices with multiple interlocks where the cause of the trip may not be apparent to the operator
   i. The faceplates shall be developed to work closely with the macros for control and status indications.
   j. Data required for the evaluation of the operating status of the plant systems shall be complete and provided quickly to the operator.
   k. The operator interface shall be the same for all control and monitoring functions. The location, layout, and orientation of data and objects on the operator graphics and displays must be consistent and logical such that the operator will instinctively know where on the display to find the needed information.
   l. File name convention of all graphics displays (permissives, firstout, control popups, etc) shall be identify the Unit with which it is associated.

3. The system shall permit the Owner’s plant engineer to create new graphics and displays, modify existing graphics and displays, and request displays on-line by using the Engineer's console with its keyboard or touch screen.
4. Graphics and displays will be hierarchical.
5. Access to the graphic displays shall be quick and efficient; to include single stroke access to related displays from a particular graphic display.
6. The system shall permit the operator to print or copy any display by utilizing one of the system printers.
7. The operation supervisor shall have the on-line capability to assign any display to any system display from the Engineer's console.
8. All operating/engineering stations shall have the capability to display graphics, trends, and every screen in the system.

9. The system shall provide a point detail for every system variable in the system that can be called up on the Operator's Station and Engineer's Console.

E. Trend Recording

1. The system shall be equipped with a flexible trend recording system that will provide facilities for real-time trending of analog data. Each trend display shall be capable of plotting at least eight analog variables against a common time axis in separate colors. The plotted data, date, point tag and description shall be displayed.
2. The system shall be capable of allowing the operator to create a trend or select from pre-established trend points/groups.
3. The trends shall be capable of displaying real time and historical data simultaneously.
4. The system must be able to handle short term and long term trend recording. Short term trending would typically include analog variables sampled every 1 second for a period of 15 minutes. Long term trending would typically include variables sampled at half hour intervals for a period of seven days. Both the sample interval and the storage period must be configurable. The system must accommodate at least 40 pre-configured trend definitions and displays. In addition a further 20 trends must be able to be configured by the operator whilst the system is on line.
5. Each variable assigned to a trend display shall be identified by the following parameters and features:

    a. Variable identifier (point name)
    b. Trace color
    c. Scale minimum and maximum values
    d. Trace value at a vertical reference line to be drawn in the trace color at position specified by movable cursor.
    e. Vertical scale values shall be assigned automatically by the system, but shall be able to be manually overridden by the operator. Vertical scale values for each trace shall be indicated on the display.
    f. Once a trend display has been selected, it shall continue to be displayed and updated in real time.
    g. The operator should be able to rescale the display and request a refresh without losing any of the data.
    h. The facility shall exist for the selection of multiple process variables for trend display on one of the OWSs. The multiple trend displays shall feature real-time information based on the same time scale. This function shall be used to monitor system response times, actuator torque-position trends (valve condition) and similar.
    i. Any digital, or analog process point, either plant input or derived data may be assigned to a trend display.

6. The ability to easily export trends into a Microsoft Excel spreadsheet shall be provided.

F. Historian

1. PCS shall be provided with two (2) levels of historians for storage and retrieval of historical I/O and process data. These historians shall consist of short-term and long-term data storage.
2. The short-term historian shall be as offered by the PCS manufacturer. The long-term data storage system shall be an OSI PI historian capable of trending analysis, report

generation, and archiving to portable media. OSI PI system shall be capable of logging all PCS data points for a period of not less than three (3) years and keep them in local storage for instant analysis, trending, and reporting access.

3. Provide three (3) licenses each for PI Datalink and PI Processbook.
4. It shall be possible to view the data logged to disk for any desired file. The historian shall be interfaced with the Owner's local area network. The historian shall be configured to provide easy transfer of archived data into Microsoft Office applications like SQL Server, Excel, and Word. Owner will provide the remote server database for corporate reporting.
5. The historical package shall be provided by the PCS Supplier. Data storage will be via RAID 5 redundant hard disk drives.
6. All inputs, outputs, set points, and logic developed points at a minimum, shall be stored at all times, even if not in alarm, in as compact a form as possible. Compacting by averaging is not acceptable. Compacting by exception for analogs with dead bands settable by the user per point percent is required. All operator actions, alarms, and returns to normal shall also be stored.
7. The system shall inform both the operator and the plant engineer when a storage disk is a stated percentage (80%) full and needs to be changed, or if an invalid storage disk has been mounted.

G. Reports

1. The PCS shall generate custom reports similar in information and style reports that shall be supplied by Owner. The PCS Supplier's control system engineers shall meet with the Owner's operations, maintenance, and engineering staff to agree to and finalize the customized reports prior to configuring the system for the reporting functionality.

2. A Logger/Report Package shall be provided by the PCS Supplier that performs the operational functions of report configuration/generation and printer management. The report configuration/generation function shall provide the user the ability to define free format reports, and automatically generate them on-line. The package shall manage printout requests generated from other workstations and designate physical printers.

3. The following types of reports shall be available from the Logger/Report Package:

    a. Periodic Reports, generated at user specified intervals.
    b. Event Reports, generated when a specific condition is met.
    c. One Time Only Reports, generated upon manual request only.

H. Security

1. The PCS shall meet the requirements for Cyber Security as published by the North American Electric Reliability Council (NERC) and the Federal Electric Reliability Council (FERC)
2. Remote access to network configuration, logic configuration, display development or any other internal controller function is prohibited. However, the system should allow remote operator stations access for "VIEW ONLY" purposes via secured network connections.

I. Licenses

1. All software licenses required to operate, maintain, and program the PCS system components shall be included with the system. The licenses shall be sufficient to meet the process operating and control requirement for the scope of I/O specified (to include spare capacity specified and that of sub-system interfaces). The licenses shall not be limited to the quantity of HMI graphic screens.
2. The Owner shall be permitted to make two copies of each piece of licensed software for backup purposes. This is for licensed software only, not the applications developed for this Project. The Owner shall be able to copy displays, configuration drawings, and database files developed for this Project without limit.

PART 3 - EXECUTION

3.1 TESTING AND INSPECTION

A. General

1. The Buyer reserves the right to witness all tests and shall be notified at least 10 working days in advance of the tests
2. The system shall be subject to Owner/EPC engineer witnessed factory and site acceptance tests. The system shall not be shipped from the place of assembly and configuration until the factory acceptance tests have been deemed to have passed by the Buyer.
3. Certified test reports for the tests performed shall be transmitted to the Buyer prior to shipment of the system. When requested by the Buyer, the Seller shall review the test results with the Buyer and obtain approval for shipping.
4. Should the system fail a specified factory test or show abnormal results, the Seller shall immediately inform the Buyer. The cause of the problem and the proposed corrective action shall be discussed with the Buyer prior to the implementation of corrective actions. After the problem is corrected, the specific system function shall be re-tested. All repair details shall be documented and included in the Test Report

B. Factory Acceptance Tests (FAT)

1. The PCS Supplier’s equipment shall be subject to witnessed factory and site acceptance tests. The PCS system shall not be shipped from the place of assembly/configuration until the factory acceptance tests have been deemed to have passed by the Owner.
2. FAT and SAT procedures and schedule shall be submitted to the Owner a minimum of 6 (six) weeks prior to said tests for review/comment.
3. A hardcopy printout and electronic copy of the I/O database, graphic screens, logic diagrams and detailed hardware configuration shall be supplied to the Owner in advance for review and comment prior to finalizations of system configuration and FAT.
4. The system checkout shall include 100% I/O checkout, closed loop simulation of binary/modulating logic, and validation of all logic, displays, and reports.
5. The PCS Supplier shall test all power systems and verify that the system common and chassis ground are isolated from each other on all cabinets.
6. The PCS Supplier shall provide 3 weeks for the FAT of the hardware, logic and software design and data communication interfaces.
7. All inputs and outputs shall be connected soft simulation and tested for functionality. The simulation software shall include:

a. Simulation of 100% I/O.
b. Simulation of all controlled analog process variables, such that a change in a controlled device shall result in a change in the correct direction for the process variable.
c. Simulation of all controlled "digital" variables such that a change in an output will result in a change in a corresponding input.
d. The capability of simulating failures of equipment by forcing inputs on/off as needed.
e. The capability of Owner's personnel to access analog and digital variables from any operating console or station shall be supplied with the system.
f. The FAT simulation models shall be "low fidelity". No modeling of any actual process is required except where noted.
g. No defeating or bypassing of any logic is permitted without the written permission of the Owner.
h. All temporary logic changes shall be logged and tracked.

8. To the greatest extent practical, communications to subsystems (GTG, STG, etc.) shall be tested during the FAT. The PCS Supplier shall work with the EPC engineers & Owner to facilitate this testing.
9. Module operation, console communications, and system communications shall be verified. The module and console shall then be loaded and tested.
10. The Factory Acceptance Test shall consist of full system checks and closed loop simulations as were completed during the PCS system integrator's checkout.
11. The FAT closed loop simulation software shall be shipped to the Owner for use in training operators. The simulation software shall be shipped as soon after the FAT as practical.
12. The PCS system integrator shall simulate/emulate all data link points for checking of displays and control logics.
13. The PCS Supplier shall be responsible for providing all substitute equipment needed to perform the Software FAT.
14. All cabling and wiring internal to the IO and controller panels will be completed and checked out at the FAT.
15. Within one week of the completion of the FAT, the PCS Supplier shall submit a FAT Test Report with action items and an estimated completion schedule for the review and approval of Owner. This report shall include all items identified by Owner during the FAT that require correction or modification.

C. Site Acceptance Test (SAT) - The SAT shall be performed after the installation and commissioning of the control system by the PCS Supplier. The functions and characteristics included in the test shall be the same as the factory checkout and acceptance tests, considering that the system will be connected to the process. Any abnormality encountered in this test shall be justified and corrected by the PCS Supplier at no additional cost to the Owner.

3.2 SITE COMMISSIONING

A. The PCS Supplier shall provide on-site commissioning support on a time and materials (T&M) basis as requested by the owner or EPC contractor/engineer. Include a minimum of six (6) months following substantial completion for on-site technical assistance. Personnel involved in the configuration shall be on-site for commissioning.

3.3 TRANSFER OF OWNERSHIP

A. All materials, warranties, software, licenses, and all documentation used in the design, development, construction, commissioning, or operation of the equipment supplied will be transferred to the Owner and become their property. The materials and documentation may include, but not necessarily be limited to:
   1. Operating systems
   2. Software tools
   3. Development tools
   4. Maintenance tools
   5. Runtime systems
   6. Configuration software
   7. HMI Graphic files
   8. Logons and passwords
   9. Device firmware files
   10. Software licenses, key disks/dongles, etc
   11. As commissioned configuration files
   12. Hardware used in design and commissioning (including communications cables)

B. Software or configurations that normally require password or other means of protection will be conveyed to the Owner in writing detailing the protection imposed and procedures or reference required to utilize or defeat its operation. During the construction and commissioning phase, it may be necessary for the protection to be controlled by those personnel performing the work. The PCS Supplier will maintain the passwords, key disks, or hardware keys in a secure area that is accessible to the Owner.

3.4 DOCUMENTATION

A. The PCS Supplier shall provide a complete set of project documentation including
   1. During the course of the contract, the PCS Supplier shall submit regularly updated schedules and status reports to Owner.
   2. Allowance for Owner and EPC Engineer's approval of key design documents. PCS Supplier shall build into the work schedule at least three (3) weeks for the review and approval process.
   3. Hard and soft copies of as configured discrete logic diagrams, SAMA logic diagrams, and process sequence charts
   4. Application and diagnostic software
   5. Hard and soft copy listings of IO
   6. Written narrative descriptions including a functional description of operations, including all emergency trip requirements.
   7. IO list including setpoints and ranges
   8. Electrical equipment list (for panels and cabinets, etc)
   9. List of spare parts and special tools
   10. Firmware and firmware revision and issue documentation
   11. Antivirus software, the most current antivirus definition files, and antivirus update procedures
   12. Turnover package including Operations and Maintenance manuals
   13. Comprehensive drawings and descriptions of the central control system.

14. All regulating, sequence, protective and data acquisition/processing functions shall be fully documented to standards for the Documentation of Industrial Software. The functional descriptions shall be both written and schematic.

3.5 TRAINING

A. Operator/Maintenance/Engineer Training

1. The PCS Supplier shall provide four (4) one week duration operator training courses at the plant site for ten (10) operators rotated on the PCS consoles in the control room. The training classes will cover all the standard capabilities of the PCS system as it has been assembled for the facility.
2. The PCS Supplier shall provide four (4) one week duration technician/engineer training courses at the suppliers training facility for three (3) technician/engineers to cover basic and advanced training on configuration and programming of the PCS system.

3.6 SHIPMENT AND STORAGE

A. The system shall be delivered FOB to the site.

B. The method of shipment shall via an air ride van.

C. A recording impact recorder shall be provided by the Seller for shipment purposes.

APPENDIX A – HARDWIRED I/O ESTIMATE

	I/O from P&IDs	I/O from Electrical	Contingency for Design	Total	20% Spares	Total w/Spares
DI	235	76	72	383	77	460
DO	60	42	36	138	28	166
AI	121	3	32	156	32	188
AO	34		16	50	10	60
SOE		26	24	50	10	60
RTD			24	24	5	29
			Design Total	801	**Installed Total**	**963**

APPENDIX B – DOCUMENT SCHEDULE

ITEM	DOCUMENT DESCRIPTION	FOR BID (included)	FOR APPROVAL (weeks after award)	CERTIFIED (weeks after approval)	FOR RECORD (weeks after delivery)
1	COMPLETED BID FORM	X			
2	DESCRIPTIVE LITERATURE CATALOG INFORMATION	X			
3	PRICED SPARE PARTS LIST	X			
4	DATA SHEET	X	4	2	2
5	DOCUMENT INDEX		4	2	2
6	ENGINEERING AND FABRICATION SCHEDULE		4	2	2
7	UTILITY DEMANDS (LOAD LIST)		4	2	2
8	CONTROL SYSTEM BLOCK DIAGRAM		8	2	2
9	CONTROL SYSTEM PANEL DESIGN		8	2	2
10	ELECTRICAL EXTERNAL CONNECTION DEFINITION		12	2	2
11	ELECTRICAL WIRING SCHEMATICS AND DIAGRAMS		12	2	2
12	INSTALLATION MANUAL		12	2	2
13	FACTORY TEST REPORT			BEFORE SHIP	
14	QUALITY ASSURANCE RECORDS			BEFORE SHIP	
15	SHIPPING INFORMATION			BEFORE SHIP	
16	OPERATION AND MAINTENANCE MANUAL		10		2
	DISTRIBUTION FORMAT	**ELECTRONIC**	**ELECTRONIC**	**ELECTRONIC**	**ELECTRONIC HARDCOPY**

APPENDIX C – REFERENCED DOCUMENTS

Control System Architecture Diagrams

Control Room Layout Drawings

Conceptual P&IDs

October 23, 2013

CITY OF PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)
Architectural Scope of Work

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123374

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Architectural Scope of Work

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TABLE OF CONTENTS

PART 1 - GENERAL ARCHITECTURAL BUILDING SCOPE 1
PART 2 - ELECTRICAL 2
PART 3 - CONTROL BUILDING 3
PART 4 - MAINTENANCE SHOP 10
PART 5 - WELDING SHOP 11
PART 6 - WATER LABORATORY BUILDING 11
PART 7 - GLENARM BUILDING 13

SPECIFICATIONS FOR BIDDING ONLY

ARCHITECTURAL SCOPE OF WORK
GLENARM REPOWERING PROJECT BUILDINGS

PART 1 - GENERAL ARCHITECTURAL BUILDING SCOPE

A. The architectural scope of work for the Glenarm Repowering Project (GT-5 Combined Cycle Installation) will consist of work on three new pre-engineered steel framed buildings, substantial modifications to an existing building (the Maintenance Shop), minor modifications to an existing building (the Glenarm Building), erection of the PIE supplied STG enclosure and the Power Distribution Center (PDC).

B. Preliminary drawings for all new structures are provided in this scope of work as well as mark-ups of existing drawings showing the extent of the planned changes. The STG enclosure is being designed and supplied by the PIE Contractor for erection by the BOP. The PDC is an engineered modular structure that will be described in the electrical scope of work and has its own set of specifications for the building and the switchgear/batteries it will enclose. This section will focus on descriptions for the following buildings:

1. Control Building
2. Maintenance Shop
3. Welding Shop
4. Water Lab Building
5. Glenarm Building

C. For this preliminary scoping exercise, a building occupancy classification F-1 was used. The BOP Contractor is required to perform a complete California Building Code review and analysis for all buildings and shall comply with all laws, regulations and ordinances stipulated by State of California, the City of Pasadena and the local Authority Having Jurisdiction. All construction documents shall be signed and sealed by an architect or engineer licensed to practice in the State of California.

D. The Site Conditions Document, Specification section 480020**,** shall be referred to for all building design conditions such as structural loads, HVAC design temperatures, etc.

E. Using the drawings, specifications and the room finish schedule, the BOP contractor shall work with the General Manager to create and agree on the final architectural finishes.

F. Finish samples shall be provided for items such as paint color, wall texture, ceiling panel texture, cove base colors, counters, bathroom partitions, FRP, tile color/texture, grout, lockers, etc., shall all be submitted for approval.

G. For each building provide a *Finish Board* with samples of each type of finish to be installed on the building. Submit *Finish Boards* to the General Manager, to verify finishes and approve the materials to be used on the project.

H. Items shall not be ordered without written approval by the General Manager.

I. All materials shall be new, of the quality stated, and shall be installed according to the materials manufacturers' written instructions and recommendations and in conformance with all applicable Codes, Regulations and ordinances of the Authority Having Jurisdiction (AHJ).

SPECIFICATIONS FOR BIDDING ONLY

PART 2 - ELECTRICAL

A. Provide an electrical panel with disconnects as required by the NEC and the local Building Department for all buildings under this scope.

B. Provide lighting for all buildings. Lighting shall be fluorescent fixtures mounted in the suspended ceilings, flush mounted on sheetrock or secured to structural steel in open shop areas. An acceptable alternate lighting source in all locations is to use LED fixtures in an arrangement appropriate for the application. Lighting in the restroom shall be a fluorescent or LED surface mounted fixture above the lavatory. Provide lighting level as recommended in the electrical code. Provide wall mounted switches for all fixtures.

C. Submit fixture manufacturer's information for owner approval before ordering fixtures.

D. Provide an exterior mounted fluorescent, LED or HPS light fixture suitable for outdoor application at all exterior personnel doors. Locate switch in interior side of wall.

E. Provide convenience 20 amp duplex outlets @ 12 feet O.C. in the general laboratory area and at 2 feet O.C. above the counter area. Provide two (2) 20 amp duplex outlets on the exterior wall of the "building" wall that faces the covered storage area. Locate outlets as indicated by the owner. Provide one 20 amp duplex outlet on each column located on column line "A". All exterior located outlets shall have weather-resistant covers.

F. Electrical circuits shall be routed through raceways listed for the use. Rigid conduit is required in all exposed areas. Electrical metallic tubing (EMT) may be used within walls if acceptable to the Owner and the AHJ. Flexible conduit may only be used as permitted by the National Electrical Code (NEC), the Owner and the AHJ.

G. All electrical work shall conform to the NEC and the State of California Electrical Code. The electrical design shall be signed and sealed by a registered electrical engineer licensed to practice electrical engineering in the State of California.

SPECIFICATIONS FOR BIDDING ONLY

PART 3 - CONTROL BUILDING

A. The Control Building will be the primary new architectural structure to be constructed on the site and will be located on the southwest portion of the site between the existing Pacific Electric (PE) building to the south and the existing Glenarm Building to the north.

B. Care must be exercised when working around the Pacific Electric and the Glenarm Buildings as both are considered buildings of historical significance. It is strongly suggested that Jersey Barriers / K-Rails or other means of protection be installed during construction to safeguard these structures.

C. The west wall of the Control Building will be in close proximity to a 10'-0" high concrete wall that will be erected along Fair Oaks Boulevard, which is further described in the Civil portion of this scope of work document.

1. Provide a minimum of four (4) feet separation between the exterior surface of the building and the concrete wall columns for access requirements on the west side. The location of this building can be moved slightly east of its location as indicated on the General Arrangement and site plans to accommodate building access on the west side. Any relocation of the building beyond this must be approved by the General Manager.

2. An east-west free standing 10'-0" high reinforced concrete fire separation wall located to the north of the north wall of the Control Building will be designed and installed to protect the occupants in the case of fire/explosion in the gas compressor area as part of the BOP scope of work. Both the perimeter wall on Fair Oaks and this separation wall are to be designed and installed by the BOP contractor.

D. The Control Building will house the Control Room, five (5) Offices, Break Room / Kitchen area, Mechanical Room, IT/Electrical Room, Storage Room, Technical Library/Training Center, Men's and Women's Locker Room/Restrooms and "Future Room" in accordance with drawings A1-2-1, A1-3-1, A4-1 which illustrate the size and configuration of this building.

1. The buildings will be pre-engineered type steel structure with pre-finished metal panel exterior walls, insulation and standing seam roof as indicated on the A drawings and architectural specifications.

2. The interior will generally be gypsum wall board (GWB) on steel studs finished as indicated on the finish schedule, unless otherwise designated on the finish schedule.

3. Windows and doors shall be as stated on the drawings and specifications.

4. The building will be constructed on a concrete foundation with the Control Room and IT/Electrical Room portions of the building to have a 1'-6" deep recessed subfloor as indicated on the drawings. Installed above the subfloor area will be an access floor with VCT covered removable floor panels creating a chase for cabling. The surface of the access floor will match the elevation of the adjacent floor surfaces (not a raised floor). The subfloor will slope to a drain sump as indicated on the drawings.

5. The HVAC system shall be an air to air heat pump design with additional and / or back-up electrical heat capacity for winter operation as required. Heat Pump(s) shall be placed on 4 inch thick reinforced concrete base(s) that are 4 inches larger on each side, than the unit and located outside on the ground adjacent to the facility on the south side with-in close proximity to the associated indoor evaporator coil section. Equipment shall not be located on the roof of the building. Space shall be reserved on the south side of the building to accommodate equipment, ductwork and electrical connection requirements.

SPECIFICATIONS FOR BIDDING ONLY

All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70 and marked for intended location and application and all equipment shall carry a minimum (5) five year warranty period from the date of substantial completion for compressors, all parts and labor. A factory-authorized service representative shall be engaged to perform the equipment startup service and train owner's maintenance personnel to adjust, operate and maintain unit(s). Equipment selection shall comply with the minimum SEER / EER requirements outlined in ASHRAE 90.1-2010 and / or California's Title 24, whichever is found to be most stringent. Provide design basis around the following equipment manufacturers:

a. Trane.

b. Lennox International Inc.

c. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.

6. HVAC design and installation shall conform to California's Title 24, current local and state codes and any amendments by the local Authority Having Jurisdiction (AHJ), as well as "green building" requirements. In addition the HVAC design shall comply with the latest AHJ adopted version of ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

7. All calculations for determining equipment heating and cooling capacities shall utilize an ASHRAE-based or commercially available software program (i.e. Trane, Carrier). Combine and provide temperature control zones for offices and other spaces located on the same exposure and with identical load characteristics. Do not combine spaces located on different zones or load profiles to form a common temperature controlled zone. A perimeter corner space with at least two exposures shall be provided with individual room temperature control.

8. Design equipment to provide for the following indoor design temperature conditions as follows:

   a. Range: 70 degree F to 75 degree F

   b. Tolerance: +/- 1.0 degree F

   c. Cooling Set Point: 75 degree F

   d. Heating Set Point: 70 degree F

   e. Relative Humidity: Range 20-50% (humidification set point if required – 20%).

9. Provide standalone HVAC controls on all equipment.

10. As a minimum, indoor unit(s) shall provide for the following:

    a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

    b. Insulation: Faced, glass-fiber duct liner

    c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal expansion valve complying with ARI 210/240.

    d. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device and one-time fuses in terminal box for over current protection.

SPECIFICATIONS FOR BIDDING ONLY

e. Filters: 2 inch Disposable filter(s) – MERV 7 according to ASHRAE 52.2.

f. Condensate Drain Pans: Comply with ASHRAE 62.1

11. As a minimum, outdoor unit(s) shall provide for the following:

a. Casing: Steel, finished with baked enamel in manufacturer's standard colors with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal and current sensitive overload devices, start capacitor, relay and contactor. Compressor shall be two-speed scroll compressor motor with manual-reset high pressure switch and automatic-reset low pressure switch.

c. Refrigerant Charge: R-410A.

d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid sub-cooler. Comply with ARI 210/240.

e. Heat-Pump Components: Reversing valve and low temperature air cutoff thermostat.

f. Fan: Aluminum propeller type, directly connected to motor.

g. Low Ambient Kit: Permit operation down to 45 deg F.

h. Reset Timer: Automatic reset timer to prevent rapid cycling of compressor.

12. As a minimum, space thermostat(s) shall provide for the following:

a. Compressor time delay.

b. 24-hour time control of system stop and start.

c. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

d. Fan-speed selection including auto setting.

13. The air distribution system shall be designed in accordance with applicable ASHRAE and SMACNA Standards. Use applicable sections of the SMACNA Standard to select the air distribution ductwork pressure classification. All ductwork shall be fabricated from galvanized steel. Use equal friction method for sizing all ductwork. The use of flexible duct shall be restricted to connections between equipment and connections between the supply air diffusers. The maximum length of flexible ductwork shall not exceed 5 feet in length. Minimum size rectangular duct shall be 8"x6" and minimum size round duct shall be 6". Maximum duct velocities shall not exceed 1,500 feet per minute (fpm), transfer air ducts – 750fpm. Maximum static pressure drop shall not exceed .08 in of water / 100 feet. Transfer air ducts - .04 in of water / 100 feet. All duct work shall be seismically braced/ secured.

14. As a minimum, duct accessories shall provide for the following:

a. Multiple or single blade, parallel or opposed blade design, standard, steel, manual volume dampers suitable for horizontal or vertical applications. Galvanized steel blades .064 inch thick.

b. Provide accessories from one of the following equipment manufacturers:

SPECIFICATIONS FOR BIDDING ONLY

1) Ruskin Company.
2) Nailor Industries Inc.
3) McGill AirFlow LLC.

15. Insulate all ductwork as required by California's Title 24, current local and state codes and any amendments by the local Authority Having Jurisdiction (AHJ).

16. Provide ventilation and required make-up air and / or transfer air as required by ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality for Men's and Women's locker / restroom, Janitor closet and Break room.

17. As a minimum, ventilation equipment shall provide for the following:
    a. Housing: Galvanized steel, mushroom-domed top; square, one-piece aluminum base with venturi inlet cone.
    b. Hinged Sub-base: Galvanized steel hinged arrangement permitting service and maintenance.
    c. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
    d. Belt Drives: Resiliently mounted to housing; bearings permanently lubricated, permanently sealed, self-aligning ball bearings.
    e. Pulleys: Cast-iron, adjustable-pitch motor pulley.
    f. Fan and motor isolated from exhaust airstream.
    g. Dampers: Counterbalanced, parallel-blade, backdraft damper mounted in curb base factory set to close when fan stops.
    h. Curbs: Galvanized steel; mitered and welded corners with 1 ½ inch thick, rigid fiberglass insulation adhered to inside walls and 1 ½ inch wood nailer. Size as required to suit roof / wall opening and fan base.

18. Provide design basis around the following ventilation equipment manufacturers:
    a. Loren Cook Company.
    b. Greenheck Fan Corporation.
    c. PennBarry.

19. Provide design basis for a small electric heater and associated thermostat for the fire riser room to temper and maintain the room temperature at 50 degrees F during the winter months.

20. Plumbing design and installation shall conform to current local and state codes and any amendments by the local Authority Having Jurisdiction (AHJ). Plumbing insulation shall comply with California's Title 24 or as required by other amendments provided by the AHJ.

21. All domestic water piping materials shall be hard copper tube, drawn temper ASTM B 88, Type L with solder-joint ends and fittings. All valves shall be from a single source manufacturer. Provide ball valves with quarter-turn actuator and extended operating handle rated for installed service.

22. All plumbing fixtures shall at a minimum meet the following low flow minimum sustainable design requirements:

SPECIFICATIONS FOR BIDDING ONLY

a. Commercial Water Closet – 1.1gpf (gallons per flush)

b. Commercial Urinal – 0.5gpf (gallons per flush)

c. Lavatory – 0.8-1.5gpm (gallons per minute)

d. Sink – 2.5gpm (gallons per minute)

23. Provide design basis around the following plumbing equipment manufacturers:

a. Water Closets and Urinals – Kohler, American Standard Companies, Inc., Eljer.

b. Flushometer Valves – Sloan Valve Company, Zurn.

c. Water Closet Seats – Bemis, Kohler, Eljer.

d. Lavatories and Sinks – Kohler, American Standard Companies, Inc., Elkay.

e. Lavatory and Sink Faucets – Kohler, Chicago, Elkay.

f. Fixture Supports – J.R. Smith, Zurn, Josam Company.

g. Floor Drains – J.R. Smith, Zurn, Josam Company.

h. Showers – Aqua Glass corporation, Kohler, Bestbath.

24. Faucets shall have a laminar flow device of brass, monel metal or stainless steel trim. Showerhead internal construction shall be of brass, monel metal or stainless steel. Provide design basis around electrical flush valves and faucets. Electrical components and accessories shall be listed and labeled as defined in NFPA 70, article 100.

25. Size the piping for the hot and cold water systems not to exceed the maximum velocity allowed by the current adopted codes. Provide necessary water hammer arrestors in accordance with the American Society of Sanitary Engineers Standard 1010 as required. Water hammer arrestors shall be installed with inlet isolation valves.

26. Maintain a minimum pressure of 35 psi at the furthest fixture within the system design.

27. Provide a 60 gallon electric hot water storage tank for Men's and Women's Locker's, Janitors Closet and Break Room. Locate water heater inside mechanical room and provide seismic bracing as required by current adopted codes and AHJ requirements. Equipment shall carry a (5) five year warranty on parts and labor for the storage tank, controls and other components from the date of substantial completion. Provide stainless steel overflow drain pan. Provide floor drain in mechanical room for emergency overflow from water heater.

28. As a minimum, design basis for the water heater shall provide for the following:

a. Tank Construction: Steel, ASME B1.20.1 pipe thread, 150 psig pressure rating. Interior finish shall comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

b. Factory-Installed Tank Appurtenances: Replaceable magnesium anode rod, corrosion-resistant metal complying with ASSE 1005. Insulation shall comply with ASHRAE / IESNA 90.1. Rectangular shaped jacket with stainless-steel front panel. Heating elements shall be electric, screw-in or bolt-on immersion type arranged in multiples of three. As an option – heaters with total of 9kW or less may have two or three elements. Temperature control shall be adjustable to a setting of at least 180 degrees F. Provide high-temperature-limit and low-water cutoff devices or systems for safety controls and ASME rated and stamped for combination temperature-and-pressure relief valve. Provide combination

SPECIFICATIONS FOR BIDDING ONLY

temperature-and-pressure type or separate thermometer and pressure gauge. Provide design basis around the following equipment manufacturers:

1) A.O. Smith
2) Cemline Corporation
3) Lochinvar Corporation

29. Install heat traps (either valve type or loops) on the cold water makeup inlet and outlet connection on the hot water storage tank.

30. All floor drains shall have a single or manifold electronic trap primer supply. The trap primer control box shall be recessed. Traps located within 50 feet of the control box shall be piped to that control box.

31. Cast iron is the preferred material for sanitary and vent piping. Solid core PVC may be used in low temperature, horizontal, buried soil. Switch to cast iron above grade. Cleanouts shall be extended to the floor or wall in an accessible location.

32. A door and room finish schedule has been provided for this building, A9-1 and A9-2. A full set of Architectural specifications have been provided to compliment the drawings located in section A-2. Architectural specifications defining the building construction will be as further defined below.

    a. For the restrooms, the floors shall be ceramic tile. The walls shall be water resistant GWB with 5 foot tall FRP wainscot panels with paint above the wainscot. The ceilings shall be painted GWB.

    b. The lockers shall be full height metal lockers and bathroom partitions per the specifications.

    c. Water closets and urinals shall be wall hung with appropriate backing provided in the walls to support the loads from these devices.

    d. The restrooms shall have a minimum of three floor drains per restroom with trap primers and clean outs as required to meet code. One floor drain will be provided in the shower area, one in the dry off area of the shower, and one in the general restroom area for water closet/sink overflows and area washdown. Submit plumbing plans to the General Manager for approval.

    e. The showers shall be tiled floor to ceiling over concrete tile backer wall board, with shower pans installed beneath the ceramic flooring. A raised "threshold" shall be constructed installed at edge of shower to prevent water from leaving the shower area, but will permit wheelchair passage. Showers shall be equipped with shower curtains and rods between the shower and dry off area. Lighting and ventilation in the shower area shall be provided. All electrical devices in the shower/locker rooms and kitchen/janitor closet areas shall be on GFCI breakers and/or outlets.

33. **Include in the bid an allowance of $75,000** for furniture and appliances. The General Manager will prepare a list of furniture and appliances at the time of building finish selection. This list includes movable items only. All permanently installed items shall be included in the base bid price.

34. The kitchen shall have a solid (color full thickness) type counter top with below counter installed kitchen sink with garbage disposal, faucet, spray hose, etc.

SPECIFICATIONS FOR BIDDING ONLY

35. Ceilings: The building will have acoustic ceiling panels installed throughout unless otherwise noted on the room finish schedule. (The Rest Rooms will have a GWB ceiling) All areas shall have flush mounted fluorescent light fixtures meeting Electrical and California Building Code lighting requirements. Contractor shall submit a reflected ceiling plan and power / lighting circuitry plans to the General Manager for approval. Lighting shall be activated by motion detection with manual override capability.

E. The BOP contractor shall connect the following onsite services to the new buildings. Refer to the Tie Point drawing M1-1-6 for locations of existing plant services:

1. Fire Protection Water Supply: This piping will come in under slab to the Fire Riser Room. This pipe will supply water for all the different water protection systems. Please refer to the Fire Protection specifications for coverage that applies to this building.

2. Potable Water Supply: Potable water will be supplied to all fixtures in both restrooms, the kitchen, janitor's closet sink and one hi/lo drinking fountain in the Control Room.

3. Sanitary Sewer: Note: this sanitary sewer is assumed be able to be gravity flowed to the connection on the west side of the property. Alternatively, the contractor may elect to put in a lift station to send the water to an existing connection on the southeast corner of the Glenarm Building (near the bathroom that will be demolished).

4. Electrical Services: The BOP will size the electrical service from the PDC to service all building loads. A UPS system will be provided power to the critical Control Room hardware. A minimum of two 110V outlets per office area will be provided. Four will be provided in the kitchen area. 10 will be provided in the control room. Install one per wall in other areas, such as the tech library, future area, mechanical area, etc.

5. Communications: The BOP Contractor will provide conduits into the building as well as distribution to each of the Offices and Control Room areas for telephones and internet. Telephones will be installed by the General Manager. Coordinate Gaitronics PA system with the BOP Electrical Contractor.

6. Security: All permanent site security cameras will be brought into the building through underground conduits. The BOP shall be responsible for the relocation of the existing system from the B-3 control room to the new control room, and for providing new cameras. Please refer to the General Manager for specific requirements.

7. Controls Interfaces: Communication between the PCS cabinets, located in the PDC, and the control console/server area will be brought into the building via underground conduits. Additionally, conduits for E-stops, both current and future, shall be brought into the Control Room. Conduits for future E-stops to the GT 1, 2, 3 and 4 plants will also be brought into the Control Room. Conduits for a future interface between GT 1, 2, 3 & 4 will also be brought into the Control Room. All conduits will terminate in the depressed area under the access floor.

8. Fire Protection: Conduits shall be run to interface between the B-3 Control Room and the new Control Room shall be installed and brought into the control building. Each of the protected areas will need to have conduits installed as required to interface with the new fire alarm control panel located in the control room as described in the fire protection/detection specifications.

9. Spare Conduits: Install empty conduits for electrical and controls circuits to the Control Room to accommodate future expansion. All conduits shall terminate in the recessed space under the access floor in the Control Room. Initial starting point shall be determined by the General Manager. A minimum of four 4" diameter conduits and five

SPECIFICATIONS FOR BIDDING ONLY

2”diameter conduits shall be installed as dedicated spares. These will be run from the PDC.

PART 4 - MAINTENANCE SHOP

A. The Maintenance Shop work will be a renovation of the existing Pump Maintenance Building to the south of State Street just off of Fair Oaks Boulevard. This building is positioned at an approximate 45 degree angle to both State Street and Fair Oaks. The intent of the renovation is to retain the majority of the structure, the exterior siding, roofing, and doors of the building. The exception to this will be the existing roof on the north end of the building, over the office areas that will be modified per the drawings to provide for increased headroom. Refer to existing drawings in A-3 for this building.

B. All existing glazing shall be removed and new insulated glazing shall be installed in all existing windows.

C. New office areas will be constructed in the north end of the building with additional floor area created on the second story with a mezzanine in accordance with drawings A2-1-1, A2-2-1, A2-2-2, A2-3-1, A2-4-1 and A2-5-1. Install a removable handrail as indicated to provide fork truck access.

D. A new fire wall will need to be added on column line 2 between the office areas and the maintenance space. A new double door flammable material storage cabinet constructed of steel will be supplied as part of this work scope.

E. As part of this scope of work, the BOP contractor shall perform a Building Code analysis and evaluation to ensure that all modifications done to the building meet applicable State of California Building Code, City of Pasadena ordinances and any Special Owner Requirements. The BOP Contractor will be required to perform a structural analysis of this building for adequacy / compliance with current building codes after the renovation is complete.

F. A structural modification must be performed to add an expanded mezzanine level, as indicated on the drawings. The BOP contractor will need to weld in new clips to bolt in new beams, install bar joists, Q decking, place reinforcing mesh and place new concrete. All structural modifications shall be performed under the direct supervision of a Professional Structural Engineer licensed to practice in the State of California who shall stamp and seal the documents.

G. The existing restroom, locker room, office, file rooms will be completely renovated. Replace the existing water heater and install a minimum 60 gallon industrial rated electric water heater for the kitchen and restrooms.

H. New HVAC and ventilation fans will be added to serve all areas in accordance with the site conditions HVAC criteria. Meet the respective minimum requirements as called for under the HVAC and plumbing criteria for the control building.

I. The exterior of the building will be thoroughly cleaned, re-caulked and repainted.

J. A new electrical service will need to be brought in from a pole near the building. PWP will coordinate supplying the electrical connection, but the BOP contractor shall include all the new lighting panels, transformers, grounding, etc., to accommodate the new feed for this building

SPECIFICATIONS FOR BIDDING ONLY

and the welding shop below. Contractor shall submit a reflected ceiling plan and power / lighting circuitry plans to the General Manager for approval. Lighting fixtures shall be new throughout the shop and office spaces. Fluorescent or LED fixtures shall be provided in sufficient numbers and spacing to supply work area illumination levels as recommended by the Illuminating Engineering Society (IES). Lighting shall be activated by motion detection with manual override capability. All electrical outlets in the shop area and kitchen/restroom shall be on GFCI circuits. A minimum of eight 110V electrical outlets shall be installed in the maintenance shop area. One electrical outlet shall be installed per each of the desks shown on the arrangement drawings.

K. Conduits will be installed for both telephone jacks and for computer Cat-5 type cable jacks

PART 5 - WELDING SHOP

A. Due south of the Maintenance Shop the new welding shop will be constructed. For this structure, a new concrete foundation will be installed with electrical services extended from the Maintenance Shop underground to accommodate lighting and ventilation equipment to the welding Shop. Fluorescent or LED lighting fixtures shall be provided in sufficient numbers and spacing to supply work area illumination levels as recommended by the Illuminating Engineering Society (IES). All receptacles shall be on GFCI circuits.

B. Two new 480V welding outlets shall be provided in the shop on opposing walls. A minimum of six 110V power receptacles shall be provided in this shop.

C. Potable water shall also be extended underground to this building to supply hose bibs and for washdowns. The building will be a pre-engineered structure with metal panel exterior walls, insulation and standing seam roof. Windows, chain operated overhead rollup doors mounted on the interior of the building and pedestrian doors shall be provided as shown on drawings A3-2-1 and A3-3-1.

D. The floor of the Welding Shop will be concrete with a steel trowel finish and sealed with an approved sealer/hardener suitable for this service.

E. Metal panel wainscot 10 feet in height shall be installed in the building per the room finish schedule.

F. Provide a Code compliant welding exhaust system to remove the welding fumes. Submit fume exhaust system to the General Manager for approval before ordering and installing the system.

G. Provide a switch controlled cross ventilation for building cooling that shall include motorized louver and an exhaust fan that are located on opposite sides of the building. Air changes per hour shall meet OSHA and State of California requirements. No heaters are required for this building.

PART 6 - WATER LABORATORY BUILDING

A. The Water Laboratory Building will be located south of the OTSG and will house the steam water sample panel, a traditional power plant water chemistry lab complete with ventilation/exhaust hood, solid chemical resistant lab counter tops, industrial cabinetry,

SPECIFICATIONS FOR BIDDING ONLY

chemical sink and a 21cf refrigerator for storing collected water samples. Install water heater to service the lab sink and restroom.

B. The location of this building shall not restrict access to equipment inside the Power Block. As detail design progresses, the final location of this structure shall be determined to limit blocking the access area between the cooling tower and the OTSG, but still maintain safe operating distances from the ammonia injection manifold and vaporization equipment. Submit final location to General Manager for approval.

C. The Water Laboratory shall be a pre-engineered structural steel building erected on a separate concrete foundation with Pre-finished metal panel exterior walls, insulation and standing seam roof. A restroom is included in this building with pedestrian doors providing access from the Water Laboratory area and the exterior of the building. A storage closet is also to be provided. See Drawings A4-1, A4-2-1, A4-3-1, A9-1 and A9-2 illustrate the size and layout of this building.

1. The steam water analyzer / sample panel shall be located within this building. The intent is to have the operating face and sink in the lab area, while the back is accessible through the north wall. It needs to be accessible, but also protected from the weather. Describe how this will be accomplished with your proposal.

D. The Laboratory Building shall meet the respective minimum requirements as called for under the HVAC and plumbing criteria for the control building. Provide an exhaust fan in the restroom. Fan control shall be a timer switch.

E. Provide a “fume exhaust system” in the Water Lab. The exhaust inlet shall be set into wall cavity. The exhaust inlet shall be constructed out of stainless steel and shall be similar to the unit shown in the photo below except the face of the exhaust inlet shall be flush with the wall face.

SPECIFICATIONS FOR BIDDING ONLY



F. Provide a complete fume exhaust system in Water Laboratory Building. System shall include a 24" wide slotted wall hood constructed with a minimum 24 gauge stainless steel and inset into the wall cavity as located on the drawing. Ductwork shall be stainless steel with welded joints.

Fan shall be an external wall mount type and shall include a gravity backdraft damper; fan shall be operated with a local switch/timer combination. Construction and installation shall be in accordance with SMACNA, Industrial Ventilation published by the *American Conference of Governmental Industrial Hygienists* and all local and state codes.

1. The Laboratory Building will have a minimum of one floor drain with trap primer as described for the Control Building.
2. Building electrical shall be fed from the PDC. All electrical outlets in this building will be on a GFCI system. A minimum of eight outlets will be provided with one being in the restroom.

SPECIFICATIONS

PART 7 - GLENARM BUILDING

A. The Glenarm Building scope generally consists of compliance with preservation measures as defined as part of the CEQA process, and any areas affected by demolition activities defined in the Civil Section F of the main scope of work document, A-1 Complete details of the preservation work can be found XXXXXX.

1. As part of the circulating water tunnel demolition, the BOP contractor shall install a water stop, drill and install dowels for reinforcing the opening and placing structural concrete to fill and seal the openings to prevent water from penetrating the basement area.

2. All areas where existing concrete/structures are removed, such as the tunnel walls and the restroom, the concrete shall be repaired to match existing adjacent surfaces. Any area where the paint surface is missing or damaged shall be touched up to with materials and finishes to match existing adjacent surfaces.

3. All areas where structures, duct work, etc., are removed, leaving an opening into the building, shall be filled and sealed with a similar construction material as approved by the General Manager.

4. The plywood currently covering the opening on the south side of the building shall be replaced with marine grade plywood of thickness matching the existing. The panels shall be caulked, prime painted and finish painted to match the color of the exterior wall.

SPECIFICATIONS FOR BIDDING ONLY

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related Sections:

1. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
2. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

SPECIFICATIONS FOR BIDDING ONLY

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B and UL 10C.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.

SPECIFICATIONS FOR BIDDING ONLY

5. Steelcraft; an Ingersoll-Rand company.
6. Windsor Republic Doors.
7. Others as Approved

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum [A40 (ZF120)] [G60 (Z180) or A60 (ZF180)] metallic coating.

E. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Manufacturer's standard glazing that complies with requirements of the International Building Code 2006.

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.2 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel as indicated on the drawings.

2. Core Construction: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.

SPECIFICATIONS FOR BIDDING ONLY

1) Locations: Exterior doors and interior doors where indicated.

3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.

4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.

5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.3 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior and Interior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.

2. Fabricate frames as full profile welded unless otherwise indicated.

3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

SPECIFICATIONS FOR BIDDING ONLY

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.5 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.6 LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- ((0.5-mm-)) thick, cold-rolled steel sheet set into 0.032-inch-(0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

2.7 ACCESSORIES

A. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

2. Glazed Lites: Factory cut openings in doors.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

SPECIFICATIONS FOR BIDDING ONLY

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
        1) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        2) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        3) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
    b. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.

SPECIFICATIONS FOR BIDDING ONLY

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

3. Provide loose stops and moldings on inside of hollow metal work.

4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL DOOR FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.

1. Color and Gloss: As selected by Owner from manufacturer's full range of standard colors. Finish shall be Semi-Gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

SPECIFICATIONS FOR BIDDING ONLY

2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

6. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

SPECIFICATIONS FOR BIDDING ONLY

b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SPECIFICATIONS FOR BIDDING ONLY

SECTION 083323
OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulated service doors.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7 and the California Building Code.

1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.

a. Basic Wind Speed: 90 mph (40 m/s)

b. Importance Factor: 1.0.

c. Exposure Category: C.

2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa)] wind load, acting inward and outward as required by the California Building Code..

D. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996 and the California Building Code..

1. Large Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.

2. Small Missile Test: For overhead coiling doors located more than 30 feet (9.144 m) above grade.

SPECIFICATIONS FOR BIDDING ONLY

E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to the California Building Code.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

2. Seismic Component Importance Factor: 1.5].

F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

3. For fire-rated doors, description of fire-release system including testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches (305 mm) long[, including vision window secured to slat].

E. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.

2. Summary of forces and loads on walls and jambs.

SPECIFICATIONS FOR BIDDING ONLY

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and the California Building Code.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm) and as required to meet requirements.

2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.

3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

4. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.

B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks

SPECIFICATIONS FOR BIDDING ONLY

on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.3 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.4 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous sheet secured to inside of hood.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

2.5 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

SPECIFICATIONS FOR BIDDING ONLY

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum [25 lbf (111 N)] [30 lbf (133 N)] <Insert force> force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.7 DOOR ASSEMBLY <Insert drawing designation>

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved others.

a. Cookson Company.
b. Cornell Iron Works, Inc.
c. McKeon Rolling Steel Door Company, Inc.
d. Overhead Door Corporation.
e. Wayne-Dalton Corp.
f. Others as approved before bidding<Insert manufacturer's name>.

B. Operation Cycles: Not less than 20,000.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Flat Manufacturer’s standard width.

1. Insulated-Slat Interior Facing: Metal.

E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

SPECIFICATIONS FOR BIDDING ONLY

F. Hood: Galvanized steel

1. Shape: Round.
2. Mounting: Face of wall.

G. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.

1. Locking Device Assembly: Single-jamb side

H. Manual Door Operator: Chain-hoist operator

I. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Owner from manufacturer's full range of standard colors.
2. Factory Prime Finish: Manufacturer's standard color.
3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

SPECIFICATIONS FOR BIDDING ONLY

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

END OF SECTION 083323

SPECIFICATIONS FOR BIDDING ONLY

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

a. Swinging doors.
b. Other doors to the extent indicated.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames".

2. Division 08 Section "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.
c. Riser diagram.
d. Elevation of each door.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Qualification Data: For Installer and Architectural Hardware Consultant.

D. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

E. Warranty: Special warranty specified in this Section.

F. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures

SPECIFICATIONS FOR BIDDING ONLY

and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

b. Content: Include the following information:

1) Identification number, location, hand, fire rating and material of each door and frame.
2) Type, style, function, size, quantity, and finish of each door hardware item.
3) Complete designations of every item required for each door or opening including name and manufacturer.
4) Fastenings and other pertinent information.
5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) Door and frame sizes and materials.
9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

a) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

10) List of related door devices specified in other Sections for each door and frame.

c. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting

SPECIFICATIONS FOR BIDDING ONLY

services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
2. Review sequence of operation for each type of electrified door hardware.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed pivots] [and] [closers] with floor construction. Cast anchoring inserts into concrete.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices.

SPECIFICATIONS FOR BIDDING ONLY

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Five years from date of Substantial Completion, except as follows:

a. Exit Devices: Five years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part3 "Door Hardware Sets" Article.

C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

SPECIFICATIONS FOR BIDDING ONLY

2.2 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Unless otherwise indicated, provide the following:

1. All Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.

D. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

B. Template Hinge Dimensions: BHMA A156.7.

C. Manufacturers:

1. Hager Companies (HAG).
2. McKinney Products Company; an ASSA ABLOY Group company (MCK).
3. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
4. Others as approved

2.4 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." and ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Lock Trim:

SPECIFICATIONS FOR BIDDING ONLY

1. Levers: Forged
2. Escutcheons (Roses): Cast.

D. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

E. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:

1. Strikes for Locks and Latches: BHMA A156.2.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Lock Trim:

1. Description: Manufacturer's Standard.
2. Levers: Forged.
3. Operating Device: Lever with escutcheons (roses).

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
1. Basis-of-Design Product: Schlage D-Series, Extra Heavy Duty Commercial. Subject to compliance with requirements, provide product indicated on schedule or comparable approved product by one of the following:
   a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
   b. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
   c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   d. Schlage Commercial Lock Division; an Ingersoll-Rand company.
   e. Yale Security Inc.; an ASSA ABLOY Group company.
   f. Others as approved before bidding.

2.6 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

B. Dustproof Strikes: BHMA A156.16, Grade 1.

SPECIFICATIONS FOR BIDDING ONLY

C. Manual Flush Bolts: BHMA A156.16, Grade 1, designed for mortising into door edge.

1. Manufacturers:

a. Adams Rite Manufacturing Co. (ARM).
b. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
c. Hager Companies (HAG).
d. Hiawatha, Inc. (HIA).
e. IVES Hardware; an Ingersoll-Rand Company (IVS).
f. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
g. Others as approved

2.7 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5, Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Match Owners existing keying system.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Construction Keying: Comply with the following:

1. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

a. Replace construction cores with permanent cores as directed by Owner.
b. Furnish permanent cores to Owner for installation.

E. Manufacturer: Same manufacturer as for locks and latches.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix. Incorporate decisions made in keying conference, and as follows:

1. Keying system to be compatible with the Owner’s existing keying system.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

SPECIFICATIONS FOR BIDDING ONLY

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

2.9 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG) and ANSI A117.1.

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1 Listed under Category C in BHMA's "Certified Product Directory." Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Manufacturers:

a. LCN Closers; an Ingersoll-Rand Company (LCN).
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
c. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
d. Others as approved

2.10 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in door hardware sets.

B. Fasteners: Manufacturer's standard machine or self-tapping screws.

C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch- (1.3-mm-) thick stainless steel.
2. Manufacturers:

SPECIFICATIONS FOR BIDDING ONLY

a. Baldwin Hardware Corporation (BH).
b. Hager Companies (HAG).
c. Hiawatha, Inc. (HIA).
d. IVES Hardware; an Ingersoll-Rand Company (IVS).
e. Others as approved

2.11 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16, Grade 1.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

C. Manufacturers:

1. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
2. Hager Companies (HAG).
3. IVES Hardware; an Ingersoll-Rand Company (IVS).
4. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
5. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
6. Others as approved

2.12 DOOR GASKETING

A. Standard: BHMA A156.22 Listed under Category J in BHMA's "Certified Product Directory."

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to [NFPA 252] [UBC Standard 7-2].

SPECIFICATIONS FOR BIDDING ONLY

F. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

G. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

H. Manufacturers:

1. Hager Companies (HAG).
2. Pemko Manufacturing Co. (PEM).
3. Zero International (ZRO).
4. Others as approved

2.13 THRESHOLDS

A. Standard: BHMA A156.21, Listed under Category J in BHMA's "Certified Product Directory."

B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG) and ANSI A117.1.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

D. Manufacturers:

1. Hager Companies (HAG).
2. Pemko Manufacturing Co. (PEM).
3. Zero International (ZRO).
4. Others as approved

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

SPECIFICATIONS FOR BIDDING ONLY

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
    a. Surface hinges to doors.
    b. Closers to doors and frames.
    c. Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

D. Standard: BHMA A156.18, as indicated in door hardware sets.

E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

F. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

SPECIFICATIONS FOR BIDDING ONLY

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

SPECIFICATIONS FOR BIDDING ONLY

3.6 DOOR HARDWARE SETS

ALL HARDWARE SHALL HAVE SATIN CHROME FINISH - US26D (BHMA 626).

A. General: Provide hardware for each door to comply with requirements of Section "Door Hardware," hardware group numbers indicated in door schedule, and in the following schedule of hardware groups.

1. Hardware groups indicate quantity, item, manufacturer's designation, size, and finish or color, as applicable.

B. Hardware Group No. 1 (Single Door with Office Function Lockset): Doors 101A, 107A, 109A, 110A, 111A, 112A, 113A.

1 ½ Pair Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each Lockset	Schlage – D50PD – RHO 626 (Office Function)
1 Each Wall Bumper	Ives - WS401 CCV

C. Hardware Group No. 2 (Exterior Single Door with Exit Device Function Lockset): Doors 108A, 108B.

1 ½ Pair Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each Lockset	Schlage – D70PD – RHO-626 (Entrance Function)r
1 Each Closer	LCN – 4111
1 Set Weatherstripping	Pemko – 379CPK
1 Each Threshold	Pemko – 2005AT
1 Each Floor Stop	Ives – FS441

D. Hardware Group No. 3 (Single Interior Door with Passage Function Latchset): Door 102A, 118D, M-102A.

1 ½ Pair Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each Latchset	Schlage – D10S – RHO 626 (Passage Function)
1 Each Wall Bumper	Ives - WS401 CCV

E. Hardware Group No. 4 (Single Interior Door with Classroom Function Lockset): Doors 103A, 104A, 106A, 114A, M-201A.

1 ½ Pair Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each Lockset	Schlage – D70PD – RHO 626 (Classroom Function)
1 Each Wall Bumper	Ives - WS401 CCV

F. Hardware Group No. 5 (Single Interior Door with Push – Pull Function): Door 115A, 116A.

1 1/2 Pair Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each Closer	LCN – 4111
1 Each Push Plates	Ives – 8200 – 4” x 16” – Stainless Steel
1 Each Pull with Plate	Ives – 8305 – 4” x 16” – Stainless Steel
1Set – Perimeter Gasketing	Pemko – 332CR

SPECIFICATIONS FOR BIDDING ONLY

1 Each	Kick Plate	Ives – 8400 – 18" high x door width minus 2" – Stainless Steel - 0.050 Thick – Beveled 3 sides. (Install on "Push" side of door).
1 Each	Wall Bumper	Ives - WS401 CCV

G. Hardware Group No. 6 (Single Interior Door with Privacy Function Latchset): Door 115B, 115C, 116B, 116C

1 ½ Pair	Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each	Latchset	Schlage – D40S – RHO 626 (Privacy Function)
1 Each	Wall Bumper	Ives - WS401 CCV

H. Hardware Group No. 7 (Single Interior Door with Classroom Function Lockset): Door: 117A

1 ½ Pair	Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each	Lockset	Schlage – D70PD – RHO– 626 (Classroom Function)
1 Each	Closer	LCN – 4111
1 Each	Wall Bumper	Ives - WS401 CCV

I. Hardware Group No. 8 (Pair of Exterior Doors with Exit Device Function Lockset): Door 117B

3 Pair	Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each	Lockset	Schlage – D70PD – RHO-626 (Entrance Function) Mount on Active Door
1 Pair	Automatic Flush Bolts	Ives FB51P with Dust Proof Strike DP2
1 Each	Astragal	Pemko – 355CP Install on Active Door
2 Each	Closer	LCN – 4111
1 Set	—Weatherstripping	Pemko – 379CPK
1 Each	Threshold	Pemko – 2005AT
2 Each	Floor Stop	Ives – FS446

J. Hardware Group No. 9 (Exterior Single Door with Entry Function Lockset): Doors: 105A, 119B, M-102B, W-106A, W-106D, M-201B..

1 ½ Pair	Butts	Hager – BB1191 --- 4 1/2 x 4 ½
1 Each	Lockset	Schlage – D70PD – RHO-626 (Entrance Function)r
1 Set	Weatherstripping	Pemko – 379CPK
1 Each	Threshold	Pemko – 2005AT
1 Each	Floor Stop	Ives – FS441

K. Hardware Group No. 10 (Hardware provided by door manufacturer.) Doors: M-100A, W-106B, W-106C, W-106E.

END OF SECTION 087100

SPECIFICATIONS FOR BIDDING ONLY

SECTION 092900
GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

B. Related Sections include the following:

1. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

SPECIFICATIONS FOR BIDDING ONLY

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. G-P Gypsum.
b. Lafarge North America Inc.
c. National Gypsum Company.
d. USG Corporation.
e. Others as approved.

B. Type X:

1. Thickness: 5/8 inch (15.9 mm).

2. Long Edges: Tapered for prefilling].

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead.

b. LC-Bead: J-shaped; exposed long flange receives joint compound.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping.

4. Finish Coat: For third coat, use setting-type, sandable topping compound.

SPECIFICATIONS FOR BIDDING ONLY

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

E. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

F. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

SPECIFICATIONS FOR BIDDING ONLY

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

   b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

   a. Primer and its application to surfaces are specified in other Division 09 Sections.

SPECIFICATIONS FOR BIDDING ONLY

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SPECIFICATIONS FOR BIDDING ONLY

SECTION 093100
CERAMIC TILE

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ceramic mosaic tile.
2. Glazed wall tile.
3. Cementitious backer units.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 SUBMITTALS

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

C. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

D. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1. Each type and composition of tile and for each color and texture required.
2. Full-size units of each type of trim and accessory for each color required.
3. Obtain Owner’s approval before ordering the tile units.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

1.5 QUALITY ASSURANCE

SPECIFICATIONS FOR BIDDING ONLY

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

1. Cementitious backer units.
2. Joint sealants.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

SPECIFICATIONS FOR BIDDING ONLY

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the ceramic tile installation schedules at the end of this Section.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tile Products:
    a. American Olean Tile Company.
    b. Dal-Tile Corporation.
    c. Summitville Tiles, Inc.

2. Tile-Setting and -Grouting Materials:
    a. American Olean Tile Company.
    b. Dal-Tile Corporation.
    c. Summitville Tiles, Inc.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide Owner's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
2. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

SPECIFICATIONS FOR BIDDING ONLY

E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

A. Unglazed Ceramic Mosaic Floor Tile: Provide factory-mounted flat tile complying with the following requirements:

1. Composition: Porcelain with abrasive admixture.
2. Module Size: 1 by 1 inch (25.4 by 25.4 mm).
3. Nominal Thickness: 1/4 inch (6.35 mm).
4. Face: Plain with cushion edges.

B. Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 4-1/4 by 4-1/4 inches (108 by 108 mm).
2. Thickness: 5/16 inch (8 mm).
3. Face: Plain with cushion edges.

C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:
   a. Base: Coved.
   b. External Corners: Bullnose shape with a radius of at least 3/4 inch (19 mm), unless otherwise indicated.
   c. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.
   d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide a reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.35 mm) across nominal 4-inch (100-mm) dimension.

2.4 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

A. General: Provide products that comply with ANSI A118.10 and the descriptions in this Article.

B. PVC-Sheet Waterproofing: Manufacturer's standard proprietary product consisting of composite sheets, 60 inches (152 mm) wide by a nominal thickness of 0.040 inches (1.01 mm), composed of an inner membrane of 2 layers of PVC sheet heat-fused together and to facings of bondable nonwoven polyester, designed for embedding in latex-portland cement mortar and as the substrate for latex-portland cement mortar setting bed.

SPECIFICATIONS FOR BIDDING ONLY

C. Available Products: Subject to compliance with requirements, products which may be incorporated into the Work include, but are not limited to, the following:

1. PVC-Sheet Waterproofing:

a. Composeal Gold; Compotite Corporation.

2.5 SETTING MATERIALS

A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1A and as specified below:

B. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

a. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

C. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:

1. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

a. Latex Additive: Acrylic resin.

2.6 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118.6 for materials described in Section H-2.4, composed as follows:

1. Factory-Prepared, Dry-Grout Mixture: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to produce the following:

a. Unsanded grout mixture for joints 1/8 inch (3.2 mm) and narrower.

2.7 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of tile manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

SPECIFICATIONS FOR BIDDING ONLY

C. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

D. Available Products: Subject to compliance with requirements, products which may be incorporated into the Work include, but are not limited to, the following:

1. Multipart, Pourable Urethane Sealants:

a. Chem-Calk 550; Bostik.
b. NR-200 Urexpan; Pecora Corp.
c. THC-900; Tremco, Inc.

2.8 CEMENTITIOUS BACKER UNITS

A. Provide cementitious backer units complying with ANSI A118.9, of thickness and width indicated below, and in maximum lengths available to minimize end-to-end butt joints.

1. Thickness: 5/8 inch (15.9 mm), where indicated.

2. Width: Manufacturer's standard width, but not less than 32 inches (813 mm).

B. Available Products: Subject to compliance with requirements, cementitious backer units that may be incorporated into the Work include, but are not limited to, the following:

1. DUROCK Cement Board; United States Gypsum Co.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

SPECIFICATIONS FOR BIDDING ONLY

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Owner.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for

SPECIFICATIONS FOR BIDDING ONLY

straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants.

G. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

H. Install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.6 WALL TILE INSTALLATION

SPECIFICATIONS FOR BIDDING ONLY

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
2. Wall Tile: 1/16 inch (1.6 mm).

3.7 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.8 CERAMIC TILE FLOOR INSTALLATION SCHEDULE

A. Ceramic Tile Floor Installation: Interior floor installations; comply with the following:

1. Tile Type: To be selected from manufacturer’s full line of products.
2. Installation Method: TCA F121 (cement mortar bed bonded to waterproof membrane over concrete subfloor).
    a. Setting Bed and Grout: ANSI A108.1A with the following mortar and grout:
    b. Latex-portland cement mortar.
    c. Commercial portland cement grout.

3.9 CERAMIC TILE WALL INSTALLATION SCHEDULE

SPECIFICATIONS FOR BIDDING ONLY

A. Ceramic Tile Wall Installations: Interior wall installations; comply with the following:

1. Tile Type: Glazed wall tile. Available products include the following: To be selected from manufacturer's full line of products.
2. Installation Method: TCA W244 (thin-set mortar bonded to cementitious backer units on metal studs).
3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:
   a. Latex-portland cement mortar.
   b. Commercial portland cement grout.

END OF SECTION 09310

SPECIFICATIONS FOR BIDDING ONLY

SECTION 095113
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square, Samples of each type, color, pattern, and texture.

2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

C. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."

4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."

5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

B. COORDINATION

1. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

SPECIFICATIONS FOR BIDDING ONLY

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide “Eclipse (ClimaPlus) Size: 2’ x 4’ x ¾”, Item # 78575 as manufactured by USG, or an approved comparable product by one of the following:

1. Armstrong World Industries, Inc.;
2. Others As Approved

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2.

C. Characteristics

1. Color: White.
2. LR: Not less than 0.84.
3. NRC: Not less than 0.70.
4. CAC: Not less than 35.
5. Edge/Joint Detail: SQ.
6. Thickness: 3/4 inch (19 mm)
7. Modular Size: 24 by 48 inches (610 by 1220 mm)

SPECIFICATIONS FOR BIDDING ONLY

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled Device. Submit attachment fastener to structural engineer for approval before installation of suspension system.

b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: NOT ALLOWED.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

SPECIFICATIONS FOR BIDDING ONLY

K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Donn DXW Exposed Ceiling Grid as manufactured by USG, or a comparable product by one of the following:

1. Armstrong World Industries, Inc.;
2. Others as approved

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.;
2. USG Interiors, Inc.;.
3. Others as approved

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

SPECIFICATIONS FOR BIDDING ONLY

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.
   c. Others as approved.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

SPECIFICATIONS FOR BIDDING ONLY

6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

a. As indicated on reflected ceiling plans.

b. Install panels with pattern running in one direction parallel to long axis of space.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SPECIFICATIONS FOR BIDDING ONLY

SECTION 096513
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

B. Related Sections:

1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

A. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

B. Product Schedule: For resilient products.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.

SPECIFICATIONS FOR BIDDING ONLY

3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

SPECIFICATIONS FOR BIDDING ONLY

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong World Industries, Inc.
b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
c. Johnsonite.
d. Mondo Rubber International, Inc.
e. Roppe Corporation, USA.
f. Others as Approved.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).

2. Manufacturing Method: Group I (solid, homogeneous).

3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: Matte.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    b. Flexco, Inc.
    c. Johnsonite.
    d. Roppe Corporation, USA.
    e. Others as Approved.

B. Description: Reducer strip for resilient floor covering to concrete floor.

C. Material: Vinyl or Rubber.

D. Colors and Patterns: As selected by Architect from full range of industry colors].

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

SPECIFICATIONS FOR BIDDING ONLY

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Inside Corners: Use straight pieces of maximum lengths possible.

SPECIFICATIONS FOR BIDDING ONLY

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SPECIFICATIONS FOR BIDDING ONLY

SECTION 096519
RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of floor tile indicated.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile.

E. Qualification Data: For qualified Installer.

F. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

SPECIFICATIONS FOR BIDDING ONLY

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Standard Excelon VCT Floor Tile as manufactured by Armstrong World Industries, Inc. or comparable product by one of the following:

1. Congoleum Corporation.
2. Mannington Mills, Inc.
3. Tarkett, Inc.
4. Others as Approved.

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

SPECIFICATIONS FOR BIDDING ONLY

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

SPECIFICATIONS FOR BIDDING ONLY

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

SPECIFICATIONS FOR BIDDING ONLY

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply one coat.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SPECIFICATIONS FOR BIDDING ONLY

SECTION 096723
RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Industrial resinous flooring systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

D. Product Schedule: For resinous flooring.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

SPECIFICATIONS FOR BIDDING ONLY

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide:

1. Sherwin-Williams Company; General Polymers.
   a. Primer: One (1) Coat Sherwin Williams ArmorSeal 33 Epoxy Primer Sealer
   b. Top Coat: One (1) Coat Sherwin Williams ArmorSeal 650 or comparable product by one of the following:
2. DUDICK Inc.
3. PPG Industries, Inc.
4. Rust-Oleum Corporation.
5. Tnemec Company, Inc.
6. Others as approved before bidding.

2.2 MATERIALS

A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

SPECIFICATIONS FOR BIDDING ONLY

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 INDUSTRIAL RESINOUS FLOORING

A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. System Characteristics:

1. Color and Pattern: As selected by Owner from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Overall System Thickness: 1/16 inch (1.6 mm).

C. Primer Coat: (One Coat)

1. Resin: Epoxy.
2. Formulation Description: 100 percent solids.
3. Application Method: Self-leveling slurry with broadcast aggregates
   a. Thickness of Coats: 1/16 inch (1.6 mm).
   b. Number of Coats: One.
4. Aggregates: Silica Sand 30-50 grit, embedded in the primer coat.

D. Broadcast Aggregate:

1. Aggregate: Silica Sand 30-50 grit, embedded in the primer coat.
2. Broadcast while primer is still “wet”.
3. Aggregate will be sealed in place with top Coat

E. Topcoat: Sealing / finish coat (One Coat).

1. Resin: Epoxy.
2. Formulation Description: 100 percent solids.
3. Type: Pigmented.
4. Finish: Low Sheen.
5. Number of Coats: One.

F. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to STM D 1308 for 50 percent immersion in the following reagents for no fewer than seven days:

2.4 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

SPECIFICATIONS FOR BIDDING ONLY

1. Formulation Description: 100 percent solids.

B. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

   b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.

3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) or resinous floor coatings maximum amount whichever is the most stringent.

   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [75] <Insert number> percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

5. Provide Test Results to the Project Engineer indicating satisfactory conditions exist for installation of the resinous flooring. Obtain approval from the Project Engineer before starting installation of the resinous flooring product.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

SPECIFICATIONS FOR BIDDING ONLY

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches (100 mm) high.

D. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

E. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.

3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

SPECIFICATIONS FOR BIDDING ONLY

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SPECIFICATIONS FOR BIDDING ONLY

SECTION 096900
ACCESS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access-flooring panels.
2. Understructure.
3. Floor panel coverings.

1.3 ALLOWANCES

A. Price in to the bid the following:

1. Six (6) each duplex outlets to be installed the access floor panels.
2. Eight (8) Phone / Data port outlets to be installed in the access floor panels.

B. Location of the openings will be determined during the review of the shop / layout drawings.

1.4 COORDINATION

A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.

B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1. Review connection with mechanical and electrical systems.
2. Review procedures for keeping underfloor space clean.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

SPECIFICATIONS FOR BIDDING ONLY

B. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.

1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples:

1. Floor Covering: Full-size units for each color and texture specified.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

D. Samples for Initial Selection: For each type of product and exposed finish.

E. Samples for Verification: For the following products:

1. Floor Covering: Full-size units.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of access-flooring system.

C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.

D. Seismic Design Calculations: For seismic design of access-flooring systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Preconstruction Test Reports: For preconstruction adhesive field test.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flooring Panels: Five (5) extra panels
2. Pedestals: Twelve (12) extra pedestals
3. Stringers: Eight (8) extra stringers

SPECIFICATIONS FOR BIDDING ONLY

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and the California Building Code.

B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":

1. Concentrated Loads: 1250 lbf (5560 N) with the following deflection and permanent set:
   a. Top-Surface Deflection: 0.10 inch (2.54 mm)
   b. Permanent Set: 0.010 inch (0.25 mm).
2. Ultimate Loads: 2500 lbf (11 121 N).
3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch (1.02 mm).
   a. CISCA Wheel 1: 10 passes at 1000 lbf (4448 N).
   b. CISCA Wheel 2: 10,000 passes at 800 lbf (3559 N).
4. Stringer Load Test: 450 lbf (2002 N) at center of span with a permanent set not to exceed 0.010 inch (0.25 mm).
5. Pedestal Axial Load Test: 5000 lbf (22 240 N).
6. Pedestal Overturning Moment Test: 1000 lbf x inches (113 N x meters).
7. Uniform Load Test: 400 lbf/sq. ft. (19.2 kPa) with a maximum top-surface deflection not to exceed 0.040 inch (1.02 mm) and a permanent set not to exceed 0.010 inch (0.25 mm).
8. Drop Impact Load Test: 150 lb (68.0 kg).

C. Fire Performance:

SPECIFICATIONS FOR BIDDING ONLY

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 50 or less.
2. Combustion Characteristics: ASTM E 136.

2.2 MANUFACTURERS

A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

2.3 FLOOR PANELS

A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.
   1. Size: Nominal 24 by 24 inches (610 by 610 mm).
   2. Attachment to Understructure: Bolted.

B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Concore 1250 as manufactured by Tate Access Floors, Inc. or comparable product by one of the following:
      a. ASM Modular Systems, Inc.
      b. Bergvik North America, Inc.
      c. Camino Modular Systems, Inc.
      d. Computer Environments, Inc.
      e. Others as approved before bidding.

2.4 UNDERSTRUCTURE

A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
   1. Provide pedestals designed for use in seismic applications.
   2. Base: Square or circular base with not less than 16 sq. in. (103 sq. cm) of bearing area.
   3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
   4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches (51 mm) and for locking at a selected height,

SPECIFICATIONS FOR BIDDING ONLY

so deliberate action is required to change height setting and prevent vibratory displacement.

5. Head: Designed to support the panel system indicated.

   a. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.

B. Stringer Systems: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

2.5 FLOOR PANEL COVERINGS

A. Vinyl Composition Tile: The access panels shall be covered with Factory applied 1/8" thick VCT (Vinyl Composition Tile). The VCT installed on the access floor panels shall match the VCT being installed in other areas of the building.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide VCT (Vinyl Composition Tile) as manufactured Armstrong Commercial Floors. Tile pattern shall be 1/8" Exelon Standard 1/8" thick tile or approved.

3. Colors, Textures, and Patterns: As selected by the Owner from manufacturer's full range of standard patterns and colors.

2.6 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch (0.50 mm) of required size.

2. Squareness: Plus or minus 0.015 inch (0.38 mm) between diagonal measurements across top of panel.

3. Flatness: Plus or minus 0.035 inch (0.89 mm), measured on a diagonal on top of panel.

B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

SPECIFICATIONS FOR BIDDING ONLY

D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Please refer to Paragraph 1.3 above.

2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange.

2.7 ACCESSORIES

A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

1. Adhesive shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)and shall also comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:

1. Structural Performance: Cover capable of supporting a 800-lbf (3559-N)

2. Cover and Box Type: Confirm with Owner on type of box re required.

3. Location: Confirm various locations with Owner.

4. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:

a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.

b. Number of Receptacles for Outlet: Four.

c. Wiring Method: Factory wired for hardwiring in field with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch- (152-mm-) long pigtail.

C. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required.

D. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

SPECIFICATIONS FOR BIDDING ONLY

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.

2. Verify that concrete floor sealer and finish have been applied and cured.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.

C. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.

D. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

E. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.

F. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

G. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.

SPECIFICATIONS FOR BIDDING ONLY

H. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.

I. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.

J. Install access flooring without change in elevation between adjacent panels and within the following tolerances:

1. Plus or minus 1/16 inch (1.5 mm) in any 10-foot (3-m) distance.

3.4 PROTECTION

A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.

B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 096900

SPECIFICATIONS FOR BIDDING ONLY

SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Gypsum board.
2. Steel Door Frames

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

SPECIFICATIONS FOR BIDDING ONLY

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 LEED Submittals:

1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

2. Laboratory Test Reports for Credit EQ 4: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

3. VOC content.

SPECIFICATIONS FOR BIDDING ONLY

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.8 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. ICI Paints.
4. Kelly-Moore Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).
7. Others as Approved

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].

SPECIFICATIONS FOR BIDDING ONLY

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Painting Sub-Contractor shall be solely responsible for VOC compliance with the requirements of the authority having jurisdiction and the laws of the State of California.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.4 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

2.5 LATEX PAINTS

A. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

B. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).

2.6 ALKYD PAINTS

A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).

2.7 QUICK-DRYING ENAMELS

A. Quick-Drying Enamel (Semigloss) MPI #81 (Gloss Level 5)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Notify Project Manager of any conditions that will prevent or negatively impact the quality of the finished work.

SPECIFICATIONS FOR BIDDING ONLY

C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Gypsum Board: 12 percent.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

SPECIFICATIONS FOR BIDDING ONLY

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Quick-Drying Enamel System: MPI INT 5.1A.

SPECIFICATIONS FOR BIDDING ONLY

a. Prime Coat: Quick-drying alkyd metal primer.

b. Topcoat: Quick-drying enamel (semigloss).

B. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer.

b. Topcoat: Interior latex (semigloss).

END OF SECTION 099123

SPECIFICATIONS FOR BIDDING ONLY

SECTION 102113
TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Laboratory Test Reports for Credit IEQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.

D. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

SPECIFICATIONS FOR BIDDING ONLY

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in California Building Code and related accessibility requirements for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Brass Castings: ASTM B 584.

D. Brass Extrusions: ASTM B 455.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.

F. Zamac: ASTM B 86, commercial zinc-alloy die castings.

SPECIFICATIONS FOR BIDDING ONLY

G. Particleboard: ANSI A208.1, Grade M-2 with 45-lb (20.4-kg) density that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 STEEL UNITS <Insert drawing designation>

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work:

1. American Sanitary Partition Corporation.
2. Bradley Corporation; Mills Partitions.
3. Global Steel Products Corp.
4. Hadrian Manufacturing Inc.
5. Sanymetal; a Crane Plumbing company.
6. Others as approved before bidding

B. Toilet-Enclosure Style: Overhead braced, Floor anchored

C. Urinal-Screen Style: Wall hung, flat panel

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.

2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.

3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.

F. Facing Sheets and Closures: Hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.036 inch (0.91 mm).

SPECIFICATIONS FOR BIDDING ONLY

2. Panels: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm) Doors: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm).

3. Flat-Panel Urinal Screens: Thickness matching the panels.

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

H. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; chrome-plated zamac

I. Steel-Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking. Apply one color in each room.

1. Color: As selected by Owner from manufacturer's full range of standard colors.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Chrome-plated zamac

2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.

3. Latch and Keeper: Manufacturer's standard [recessed] [surface-mounted] latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.

6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

SPECIFICATIONS FOR BIDDING ONLY

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).

b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SPECIFICATIONS FOR BIDDING ONLY

SECTION 102800
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Underlavatory guards.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Owner.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Other manufacturers' products with equal characteristics may be considered. See Division 1 Section "Substitutions."

SPECIFICATIONS FOR BIDDING ONLY

2. Do not modify aesthetic effects, as judged solely by Owner, except with Owner's approval. Where modifications are proposed, submit comprehensive explanatory data to Owner for review.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:

1. Toilet and Bath Accessories:
   a. Bobrick Washroom Equipment, Inc.
   b. Bradley Corporation.
2. Underlavatory Guards:
   a. Brocar Products, Inc.
   b. Truebro, Inc.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Toilet and Bath Accessory Schedule at the end of Part 3.

SPECIFICATIONS FOR BIDDING ONLY

C. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Toilet and Bath Accessory Schedule at the end of Part 3.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. General: One, maximum 1-1/2-inch- (38-mm-) diameter, unobtrusive stamped manufacturer logo, as approved by Owner, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

SPECIFICATIONS FOR BIDDING ONLY

1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows: (Contractor's Option)

1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. Toilet Tissue Dispenser: Provide toilet tissue dispenser complying with the following:

1. Type: Double-roll dispenser.

2. Mounting: Surface mounted with concealed anchorage.

SPECIFICATIONS FOR BIDDING ONLY

3. Material: Satin-finish aluminum bracket with plastic spindle.
4. Operation: Noncontrol delivery with mfr's standard spindle.
5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter-core tissue rolls.

B. Combination Towel Dispenser/Waste Receptacle: Provide stainless-steel combination unit complying with the following:

1. Recessed Type with Projecting Receptacle: Designed for nominal 4-inch (100-mm) wall depth with continuous, seamless wall flange; towel dispenser in unit's upper compartment designed to dispense minimum of 600 C-fold or 800 multifold paper towels; waste receptacle in unit's lower portion secured by tumbler lockset and with minimum 12-gal. (45.4-L) capacity, reusable, vinyl liner; and upper compartment double-panel door with continuous hinge and tumbler lockset.

C. Soap Dispenser: Provide soap dispenser complying with the following:

1. Liquid Soap Dispenser, Horizontal-Tank Type: Surface-mounted type, minimum 40-oz. (1182.9-mL) capacity tank with stainless-steel piston, springs, and internal parts designed to dispense soap in measured quantity by pump action; and stainless-steel cover with unbreakable window-type refill indicator.
    a. Soap Valve: Designed for dispensing soap in liquid form.

D. Grab Bar: Provide stainless-steel grab bar complying with the following:

1. Stainless-Steel Nominal Thickness: Minimum 0.05 inch (1.3 mm).
2. Mounting: Concealed with manufacturer's standard flanges and anchors.
3. Gripping Surfaces: Manufacturer's standard slip-resistant texture.
4. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications.

E. Sanitary Napkin Vendor: Provide stainless-steel sanitary napkin vendor complying with the following:

1. General: Fabricate cabinet of all-welded construction. Provide seamless door with returned edges and secured by tumbler lockset. Provide identification reading "Napkins" and "Tampons"; brand-name advertising is not allowed. Capacity not less than 15 napkins and 20 tampons.
2. Mounting: Fully recessed type designed for nominal 4-inch (100-mm) wall depth.
3. Operation: Single-coin operation, 25 cents.

F. Sanitary Napkin Disposal Unit: Provide stainless-steel sanitary napkin disposal unit complying with the following:

1. Surface-Mounted Type: With seamless exposed walls; self-closing top cover; locking bottom panel with stainless-steel, continuous hinge; and removable, reusable receptacle.

G. Seat-Cover Dispenser: Provide seat-cover dispenser complying with the following:

SPECIFICATIONS FOR BIDDING ONLY

1. Surface-Mounted Type: Stainless-steel unit with concealed opening at bottom for filling; minimum 250-seat-cover capacity.

H. Mirror Unit: Provide mirror unit complying with the following:

1. Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.

a. Shelf: Stainless steel in thickness recommended by manufacturer, but not less than thickness of mirror frame, approximately 5 inches (127 mm) deep by width of mirror, with edges turned down and returned for rigidity; secure shelf to bottom of mirror frame and provide concealed, rigid bracket supports for widths exceeding 36 inches (900 mm).

b. Mirror Size: 24" w x 36" h

I. Mop and Broom Holder: Provide mop and broom holder complying with the following:

1. Mop and Broom Holder with Utility Shelf: 36-inch- (914-mm-) long unit fabricated of minimum nominal 0.05-inch- (1.3-mm-) thick stainless steel with shelf; support brackets for wall mounting; three hooks for wiping rags; four spring-loaded, rubber hat, cam-type, mop/broom holders mounted on front of shelf; and approximately 1/4-inch- (6-mm-) diameter, stainless-steel rod suspended beneath shelf for drying rags.

J. Underlavatory Guard: Provide underlavatory guard complying with the following:

1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

Toilet and Bath Accessory Schedule

Control Building Women's Bathroom – Room 116

1 each	Toilet Tissue Dispenser	Bobrick	B-2740
1 each	Combination Paper Towel Dispenser/Waste Receptacle	Bobrick	B-3944
1 each	Soap Dispenser	Bobrick	B-2112
1 each	Toilet Grab Bar	Bobrick	B-62616 (42" x 54") LH
1 each	Toilet Grab Bar	Bobrick	B-5806 x 18 (Vertical Mounted)
1 each	Seat Cover Dispenser	Bobrick	B-221
1 each	Mirror/Shelf Combination	Bobrick	B-166 24"w x 36"h
1 each	Shower Grab Bar	Bobrick	B-68137 (36" x 54")
1 each	Shower Grab Bar	Bobrick	B-5806 x 18 (Vertical Mounted)
1 each	Underlavatory Guard	Brocar Products, Inc.	
1 each	Sanitary Napkin/Tampon Dispenser	Bobrick	B-3500
1 each	Sanitary Napkin Disposal	Bobrick	B-270

SPECIFICATIONS FOR BIDDING ONLY

Control Building Men's Bathroom – Room 115

1 each	Toilet Tissue Dispenser	Bobrick	B-2740
1 each	Combination Paper Towel Dispenser/Waste Receptacle	Bobrick	B-3944
1 each	Soap Dispenser	Bobrick	B-2112
1 each	Toilet Grab Bar	Bobrick	B-62616 (42" x 54") LH
1 each	Toilet Grab Bar	Bobrick	B-5806 x 18 (Vertical Mounted)
1 each	Seat Cover Dispenser	Bobrick	B-221
2 each	Mirror/Shelf Combination	Bobrick	B-166 24"w x 36"h
1 each	Shower Grab Bar	Bobrick	B-68137 (36" x 54")
1 each	Shower Grab Bar	Bobrick	B-5806 x 18 (Vertical Mounted)
1 each	Underlavatory Guard	Brocar Products, Inc.	

Control Building - Janitor's Closet – Room 103

Water Laboratory Building -- Bathroom – Room 119

1 each	Toilet Tissue Dispenser	Bobrick	B-2740
1 each	Combination Paper Towel Dispenser/Waste Receptacle	Bobrick	B-3944
1 each	Soap Dispenser	Bobrick	B-2112
1 each	Toilet Grab Bar	Bobrick	B-62616 (42" x 54") LH
1 each	Toilet Grab Bar	Bobrick	B-5806 x 18 (Vertical Mounted)
1 each	Seat Cover Dispenser	Bobrick	B-221
1 each	Mirror/Shelf Combination	Bobrick	B-166 24"w x 36"h
1 each	Underlavatory Guard	Brocar Products, Inc.	

END OF SECTION 102800

SPECIFICATIONS FOR BIDDING ONLY

SECTION 105113
METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard metal lockers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.

1. Show locker trim and accessories.

2. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

C. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures.
    b. Faulty operation of latches and other door hardware.
2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

SPECIFICATIONS FOR BIDDING ONLY

C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.

D. Steel Tube: ASTM A 500, cold rolled.

E. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

F. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.

2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 STANDARD METAL LOCKERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Art Metal Products; Standard K.D. Lockers.
2. Lyon Workspace Products, LLC; Standard Lockers.
3. Penco Products, Inc.; Vanguard Lockers.
4. Republic Storage Systems Company; Standard Lockers.
5. Others as Approved.

B. Locker Arrangement: Single tier configuration.

C. Quantity: As indicated on the drawings.

D. Locker Size

1. Size per locker opening: 12”w x 12”d x 72”high

E. Material: Metallic-coated steel sheet.

F. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.

2. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.

3. Shelves: 0.024-inch (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.

G. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

SPECIFICATIONS FOR BIDDING ONLY

H. Doors: One piece; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches (305 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

2. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

3. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.

4. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.

5. Door Style: Vented panel as follows:

a. Louvered Vents: No fewer than three louver openings at top and bottom for double-tier lockers.

I. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

J. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks]; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

c. Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

K. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:

1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

L. Accessories:

a. Closed Front and End Bases: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.

SPECIFICATIONS FOR BIDDING ONLY

2. Continuous Zee Base: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.

   a. Height: 4 inches (102 mm.

3. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm)] nominal-thickness steel sheet.

4. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm)] nominal-thickness steel sheet.

5. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

M. Finish: Baked enamel or powder coat.

1. Color(s): As selected by Architect from manufacturer's full range.

2.3 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.

2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.

D. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.

G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

SPECIFICATIONS FOR BIDDING ONLY

I. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

K. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.4 STEEL SHEET FINISHES

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

OR

C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.

2. Anchor single rows of metal lockers to walls near top of lockers and to floor].

3. Anchor back-to-back metal lockers to floor.

SPECIFICATIONS FOR BIDDING ONLY

B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Identification Plates: Identify metal lockers with identification indicated on Drawings.
    a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
3. Attach recess trim to recessed metal lockers with concealed clips.
4. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
5. Attach sloping-top units to metal lockers, with closures at exposed ends.
6. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding..

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SPECIFICATIONS FOR BIDDING ONLY

SECTION 123200
MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced wood cabinets of stock design.
2. Solid-surfacing-material countertops.

B. Related Sections:

1. Section 123553 "Laboratory Casework."

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets.

C. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semi-exposed.

D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 ACTION SUBMITTALS

1. Laboratory Test Reports for Credit IEQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.

D. Samples for Verification: 8-by-10-inch (200-by-250-mm) Samples for each type of finish, including top material and the following:

1. Section of countertop showing top, front edge, and backsplash construction.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.7 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."

1. Provide AWI Quality Certification Program certificate indicating that manufactured wood casework complies with requirements.

B. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for Custom grade.

1. Provide WI-certified compliance certificate indicating that manufactured wood casework complies with requirements of grades specified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers of Plastic-Laminate-Faced Manufactured Casework:

B. Basis-of-Design Product:

1. Subject to compliance with requirements, provide CampbellRhea; a Sagas International company, or comparable product.

a. Submit name of casework manufacturer, with product literature to General Manager for approval before ordering casework.

2.2 MATERIALS, GENERAL

A. Low-Emitting Materials: Adhesives and composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard

Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.

D. Softwood Plywood: DOC PS 1.

E. Particleboard: ANSI A208.1, Grade M-2.

F. MDF: ANSI A208.2, Grade 130.

G. Hardboard: AHA A135.4, Class 1 Tempered.

H. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Formica Corporation.
b. Nevamar Company, LLC; Decorative Products Div.
c. Wilsonart International; Div. of Premark International, Inc.
d. Others as approved before bidding.

I. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

J. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

K. Edgebanding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.

L. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Formica Corporation.
b. Nevamar Company, LLC; Decorative Products Div.
c. Wilsonart International; Div. of Premark International, Inc.
d. Others as approved before Bidding.

2. Type: Provide Standard type:

2.3 CABINET MATERIALS

A. Exposed Cabinet Materials:

1. Plastic Laminate: Grade VGS.

2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

B. Semi-exposed Cabinet Materials:

1. Thermoset Decorative Panels: Provide thermoset decorative panels for semi-exposed surfaces unless otherwise indicated.

2. Unless otherwise indicated, provide specified edgebanding on all semi-exposed edges.

C. Concealed Cabinet Materials:

1. Plywood: Hardwood plywood. Provide backs of same species as faces.

2.4 DESIGN, COLOR, AND FINISH

A. Design: Provide manufactured wood casework of the following design:

1. Reveal overlay with wire pulls.

B. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Owner from plastic-laminate manufacturer's full range of standard colors and patterns.

C. PVC Edgebanding Color: Casework manufacturer's standard

D. Solid-Surfacing Material Colors and Patterns: As selected by Owner from manufacturer's full range of standard colors and patterns.].

2.5 CABINET FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:]

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.

2. Shelves: 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces

3. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.

4. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced.

5. Drawer Sides and Backs: 1/2-inch (12.7-mm) solid-wood or veneer-core hardwood plywood thermoset decorative panels, with glued dovetail or multiple-dowel joints.

6. Drawer Bottoms: 1/4-inch (6.4-mm) thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.]

7. Doors: 3/4-inch (19-mm) particleboard or MDF with wood stiles and rails, plastic-laminate faced.

B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.6 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Chrome-plated or Powder-coated, semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches (1220 mm) high and 3 hinges for doors more than 48 inches (1220 mm) high. Hinges to be self closing.

C. Pulls: Solid stainless-steel or chrome-plated brass wire pulls, fastened from back with two screws. For sliding doors, provide recessed [stainless-steel] [or] [chrome-plated] flush pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.

D. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.

2.7 COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.

B. Solid-Surfacing-Material Tops: 3/4-inch- (19-mm-) thick, solid-surfacing material

1. Front: Straight, slightly eased at top.

2. Backsplashes: 3/4-inch- (19-mm-)] thick, solid-surfacing material; slightly eased at edge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 16 inches (400 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm).
2. Use toggle bolts at hollow masonry.
3. Use expansion anchors at solid masonry.
4. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish and toggle bolts through metal backing or metal framing behind wall finish at metal-framed partitions.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and walls with adhesive.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 CLEANING AND PROTECTING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123200

SECTION 123553
LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Plastic-laminate laboratory casework.
2. Laboratory countertops.
3. Laboratory sinks

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1200 mm) above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."

C. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches (1980 mm) or more above floor are defined as "semi-exposed."

D. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

1.4 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

1. Support Framing System: 600 lb/ft. (900 kg/m).
2. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft. (240 kg/m).
3. Wall Cabinets (Upper Cabinets): 160 lb/ft. (240 kg/m).
4. Shelves: 40 lb/sq. ft. (200 kg/sq. m).

B. Delegated Design: Design laboratory casework, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.

SPECIFICATIONS FOR BIDDING ONLY

C. Seismic Performance: Laboratory casework and support framing system, including attachments to other work, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and the California Building Code.

1. Component Importance Factor is 1.0.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Laboratory Test Reports for Credit IEQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware.
2. Indicate locations and types of service fittings.
3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
4. Include details of utility spaces showing supports for conduits and piping.
5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
6. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

D. Samples for Verification: For each type of cabinet finish and each type of countertop material indicated, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

B. QUALITY ASSURANCE

C. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8.

SPECIFICATIONS FOR BIDDING ONLY

D. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.

E. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered.

F. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended Practices."

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE CABINET MATERIALS

A. General:

1. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

SPECIFICATIONS FOR BIDDING ONLY

2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

3. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated, made without urea formaldehyde.

4. Particleboard: ANSI A208.1, Grade M-2.

5. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

6. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

7. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

8. Edge banding for Plastic Laminate: Plastic laminate matching adjacent surfaces

   a. Colors: As selected by General Manager from manufacturer's full range of standard colors and patterns.].

9. Edge banding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.

B. Exposed Materials:

1. Plastic Laminate: Grade VGS.

   a. Colors: As selected by General Manager from manufacturer's full range of standard colors and patterns.

C. Semi-exposed Materials:

1. Plastic Laminate: Grade VGS].

   a. Colors: As selected by General Manager from manufacturer's full range of standard colors and patterns.].

   b. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.

   c. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.

2. Thermoset Decorative Panels: Provide thermoset decorative panels for semi-exposed surfaces unless otherwise indicated.

   a. Colors: As selected by General Manager from manufacturer's full range of standard colors and patterns.].

3. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects.

4. Plywood: Hardwood plywood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.

D. Concealed Materials:

1. Solid Wood: Any species, with no defects affecting strength or utility.

2. Plywood: Hardwood plywood.

SPECIFICATIONS FOR BIDDING ONLY

3. Particleboard.
4. MDF.
5. Hardboard.

2.2 COUNTERTOP AND SINK MATERIALS

A. Adhesive for Bonding Plastic Laminate: Manufacturer's standard waterproof adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Durcon Company (The).
b. Epoxyn Products.
c. Laboratory Tops, Inc.
d. Others as approved before bidding.

2. Physical Properties:

a. Flexural Strength: Not less than 10,000 psi (70 MPa).
b. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F (127 deg C).

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.

b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

4. Color: Black.

2.3 PLASTIC-LAMINATE CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fisher Hamilton L.L.C.
2. LSI Corporation of America; a Sagus International company.
3. Sheldon Laboratory Systems.
4. Stevens Industries, Inc.
5. TMI Systems Design Corporation.

SPECIFICATIONS FOR BIDDING ONLY

6. Others as approved before bidding

B. Design: Reveal overlay.

C. Construction: Provide plastic-laminate-faced laboratory casework of the following minimum construction:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces].

2. Shelves: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.

3. Backs of Cabinets: 1/2-inch- (12.7-mm-) thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.

4. Drawer Fronts: 3/4-inch- (19-mm-) thick particleboard, plastic-laminate faced.

5. Drawer Sides and Backs: 1/2-inch- (12.7-mm-) thick solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.

6. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch- (12.7-mm-) thick material for drawers more than 24 inches (600 mm) wide.]

7. Doors 48 Inches (1200 mm) High or Less: 3/4 inch (19 mm) thick, with particleboard or MDF cores, plastic-laminate faced.

8. Stiles and Rails of Glazed Doors[48 Inches (1200 mm) High or Less]: 3/4 inch (19 mm) thick, with particleboard cores, plastic-laminate faced.

9. Stiles and Rails of Glazed Doors More Than 48 Inches (1200 mm) High: 1-1/16-inch- (27-mm-) thick, solid wood, plastic-laminate faced.

D. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.

1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.

2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.

2.4 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel or [Epoxy-coated steel], 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches (1200 mm) high or less and 3 for doors more than 48 inches (1200 mm) high.

SPECIFICATIONS FOR BIDDING ONLY

C. Hinged Door and Drawer Pulls: stainless steel, or chrome-plated brass back-mounted pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.

1. Design: Wire pulls as selected from manufacturer's full range.

2. Overall Size: Manufacturer’s Standard

D. Door Catches: Dual, self-aligning, permanent magnet catches. Provide 2 catches on doors more than 48 inches (1200 mm) high.

E. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

1. Provide Grade 1HD-100; for all drawers.

2. Heavy Duty (Grade 1HD-100: Full-extension, ball-bearing type.

F. Adjustable Shelf Supports for Plastic-Laminate Cabinets: Mortise-type, powder-coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091.

2.5 COUNTERTOPS AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch (25 mm), with continuous drip groove on underside 1/2 inch (13 mm) from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.

1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.

2. Overflows: provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.

C. Epoxy Countertops and Sinks:

1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.

a. Countertop Configuration: Flat, 3/4 inch (19 mm) thick, with rounded edge and corners, and with drip groove and applied backsplash.

b. Countertop Construction: Uniform throughout full thickness

2. Sink Fabrication: Molded in 1 piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch (13-mm) minimum thickness.

a. Provide with polypropylene strainers and tailpieces.

b. Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.

SPECIFICATIONS FOR BIDDING ONLY

3. Shelf Configuration: Flat, 3/4 inch (19 mm) thick, with rounded] edge and corners.

2.6 WATER AND LABORATORY GAS SERVICE FITTINGS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Broen A/S.
2. Chicago Faucet Company (The); a Geberit company.
3. WaterSaver Faucet Co.
4. Others as approved before bidding.

2.7 ELECTRICAL SERVICE FITTINGS

A. Service Fittings, General: Provide units complete with metal housings, receptacles, terminals, switches, pilot lights, device plates, accessories, and gaskets required for mounting on laboratory casework.

B. Receptacles: Comply with NEMA WD 1, NEMA WD 6, and UL 498. Duplex type, Configuration 5 20R.

1. Receptacle Grade: General grade unless otherwise indicated.
2. Color of Receptacles: Ivory unless otherwise indicated or required by NFPA 70.
3. GFCI Receptacles: Straight blade type. Comply with UL 943, Class A, General grade, and include indicator light that is lighted when device is tripped.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).

SPECIFICATIONS FOR BIDDING ONLY

4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).

5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than 2 fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

C. Fastening:

1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.

2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches (1200 mm) o.c.

3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch (3 mm) and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for service fittings.

E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.

SPECIFICATIONS FOR BIDDING ONLY

F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 INSTALLATION OF SERVICE FITTINGS

A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.

B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.7 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION 123553

SPECIFICATIONS FOR BIDDING ONLY

SECTION 133419
METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Thermal insulation.
5. Windows.
6. Accessories.

1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SUBMITTALS

A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

1. Structural-steel-framing system.
2. Metal roof panels.
3. Metal wall panels.
4. Insulation and vapor retarder facings.
5. Flashing and trim.
6. Windows.
7. Accessories.

B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.

SPECIFICATIONS FOR BIDDING ONLY

2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:8):

   a. Flashing and trim.
   b. Gutters.
   c. Downspouts.

C. Samples for Initial Selection: For units with factory-applied color finish.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Metal Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.

2. Flashing and Trim: Nominal 12 inches (300 mm) long. Include fasteners and other exposed accessories.

3. Windows: Full-size, nominal 12-inch- (300-mm-) long frame Samples showing typical profile.

4. Accessories: Nominal 12-inch- (300-mm-) long Samples for each type of accessory.

E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.

1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.

2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

F. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Qualification Data: For qualified erector and manufacturer.

H. Welding certificates.

I. Metal Building System Certificates: For each type of metal building system, from manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

    a. Name and location of Project.
    b. Order number.
    c. Name of manufacturer.
    d. Name of Contractor.
    e. Building dimensions including width, length, height, and roof slope.
    f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
    g. Governing building code and year of edition.
    h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
    i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
    j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
    k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.

J. Erector Certificates: For each product, from manufacturer.

K. Manufacturer Certificates: For each product, from manufacturer.

L. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

M. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

N. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.

1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.

2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer licensed to practice in the State of California.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

D. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

F. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.

G. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

H. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2. Combustion Characteristics: ASTM E 136.

I. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

J. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
   a. Condition of foundations and other preparatory work performed by other trades.
   b. Structural load limitations.
   c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
   d. Required tests, inspections, and certifications.
   e. Unfavorable weather and forecasted weather conditions.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
   b. Structural limitations of purlins and rafters during and after roofing.
   c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   d. Temporary protection requirements for metal roof panel assembly during and after installation.
   e. Roof observation and repair after metal roof panel installation.

SPECIFICATIONS FOR BIDDING ONLY

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
    a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
    b. Structural limitations of girts and columns during and after wall panel installation.
    c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
    d. Temporary protection requirements for metal wall panel assembly during and after installation.
    e. Wall observation and repair after metal wall panel installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements:
    1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
    2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

SPECIFICATIONS FOR BIDDING ONLY

1.8 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings.

B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. Behlen Mfg. Co.
2. Butler Manufacturing Company; a BlueScope Steel company.
3. Ceco Building Systems; Division of NCI Building Systems, L.P.
4. Chief Buildings; Division of Chief Industries, Inc.
5. Garco Building Systems; Division of NCI Building Systems, L.P.
6. Robertson Building Systems; an NCI company.
7. Star Building Systems; an NCI company.
8. VP Buildings; a United Dominion company.
9. Others as approved before bidding.

2.2 METAL BUILDING SYSTEMS

A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system

SPECIFICATIONS FOR BIDDING ONLY

capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
2. Provide and install interior components as indicated on the drawings and in other sections of these specifications.

B. Primary-Frame Type:

1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed as indicated on the drawings.

E. Eave Height: 12 feet. as indicated on the Drawings

F. Bay Spacing: 25 feet (7.6 m).

G. Roof Slope: 2 inches per 12 inches (2:12)

H. Roof System: Manufacturer's standard vertical-rib, standing-seam metal roof panels with field-installed insulation.

I. Exterior Wall System: Manufacturer's standard concealed-fastener metal wall panels with field-installed insulation.

2.3 METAL BUILDING SYSTEM PERFORMANCE

A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer licensed to practice in the State of California, using performance requirements and design criteria indicated.

1. All drawings and calculations shall be prepared under the direct supervision of the professional engineer licensed to practice in the state of California who shall stamp and seal all documents.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads:

a. As required by the State of California and ASCE/SEI 7 for the project location and MBMA's "Metal Building Systems Manual." In case of conflict, the most stringent shall apply.

SPECIFICATIONS FOR BIDDING ONLY

b. All building design shall comply with the California Building Code, including all local ordinances and provisions.

2. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:

   a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
   b. Girts: Horizontal deflection of 1/240 of the span.
   c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
   d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
   e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.

3. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than allowed by the California Building Code.

4. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

C. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to the California Building Code and ASCE/SEI 7, whichever is the most stringent.

D. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) temperature range, material surfaces.

E. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft. (75 Pa).

F. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft. (137 Pa).

H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft. (137 Pa).

I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

SPECIFICATIONS FOR BIDDING ONLY

J. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C 1363 or ASTM C 518:

1. Metal Roof Panel Assemblies:

   a. R-Value as required by the State of California Building Code and the California Energy Code – Title 24.

2. Metal Wall Panel Assemblies:

   a. R-Value as required by the State of California Building Code and the California Energy Code – Title 24.

K. Energy Performance: Provide roof panels with 3 year aged reflectance, thermal emittance and Solar Reflectance index in compliance tithe the State of California Title 24, Cool Roof Rating Council.

2.4 STRUCTURAL-STEEL FRAMING

A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.

3. Frame Configuration: Single gable.

4. Exterior Column Type: Uniform depth.

5. Rafter Type: Uniform depth or Tapered.

B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.

C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- (64-mm-) wide flanges.

   a. Depth: As required to comply with system performance requirements.

SPECIFICATIONS FOR BIDDING ONLY

2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- (64-mm-) wide flanges.

   a. Depth: As required to comply with system performance requirements.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

4. Flange Bracing: Minimum 2-by-2-by-1/8-inch (51-by-51-by-3-mm) structural-steel angles or 1-inch (- (25-mm-) diameter, cold-formed structural tubing to stiffen primary-frame flanges.

5. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3-mm) structural-steel angles.

6. Base or Sill Angles: Minimum 3-by-2-inch (76-by-51-mm) zinc-coated (galvanized) steel sheet.

7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) structural-steel sheet.

9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.

10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

D. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.

   1. Type: Straight-beam, below-eave type as indicated on the drawings

E. Bracing: Provide adjustable wind bracing as follows:

   1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13-mm-) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.

   2. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

F. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide hot-dip galvanized bolts for structural-framing components that are galvanized.

G. Materials:

   1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).

SPECIFICATIONS FOR BIDDING ONLY

2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).

3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).

4. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

5. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.

6. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 (170 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480).

7. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.

8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550), or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.

9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts; ASTM A 563 (ASTM A 563M) carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.

    a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C

10. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

    a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

11. Unheaded Anchor Rods: [ASTM F 1554, Grade 36

    a. Configuration: Straight.
    b. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
    c. Plate Washers: ASTM A 36/A 36M carbon steel.
    d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
    e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C

12. Threaded Rods: ASTM A 572/A 572M, Grade 50 (345).

    a. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
    b. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
    c. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C

H. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

SPECIFICATIONS FOR BIDDING ONLY

1. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil (0.025 mm).
    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil (0.013 mm) on each side.
2. Prime galvanized members with specified primer after phosphoric acid pretreatment.
3. Primer: SSPC-Paint 15, Type I, red oxide.
4. Primer shall meet all requirements for application in the State of California.

2.5 METAL ROOF PANELS

A. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.034-inch (0.86-mm) nominal thickness.
    a. Exterior Finish: Fluoropolymer.
    b. Color: As selected by Owner from manufacturer's full range of standard colors.
2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel or aluminum-zinc alloy-coated steel
3. Joint Type: Mechanically seamed, double folded.
4. Panel Coverage: 16 inches (406 mm).
5. Panel Height: 2 inches (51 mm).
6. Uplift Rating: UL 90.

B. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

    OR

    b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
    c. Surface: Embossed finish.

C. Finishes:

1. Exposed Coil-Coated Finish:

SPECIFICATIONS FOR BIDDING ONLY

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.6 METAL WALL PANELS

A. Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges with flush joint between panels; with 1.5-inch wide flange designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.

1. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 22 gauge 0.034-inch (0.86-mm) nominal thickness.

a. Exterior Finish: Fluoropolymer

b. Color: As selected by Owner from manufacturer's full range of standard colors.

2. Panel Coverage: nominal 12 inches with minor valley rib at midspan of panel

3. Panel Height: 1.5 inches.

B. Flush-Profile, Metal Liner Panels: **Solid** panels formed with vertical panel edges and **flat pan** between panel edges; with flush joint between panels; designed for interior side of metal wall panel assemblies and installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.

1. Material: **Zinc-coated (galvanized)** steel sheet, **0.034-inch (0.86-mm)** nominal thickness.

a. Exterior Finish: **Siliconized polyester**.

b. Color: **As selected by General Manager from manufacturer's full range of colors and textures.**

2. Panel Coverage: **12 inches (305 mm)**.

3. Panel Height: **1.5 inches (38 mm)**.

C. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

OR

SPECIFICATIONS FOR BIDDING ONLY

b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.

c. Surface: Flat Embossed finish.

D. Finishes:

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.7 THERMAL INSULATION

A. Sufficient insulation shall be installed in the building to comply with all parts of the California Building and the California Energy Code.

B. Provide all analysis and submit all forms as required by the Local Authority having jurisdiction.

C. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. (8-kg/cu. m) density; 2-inch- (51-mm-) wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

1. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm (1.15 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M, Desiccant Method.

a. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.

D. Retainer Strips: 0.025-inch (0.64-mm) nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.

E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.8 DOORS AND FRAMES

A. Swinging Personnel Doors and Frames: As specified in Division 08 Section "Hollow Metal Doors and Frames."

2.9 DOOR HARDWARE

A. Door Hardware: As specified in Division 08 Section "Door Hardware

SPECIFICATIONS FOR BIDDING ONLY

2.10 WINDOWS

A. Aluminum Windows: Metal building system manufacturer's standard, with self-flashing mounting fins, and as follows:

1. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and as follows:

a. Fixed Units: F-C30.

2. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch (1.63-mm) thickness at any location for main frame and sash members.

a. Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

3. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.

a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch (3.26 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.

4. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

B. Glazing:

1. Comply with all glazing requirements of the California energy Code.

2. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of 2.5-mm-thick clear float glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

3. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

a. Provide safety glazing labeling.

4. Glazing Stops: Screw-applied or snap-on glazing stops coordinated with Division 08 Section "Glazing" and with glazing system indicated. Match material and finish of window frames.

5. Factory-Glazed Fabrication: Glaze window units in the factory to greatest extent possible and practical for applications indicated. Comply with requirements in Division 08 Section "Glazing."

C. Finish:

SPECIFICATIONS FOR BIDDING ONLY

1. Baked-Enamel Finish: Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 0.7 mil (0.02 mm), medium gloss.

    a. Color: As selected by Owner from manufacturer's full range of standard colors.

2.11 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.

2. Clips: Manufacturer's standard, formed from stainless steel sheet, designed to withstand negative-load requirements.

3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet.

4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch (25-mm) standoff; fabricated from extruded polystyrene.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Formed from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.

2. Opening Trim: Formed from 0.034-inch (0.86-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Gutters: Formed from 0.022-inch (0.56-mm) nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2438-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.

F. Downspouts: Formed from 0.022-inch (0.56-mm) nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

a. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws[, with EPDM sealing washers bearing on weather side of metal panels].

b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head[, with EPDM sealing washers bearing on weather side of metal panels].

c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

SPECIFICATIONS FOR BIDDING ONLY

3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

4. Metal Panel Sealants:

   a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.

   b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Testing will be performed by the Owner.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

2.13 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.

2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.

3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.

4. Attach clips to frames for attaching secondary framing. (welding is preferred if allowed by AHJ.)

SPECIFICATIONS FOR BIDDING ONLY

5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.

2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

SPECIFICATIONS FOR BIDDING ONLY

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.

a. Joint Type: Snug tightened or pretensioned.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.

2. Locate and space wall girts to suit openings such as doors and windows.

3. Locate canopy framing as indicated.

4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

SPECIFICATIONS FOR BIDDING ONLY

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.

2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.

4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.

6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.

SPECIFICATIONS FOR BIDDING ONLY

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
5. Provide metal closures at peaks, rakes and each side of ridge caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. No horizontal wall panel joints will be allowed.
4. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
5. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
6. Install screw fasteners in predrilled holes.
7. Install flashing and trim as metal wall panel work proceeds.

SPECIFICATIONS FOR BIDDING ONLY

8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.

9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.

10. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.7 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.

2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.

3. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.

a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.

SPECIFICATIONS FOR BIDDING ONLY

B. Personnel Doors and Frames: Install doors and frames according to SDI A250.8. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

1. Between Doors and Frames at Jambs and Head: 1/8 inch (3 mm).
2. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
3. At Door Sills with Threshold: 3/8 inch (9.5 mm).
4. At Door Sills without Threshold: 3/4 inch (19.1 mm).
5. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.

C. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

1. Install surface-mounted items after finishes have been completed on substrates involved.
2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
4. Set thresholds for exterior doors in full bed of butyl-rubber sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.9 WINDOW INSTALLATION

A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.

1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.

B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Mount screens directly to frames with tapped screw clips.

E. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing."

3.10 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

SPECIFICATIONS FOR BIDDING ONLY

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building or tie downspouts to underground drainage system indicated as indicated by the Owner.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Inspection of fabricators.

2. Steel construction.

SPECIFICATIONS FOR BIDDING ONLY

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

3.12 ADJUSTING

A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

C. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.13 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."

2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

D. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

F. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.

1. Immediately before final inspection, remove protective wrappings from doors and frames.

SPECIFICATIONS FOR BIDDING ONLY

G. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.

END OF SECTION 133419

SPECIFICATIONS FOR BIDDING ONLY

September 18, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485080
Piping and Equipment Insulation

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Section 485080
Piping and Equipment Insulation

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REVISION HISTORY		
DATE	REVISED BY	REVISION
9/18/2013	S. Goldstein	A

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 RELATED SECTIONS 1
1.3 CODES AND STANDARDS 1
1.4 DEFINITIONS 2
1.5 SUBMITTALS 3
1.6 PRODUCT OPTION 4
1.7 QUALITY ASSURANCE 4
1.8 PACKAGING, DELIVERY, STORAGE AND HANDLING 5
1.9 SITE CONDITIONS 6

PART 2 - PRODUCTS 6

2.1 GENERAL MATERIAL REQUIREMENTS 6
2.2 MANUFACTURERS 6
2.3 INSULATION MATERIALS 7
2.4 INSULATION JACKETS 8
2.5 ACCESSORIES AND ATTACHMENTS 10
2.6 INSULATION IDENTIFICATION CODE 11

PART 3 - EXECUTION 13

3.1 GENERAL 13
3.2 EXAMINATION 14
3.3 SURFACE PREPARATION 14
3.4 GENERAL APPLICATION REQUIREMENTS 14
3.5 EQUIPMENT APPLICATIONS 17
3.6 PIPING SYSTEM APPLICATIONS 18
3.7 PENETRATIONS 19
3.8 CALCIUM SILICATE INSULATION APPLICATION 19
3.9 FIBERGLASS INSULATION APPLICATION 20
3.10 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION 21
3.11 POLYISOCYANURATE INSULATION APPLICATION 22
3.12 CELLULAR-GLASS INSULATION APPLICATION 23
3.13 FIELD-APPLIED JACKET APPLICATION 24
3.14 FINISHES 25
3.15 FIELD QUALITY CONTROL 26
3.16 START-UP AND CURING 26
3.17 FIELD QUALITY CONTROL 26

APPENDIX A INSULATION MATERIAL 27

APPENDIX B SUBMITTAL REQUIREMENTS SCHEDULE 29

SECTION 485080
PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Specification Section covers the procurement, supply, handling, management, installation and testing of piping, equipment, vessels and duct thermal insulation (-100°F to 1200°F) systems for the Project.

1.2 RELATED SECTIONS

A. Drawings, documents and general provisions of the Contract, including General and Special Conditions apply to this Section.

B. Section 485072 – Coatings for Piping and Tanks

C. Section 485140 – Pipe Supports and Hangers

D. Section 485972 – Mechanical Installation Requirements

1.3 CODES AND STANDARDS

A. ASTM – American Society for Testing and Materials

1. ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
2. ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, and Flat Bar
3. ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric])
4. ASTM C168, Standard Terminology Relating to Thermal Insulating Materials
5. ASTM C195, Standard Specification for Mineral Fiber Thermal Insulating Cement
6. ASTM C196, Standard Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement
7. ASTM C449/C449M, Standard Specification for Mineral Fiber Hydraulic-Setting thermal Insulating and Finishing Cement
8. ASTM C450, Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments
9. ASTM C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
10. ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
11. ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation
12. ASTM C552, Standard Specification for Cellular Glass Thermal Insulation
13. ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

14. ASTM C585, Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
15. ASTM C591, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
16. ASTM C610, Standard Specification for Molded Expanded Perlite Block and Pipe thermal Insulation
17. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
18. ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
19. ASTM C920, Standard Specification for Elastomeric Joint Sealants
20. ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
21. ASTM C1136, Standard Practice for Flexible, Low Permanence Vapor Retarders for Thermal Insulation
22. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
23. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials

B. MICA – Midwest Insulation Contractors Association

1. Commercial & Industrial Insulation Standards

C. MIL – Military Specification

1. MIL-A-3316C, Adhesives, Fire-Resistant, Thermal Insulation
2. MIL-C-19565C, Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier
3. MIL-C-20079H, Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass

D. NFPA – National Fire Protection Association

1. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

E. SSPC – Steel Structure Painting Council

1. SSPC-SP 1, Solvent Cleaning
2. SSPC-SP 2, Hand Tool Cleaning
3. SSPC-SP 3, Power Tool Cleaning

F. UL – Underwriters Laboratories, Inc.

1. UL 723, Standard for Test for Surface Burning Characteristics of Building Materials

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.

E. Interpretations: ASTM C168 and ASTM C585 for terms used in this Section.

F. The word "insulation" means a complete system including insulation, jackets, inserts, adhesives, mastics, sealing compounds, vapor retarders and other accessory items as required for installation of a complete insulated system.

G. Shop: Location where fabrication or assembly is performed away from the job site.

H. Field: Locations on the job site where fabrication, assembly or erection is performed.

I. The words “Project Documents” refers to Drawings, Related Sections and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.5 SUBMITTALS

A. Submit the following for review in accordance with requirements of Section 481200, Combined Cycle Balance of Plant.

B. Product Data:

1. Product Catalog Data Sheets with product description, service application and limitations. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
2. Product Dimensional Drawings showing product dimensions, bill of materials, location and dimensions of accessories and product weight.
3. Shop Drawings: Show fabrication and installation details for the following:

    a. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
    b. Attachment and covering of heat trace inside insulation.
    c. Insulation application at pipe expansion joints for each type of insulation.
    d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
    e. Removable insulation at piping specialties and equipment connections.
    f. Application of field-applied jackets.

4. MSDS for materials, insulation, jackets, inserts, adhesives, mastics, sealing compounds, vapor retarders and other accessory items or products.
5. Samples: For each type of insulation and jacket. Identify each Sample, describing product and intended use. Submit Samples in the following sizes:

a. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN50).
b. Sheet Form Insulation Materials: 12 inches (300 mm) square.
c. Jacket Materials: 12 inches (300 mm) long by NPS 2 (DN50).
d. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.

C. Certificates:

1. Submit certificate stating materials supplied are Asbestos Free.
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

D. Manufacturer Instructions: Product Installation Instructions describing standard and special installation methods, requirements for protection of sensitive components and required adjustments or settings after installation.

E. Contract Closeout Submittals: Submit Certified Data and Documents identified in the Contract Documents.

F. Project Record Documents: Submit Record Drawings and Documents that record final certified data for products, designs and installation.

G. Warranty: Submit Product Warranty Certificates.

1.6 PRODUCT OPTION

A. Substitution of approved submittal material shall not be allowed without re-submittal and re-approval.

1.7 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. Submit conflicts between construction documents to the General Manager for resolution.

C. Comply with approved submittal documents and procedures.

D. Certify that materials supplied are asbestos free.

E. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.

F. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency. Flame-spread rating of 25 or less and smoke-developed rating of 50 or less.

1. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
2. Include the following mockups for NPS 2 (DN50) and NPS 4 (DN100) line sizes:

    a. One 10-foot (3-meter) section of straight pipe.
    b. One 90-degree elbow.
    c. One tee fitting.
    d. One strainer with removable portion of insulation.
    e. One reducer.
    f. Three valves (ball, globe, and butterfly).
    g. One special coupling (Socket/threaded, Victaulic, Lokring)
    h. Four support hangers, including hanger shield and insert.

3. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
4. Build mockups in the location indicated or, if not indicated, as directed by Contractor.
5. Notify Contractor seven days in advance of dates and times when mockups will be constructed.
6. Obtain Contractor's approval of mockups before starting insulation application.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.
9. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PACKAGING, DELIVERY, STORAGE AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

B. Packaging: Ship insulation materials in containers marked by Manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

C. Protective shipping containers and covers shall remain on components until removed for installation. Containers and covers that have been removed or opened for completion of required receiving inspections shall be replaced and resealed after completion of the required inspection.

D. Maintain materials in good, as delivered condition until installation at the job site.

E. Replace damaged materials.

1.9 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions for general site conditions affecting products on site.

PART 2 - PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

A. New, clean, free from defect and meet the requirements of the referenced standards. All materials shall be UL approved.

B. Compatible with the materials to which they are applied, and shall not contribute to corrosion, soften, or otherwise attack surfaces, in either the wet or dry state. Materials used on stainless steel surfaces shall meet the requirements of ASTM C795.

C. Supply items consistent in manufacture, model and style for items that are used in quantity such as high-density insulation, lagging, specialties, accessories, special fittings, etc.

D. Maximum flame spread/smoke developed rating of 25/50, in accordance with ASTM E84, NFPA 255, or UL 723, whichever is more stringent.

E. Asbestos is prohibited.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Calcium Silicate Insulation:

    a. Owens-Corning Fiberglas Corp.
    b. Pabco.
    c. Schuller International, Inc.
    d. Calsite Group
    e. John Mansville

2. Mineral-Fiber Insulation:

    a. CertainTeed Manson.
    b. Knauf FiberGlass GmbH.
    c. Owens-Corning Fiberglas Corp.
    d. Schuller International, Inc.
    e. John Mansville Corp.
    f. Rock Wool Manufacturing
    g. Roxul, Inc.

3. Flexible Elastomeric Thermal Insulation:

    a. Armstrong World Industries, Inc.

b. Rubatex Corp.
c. Armacell LLC
d. Nomaco

4. Polyisocyanurate Insulation:

a. Dow Chemical Co.
b. Kingspan Corp.
c. Apache Products Co.

5. Cellular-Glass Insulation:

a. Pittsburgh-Corning Corp.
b. Cell-U-Foam Corp.

6. Aluminum and Aluminum Alloy Sheet Jacket (Type I or II)

a. Childers Products
b. Pabco Metals
c. RPR Products

7. All Service Jacket (Type I) - ASJ

a. John Mansville
b. Pittsburgh Corning

2.3 INSULATION MATERIALS

A. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Supply in hollow cylindrical shapes split in half lengthwise or as curved segments. Comply with ASTM C533, Type I.

B. Fiberglass Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
5. Mineral-Fiber Insulating Cements: Comply with ASTM C195. Cement shall have inhibitors to prevent rust and corrosion of aluminum

6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C196.
7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449/C 449M.

C. Mineral-Wool Insulation: Not Used.

D. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials. Preformed tubular shape shall be slit for placement around pipe.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

E. Polyisocyanurate Thermal Insulation: Unfaced preformed rigid cellular plastic materials. Comply with ASTM C591, Type VI.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.

1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C552, Type II, Class 1.
2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C552, Type II, Class 2.

G. Perlite Insulation: Not Used.

H. Flange Blankets: Unless specified otherwise, pipe flanges shall be covered with removable stitched ASTM C553, Type II fiberglass insulation blankets. Removable blankets shall be 1" minimum thickness and constructed of a silicone coated cloth outer facing, 304 stainless steel mesh inner facing, stainless lacing hooks and Teflon coated fiberglass drawstrings.

2.4 INSULATION JACKETS

A. General: Jackets for insulation shall be as indicated on the data sheets unless otherwise specified.

1. Type I (vapor barrier - cold surfaces) or,

   a. Maximum moisture vapor transmission: 0.02 perms
   b. Minimum puncture resistance: 50 beach units

2. Type II (water vapor permeable - hot surfaces)

   a. Minimum puncture resistance: 25 beach units

3. Jacket properties shall conform to ASTM C921.
4. Finish: White – suitable for painting without sizing.
5. Conform to ASTM C1136

B. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C450 for dimensions used in preforming insulation to cover valves, elbows, tees, flanges and other fittings.

C. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), 3003 alloy, H-14 temper. Factory cut and rolled to indicated sizes. For shop or field cutting and forming supply aluminum roll stock.

1. Finish and Thickness for Pipe:

    a. Smooth finish, 0.016 inch (0.40 mm) thick.
    b. Corrugated finish, 0.016 inch (0.40 mm) thick.
    c. Stucco-embossed finish, 0.016 inch (0.40 mm) thick.
    d. Painted finish, 0.016 inch (0.40 mm) thick.

2. Finish and Thickness for Equipment, Vessels, Tanks:

    a. Smooth finish, 0.032 inch (0.80 mm) thick.
    b. Corrugated finish, 0.032 inch (0.80 mm) thick.
    c. Stucco-embossed finish, 0.032 inch (0.80 mm) thick.
    d. Painted finish, 0.032 inch (0.80 mm) thick.

3. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
4. Seal metal lagging and metal finishing edges of insulation to equipment, comply with ASTM C920, Type S, Grade NS, Class 25, Use A.
5. Fitting Jackets: Preformed, 45- and 90-degree, short- and long-radius elbows, tee; same material, finish, and thickness as jacket.

    a. Two-piece construction. Where two-piece jacket unit is not available, use factory or field supplied jackets with interlocking segments which, when assembled, form a smooth bend.
    b. Attach jackets with stainless steel bands, corner angles and pop rivets, or Pittsburgh or Z lock fasteners.

D. Stainless-Steel Jacket: ASTM A666, Type 304 or 316; 0.10 inch (2.5 mm) thick; and factory cut and rolled to indicated sizes. For shop or field cutting and forming Stainless-Steel roll stock.

1. Moisture Barrier: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch (19 mm) wide.

E. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: Gray.
3. Installed in conformance with manufacturer's written instructions.

F. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-(0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
2. Adhesive: As recommended by insulation material manufacturer.

G. All Service Jacket (ASJ): Jacketing consisting of aluminum foil, fiberglass reinforcing yarn, and high intensity bleached Kraft paper laminated together with flame retardant adhesive.

H. Foil, Scrim, Kraft (FSK): Jacketing consisting of aluminum foil, fiberglass reinforcing yarn, and natural Kraft paper laminated together with flame retardant adhesive.

2.5 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide with suitable end fastening devices, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A666, Type 304; 0.020 inch (0.5 mm) thick.
2. Galvanized Steel: 0.005 inch (0.13 mm) thick.
3. Aluminum: 0.007 inch (0.18 mm) thick.
4. Brass: 0.010 inch (0.25 mm) thick.
5. Nickel-Copper Alloy: 0.005 inch (0.13 mm) thick.

C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, Type 304 stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

D. Staples: ASTM A167, Type 304 316 stainless steel outside-clinch type

E. Self Tapping Screws: Type A stainless steel, No. 10 by ½ inch long for jacket

F. Poultry Wire Mesh: One-inch hexagonal wire mesh woven from No. 20 gauge wire, galvanized after fabrication. Furnish poultry mesh in 48-inch width rolls.

G. Polyvinyl Chloride (PVC) Inserts: Same material as the PVC jackets and same thickness as the insulation. Install inserts in strict conformance with Manufacturer’s instructions.

H. Install Insulation Expansion Joints in systems with temperatures above 600°F.

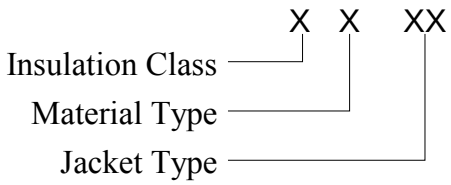
I. Vapor Retarder Material:

1. Conform to ASTM C1136.
2. Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.
3. Vapor Retarder Coating:

   a. Provide in accordance with insulation manufacturers' recommendations.
   b. Vapor retarder coating: non-flammable, fire and water-resistant and appropriately selected for either indoor or outdoor application.
   c. Color: White.
   d. Water vapor permeance: Maximum of 0.05 perm (ASTM E96, Procedure B).

2.6 INSULATION IDENTIFICATION CODE

A. Insulation systems are identified with a four-digit alphanumeric Insulation Code.



Example: WF12 – Condensation Control, Cellular Glass, Embossed Aluminum jacket with factory applied vapor retarder.

The insulation class is based on the service requirements with the service temperature limits shown in the following table.

INSULATION CLASS			
		Fluid/Pipe Temperature (°F)	
Class	Service Description	Min	Max
W	Condensation Control	32	Ambient
C	Cold Temperature Insulation	-100	32
F	Freeze Protection Insulation	32	140
L	Low Temperature Insulation	32	200
M	Medium Temperature Insulation	80	600
H	High Temperature Insulation	80	1200
P	Personnel Protection Insulation	150	1000

Note 1: Personnel protection insulation shall be sized to ensure that the surface temperature after insulation is below 140°F.

Insulating material service temperature limits are established by ASTM standards, MICA standards (National Commercial & Industrial Insulation Standards), and the following table.

MATERIAL TYPE						
				Service Temperature (°F)		
Type	Insulating Material	Insulation Shape	ASTM No.	Min	Max	Insulation Class
A	Calcium Silicate	Molded Pipe	C533 Type I	80	1200	M,H,P
B	Fiberglass	Molded Pipe and Blanket	C547 Type I	-20	850	F,L,M,P
C	Mineral Fiber and Wool	Molded Pipe and Blanket	C547 Type II	-20	1200	L,M,H,P
D	Flexible Elastomeric	Molded Pipe or Sheet	C534 Type I & II	-40	200	W,C,F,L,P
E	Polyisocyanurate	Molded Pipe	C591 Type VI	-70	300	W,C,F,L,P
F	Cellular Glass	Molded Pipe	C552 Type II & III	-450	800	W,C,F,L,M,P
G	Perlite	Molded Pipe	C610	80	1200	M,H,P

B. A numeric code describes the jacket type.

JACKET TYPE	
Jacket Type	Jacket Material
00	None
11	Smooth aluminum with factory applied vapor retarder (Type I)
12	Embossed aluminum with factory applied vapor retarder (Type I)
13	Smooth aluminum no vapor retarder (Type II)
14	Embossed aluminum no vapor retarder (Type II)
21	Smooth stainless steel with factory applied vapor retarder (Type I)
22	Embossed stainless steel with factory applied vapor retarder (Type I)
23	Smooth stainless steel no vapor retarder (Type II)
24	Embossed stainless steel no vapor retarder (Type II)
31	“PVC” Ultra-violet resistant polyvinyl chloride jacket (Type I)
41	“ASJ” (All Service Jacket) reinforced, flame retardant, vapor barrier (Type I)
42	“FSK” (Foil, Scrim, Kraft) flame retardant, vapor barrier (Type I)
51	Field applied fiberglass cloth or tape (Type II)

PART 3 - EXECUTION

3.1 GENERAL

A. Furnish, fabricate, install, assemble and examine insulation for piping and equipment as shown on the Drawings. For installation details not shown on drawings, submit detail drawings for approval.

B. The Work includes, but is not limited to the following items:

1. Labor and construction materials, except as specified otherwise herein, for the installation of the piping and equipment insulation systems specified under this Specification.
2. Material required for insulation systems as specified herein.
3. Loading, transporting and unloading of insulation materials from the job site storage to the work area.
4. Compressed air supply, tools, connectors and hoses if required.
5. Electric generators, electric tools, hand tools, and other miscellaneous tools.
6. Rigging equipment and components.
7. Consumables and paints necessary to complete job.
8. Labor and materials for temporary scaffolding.
9. Temporary work enclosures for storage of material and installation of weather protection.
10. Temporary buildings, trailers, tool trailers, etc. for offices, locker/change rooms and bathrooms.
11. Safety gear, equipment, and supplies and compliance with the Installer's Safety Practices.
12. Communication devices (radios, phones, etc.) and equipment.
13. Reports and documentation as specified and required under this Specification.
14. Waste management, control and disposal procedure.
15. Clean-up and removal of trash to designated receptacles or disposal area on a daily basis or as additionally directed by the Contractor.

C. Fluid or plastic material such as coatings, sizing, plastic insulation, etc., which is applied, over sprayed, dropped, or splattered on any object or surface other than to which it is being applied, shall be removed at once. The surfaces upon which it was present shall be cleaned or replaced, as necessary, to remove traces of soiling.

D. Welding on pipe, pipe components or equipment is prohibited.

E. Protect surfaces adjacent to the work area from the insulating materials or required installation tools.

F. Temporary Removal of Installed Work: During the course of work, removal and reinstallation or replacement of certain floor grating or other items which have previously been installed may be necessary or of major advantage. Removal/installation of such items will be by the Contractor. Contractor shall provide temporary barriers, markers and signage to guard areas around removed grating until work is complete and grating is reinstalled.

3.2 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SURFACE PREPARATION

A. Prior to application of insulation, verify that the piping and equipment system installation is complete.

B. Verify that piping and equipment system have been cleaned, tested and are free of leaks prior to applying insulation.

C. Inspect surfaces prior to applying insulation. Remove deleterious material, rust, scales, dirt, surfaces to receive insulation. Use wire brushes, scrapers or other devices as necessary to accomplish the work and ensure proper surface preparation. Clean surfaces to SSPC SP1 and SP2. Surfaces shall be dry when insulated. Cleaning of stainless steel materials shall be in accordance with an approved procedure.

D. For piping and equipment that is coated, verify that the coating is intact and fully cured.

3.4 GENERAL APPLICATION REQUIREMENTS

A. Refer to Appendix A “Insulation Schedule” for materials, forms, jackets, and thickness required for piping and equipment systems shown on the Drawings.

B. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping and equipment, including fittings, valves, and specialties. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Use approved clamp-on insulation supports where welded lugs are not provided. Welding to equipment, ductwork, vessels or piping is prohibited. Where welded lug or clips are required, submit request for installation of devices.

E. Apply insulation with longitudinal seams at bottom of horizontal runs.

F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

G. Apply insulation with the least number of joints practical.

H. Apply insulation in multiple layers with staggered joints when specified insulation thickness is greater than 2 inches. Maintain Manufacturers' recommended temperatures and environmental conditions during curing time for tapes, adhesives, mastics, coatings, and cements.

I. For insulation indicated to receive a vapor retarder, seal joints and seams with vapor-retarder mastic. Seal remaining joints with weatherproof caulking to prevent moisture penetration. Where jacketing abuts a non-insulated surface, joints shall be sealed with suitable caulking.

J. Insulation Expansion Joints: Insulation on pipes subjected to temperature differential greater than 200°F between operating and ambient shall incorporate suitable insulation expansion joints. Insulation expansion joints shall be packed, insulated and protected with metal covering in such a manner so as not to inhibit movement of the expansion joint. Insulation expansion joints shall be located to accommodate for differential expansion between pipe and insulation materials.

K. Keep insulation clean and dry during storage and application.

1. Protect incomplete insulation work and insulating materials stored on the project site from weather, dirt, and possible damage.
2. Do not remove insulation from shipping containers until it is needed for installation.
3. Returned insulation to like containers or comparably protected insulation from dirt and moisture at the end of each workday.
4. Thoroughly clean insulation that has become dirty prior to use.
5. If cleaning does not restore the surfaces to like new condition, the insulation will be rejected and shall be immediately removed from the job site.

L. If insulation becomes wet, the insulation will be rejected and shall be removed from the job site.

M. Insulation Outer Surface: The thickness of protective coverings, flashing and finishing cement applied to exterior surfaces of insulation shall be in addition to the specified insulation thickness, and shall not be counted as part of the specified insulation thickness.

N. Insulation Cement:

1. Mix insulating cement in accordance with the manufacturer's instructions.
2. When used for pointing joints or filling voids in molded pipe or block insulation, insulating cement may be applied to the thickness of that layer of insulation being pointed or filled. Each layer shall be dry before the succeeding layer is applied.
3. Mix mineral fiber hydraulic-setting thermal insulating cement in contact with austenitic stainless steel piping and equipment systems with distilled or demineralized water.

O. Finishing Cement:

1. Mix finishing cement in accordance with the manufacturer's instructions, and apply in ¼-inch maximum thickness layers by troweling or palming.
2. Reinforce the cement when necessary to comply with best trade practice.
3. Two coats of finishing cement are required on surfaces to be left unjacketed for ½ inch total thickness. First layer shall be dry before second layer is applied. Temper second layer by adding 10 percent (by weight) of Portland cement to the insulating cement to produce a hard finish for the paint primer or canvas adhesive.

4. Finishing cement is not required where metal jacketing will be applied over pipe insulation. Finishing cement is not required over fast-drying cement which has been applied to metal mesh reinforcement on blanket insulation as a base for a weatherproof coating.
5. Regardless of type jacketing or finish specified, use finishing cement where necessary to provide a smooth surface or contour on insulation covering long radius pipe bends, valves, fittings, specialty items, etc.
6. Mix mineral fiber hydraulic-setting thermal insulating cement with distilled or demineralized water.

P. On cold surfaces where a vapor barrier must be maintained, apply insulation with a continuous, unbroken moisture and vapor seal. Insulate and vapor seal hangers, supports, anchors, and other projections that are secured to cold surfaces to prevent condensation. Extend surface finishes to protect raw edges, ends and surfaces of insulation.

Q. Patches:

1. Cover breaks in the vapor retarder jacket material with patches of the same material as the vapor retarder.
2. The patches shall extend a minimum of 2 inches beyond the break or penetration in all directions.
3. Secure patches with adhesive and staples.
4. Seal staples and joints with a brush coat of vapor retarder coating.

R. Mastic Finish: If specified aluminum jacketing cannot be applied to valve bodies, fittings or equipment, finish insulation surfaces with a bedding coat of white mastic, a layer of white glass fabric applied into the bedding coat while still tacky, and a brush-applied finish coat of mastic over the glass fabric, sealing pores in the fabric.

S. Weatherproof Coating:

1. Approved substitute for metal jacketing: Weatherproof coatings applied by troweling, palming or spraying as recommended by the coating manufacturer. When used on valves, fittings or other locations adjoining piping and equipment to be jacketed with metal, weatherproof coating shall be applied over the pipe insulation for sufficient distance to provide at least 4-inch overlap by the pipe jacketing.
2. Insulation diameters 6 inches or greater: Apply poultry netting over the finishing cement surface to reinforce the weatherproof coating.
3. Weatherproof coating total thickness when dry: Minimum of $^{1}/_{8}$ inch.
4. Apply weatherproof coating in one or more coats as recommended by the manufacturer for the product and application method being used.

T. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to applicable sections for applying insulation over fittings, valves, and specialties.

U. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation-to-insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

V. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

1. Terminate the insulation to allow enough space for stud removal without damaging the insulation. Provide removable blankets to cover bolted flange connections and the space on either side provided for stud removal.

W. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1½ inch (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
4. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
5. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
6. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

3.5 EQUIPMENT APPLICATIONS

A. Insulation material and thickness is specified in schedules in Appendix A.

B. Personnel Protection: When insulation is required for personnel protection, apply insulation around the portion of the pipe length, or to those surfaces of equipment, which are located within 8 feet above, 2 feet below, or 4 feet horizontally of floors, roofs, platforms, walkways, stairs or ladders.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Relief valves above the inlet flange
2. Bearings or couplings
3. Seals, packing or stuffing boxes
4. Motors or electrical devices

5. Flexible connectors.
6. Vibration-control devices.
7. Chrome-plated components, unless potential for personnel injury.
8. Air chambers, steam traps and instrumentation/controls requiring heat dissipation.

D. Do not insulate factory insulated equipment.

E. On exposed equipment, locate insulation and cover seams in least visible locations.

F. Finish insulation at stiffeners or flanges of casings, flues and duct, legs, supports, protrusions, interruptions and other projections.

G. For exterior applications, provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located and lapped to prevent water entry.

H. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

I. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage (removable blankets).

J. For equipment requiring heat trace, provide permanent labels affixed to the insulation.

3.6 PIPING SYSTEM APPLICATIONS

A. Insulation material and thickness is specified in schedules in Appendix A.

B. Personnel Protection: When insulation is required for personnel protection only, apply insulation around the portion of the pipe length, or to those surfaces of equipment, which are located within 8 feet above, 2 feet below, or 4 feet horizontally of floors, roofs, platforms, walkways, stairs or ladders.

C. Piping in vertical runs which are greater than 10 feet long, and which will be insulated, shall be provided with insulation supports. Three lugs on 120-degree radial spacing shall be used at each support level. Lugs on piping which must be stress relieved shall be shop welded to shop fabricated pipe. All other insulation support lugs, collars, skirts, etc., shall be furnished for field installation. Use approved clamp-on insulation supports where lugs are not provided. Welding to equipment, vessels or piping is prohibited.

D. Items Not Insulated: Unless otherwise indicated, or essential for personnel protection, do not apply insulation to the following systems, materials, and equipment:

1. Relief valves above the inlet flange
2. Valves above the bonnet, leave the stuffing box and stem exposed
3. Flexible connectors.
4. Vibration-control devices.
5. Below-grade piping.
6. Chrome-plated pipes and fittings, unless potential for freeze or personnel protection.
7. Air chambers, steam traps and instrumentation/controls requiring heat dissipation.

3.7 PENETRATIONS

A. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic unless otherwise shown on Drawings.

B. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

C. Fire-Rated Wall and Partition Penetrations: Where pipes pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, seal the penetration with fire stopping materials as specified and approved by the AHJ.

D. Floor Penetrations: Apply insulation continuously through floor assembly. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.8 CALCIUM SILICATE INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with stainless-steel bands at 12-inch (300-mm) intervals and tighten without deforming insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm), soft-annealed, stainless-steel wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same material and thickness as pipe insulation.
4. Finish flange insulation the same as pipe insulation.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to Manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of calcium silicate insulation. Secure insulation materials with stainless-steel wire.
3. Finish insulation of fittings the same as pipe insulation.

D. Apply insulation to valves and specialties as follows:

1. Apply mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves with integral strainer, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation the same as pipe insulation.

3.9 FIBERGLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with standard PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves with integral strainer, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.10 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.

2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves with integral strainer, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.11 POLYISOCYANURATE INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of the same thickness as pipe insulation.
4. Apply canvas jacket material with Manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of polyisocyanurate insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded segments of polyisocyanurate insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves with integral strainer, arrange insulation for access to strainer basket without disturbing insulation.

2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.12 CELLULAR-GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of the same thickness as pipe insulation.
4. Apply canvas jacket material with Manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves with integral strainer, arrange insulation for access to strainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.

3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.13 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.
2. Apply lap or joint strips with the same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Apply jackets with 1½-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Metal Jacketing and Lagging:

1. General:

a. Secure metal jacketing with metal screws on 4-inch centers and bands. Provide a weather tight seal and allow for thermal expansion of the pipe and insulation. Do not install jacketing and lagging over wet insulation.
b. Exterior: Lap joints in the metal jacketing a minimum of 2 inches in a direction to shed water. Locate longitudinal seams in jacketing on vertical runs of piping on the side away from the prevailing wind direction. Locate longitudinal seams in jacketing on horizontal piping and piping other than vertical on the bottom. Seams shall be sealed weather tight with Alumilastic caulking compound.
c. Interior: Lap joints in the metal jacketing a minimum of 2 inches. Locate the longitudinal seam in the jacketing to be least visible from nearby floors, platforms and walkways.
d. Circumferential laps of 3½ inches minimum are required over or adjacent to expansion joints in insulation. Laps shall be free of attachment screws at locations which would restrict necessary movement at the expansion joint.

e. Machine-form jacketing for flanges, ends of heat exchangers and similar areas to the required contour with the fewest practical number of pieces consistent with fabrication, assembly and removal requirements. Field-formed metal jacketing around pipes or other surfaces shall be in firm contact with the insulation, and remain free of sags, bulges or distortions after attachments are installed. Machine roll aluminum as necessary to assure a snug fit and to match the curvature of the insulation.

f. Openings cut in the jacketing to fit around exposed metal components shall provide a rub-fit between the jacketing and exposed metal to minimize moisture penetration at the opening.

g. Paint steel surfaces that contact aluminum with a minimum of one (1) coat of asphalt aluminum paint.

1) Remove oil and grease in accordance with SSPC SP-1, using the specified solvents and clean cloths
2) Remove dirt, loose rust, weld spatter, mill scale and other foreign material by mechanical cleaning in accordance with SSPC SP-2 or SP-3.
3) Apply paint in accordance with the manufacturer's instructions.

h. Insulation cement, paint, coatings, mastics, and/or loose mineral fibers, where dropped on installed aluminum, shall be immediately removed. Such debris, when wet, will cause water staining of the aluminum.

i. Reject aluminum which is rust stained, water stained, and/or oxidized.

j. Equipment and valves 3 Inches and Larger: Jacket with "suitcase" type enclosures with hinges or latches to facilitate ease of access by maintenance personnel.

2. Metal Pipe Jacketing:

a. Jacket insulated elbows with the specified factory-fabricated preformed fittings, made in halves. Fasten together in the field with self-tapping screws.

b. Jacket large elbows and long radius bends with the specified gore-type factory-fabricated ells.

c. Cover flanges with a removable aluminum jacket.

3.14 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket (color to be Manufacturer's standard unless indicated in the Project Documents).

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

C. Color: Final color to be Manufacturer's standard unless indicated in the Project Documents. Vary first and second coats to allow visual inspection of the completed Work.

3.15 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after or during installation of insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by the Contractor, remove and replace fitting covers/jackets/insulation where required.
2. Inspect a minimum of:

a. 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes
b. 20 valves or 1 percent of valves, whichever is less, for various pipe sizes

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.16 START-UP AND CURING

A. During initial heat-up of high temperature insulation products to temperatures above 350°F, an acrid odor and smoke may be given off. Provide adequate ventilation to protect against harmful fumes.

3.17 FIELD QUALITY CONTROL

A. Obtain the required approved submittals including Product Data, Shop Drawings, Quality Control Procedures, Test Reports and Project Record Documents.

B. Examine insulation applied to surfaces subject to sweating (Class W, C, F, and L) to assure vapor barrier is intact.

END OF SECTION 485080

APPENDIX A
INSULATION MATERIAL

INSULATION CODE	IDENTIFICATION CODE	SHORT DESCRIPTION
N	-	NOT INSULATED
L	LE12	POLYISOCYANURATE W/ ALUMINUM JACKET AND VAPOR RETARDER
H	HA12	CALCIUM SILICATE W/ ALUMINUM JACKET AND VAPOR RETARDER
P	PA12	CALCIUM SILICATE W/ ALUMINUM JACKET AND VAPOR RETARDER

Note: Insulation thicknesses included in this Section are estimates only. BOP Contractor is responsible for final insulation thickness selection during detailed design.

INSULATION THICKNESS – CODE H

Operating Temperature	900-1000 °F
Nominal Pipe Size	**Insulation Thickness (inches)**
2”	2
4"	2 ½
6"	3 ½
8"	4 ½
10"	5 ½
12”	6 ½

INSULATION THICKNESS (in) – CODE P

Nominal Pipe Size	Operating Temperature Range (F)						
	140 - 200	201 - 300	301 - 400	401-500	501-600	601-800	801-1000
1.5” & less	1	1½	2	2½	3 ½	4 ½	6
2”	1	1½	2	3	3 ½	5	7
3"	1	1½	2½	3 ½	4	5 ½	7 ½
4"	1	1½	2½	3 ½	4 ½	6	8
6"	1	2	3	3 ½	4 ½	6 ½	9
8"	1	2	3	4	5	7	9 ½
10"	1	2	3	4	5 ½	7 ½	10
12”	1	2	3	4 ½	5 ½	8	10

Personnel Protection insulation thickness shall be selected to ensure a surface temperature of less than 140°F after insulation.

INSULATION THICKNESS (in) – CODE L

Nominal Pipe Size	Operating Temperature Range (F)
	32-200
10”	**2**
12”	**2**
14"	**2**

APPENDIX B
SUBMITTAL REQUIREMENTS SCHEDULE

		Equipment No.
	Client	Requisition No.
SUBMITTAL REQUIREMENTS SCHEDULE PIPING AND EQUIPMENT INSULATION	Contract	Specification No.
The following Submittals must be furnished to the entity noted under "Submit To" by the dates indicated (Engr = Engineer)	Location	File No.

	Submittal Description[4]	*Data with Bid*		*Copies for Review*			*Certified Copies*		
		Submit To		*Submit To*		*Date Req'd*	*Submit To*		*Date Req'd*
		Owner	*Engr*[1]	*Owner*	*Engr*[2]		*Owner*	*Engr*[3]	
1.	**Administrative Submittals**								
	Contract Closeout Submittal						X		10DFC
5.	**Manufacturer's Standard Data**								
	Catalog Data Sheets	X		X		2ARO	X	X	10DFC
6.	**Field Installation, Erection and Placing Instructions or Procedures**								
	Manufacturer Instructions	X		X		2ARO	X	X	10DFC
7.	**Product Data**								
	Catalog Data	X	X	X		2ARO	X	X	10DFC
	Dimensional Drawings	X	X	X		2ARO	X	X	10DFC
	Shop Drawings	X	X	X		2ARO	X	X	10DFC
	Material Safety Data Sheets (MSDS)	X		X		2ARO			
	Samples	X	X	X		2ARO			
9.	**Inspection, Test Reports and Certificates of Compliance**								
	Asbestos Free Certificate	X		X		2ARO			
	Material Test Reports	X		X		2ARO			
14.	**Record Documents**								
	Project Record Documents						X	X	10DFC
15.	**Warranties and Guarantees**								
	Warranty	X							

SPECIAL NOTES:

1. Indicates submittal by Contractor requiring Engineer's review to allow technical evaluation of bids.
2. Indicates submittal by Contractor requiring Engineer's review prior to proceeding with fabrication or construction activities for work covered by submittal.
3. Indicates submittal by Contractor required for Engineer's use as a record document.
4. Quantity of prints/copies/media required for each type of submittal is defined in Project Documents.

SCHEDULE ABBREVIATIONS:

ARO = Weeks After Order Received by Subcontractor/Supplier
AAR = Weeks After Review (defined as date review comments received by Subcontractor/Supplier from Contractor/Engineer
DFC = Days After Completion (completion is defined contractually completion of work)
PTC = Weeks Prior To Construction (initiation of fabrication in Supplier's shop or work in field)
PTS = Weeks Prior To Shipment (date of shipment from Supplier's shop)

September 9, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485090
Cathodic Protection System

PROJECT NUMBER:
123374

PROJECT CONTACT:
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Section 485090
Cathodic Protection System

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: TONY CLARK

REVISION HISTORY		
DATE	REVISED BY	REVISION
9/9/2013	T. Clark	A

SECTION 485090
CATHODIC PROTECTION

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 RELATED SECTIONS 2
1.3 CODES AND STANDARDS 2
1.4 DEFINITIONS 2
1.5 SYSTEM DESCRIPTION 3
1.6 SUBMITTALS 4
1.7 QUALITY ASSURANCE 5
1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING 6
1.9 SITE CONDITIONS 6
1.10 WARRANTY 6

PART 2 - PRODUCTS 7

2.1 MATERIALS 7
2.2 SACRIFICIAL ANODE SYSTEM 7
2.3 IMPRESSED CURRENT SYSTEM 8
2.4 ACCESSORIES 8
2.5 SOURCE QUALITY CONTROL 9

PART 3 - EXECUTION 10

3.1 FIELD QUALITY CONTROL 10
3.2 COMMISSIONING 11

PART 4 - ATTACHMENTS (PROVIDED BY BOP CONTRACTOR) 12

4.1 UNDERGROUND PIPING LINE LIST 12
4.2 UNDERGROUND PIPING LAYOUT DRAWINGS 12
4.3 UNDERGROUND EQUIPMENT AND BURIED STRUCTURE LIST 12
4.4 STRUCTURAL FOUNDATIONS DRAWINGS 12
4.5 ELECTRICAL DUCTBANK DRAWINGS 12

SECTION 485090
CATHODIC PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. These specifications describe the requirements for a corrosion study assessment and cathodic protection (CP) system designed to mitigate corrosion activity on underground piping and buried structures. The cathodic protection system shall be the sacrificial anode type or impressed current system as determined appropriate for the site conditions.

B. The scope of work for the BOP Contractor described herein includes assessment of the cathodic protection needs of the site, supply of equipment necessary for an adequate level of protection, and field services to install, test, and commission the cathodic protection system.

C. It is not the intent to specify completely herein all details of design and construction of the equipment and systems. However, the equipment and systems shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to 30 years.

D. Section Includes:

1. Cathodic protection system design by:

    a. Sacrificial Anodes
    b. Impressed Current

2. Equipment and materials supplied as part of the cathodic protection system
3. Field installation and commissioning

E. Furnished Under This Section

1. The follow shall design, fabricate and test the specified equipment and services, including but not limited to the following:

    a. Full corrosion engineering review study of site data with respect to cathodic protection requirements
    b. Initial report to include cathodic protection system design recommendations
    c. Related system components (cables, anodes, rectifier, test stations, etc.)
    d. Required supervisory instrumentation
    e. Field installation supervision, inspection, and testing
    f. Startup spares and special tools
    g. Drawings and design data to support facility design, construction and maintenance
    h. Inspection certificates and quality control documentation listed in this Section
    i. Complete set of component cut sheets
    j. Operating, commissioning, installation and maintenance manuals for the supplied equipment.
    k. Priced list of recommended spare parts for two years of operation
    l. 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.

m. Insulating flanges at underground risers and at dissimilar metal interfaces
n. Coating repair at locations of lead wires
o. Receipt and off-loading at site
p. Installation labor at site

F. Furnished by Others Under this Section

1. The supply by Others shall be limited to the following:

a. Site geotechnical studies, soil and water test reports

1.2 RELATED SECTIONS

A. Section 16000, Electrical Installation

B. Section 260000, Electrical - Mechanical Equipment

C. Section 480020, Site Conditions

D. Section 481200, Combined Cycle Balance of Plant

1.3 CODES AND STANDARDS

A. Refer to 481200 Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment and services supplied under this Section.

1. ASTM International (ASTM)

a. B418 - Standard Specification for Cast and Wrought Galvanic Zinc Anodes
b. B843 - Standard Specification for Magnesium Alloy Anodes for Cathodic Protection

2. American Water Works Association (AWWA)

a. D104 - Automatically Controlled, Impressed-Current Cathodic Protection for the Interior Submerged Surfaces of Steel Water Storage Tanks
b. D106 - Sacrificial Anode Cathodic Protection Systems for the Interior Submerged Surfaces of Steel Water Storage Tanks

3. NACE International (NACE)

a. RP0285 - Corrosion Control of Underground Storage Tank Systems By Cathodic Protection
b. SP0169 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems

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 SYSTEM DESCRIPTION

A. Design Requirements:

1. Cathodic Protection Assessment

a. The need for external corrosion protection shall be based on field data on site conditions provided as attachments to this Section, operating experience with similar systems in similar environments, engineering and design specifications, sound engineering practices, and operating, safety, and economic considerations.
b. For the initial phase of work, the BOP Contractor shall prepare a written report and recommendation for the cathodic protection system. This report shall be submitted to the General Manager for review and approval prior to purchasing or installing any equipment. The report shall include a cost estimate for the recommended cathodic protection system equipment. The report must include literature and descriptive catalogs covering all equipment proposed.
c. Unless otherwise specified by the General Manager or local authorities, it is the discretion of the BOP Contractor to identify the best cathodic protection arrangement (cathodic protection or impressed current) for application at the site.

2. General

a. The BOP Contractor's cathodic protection design shall include protection for the new and existing underground features on the site.
b. The BOP Contractor shall be responsible for coordinating this cathodic protection design with General Managers of other cathodic protection systems associated with new and existing cathodic protection systems of underground piping and structures on or nearby the site.
c. The cathodic protection system shall be designed to facilitate periodic inspection and maintenance to ensure an adequate level of protection is provided throughout the design life of protected piping and structures.
d. Hazardous operating conditions present at the proposed installation site should be identified ad properly addressed in the design of the CP system.
e. Locations of anode installation shall be selected to minimize stray currents or earth potential gradients which can cause detrimental effects on foreign buried piping and structures.

f. Special consideration shall be given to the presence of sulfides and sulfate reducing bacteria.
g. Excessive current that can cause coating disbondment or hydrogen evolution should be avoided.
h. Where applicable, interference currents shall be investigated and appropriate measures shall be taken to mitigate corrosion effects on protected structures and piping as well as nearby features that may not be protected.

B. Performance Requirements:

1. General

a. Cathodic protection systems design shall mitigate adverse effects of stray current on foreign structures within the influence of the CP system.
b. All impressed current systems must be designed with priority for safety considerations.
c. In the absence of data that demonstrates adequate CP voltage is applied, a cathodic potential of at least 850mV (referenced to copper/copper sulfate) or minimum of 100mV of cathodic polarization is required for steel piping and buried structures.

1.6 SUBMITTALS

A. Refer to 481200, Combined Cycle Balance of Plant for general proposal requirements and general requirements of submittals provided after award of contract.

B. Product Data

1. Provide bills of material, manufacturer catalog sheets, MSDS, and other pertinent details describing all components of the proposed system, including insulated joint details, anode description and test station details. Anode details shall include a description of the type and size of anode.

C. Drawings

1. System drawings must show overall layout of the piping and structures to be protected and locations of anode beds, test stations, electrical bonds, electrical isolating devices, and rectifiers.
2. Outline drawings include layouts, general assembly, components, foundation requirements, dimensions, weights, clearances, and methods of assembly.
3. The BOP Contractor shall submit all drawings and design data to support facility design, construction and maintenance.

D. Schedule

1. BOP Contractor shall provide a preliminary schedule with estimates for the following:

a. Number of days required for preparation of Evaluation Report and Recommendations
b. Number of days required for approval drawings
c. Number of days required for certified drawings
d. Number of days required for equipment to arrive on site (estimate)

e. Number of days included in price to inspect and test the installation and to start-up the system

E. Operating and Maintenance Instructions

1. Product Operational and Maintenance Instructions including:

a. Data Sheets
b. Special shipping, handling, and storage instructions
c. Recommended maintenance frequency and listing of suggested spare parts
d. Maintenance and repair instructions, including procedures and tolerances
e. Special tool or facility needs, etc.
f. Bill of materials
g. Descriptive literature
h. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)

2. Instruction books shall include literature on all instruments and devices furnished with the equipment.

F. Quality Assurance/Control Submittals

1. Submit qualification, inspection and testing procedures for review and approval prior to commencement of work activities. Quality related submittals may include:

a. Design Data
b. Test Reports
c. Certificates
d. Manufacturer's Instructions
e. Manufacturer's Field Reports

G. Closeout Submittals

1. Updated layout drawings of the system and components shall be provided where field installation differs from original design.
2. Locations of anode installations shall be recorded in tabular form as well as on layout drawings and list appropriate notes on anode type, weight, spacing, depth, and backfill.

H. Warranty: Submit product warranty certificates.

1.7 QUALITY ASSURANCE

A. Refer to 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. Qualifications

1. The cathodic protection system shall be designed by a firm regularly engaged in the field of corrosion protection. An experience and customer list shall be provided for reference.
2. The BOP Contractor shall directly employ a registered Professional Engineer in the jurisdiction of the project site who is also certified as a Corrosion specialist by NACE International.

C. Regulatory Requirements

1. Consideration shall be made in the design process to comply with all federal and local jurisdiction requirements for corrosion protection of underground and submerged structures.

1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general packaging, delivery, storage, and handling requirements.

1.9 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.10 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All material selected for the construction of a cathodic protection system shall be new and the best available for the purpose for which they are used, considering strength, ductility, durability, and the best engineering practice.

B. All materials and equipment supplied by the BOP Contractor shall be listed by Underwriters Laboratories except for classes of materials and equipment not available with such listing.

C. The following materials shall not be used under any circumstances:

1. Cadmium
2. Silver
3. Asbestos
4. Cupronickel
5. Paint containing lead of chromates
6. Heavy metals including mercury and arsenic
7. PCBs or other similarly hazardous materials

2.2 SACRIFICIAL ANODE SYSTEM

A. Anode

1. Sacrificial anodes shall be constructed of one of the following materials:

a. Standard potential magnesium: ASTM B 843, UNS M11632
b. High potential magnesium: ASMT B 843, UNS M151102
c. High purity zinc: ASTM B 418, UNS Z13000

2. Anodes shall be provided prepackaged with special backfill and 10 ft (3 m) lead wire attached.
3. Anodes shall be installed near protected pipes and structures in a manner that allows optimal current distribution. Spacing will typically be 5-10 ft from the protected structure and as close to the bottom elevation of the structure as feasible.
4. Anodes shall be installed vertically in an augered hole with minimum 12 inch (300mm) diameter hole.

B. Backfill

1. Magnesium anodes shall be backfilled with a mixture of 75% gypsum, 20% bentonite clay, and 5% sodium sulfate.
2. Zinc anodes shall be backfilled with a mixture of 75% gypsum, 20% bentonite clay, and 5% sodium sulfate or 50% gypsum and 50% bentonite clay.

2.3 IMPRESSED CURRENT SYSTEM

A. General

1. All protected piping and structures must be electrically continuous. Bonds may be required from pipe to tank, tank to tank. Foreign underground structures may need investigation for isolation or continuity to mitigate the effects of stray current.

B. Rectifier

1. Wiring to rectifiers shall comply with local electrical codes.
2. An external disconnect switch shall be provided in the AC power supply to the rectifier.
3. The rectifier case shall be properly grounded

C. Anode

1. Impressed current anodes may be either high silicon cast iron or graphite. Alternate materials may be considered if appropriate for the site conditions.

D. Backfill

1. Anode life can be extended by the use of low resistivity backfill suck as coke breeze made from coal and calcined petroleum coke.

2.4 ACCESSORIES

A. Test Stations

1. Test stations for potential and current measurements shall be at sufficient locations to facilitate CP testing per BOP Contractor provided operation and maintenance procedures.
2. Test station design shall permit disconnection of the anodes to correct potential measurements for IR drop to evaluate the protection level and include test leads from buried reference electrodes.
3. The test stations should be supported with a 4” x 4” x 6’- 6” treated redwood post. The test leads should be installed in conduit attached with straps to the post.
4. Test stations shall be visibly marked and installed at locations accessible for maintenance personnel, visibly marked, and protected from high traffic areas.

B. Reference Electrodes

1. Reference electrodes shall be copper/copper sulfate material. Alternate reference electrode materials may be considered with proper voltage measurement corrections provided by the BOP Contractor.

C. Lead Wire

1. Lead wire shall be minimum #12 AWG solid copper wire with thermoplastic insulation.
2. Where lead wires are to be thermally welded to the protected structure, wire shall be provided with a weldable steel core.

3. Lead wire connections shall be tested for mechanical strength and electrical continuity.
4. Sufficient slack shall be provided in lead wires to avoid damage due to soil settlement.
5. Lead wires shall be installed with at least 18 inch (0.5m) soil cover.
6. Lead wire connectors and connections shall be properly cleaned and coated after attachment with touchup coating compatible with the existing coating on the protected pipe or structure. Where necessary to connect lead wires to coating pipes and structures, a non-metallic abrasive sanding disc may be used to remove coating provided the area is properly recoated following wire connection.

D. Insulated Joints

1. Insulated joints as detailed on the drawings, shall be installed in the flanged connections where indicated. Each of these insulated joints shall be equipped with an overvoltage protector, installed in accordance with the manufacturer's instructions.
2. Insulated flange assembly shall be assembled and tested before welding it into the line.

E. Over Voltage Protection:

1. A device to provide over-voltage protection from lightning and fault current for an insulated joint. Dairyland Electrical Industries, Type OVP, or an approved equivalent, complete with mounting brackets suitable for installing the device utilizing the pipe flange connecting bolts.

2.5 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. Inspection and testing shall be in accordance codes specified.
2. Instruments shall be protected during testing.
3. Wiring shall be checked for continuity and insulation integrity.
4. Full information describing the tests which are included in the price quotation shall be included with the Proposal.
5. Certified copies of test results shall be submitted for acceptance before shipment of the equipment is made.

B. The BOP Contractor will establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The BOP Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Field Service

1. The BOP Contractor shall furnish the services of a qualified and experienced corrosion engineer to supervise the installation, start-up and testing of the cathodic protection system.

B. Inspections

1. For anode installations, the BOP Contractor's field engineer will verify that the anode is centered in the hole or trench per the BOP Contractors design and that the fill is placed and compacted so that no voids can exist.
2. The BOP Contractor's field engineer will inspect cable insulation, and anode and pipe line connections to make there is good continuity and connections make sure there is no damage prior to placement of backfill.

C. Tests

1. Prior to energizing the CP system, data shall be collected to provide baseline measurements of such items as:

   a. Structure to soil potential
   b. Pipe to soil potential
   c. Dielectric isolation, if present
   d. Foreign structure to soil potentials
   e. Test coupons, if present
   f. Permanent reference electrodes, if present

2. Testing of Insulated Flanged Joints (By BOP Contractor)

   a. Using a test current applied from a temporary D.C. source, interrupt the current source.
   b. Measure the potential to a remote copper/copper sulfate electrode on side of the new pipeline.
   c. The potential should change with a positive shift with the current interrupted. The potential on the other side of the insulated joint should move in a negative direction. This is an indication that the insulated joint is effective.
   d. Improperly installed non-conducting flange insulation shall be replaced by the BOP Contractor.

3. Following successful installation and testing of the cathodic protection system the following should be recorded and provided with the final report submittal.

   a. Results of current requirement tests
   b. Results of soil resistivity surveys;
   c. Location of foreign structures

d. Interference tests and design of interference bonds and reverse current switch installations.

3.2 COMMISSIONING

A. Current Adjustment

1. The exact operating level of CP systems shall be determined by testing the installed system at different operating levels to ensure proper protection potential. If protective potentials are not adequate, the system shall be modified as required to provide an acceptable design in accordance with design requirements.
2. A survey should be performed after each CP current adjustment to determine whether the sufficient protection is satisfied and to reassess interference to other structures or isolation points.
3. After installation is complete, the BOP Contractor shall re-calculate the useful life of the anodes based upon soil resistivity and actual potential measurements. (The BOP Contractor shall provide and use test coupons to determine actual corrosion rates and shall install test points to facilitate the taking of potential measurements).

B. Stray Current Mitigation

1. If during commissioning and testing stray currents potentially detrimental to unprotected structures are measured or suspected to be present, the BOP Contractor shall identify the points of concern to the General Manager so they may be properly addressed prior to plant startup.

END OF SECTION 485090

PART 4 - ATTACHMENTS (PROVIDED BY BOP CONTRACTOR)

4.1 UNDERGROUND PIPING LINE LIST

4.2 UNDERGROUND PIPING LAYOUT DRAWINGS

4.3 UNDERGROUND EQUIPMENT AND BURIED STRUCTURE LIST

4.4 STRUCTURAL FOUNDATIONS DRAWINGS

4.5 ELECTRICAL DUCTBANK DRAWINGS

PIPE MATERIAL SPECIFICATIONS

NOTES:

A. This specification shall be used as referenced for the development of construction documents, P&IDs, Piping Isometrics, 3D project model and Piping Line List. The material specifications listed below are required as part of this specification.

B. The current revision of the below listed specification may not match the revision of this sheet.

C. Refer to project specific documents for general quality assurance requirements.

D. Comply with approved submittal documents and procedures. Substitutions shall be submitted in accordance with the General Manager's specifications.

E. If conflicts exist between documents, the General Manager and Engineer shall determine requirements.

A	ISSUE FOR BID	10.18.13	SEG	TRC	GTH
REV	REVISIONS	DATE	DSGN	CHK	APPD

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F. Pipe Specification Codes are based on the following table:

PIPE SPECIFICATION CODE

PIPE MATERIAL		PRESSURE CLASS		SEQUENTIAL #
A	CARBON STEEL	A	>2500	A
B	LOW & INTERMEDIATE ALLOY	B	2500	B
C	STAINLESS STEEL	C	1500	C
D	NICKEL & HIGH NICKEL ALLOY	D	900	D
E	CAST/DUCTILE IRON	E	600	E
F	COPPER & COPPER ALLOYS	F	400	F
G	ALUMINUM & ALUMINUM ALLOYS	G	300	G
H	TITANIUM & TITANIUM ALOYS	H	150	H
I		I	350 (AWWA)	I
J		J	250 (AWWA)	J
K		K	125 (AWWA)	K
L		L	25 (AWWA)	L
M	MORTAR LINED	M	ATM	M
N		N		N
O	HDPE	O		O
P	THERMOSETTING PLASTIC	P		P
Q		Q		Q
R	RUBBER LINED	R		R
S	GLASS LINED	S		S
T	TEFLON LINED	T		T
U	CORRUGATED METAL PIPE	U		U
V		V		V
W		W		W
X		X		X
Y	SPECIAL	Y	SPECIAL	Y
Z		Z		Z

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PIPING MATERIAL SPECIFICATIONS

SPEC	DESCRIPTION	REV	DATE
AEB	CARBON STEEL: ASTM A106B, CL 600, SCH 80, BW & SW, ,	4	10.01.10
AGA	CARBON STEEL: ASTM A106B, CL 300, SCH 40/80, BW & SW, ,	5	10.01.10
AHA	CARBON STEEL: ASTM A106B, CL 150, SCH STD/80, BW & SW, ,	2	10.01.10
AHD	CARBON STEEL: ASTM A53B, CL 150, SCH STD, BW, EPOXY LINED, AWWA C207	1	10.01.10
BEA	LOW ALLOY: ASTM A335 P22, CL 600, SCH 40/80, BW & SW,	2	10.01.10
CBC	STAINLESS STEEL: ASTM A213 TP 316, CL 2500, TUBING, BW & SW, ,	1	10.01.10
CDC	STAINLESS STEEL: ASTM A213 TP 316, CL 900, TUBING, BW & SW, ,	1	10.01.10
CEA	STAINLESS STEEL: ASTM A312 TP304, CL 600, SCH 80S, BW & SW, ,	2	10.01.10
CGC	STAINLESS STEEL:ASTM A312 TP304, CL 300, SCH 40S/80S, BW & SW	3	10.01.10
CHA	STAINLESS STEEL: ASTM A312 TP304L, CL 150, SCH 10S/40S, BW & SW, THIN WALL,	5	10.01.10
CHB	STAINLESS STEEL: ASTM A312 TP304L, CL 150, SCH 40S/80S, BW & SW, ,	2	10.01.10
CHE	STAINLESS STEEL: ASTM A312 TP304, CL 150, SCH 40S/80S, BW & SW, ,	2	10.01.10
EJA	CAST/DUCTILE IRON: AWWA C151, CL 250, CEMENT-MORTOR LINED, MJ DI FITTINGS, AWWA C110 CL250,	0	10.01.10
EMA	CAST/DUCTILE IRON: ASTM A74, CL ATM, SERVICE WT, HUB & SPIGOT, ,	1	10.01.10
FHA	COPPER ALLOYS: ASTM B88, CL 150, TYPE L TUBE, SOLDERED, ,	1	10.01.10
YHB	STAINLESS STEEL: TP304L, CL 150, SCH 10S/40S, BW & SW, THIN WALL, TP304L DOUBLE CONTAIN		

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	
4	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A106B, CL 600, SCH 80, BW & SW	AEB 4
3	06.12.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2

DESIGN PRESS. (PSIG)	-14.7 to1480	1360	1310	1265	1205	1135	1100	1060	1015
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 102.0	93.4	90.3	87.5	83.8	77.4	75.2	72.7	69.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A106 Gr. B, ASME B36.10M Sch. 80 PE	ASTM A106 Gr. B, ASME B36.10M Sch. 80 BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9 Sch. 80 BE
Laterals, Wyes	N/A	ASTM A105, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A105, MSS SP-79 Class 3000 SW	N/A
Unions	N/A	N/A
FLANGES	ASTM A105, ASME B16.5 Class 600 RF x SW, Sch. 80 bore	ASTM A105, ASME B16.5 Class 600 RF, Sch. 80 bore, WN
BRANCH CONNECTIONS		
Reducing Tees	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9, Sch. 80 BE
Sockolets	ASTM A105, MSS SP-97 Class 3000 SW	ASTM A105, MSS SP-97 NPS 2 1/2 (DN 65) thru NPS 8 (DN 200) run size: Class 3000 SW NPS 10 (DN 250) thru NPS 24 (DN 600) run size: Class 6000 SW
Weldolets	N/A	ASTM A105 NPS 2 1/2 (DN 65) thru NPS 8 (DN 200): MSS SP-97 Sch. XS NPS 10 (DN 250) thru NPS 24 (DN 600): run size/wall by branch size/wall, see Add'l Requirements
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts.	
GASKETS	ASME B16.20, Class 600, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

ADDITIONAL REQUIREMENTS

1. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
2. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
3. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.063 in (1.59 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
4. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "Heavy Wall Forged WELDOLET". Order by "run material size/wall by branch size/wall".

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					POWER ENGINEERS	MATERIAL SPECIFICATION	AEB	REV
						PIPE		4
4	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A106B, CL 600, SCH 80, BW & SW		
3	06.12.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2	

NOTES

1. Pressure & temperature limitations are controlled by ASME B16.5 flange ratings.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-1 notes.
3. Pipe wall thickness based on 0.063 in (1.59 mm) corrosion, erosion or mechanical allowance.
4. Pipe fabricator to confirm final wall thickness on piping bends does not violate minimum wall thickness. Pipe bending shall comply with ASME B31.1 and Pipe Fabricators Institute (PFI) ES-24. Wall thickness reduction during bending may utilize excess material available from manufacturer's 12.5% nominal wall tolerance.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	AGA	REV
						PIPE		
5	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A106B, CL 300, SCH 40/80, BW & SW		5
4	06.25.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2	

DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.0	46.7	45.1	43.9	42.1	38.8	37.6	36.3	34.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A106 Gr. B, ASME B36.10M Sch. 80 PE	ASTM A106 Gr. B, ASME B36.10M Sch. 40 BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9 Sch. 40 BE
Laterals, Wyes	N/A	ASTM A105, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A105, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A105, MSS-SP-83 Class 3000 SW	N/A
FLANGES	ASTM A105, ASME B16.5, Class 300 RF x SW, Bore: Sch. 80	ASTM A105, ASME B16.5, Class 300 RF WN, Bore: Sch. 40 BE
BRANCH CONNECTIONS		
Reducing Tees	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9 Sch. 40 BE
Sockolets	ASTM A105, MSS SP-97 Class 3000 SW	ASTM A105, MSS SP-97 NPS 2 1/2 (DN 65) thru NPS 16 (DN 400) run size: Class 3000 SW NPS 18 (DN 450) thru NPS 24 (DN 600) run size: Class 6000 SW
Weldolets	N/A	ASTM A105, MSS SP-97 NPS 2 1/2 (DN 65) thru NPS 10 (DN 250): Sch. STD NPS 12 (DN 300) thru NPS 16 (DN 400): Sch. XS NPS 18 (DN 450) thru NPS 24 (DN 600): run size/wall by branch size/wall, see Add'l Requirements
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts.	
GASKETS	ASME B16.20, Class 300, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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ADDITIONAL REQUIREMENTS

1. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
2. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
3. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
4. Interface aboveground and buried piping with flange insulating kits (gasket).
5. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.063 in (1.59 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 buttwelding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
6. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 buttwelding end preparations and bore to match branch pipe ID. Bonney Forge "Heavy Wall Forged WELDOLET". Order by “run material size/wall by branch size/wall”.

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-1 notes.
3. Pipe wall thickness based on 0.063 in (1.59 mm) corrosion, erosion or mechanical allowance.
4. Pipe fabricator to confirm final wall thickness on piping bends does not violate minimum wall thickness. Pipe bending shall comply with ASME B31.1 and Pipe Fabricators Institute (PFI) ES-24. Wall thickness reduction during bending may utilize excess material available from manufacturer’s 12.5% nominal wall tolerance.

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					POWER ENGINEERS	MATERIAL SPECIFICATION PIPE	AHA SHEET 1 OF 2	REV 2
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A106B, CL 150, SCH STD/80, BW & SW		
1	06.30.09	SMB	STH	STH				
REV	DATE	DSGN	CHK	APPD				

DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.7	17.7	15.8	14.0	12.1	9.3	8.4	7.5	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A106 Gr. B, ASME B36.10M Sch. 80 PE	ASTM A106 Gr. B, ASME B36.10M Std wt. BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9 Std wt. BE
Laterals, Wyes	N/A	ASTM A105, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A105, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A105, MSS-SP-83 Class 3000 SW	N/A
FLANGES	ASTM A105, ASME B16.5 Class 150 RF x SW	ASTM A105, ASME B16.5 Class 150 RF, Std bore, WN or Slip-on
BRANCH CONNECTIONS		
Reducing Tees	ASTM A105, ASME B16.11 Class 3000 SW	ASTM A234 Gr. WPB, ASME B16.9 Std wt
Sockolets	ASTM A105, MSS SP-97 Class 3000 SW	ASTM A105, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A105, MSS SP-97 Std wt.
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts.	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

ADDITIONAL REQUIREMENTS

1. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
2. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
3. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
4. Interface aboveground and buried piping with flange insulating kits (gasket).
5. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.063 in (1.59 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
6. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "Heavy Wall Forged WELDOLET". Order by “run material size/wall by branch size/wall”.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	AHA	REV
						PIPE		2
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A106B, CL 150, SCH STD/80, BW & SW		
1	06.30.09	SMB	STH	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2	

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-1 notes.
3. Pipe wall thickness based on 0.063 in (1.59 mm) corrosion, erosion or mechanical allowance.
4. Pipe fabricator to confirm final wall thickness on piping bends does not violate minimum wall thickness. Pipe bending shall comply with ASME B31.1 and Pipe Fabricators Institute (PFI) ES-24. Wall thickness reduction during bending may utilize excess material available from manufacturer's 12.5% nominal wall tolerance.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A53B, CL 150, SCH STD, BW, EPOXY LINED, AWWA C207	AHD 1
0	06.12.06	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2

DESIGN PRESS. (PSIG)	-14.7 to 150									
DESIGN TEMP. (°F)	-20 to 180									
DESIGN PRESS. (BARG)	-1.0 to 10.4									
DESIGN TEMP. (°C)	-29 to 82									

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 - NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 - BUILDING SERVICES PIPING (2008) AWWA – C200, C207, C210, C213
SIZE RANGE	NPS 6 (DN 150) thru NPS 48 (DN 1200)
PRIMARY JOINT TYPE	Butt weld
PIPE	ASTM A53 Gr. B Type E or Type S, ASME B36.10M Std wt. BE
FITTINGS	
Couplings, Tees, Ells, Reducers, etc.	ASTM A234 Gr. WPB, ASME B16.9 Std wt. BE
Laterals, Wyes	
Reducing Inserts	
Unions	
FLANGES	ASTM A105, NPS 6 (DN 150) thru NPS 24 (DN 600) ASME B16.5 Class 150 Flat Face, Std bore, WN or Slip-on NPS 26 (DN 650) thru NPS 48 (DN 1200) AWWA C207 Class D (150 PSI) Flat Face, slip-on
Flange Bolting	Zinc Coated carbon steel bolts and nuts ASTM A307 Gr. B bolts with ASTM A563 Gr. A nuts or ASTM A193 Gr. B7 continuous thread stud bolts (aboveground only) ASTM A194 Gr. 2H Heavy Hex nuts
Flange Gasket	ASTM D1330, Red rubber (SBR), 0.063 in (1.59 mm) thick, flat ring or full face, Class 150 drilling, ASME B16.21; GARLOCK Style # 50
BRANCH CONNECTIONS	
Reducing Tees	ASTM A234 Gr. WPB, ASME B16.9 Std wt
Sockolets	ASTM A105, MSS SP-97 Class 3000 SW
Weldolets	ASTM A105, MSS SP-97 Std wt.
Reinforced Branch	ASTM A285 Gr. C See Additional Requirements

LINING AND COATING

Apply interior lining and exterior coating in accordance with ANSI/AWWA C210-03: Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines or ANSI/AWWA C213-03: Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. Field repairs for AWWA C210 systems shall be in accordance with AWWA C210.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	AHD 1
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CARBON STEEL: ASTM A53B, CL 150, SCH STD, BW, EPOXY LINED, AWWA C207	
0	06.12.06	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2

ADDITIONAL REQUIREMENTS

1. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Use sockolets.
2. Outlet sizes NPS 2 1/2 (DN 65) thru NPS 4 (DN 100): Use weldolets, use reducing tee for NPS 6 (DN 150) x NPS 4 (DN 100).
3. Outlet sizes NPS 6 (DN 150) and greater: Use reducing tees, use weldolets or reinforced branch connections for 50% or greater reduction in branch to header pipe size.
4. Branch Reinforcement ring to match pipe run thickness and provide full area replacement of branch opening. Branch to be connected with full penetration groove weld and reinforcement to be connected with full fillet welds in accordance with B31.1 Fig. 104.3.1 (D) Example B. All metal surfaces to be prepared for lining and coating in accordance with AWWA C210.
5. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat faced flanges.
6. Interface aboveground and buried piping with flange insulating kits (gasket).
7. Certification to NSF 61 – Drinking Water System Components is not required.

NOTES

1. Pressure and temperature limitations are controlled by the AWWA C207 Class D flanges.
2. Not approved for flammable, combustible or toxic fluids.
3. Bending is prohibited.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	BEA	REV
						PIPE		
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	LOW ALLOY: ASTM A335 P22, CL 600, SCH 40/80, BW & SW,		2
1	06.29.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2	

DESIGN PRESS. (PSIG)	-14.7 to 783	760	760	760	623	497	371	265	176
DESIGN TEMP. (°F)	-20 to 200	400	600	800	900	950	1000	1050	1100
DESIGN PRESS. (BARG)	-1.0 to 53.8	52.4	52.4	52.4	45.4	37.4	25.6	16.2	12.9
DESIGN TEMP. (°C)	-29 to 100	200	325	425	475	500	538	575	590

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A335 Gr. P22, ASME B36.10 Sch. 80 PE	ASTM A335 Gr. P22, ASME B36.10 Sch. 40 BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr.F22, Class 1 ASME B16.11 Class 3000 SW 5D pipe bends	ASTM A234 Gr. WP22, Class 1 ASME B16.9 Sch. 40 BE 4D & 5D pipe bends, see Add'l Requirements
Laterals, Wyes	N/A	ASTM A182 Gr.F22, Special fittings, see Add'l Requirements
Reducing Inserts	ASTM A182 Gr.F22, Class 1 MSS SP-79 Class 3000 SW	N/A
Unions	N/A	N/A
FLANGES	ASTM A182 Gr.F22, Class 3 ASME B16.5 Class 600 RF x SW Bore: Sch 80	ASTM A182 Gr.F22, Class 3 ASME B16.5 Class 600 RF WN, Bore: Sch 40
BRANCH CONNECTIONS		
Reducing Tees	ASTM A182 Gr.F22, Class 1 ASME B16.11 Class 3000 SW	ASTM A234 Gr. WP22, Class 1 ASME B16.9 Sch. 40 BE
Sockolets	ASTM A182 Gr.F22, Class 1 MSS SP-97 Class 3000 SW	ASTM A182 Gr.F22, Class 1 MSS SP-97 NPS 2 1/2 (DN 65) thru NPS 16 (DN 400) run size: Class 3000 SW NPS 18 (DN 450) thru NPS 24 (DN 600) run size: Class 6000 SW
Weldolets	N/A	ASTM A182 Gr.F22, Class 1 MSS SP-97 NPS 2 1/2 (DN 65) thru NPS 10 (DN 250) run size: Sch. STD NPS 12 (DN 300) thru NPS 16 (DN 400) run size: Sch. XS NPS 18 (DN 450) thru NPS 24 (DN 600): run size/wall by branch size/wall, see Add'l Requirements
BOLTING	ASTM A193 Gr. B16 continuous thread stud bolts ASTM A194 Gr. 3 Heavy Hex nuts.	
GASKETS	ASME B16.20, Class 600, Spiral Wound, 0.175 in (4.45 mm) thick 316LSS metallic winding, 0.125 in (3.18 mm) thick 316LSS centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	BEA 2
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	LOW ALLOY: ASTM A335 P22, CL 600, SCH 40/80, BW & SW,	
1	06.29.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2

ADDITIONAL REQUIREMENTS

1. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
2. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
3. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temp. with 0.063 in (1.59 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
4. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "Heavy Wall Forged WELDOLET". Order by “run material size/wall by branch size/wall”.
5. Pipe fabricator to confirm final wall thickness on piping bends does not violate minimum wall thickness. Pipe bending shall comply with ASME B31.1 and Pipe Fabricators Institute (PFI) ES-24. Wall thickness reduction during bending may utilize excess material available from manufacturer’s 12.5% nominal wall tolerance or additional thickness available from thicker sections of pipe.

NOTES

1. Pressure and temperature limitations are controlled by pipe wall thickness.
2. Pipe wall thickness based on 0.063 in (1.59 mm) corrosion allowance.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CBC	REV
						PIPE		
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A213 TP 316, CL 2500, TUBING, BW & SW,		1
0	12.06.06	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

DESIGN PRESS. (PSIG)	-14.7 to 4500	4285	3544	3121	2910	2804	2545	1545	
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1200	
DESIGN PRESS. (BARG)	-1.0 to 310.3	292.4	246.4	214.0	200.9	193.3	167.2	106.5	
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	650	

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)					
SIZE RANGE	NPS 1/4 (DN 8) thru NPS 3/4 (DN 20)			N/A		
PRIMARY JOINT TYPE	Socket weld or Butt weld			N/A		
TUBING	ASTM A213 Gr. TP316 Fully annealed, high quality seamless steel hydraulic tubing. Hardness 80HRB or less. Tubing to be free of scratches, suitable for bending and flaring, minimum carbon content of 0.04%. Swagelok					
Tube Outside Diameter	0.250 in (6.35 mm)	0.313 in (7.95 mm)	0.375 in (9.53 mm)	0.500 in (12.70 mm)	0.625 in (15.88 mm)	0.750 in (19.05 mm)
Tube Min. Wall Thickness	0.035 in (0.89 mm)	0.049 in (1.245 mm)	0.049 in (1.24 mm)	0.065 in (1.65 mm)	0.083 in (2.11 mm)	0.109 in (2.77 mm)
FITTINGS	ASTM A479 Gr. TP316, minimum carbon content of 0.04%					
Couplings, Tees, Ells, Reducers, etc.	Swagelok Tube Socket Weld			N/A		
Compression fittings	Swagelok (prohibited above 1000°F (538°C))			N/A		
Reducing Inserts	N/A			N/A		
Unions	N/A			N/A		
FLANGES	N/A			N/A		
BRANCH CONNECTIONS						
Reducing Tees	N/A			N/A		
Sockolets	N/A			N/A		
Weldolets	N/A			N/A		
BOLTING	N/A					
GASKETS	N/A					

ADDITIONAL REQUIREMENTS

1. Stainless steel material to have a minimum carbon content of 0.04%.

NOTES

1. Pressure and temperature limitations are controlled by tube wall thickness, manufacturers tube rating and ASME B16.5.
2. Tube wall thickness based on 0.0 in (0.0 mm) corrosion or threading allowance with 8% bending allowance.
3. 8D or larger diameter bends may be used as required.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CDC	REV
						PIPE		
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A213 TP 316, CL 900, TUBING, BW & SW,		1
0	12.06.06	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

DESIGN PRESS. (PSIG)	-14.7 to 2160	1860	1540	1355	1265	1090	915	555	
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1200	
DESIGN PRESS. (BARG)	-1.0 to 149	126.9	107.1	92.9	87.3	75.1	60.1	38.3	
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	650	

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)							
SIZE RANGE	NPS 1/4 (DN 8) thru NPS 1 (DN 25)				N/A			
PRIMARY JOINT TYPE	Socket weld or Butt weld				N/A			
TUBING	ASTM A213 Gr. TP316 Fully annealed, high quality seamless steel hydraulic tubing. Hardness 80HRB or less. Tubing to be free of scratches, suitable for bending and flaring, minimum carbon content of 0.04%. Swagelok							
Tube Outside Diameter	.250 in (6.35 mm)	0.313 in (7.95 mm)	0.375 in (9.53 mm)	0.500 in (12.70 mm)	0.625 in (15.9 mm)	0.750 in (19.05 mm)	0.875 in (22.23 mm)	1.000 in (25.40 mm)
Tube Min. Wall Thickness	0.035 in (0.89 mm)	0.035 in (0.89 mm)	0.035 in (0.89mm)	0.049 in (1.25 mm)	0.065 in (1.65 mm)	0.065 in (1.65 mm)	0.083 in (2.11 mm)	0.083 in (2.11 mm)
FITTINGS	ASTM A479 Gr. TP316, minimum carbon content of 0.04%							
Couplings, Tees, Ells, Reducers, etc.	Swagelok Tube Socket Weld				N/A			
Compression fittings	Swagelok (prohibited above 1000°F (538°C))				N/A			
Reducing Inserts	N/A				N/A			
Unions	N/A				N/A			
FLANGES	N/A				N/A			
BRANCH CONNECTIONS								
Reducing Tees	N/A				N/A			
Sockolets	N/A				N/A			
Weldolets	N/A				N/A			
BOLTING	N/A							
GASKETS	N/A							

ADDITIONAL REQUIREMENTS

1. Stainless steel material to have a minimum carbon content of 0.04%.

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange rating.
2. Tube wall thickness based on 0.0 in (0.0 mm) corrosion or threading allowance with 8% bending allowance.
3. 8D or larger diameter bends may be used as required.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CEA	REV
						PIPE		
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A312 TP304, CL 600, SCH 80S, BW & SW		2
1	06.29.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2	

DESIGN PRESS. (PSIG)	-14.7 to 1411	1178	974	868	790	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 97.3	80.3	67.6	59.4	54.6	48.9	36.6	27.5	22.8
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	590	625	649

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A312 Gr. TP304, SMLS ASME B36.19M Sch. 80S PE	ASTM A312 Gr. TP304, SMLS ASME B36.19M Sch. 80S BE
FITTINGS	(Carbon content is to be 0.04% or higher)	
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 Gr.WP304-WX or S ASME B16.9 Sch. 80S
Laterals, Wyes	N/A	ASTM A182 Gr. F304, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304, MSS SP-79 Class 3000 SW	N/A
Unions	N/A	N/A
FLANGES (Carbon content is to be 0.04% or higher)	ASTM A182 Gr. F304, ASME B16.5 Class 600 RF x SW	ASTM A182 Gr. F304, ASME B16.5 Class 600 RFWN Sch. 80S
BRANCH CONNECTIONS	(Carbon content is to be 0.04% or higher)	
Reducing Tees	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 Gr. WP304-WX or S, ASME B16.9 Sch. 80S
Sockolets	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304, MSS SP-97 Sch. XS BE
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts	
GASKETS	ASME B16.20, Class 600, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Outlet sizes NPS 1/2 (DN 15) through NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
3. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
4. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
5. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by “run material size/wall by branch size/wall”.
6. Stainless steel material to have a minimum carbon content of 0.04%.

NOTES

1. Pressure and temperature limitations are controlled by pipe wall thickness and ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

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					POWER ENGINEERS	MATERIAL SPECIFICATION PIPE	CGC REV 3
3	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A312 TP304, CL 300, SCH 40S/80S, BW & SW	
2	06.29.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2

DESIGN PRESS. (PSIG)	-14.7 to 553	462	382	340	310	288	255	205	165
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 38.1	31.5	26.5	23.3	21.4	19.8	17.8	13.8	11.4
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	590	625	649

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A312 Gr. TP304, SMLS ASME B36.19M Sch. 80S PE	ASTM A312 Gr. TP304, SMLS ASME B36.19M Sch. 40S BE
FITTINGS	(Minimum carbon content of 0.04%)	
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 GrWP304-WX or S ASME B16.9 Sch. 40S
Laterals, Wyes	N/A	ASTM A182 Gr. F304, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304, MSS SP-83 Class 3000 SW	N/A
FLANGES (Minimum carbon content of 0.04%)	ASTM A182 Gr. F304, ASME B16.5 Class 300 RF x SW	ASTM A182 Gr. F304, ASME B16.5 Class 300 RFWN Sch. 40S
BRANCH CONNECTIONS	(Minimum carbon content of 0.04%)	
Reducing Tees	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 GrWP304L-WX or S ASME B16.9 Sch. 40S
Sockolets	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304, MSS SP-97 Std wt BE
BOLTING	ASTM A193 Gr. B16 continuous thread stud bolts ASTM A194 Gr. 3 Heavy Hex nuts	
GASKETS	ASME B16.20, Class 300, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Outlet sizes NPS 1/2 (DN 15) through NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
3. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
4. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/**wall** by branch size/wall.
5. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by “run material size/wall by branch size/wall”.
6. Interface aboveground and buried piping with flange insulating kits (gasket).

NOTES

1. Pressure and temperature limitations are controlled by pipe wall thickness and ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	CHA 5
5	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A312 TP304L, CL 150, SCH 10S/40S, BW & SW, THIN WALL	
4	09.09.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

DESIGN PRESS. (PSIG)	-14.7 to 230	195	175	160	150	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 15.9	13.3	12.1	11.1	10.5	9.3	7.5	6.5	5.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A312 Gr. TP304L, SMLS ASME B36.19M Sch. 40S PE	ASTM A312 Gr. TP304L, SMLS ASME B36.19M Sch. 10S BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	ASTM A403 Gr WP304L-WXorS, ASME B16.9 Sch 10S
Laterals, Wyes	N/A	ASTM A182 Gr. F304L, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304L, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304L, MSS SP-83 Class 3000 SW	N/A
FLANGES	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x SW	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF WN Sch 10S
BRANCH CONNECTIONS		
Reducing Tees	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	ASTM A403 Gr WP304L-WXorS, ASME B16.9 Sch 10S
Sockolets	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304L, MSS SP-97 Std wt.
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CGI "Compression-Gauge" with 316SS inner ring.	

ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
3. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
4. Interface aboveground and buried piping with flange insulating kits (gasket).
5. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 buttwelding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
6. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 buttwelding end preparations and bore to match branch pipe ID. Bonney Forge "Heavy Wall Forged WELDOLET". Order by “run material size/wall by branch size/wall”.

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.
4. Threaded connections or threadolets may be used for piping specialty or instrument connections where specified on piping isometrics or approved by the engineer.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CHB	REV
						PIPE		
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A312 TP304L, CL 150, SCH 40S/80S, BW & SW,		2
1	06.29.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2	

DESIGN PRESS. (PSIG)	-14.7 to 230	195	175	160	150	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 15.9	13.3	12.1	11.1	10.5	9.3	7.5	6.5	5.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A312 Gr. TP304L, SMLS ASME B36.19M Sch. 80S PE	ASTM A312 Gr. TP304L, WLD ASME B36.19M Sch. 40S BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	ASTM A403 Gr WP304L-WXorS, ASME B16.9 Sch 40S
Laterals, Wyes	N/A	ASTM A182 Gr. F304L, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304L, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304L, MSS SP-83 Class 3000 SW	N/A
FLANGES	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x SW Bore: Sch 80S	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x WN Bore: Sch 40S
BRANCH CONNECTIONS		
Reducing Tees	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	ASTM A403 Gr WP304L-WXorS, ASME B16.9 Sch 40S
Sockolets	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304L, MSS SP-97 Std wt.
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CHB
						PIPE	
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: ASTM A312 TP304L, CL 150, SCH 40S/80S, BW & SW,	
1	06.29.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2

REV 2

ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
3. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
4. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
5. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by “run material size/wall by branch size/wall”.
6. Interface aboveground and buried piping with flange insulating kits (gasket).

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CHE	REV
						PIPE		
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: A312 TP304, CL 150, SCH 40S/80S, BW & SW		2
1	06.29.09	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2	

DESIGN PRESS. (PSIG)	-14.7 to 275	230	190	170	140	110	80	50	20
DESIGN TEMP. (°F)	-20 to 100	200	400	500	600	700	800	900	1000
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	13.2	12.0	9.3	7.5	5.6	3.7	1.4
DESIGN TEMP. (°C)	-29 to 38	100	200	250	325	375	425	475	538

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2009)	
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	Socket weld	Butt weld
PIPE	ASTM A312 Gr. TP304, SMLS ASME B36.19M Sch. 80S PE	ASTM A312 Gr. TP304, WLD ASME B36.19M Sch. 40S BE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 GrWP304-WX or S ASME B16.9 Sch. 40S
Laterals, Wyes	N/A	ASTM A182 Gr. F304, Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304, MSS SP-83 Class 3000 SW	N/A
FLANGES	ASTM A182 Gr. F304, ASME B16.5 Class 150 RF x SW Bore: Sch 80S	ASTM A182 Gr. F304, ASME B16.5 Class 150 RF x WN Bore: Sch 40S
BRANCH CONNECTIONS		
Reducing Tees	ASTM A182 Gr. F304, ASME B16.11 Class 3000 SW	ASTM A403 GrWP304-WX or S ASME B16.9 Sch. 40S
Sockolets	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304, MSS SP-97 Std wt BE
BOLTING	ASTM A193 Gr. B7 continuous thread stud bolts ASTM A194 Gr. 2H Heavy Hex nuts	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 735 filler, Flexitallic Style CG "Compression-Gauge"	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CHE
						PIPE	
2	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	STAINLESS STEEL: A312 TP304, CL 150, SCH 40S/80S, BW & SW	REV 2
1	06.29.09	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 2 OF 2

ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Outlet sizes NPS 1/2 (DN 15) thru NPS 2 (DN 50): Sockolets for 50% or greater reduction in branch to header pipe size.
3. Outlet sizes NPS 2 1/2 (DN 65) and greater: Weldolets for 50% or greater reduction in branch to header pipe size.
4. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
5. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by “run material size/wall by branch size/wall”.
6. Interface aboveground and buried piping with flange insulating kits (gasket).

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	EJA / REV 0
						PIPE	
0	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CI/DI: AWWA C151, CL 250, CEMENT-MORTAR LINED, MJ DI FITTINGS, AWWA C110 CL250	
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 2

DESIGN PRESS. (PSIG)	-14.7 to 200									
DESIGN TEMP. (°F)	40 to 75									
DESIGN PRESS. (BARG)	-1.0 to 13.8									
DESIGN TEMP. (°C)	4 to 24									

DESIGN CODE(S)	UPC - UNIFORM PLUMBING CODE (2009) NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010)	
SIZE RANGE	NPS 2 (DN 50) thru NPS 2 1/2 (DN 65)	NPS 4 (DN 100) thru NPS 24 (DN 600)
PRIMARY JOINT TYPE	N/A	AWWA C111 Mechanical Joints or Integral Bell & Spigot Push-on Type Joints (Tyton® or Fastite®)
PIPE	N/A	AWWA C151 Cement-Mortar Lined Ductile-Iron Water Pipe with Integral Bell & Spigot Push-on Type Joints NPS 4 (DN 80)-NPS 12 (DN 300) 350 psi NPS 14 (DN 350)-NPS 24 (DN 600)250 psi
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	N/A	AWWA C153 Ductile-Iron Compact Fittings, mechanical joints, 350 psi rating
Reducing Inserts	N/A	N/A
Adapters	N/A	AWWA C110 Ductile-Iron fittings, Mechanical Joints x Plain End, 350 psi rating, Figure 11
Unions	N/A	N/A
FLANGES	N/A	AWWA C110 Figure 12, Ductile-Iron Connecting Piece, flanged x Mechanical Joint or Plain End, 250 psi rating
BRANCH CONNECTIONS		
Reducing Tees	N/A	AWWA C153 Ductile-Iron Compact Fittings, mechanical joints, 350 psi rating
Sockolets	N/A	N/A
Weldolets	N/A	N/A
BOLTING		
Mechanical Joint:	AWWA C111 bolts and nuts	
Flanged Joint:	Heavy Hex, Zinc Coated, carbon steel bolts and nuts ASTM A307 Gr. B bolts, ASTM A563 Gr. A nuts	
GASKETS		
Mechanical Joint:	Elastomeric gasket, AWWA C111	
Flanged Joint:	AWWA C110, full faced, 0.125 in (3.175 mm) thick, Synthetic Rubber for ASME B16.5 Class 150 or ASME B16.1 Class 125 drilled flat faced flanges	

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ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Piping shall be listed for fire protection service.
3. Certify all components to NSF 61 – Drinking Water System Component
4. Pipe shall have standard asphaltic coating on the exterior.
5. Pipe and fittings shall have a cement-mortar lining on the interior in accordance with AWWA C104.

NOTES

1. Pressure and temperature are controlled by AWWA C110 & C151 limitations.
2. Depth of cover is limited to a minimum of 3ft (914.4 mm) and a maximum of 16 ft (4876.8 mm). Depth of cover is based on AWWA C151 Figure 3, Type 5 laying conditions. Other depths of cover or laying conditions require Engineer approval on a case by case basis.
3. AWWA C110 Ductile Iron fittings, mechanical joints, 350 psi rating not listed above, are approved for use.

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					POWER ENGINEERS	MATERIAL SPECIFICATION PIPE	EMA SHEET 1 OF 1	REV 1
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	CAST/DUCTILE IRON: ASTM A74, CL ATM, SERVICE WT, HUB & SPIGOT		
0	06.12.06	SQ	STH	STH				
REV	DATE	DSGN	CHK	APPD				

DESIGN PRESS. (PSIG)	-14.7 to ATM									
DESIGN TEMP. (°F)	-33 to 200									
DESIGN PRESS. (BARG)	-1.0 to ATM									
DESIGN TEMP. (°C)	-36 to 93									

DESIGN CODE(S)	IPC – INTERNATIONAL PLUMBING CODE (2009) UPC – UNIFORM PLUMBING CODE (2009)	
SIZE RANGE	NPS 2 (DN 50) thru NPS 15 (DN 375)	N/A
PRIMARY JOINT TYPE	Hub & Spigot Compression Joint	N/A
PIPE	Cast Iron Soil Pipe: Hub & Spigot Service Weight, Compression gasket, w/o spigot bead, ASTM A74	N/A
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	Cast Iron Soil Fittings: Hub & Spigot Service Weight, Compression gasket, w/o spigot bead, ASTM A74	N/A
Adapters	N/A	N/A
Unions	N/A	N/A
FLANGES	N/A	N/A
BRANCH CONNECTIONS		
Reducing Tees	Cast Iron Soil Fittings: Hub & Spigot Service Weight, Compression gasket, w/o spigot bead, ASTM A74	N/A
Sockolets	N/A	N/A
Weldolets	N/A	N/A
BOLTING	N/A	
GASKETS	Compression Gasket: Preformed virgin vulcanized rubber, ASTM C564	

ADDITIONAL REQUIREMENTS

1. See IPC/UPC for prohibited fittings.
2. Wrap buried pipe and fittings in polyethylene encasement. Comply with ASTM A74.

NOTES

1. Pressure and temperature limitations are controlled by the IPC/UPC for pressure, and gasket material for temperature.
2. Suitable for non-pressurized service.
3. Suitable for underground service.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	FHA	REV
						PIPE		
1	10.01.10	EAP	SMB	STH	ENGINEERING STANDARD	COPPER ALLOYS: ASTM B88, CL 150, TYPE L TUBE, SOLDERED		1
0	06.12.06	SMB	STH	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

DESIGN PRESS. (PSIG)	-14.7 to 150									
DESIGN TEMP. (°F)	33 to 200									
DESIGN PRESS. (BARG)	-1.0 to 10.3									
DESIGN TEMP. (°C)	0 to 93									

DESIGN CODE(S)	IPC - INTERNATIONAL PLUMBING CODE (2009) UPC - UNIFORM PLUMBING CODE (2009) ASME B31.9 - BUILDING SERVICES PIPING (2008)	
SIZE RANGE	NPS 1/4 (DN 8) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 4 (DN 100)
PRIMARY JOINT TYPE	Solder Joint	Solder Joint
PIPE (TUBE)	ASTM B88 Type L H58 PE	ASTM B88 Type L H58 PE
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASME B16.18 or ASME B16.22	ASME B16.18 or ASME B16.22
Laterals, Wyes	ASME B16.18, or ASME B16.22, solder joint to threaded ends	ASME B16.18, or ASME B16.22, solder joint to threaded ends
Reducing Inserts	N/A	N/A
Unions	ASME B16.18 or ASME B16.22	ASME B16.18 or ASME B16.22
FLANGES	N/A	ASTM B62, ASME B16.24 Class 150 FF x FPT
BRANCH CONNECTIONS		
Reducing Tees	ASME B16.18 or ASME B16.22	ASME B16.18 or ASME B16.22
Sockolets	Brazolet (Bonney Forge) solder joint or threaded end for Type L tube, ASME SB-98 UNS C65500 Alloy A	Brazolet (Bonney Forge) solder joint or threaded end for Type L tube, ASME SB-98 UNS C65500 Alloy A
Weldolets	N/A	N/A
BOLTING	ASTM A307 bolt and nut, galvanized	
GASKETS	ASTM D2000, 0.125 in (3.18 mm) thick Red Rubber, full face gaskets	

ADDITIONAL REQUIREMENTS

1. Flat face flanges required for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Flange insulating kits (gasket) required at the interface between aboveground and buried piping.
3. Comply with IAPMO IS-3, Installation Standard for Copper Plumbing Tube, Pipe and Fittings.
4. Solder and solder flux shall comply with ASTM B32, Alloy grade Sn95 and ASTM B813 respectively.
5. Teflon tape shall be used on threaded connections.
6. Brazolets (Bonney Forge) are to be silver brazed to the main run in accordance with ASME code requirements and manufacturers written instructions.

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.24 Class 150 flanges.

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						PIPE	A
					GLENARM REPOWERING PROJECT	STAINLESS STEEL: TP304L, CL 150, SCH 10S/40S, BW & SW, THIN WALL, TP304L DOUBLE CONTAIN.	YHB*
A	10/18/13	SMB	JRC	TRC			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 6

PRIMARY PIPING

DESIGN PRESS. (PSIG)	0 to 230	195	175	160	150				
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500				
DESIGN PRESS. (BARG)	0 to 15.9	13.3	12.1	11.1	10.5				
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250				

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2012) ASME B31.3 - NORMAL FLUID SERVICE PIPING (2008)	
PRIMARY JOINT TYPE	Butt weld carrier pipe (Socket weld containment pipe)	Butt weld
SIZE RANGE	NPS 3/4 (DN 20) thru NPS 2 (DN 50)	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)
PIPE	ASTM A312 Gr. TP304L, SMLS ASME B36.19M Sch. 40S BE (PE)	ASTM A312 Gr. TP304L, WLD ASME B36.19M Sch. 10S BE
FITTINGS		
Butt Welded – Couplings, Tees, Ells, Reducers, etc.	ASTM A403 Gr. WP304L-WX or S, ASME B16.9 Sch 40S,	ASTM A403 Gr. WP304L-WX or S, ASME B16.9 Sch 10S,
Socket welded – Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW See Additional Requirements	N/A
Laterals, Wyes	ASTM A182 Gr. F304L, Special fittings, see Additional Requirements	ASTM A182 Gr. F304L, ASTM A403 Gr. WP304L-S, or ASTM A312 Gr. TP304L, SMLS Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304L, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304L, MSS SP-83 Class 3000 SW	N/A
FLANGES	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x SW Bore: Sch 40S	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x WN Bore: Sch 10S
BRANCH CONNECTIONS		
Butt Welded Reducing Tees	ASTM A403 Gr WP304L-WX or S, ASME B16.9 Sch 40S	ASTM A403 Gr WP304L-WX or S, ASME B16.9 Sch 10S
Socket Welded Reducing Tees	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	N/A
Sockolets	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304L, MSS SP-97 Std wt.
BOLTING	ASTM A193 Gr. B8M Class 2 continuous thread stud bolts (carbide solution and strain hardened) ASTM A194 Gr. 8M Heavy Hex nuts	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 835 filler, Flexitallic Style CGI "Compression-Gauge" with 304SS inner and outer ring.	

ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
3. Outlet sizes shown on Primary Pipe Branch Connection Chart
4. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or

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burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by "run material size/wall by branch size/wall".

5. Interface aboveground and buried piping with flange insulating kits (gasket).
6. Use only seamless pipe when bending.
7. Pipe fabricator to confirm final wall thickness on piping bends does not violate minimum wall thickness. Pipe bending shall comply with ASME B31.1 and Pipe Fabricators Institute (PFI) ES-24. Wall thickness reduction during bending may utilize excess material available from manufacturer's 12.5% nominal wall tolerance or additional thickness available from thicker sections of pipe.
8. Socket welded fittings:
   - Socket weld fittings are permitted outside of the containment piping with no restriction.
   - Socket weld fittings and other components within the containment piping are permitted but the Designer is cautioned that these components will not fit within the containment piping based on the "Primary and Containment Piping Sizing Chart". Local or overall increase in the containment piping may be required. Review and approval from the Engineer is required.

NOTES

1. Pressure and temperature limitations are controlled by ASME B16.5 flange ratings and containment piping requirements.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

CONTAINMENT PIPING

DESIGN PRESS. (PSIG)	-14.7 to 230	195	175	160	150				
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500				
DESIGN PRESS. (BARG)	-1.0 to 15.9	13.3	12.1	11.1	10.5				
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250				

DESIGN CODE(S)	ASME B31.1 - NON-BOILER EXTERNAL PIPING (2012) ASME B31.3 - NORMAL FLUID SERVICE PIPING (2008)	
PRIMARY JOINT TYPE	Socket weld	Butt weld
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	NPS 2 (DN 50) thru NPS 24 (DN 600)
PIPE	ASTM A312 Gr. TP304L, SMLS ASME B36.19M Sch. 40S PE	ASTM A312 Gr. TP304L, WLD ASME B36.19M NPS 2 (DN 50): Sch 40S BE NPS 2 ½ (DN 65) and above: Sch. 10S BE
Clamshell Pipe (Containment Closure Piping)	N/A	ASTM A358 Gr. 304L, Class 3, Sch. 40S, BE, See Additional Requirements
FITTINGS		
Couplings, Tees, Ells, Reducers, etc.	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW, See Additional Requirements	ASTM A403 Gr WP304L-WX or S, ASME B16.9 Sch 10S,
Laterals, Wyes	ASTM A182 Gr. F304L, Special fittings, see Additional Requirements	ASTM A182 Gr. F304L, ASTM A403 Gr. WP304L-S, or ASTM A312 Gr. TP304L, SMLS Special fittings, see Additional Requirements
Reducing Inserts	ASTM A182 Gr. F304L, MSS SP-79 Class 3000 SW	N/A
Unions	ASTM A182 Gr. F304L, MSS SP-83 Class 3000 SW	N/A
Special Fittings, see Additional Requirements	ASTM A182 Gr. F304L	ASTM A182 Gr. F304L, ASTM A403 Gr. WP304L-S Split ASME

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		B16.9 fittings, ASTM A312 Gr. TP304L, SMLS,
FLANGES	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x SW Bore: Sch 40S	ASTM A182 Gr. F304L, ASME B16.5 Class 150 RF x WN Bore: Sch 10S
BRANCH CONNECTIONS		
Reducing Tees	ASTM A182 Gr. F304L, ASME B16.11 Class 3000 SW	ASTM A403 Gr WP304L-WX or S, ASME B16.9 Sch 10S
Sockolets	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW	ASTM A182 Gr. F304L, MSS SP-97 Class 3000 SW
Weldolets	N/A	ASTM A182 Gr. F304L, MSS SP-97 Std wt.
BOLTING	ASTM A193 Gr. B8M Class 2 continuous thread stud bolts ASTM A194 Gr. 8M Strain Hardened Heavy Hex nuts	
GASKETS	ASME B16.20, Class 150, Spiral Wound, 0.175 in (4.45 mm) thick 304SS metallic winding, 0.125 in (3.18 mm) thick centering ring, with Thermiculite 835 filler, Flexitallic Style CGI "Compression-Gauge" with 304SS inner and outer ring.	

ADDITIONAL REQUIREMENTS

1. Use flat face flanges for connection to ductile iron, brass, non-metallic, or other flat face flanges.
2. NPS 22 (DN 550) piping is not permitted.
3. Special fittings - shall meet ASME B31.1 wall thickness requirements to match pipe design pressure and temperature with 0.0 in (0 mm) corrosion allowance. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match pipe ID. Order by material, run size/wall by branch size/wall.
4. Outlet sizes shown on Primary Pipe Branch Connection Chart.
5. Weldolets - Integrally Reinforced Branch Connection shall meet ASME B31.1 wall thickness area replacement or burst test requirements and provide 100% pipe strength. Fittings to be furnished with ASME B16.25 butt-welding end preparations and bore to match branch pipe ID. Bonney Forge "WELDOLET". Order by “run material size/wall by branch size/wall”.
6. Branch tee and elbow containment fittings which are required to be split in half to allow for installation and inspection of the primary pipe branch connections shall be resurfaced and rewelded to the full requirements of ASTM A403 Grade WP Class W. Exceptions to this are permitted when sufficient branch or elbow clearance is given for primary pipe welding and inspection (such as NPS ¾ sock-o-let placed on a NPS 12 (DN300) pipe has sufficient clearance to be slid into the NPS 16 (DN400) containment pipe) and the containment fitting does not require slitting and re-welding.
7. Clamshell pipe required for containment closure is to be split in half to allow for installation and shall be resurfaced and rewelded to the full requirements of ASTM A358 Grade 304L Class 3.
8. Interface aboveground and buried piping with flange insulating kits (gasket).
9. Use of socket welded fittings is limited to piping used for ancillary service not requiring containment (vents/ drains).

NOTES

1. Pressure and temperature limitations are controlled by pipe and ASME B16.5 flange ratings.
2. Pipe wall thickness based on 0 in (0 mm) corrosion, erosion or mechanical allowance.
3. Bolting/gasket selection based on ASME B16.5 requirements for bolt strength and spiral wound gaskets use.

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DOUBLE CONTAINMENT SYSTEM PIPING REQUIREMENTS

CONTAINMENT DESIGN	The containment piping system shall be used for full pressure containment, liquid containment, above grade use (non-buried), and thermal applications.
DOUBLE CONTAINMENT JOINT TYPE	The primary and containment piping is to be of a butt welded design to minimize containment pipe size. See General Requirements below for other joint types.
LEAK DETECTION METHODS	Continuous monitoring detection probe (drain collection) with visual inspection ports for liquids and pressure detection for gas services.
PURGE REQUIREMENT	Connections for purge valves - Flanged

PRIMARY & CONTAINMENT PIPING RUN SIZING CHART

PRIMARY PIPING SIZE		**PIPE CONTAINMENT PIPING MINIMUM SIZE**	
PIPE SIZE	**90° ELBOW – LONG RADIUS**	**PIPE SIZE**	**90° ELBOW – SHORT RADIUS**
NPS ¾ (DN 20)	Use two 45° Ells, See Notes	NPS 2 (DN 50)	NPS 2 (DN 50)
NPS 1 (DN 25)	Use two 45° Ells, See Notes	NPS 2.5 (DN 65)	NPS 2.5 (DN 65)
NPS 1 ¼ (DN 32)	Use two 45° Ells, See Notes	NPS 3 (DN 80)	NPS 3 (DN 80)
NPS 1 ½ (DN 40)	Use two 45° Ells, See Notes	NPS 3 (DN 80)	NPS 3 (DN 80)
NPS 2 (DN 50)	Use two 45° Ells, See Notes	NPS 4 (DN 80)	NPS 4 (DN 80)
NPS 2 ½ (DN 65)	Single elbow	NPS 4 (DN 100)	NPS 4 (DN 100)
NPS 3 (DN 80)	Single elbow	NPS 6 (DN 150)	NPS 6 (DN 100)
NPS 4 (DN 100)	Single elbow	NPS 6 (DN 150)	NPS 6 (DN 150)
NPS 6 (DN 150)	Single elbow	NPS 8 (DN 200)	NPS 8 (DN 200)
NPS 8 (DN 200)	Single elbow	NPS 10 (DN 250)	NPS 12 (DN 300)
NPS 10 (DN 250)	Single elbow	NPS 12 (DN 300)	NPS 14 (DN 350)
NPS 12 (DN 300)	Single elbow	NPS 16 (DN 400)	NPS 16 (DN 400)

Table Notes

1. This table is based on the primary and containment piping being at nominal temperature difference of not more than 90°F (32 C). Differences greater than this requires engineering analysis.
2. Thermal movements are not to exceed ¼" (6mm). Thermal movements exceeding ¼" (6mm) requires the containment system to be sized to accept the larger movements.
3. The primary to containment run sizes are based ASME B36.10M butt welded standard wall pipe thicknesses clearances.
4. The use of two 45° Ells in lieu of standard elbow allows for more clearance within the containment pipe without having to increase size of the containment pipe.

PRIMARY PIPE BRANCH CONNECTION CHART

Branch	**Run Size**											
Size	**¾"**	**1"**	**1 ¼"**	**1 ½"**	**2"**	**2 ½"**	**3"**	**4"**	**6"**	**8"**	**10"**	**12"**
¾"	T	Red T	Red T	SOL	SOL	SOL	SOL	SOL	SOL	SOL	SOL	SOL
1"		T	Red T	Red T	SOL	SOL	SOL	SOL	SOL	SOL	SOL	SOL
1 ¼"			T	Red T	Red T	SOL	SOL	SOL	SOL	SOL	SOL	SOL
1 ½"				T	Red T	Red T	SOL	SOL	SOL	SOL	SOL	SOL
2"					T	Red T	Red T	SOL	SOL	SOL	SOL	SOL
2 ½"						T	Red T	Red T	WOL	WOL	WOL	WOL
3"							T	Red T	WOL	WOL	WOL	WOL
4"								T	Red T	WOL	WOL	WOL
6"									T	Red T	WOL	WOL
8"										T	Red T	Red T
10"											T	Red T
12"												T

Table Notes:

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PRIMARY PIPE BRANCH CONNECTION CHART

Branch Size	Run Size ¾"	1"	1 ¼"	1 ½"	2"	2 ½"	3"	4"	6"	8"	10"	12"

1. WOL and SOL can be replaced by reducing tees (where available) to minimize containment piping sizes.

DOUBLE CONTAINMENT PIPE BRANCH CONNECTION CHART

PRIMARY BRANCH CONNECTION	CONTAINMENT PIPE MINIMUM BRANCH CONNECTION SIZE TEES & REDUCING TEES	CONTAINMENT PIPE MINIMUM BRANCH CONNECTION SIZE SOCK-O-LETS & WELD-O-LETS
NPS ¾ (DN 20)	NPS 2 (DN 50)	NPS 3 (DN 80)
NPS 1 (DN 25)	NPS 2 1/2 (DN 65)	NPS 3 (DN 80)
NPS 1 ¼ (DN 32)	NPS 3 (DN 80)	NPS 4 (DN 100)
NPS 1 ½ (DN 40)	NPS 3 (DN 80)	NPS 4 (DN 100)
NPS 2 (DN 50)	NPS 4 (DN 100)	NPS 6 (DN 150)
NPS 2 ½ (DN 65)	NPS 4 (DN 100)	NPS 6 (DN 150)
NPS 3 (DN 80)	NPS 6 (DN 150)	NPS 6 (DN 150)
NPS 4 (DN 100)	NPS 6 (DN 150)	NPS 8 (DN 200)
NPS 6 (DN 150)	NPS 8 (DN 200)	NPS 10 (DN 250)
NPS 8 (DN 200)	NPS 10 (DN 250)	N/A
NPS 10 (DN 250)	NPS 12 (DN 300)	N/A
NPS 12 (DN 300)	NPS 16 (DN 350)	N/A

Table Notes:

1. Based on ASME B36.10M standard wall pipe thicknesses, MSS SP-97 Class 3000 integrally reinforced forged branch outlet fittings, and Bonney Forge dimensions – sock-o-let and weld-o-let.

GENERAL REQUIREMENTS:

1. The double containment piping system is an engineered system. Field modifications are not permitted without engineers review and approval.
2. Minimum installed clearance between containment piping and primary piping (pipes and fittings) is to be no less than 1/2" (12mm).
3. The containment piping shall allow free movement of liquid along the piping system.
4. Piping shall be prefabricated as complete as possible in sections within a shop environment.
5. Where there are local increases in containment pipe sizes drains and vents may be required for liquid detection and pressure testing.
6. Refer to the attached details for piping assemblies, interstitial primary pipe supports, sensing stations, etc….

BRANCH REQUIREMENTS:

1. The Double Containment Pipe Branch Connection Chart is used to size the containment branch size. Deviation from the chart is permitted so long as branch pipe and fitting have sufficient clearance for installation and thermal growth.

INTERSTITIAL SUPPORT REQUIREMENTS:

1. Interstitial anchors near branch connections are required to align connections within the piping system. The designer/engineer is to approve systems where anchors are not used. This will require the thermal growth to be managed in elbows where increased clearances are required. Minimum radial clearance is 1/16 inch (1.59mm)
2. Interstitial supports shall be sized to fit with the containment piping, yet allow the primary piping to be inserted into its containment (or conversely, allow the containment pipe to be slipped over its associated primary pipe) these interstitial supports shall be affixed to adequately support the carrier piping along its length. The design shall allow for movement including thermal expansion and seismic restraint while minimizing sag.
3. Interstitial supports shall be placed as shown on attached details or as directed by the engineer.
4. Interstitial supports shall be placed away from containment and primary pipe girth and longitudinal welds to allow thermal movement.

THERMAL EXPANSION REQUIREMENTS:

1. To allow for primary piping thermal growth, the containment piping elbows shall be increased in size, offset, or a combination of both.
2. Interstitial supports are to be designed to allow for local thermal movement and maintain dead weight support based on ASME B31.1 spacing requirements.

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DOUBLE CONTAINMENT PIPE BRANCH CONNECTION CHART

PRIMARY BRANCH CONNECTION	CONTAINMENT PIPE MINIMUM BRANCH CONNECTION SIZE TEES & REDUCING TEES	CONTAINMENT PIPE MINIMUM BRANCH CONNECTION SIZE SOCK-O-LETS & WELD-O-LETS

LEAK DETECTION REQUIREMENTS - LIQUID

1. Leak detection points shall be located at low points in the piping system and no further than 200 feet (60m) apart.
2. Piping shall be sloped no less than 0.5% to low point drains.
3. Leak detection drain piping is to be set so as to allow liquid to drain out of the main containment piping into low point leak detection vertical stand pipes with access port/flange to allow for visual inspection, placement of monitoring probe, and independent pump out standpipe. See attached details.
4. Drain piping shall be no less than NPS 2 (DN 50). The cap/ flange for pump-outs, visual inspection stand pipes, sensor stand pipes and combination pipes shall contain a high point vent/ purge valve connection.

LEAK DETECTION REQUIREMENTS - GAS

1. Containment pressure connection(s) are to be located in each isolated compartment within containment system. Each isolated compartment shall be located no more than 200 feet (60m) apart to locate leaks.
2. Isolated compartments which are separated by solid interstitial anchors, flanges, or other means that will physically separate the compartments shall have purge valve connections at the beginning and end of each isolated compartment.

CONTAINMENT LIMITS REQUIREMENTS:

1. Primary and containment piping is to be separately pressure tested as required by the code, local and federal regulations.
2. Where primary piping can be overstressed due to external pressure from the containment piping annulus, provide overprotection by means of a pressure relief device located on the containment piping.

GENERAL NOTES

1. The pressure of the fluid in the primary pipe shall not exceed the maximum temperature and pressure rating of the containment piping specification and Double Containment System Piping Requirements.
2. Installation detail drawings to be provided by the BOP Contractor and approved by the General Manager

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VALVE MATERIAL SPECIFICATIONS

NOTES:

A. This specification shall be used as referenced for the development of construction documents, P&IDs, Piping Isometrics, 3D project model and Piping Line List. The material specifications listed below are required as part of this specification.

B. The current revision of the below listed specification may not match the revision of this sheet.

C. Refer to project specific documents for general quality assurance requirements.

D. Comply with approved submittal documents and procedures. Substitutions shall be submitted in accordance with the General Manager's specifications.

E. If conflicts exist between documents, the General Manager and Engineer shall determine requirements.

F. Submittal Register

1. Submit the following to the Engineer for review:
    a. Certified valve cut sheet showing dimensional data, materials of construction, testing data, and construction codes.
    b. Certified actuator cut sheet showing dimensional data, materials of construction, testing data, and construction codes.
    c. Valve and actuator outline drawings.
    d. Valve and Actuator Operation and Maintenance Manuals
    e. Wiring Diagrams for Motor Operated Valves
    f. Submittal Schedule
    g. Completed Data Sheets for Motor, Air, or Hydraulic Operated Valves
    h. Calculations including flow versus disc/handwheel position for valves requiring orifice sizing.
2. Valves on the Pre-Approved Manufactures List shall be submitted as stated above, but for information only.

G. Valves and actuators shall be coated in accordance with manufacturer's standard coating and shall meet the temperature requirement within the specification.

H. Turbine non-return valves and motor operated valves are to be datasheet specified.

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I. Valve Specification Codes are based on the following table:

VALVE SPECIFICATION CODE

VALVE TYPE		BODY MATERIAL		PRESSURE CLASS		VALVE END PREP		SEQ.#
BA	BALL	A	CARBON STEEL	A	>2500	0	WELDED - BW	0
BF	BUTTERFLY	B	LOW & INTERMEDIATE ALLOY	B	2500	1	WELDED - SW	1
CK	CHECK	C	STAINLESS STEEL	C	1500	2	FLANGED	2
DV	DIAPHRAGM	D	NICKEL & HIGH NICKEL ALLOY	D	900	3	SCREWED	3
GA	GATE	E	CAST/DUCTILE IRON	E	600 (800)	4	LUG	4
GL	GLOBE	F	COPPER & COPPER ALLOYS	F	N/A	5	WAFER	5
KN	KNIFE GATE	G	ALUMINUM & ALUMINUM ALLOYS	G	300	6	GROOVED	6
NV	NEEDLE	H	TITANIUM & TITANIUM ALLOYS	H	150	7	MECHANICAL JOINT	7
PN	PINCH	I		I	350 (AWWA)	8	PUSH ON	8
PL	PLUG	J		J	250 (AWWA)	9	SPECIAL	9
		K		K	125 (AWWA)			
		L		L	25 (AWWA)			
		M	MORTAR LINED	M	ATM			
		N		N				
		O	HDPE	O				
		P	THERMOSETTING PLASTIC	P				
		Q		Q				
		R	RUBBER LINED	R				
		S	GLASS LINED	S				
		T	TEFLON LINED	T				
		U	CORRUGATED METAL PIPE	U				
		V		V				
		W		W				
VA	ACTUATOR	X		X				
ZZ	SPECIAL	Y	SPECIAL	Y	SPECIAL			
		Z		Z				

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MANUAL VALVES

SPEC	DESCRIPTION	REV	DATE
BAAE10	BALL VALVE, CS, A105, REGULAR PORT, , CL 600, SW, PTFE SEAT,	1	10.08.10
BAAE11	BALL VALVE, CS, A105, FULL PORT, , CL 600, SW, PTFE SEAT,	1	10.12.10
BAAH21	BALL VALVE, CS, A105, FULL PORT, TEFLON SEATED, CL 150, FLG, TRUNNION,	2	10.12.10
BACE12	BALL VALVE, SS, TP304L, REGULAR PORT, TEFLON SEATED, CL 600, SW, , NSF POTABLE WATER	1	10.08.10
BAFE10	BALL VALVE, BRONZE, , FULL PORT, TEFLON SEATED, CL 600, SOLDER JOINT, , NSF POTABLE WATER	1	10.08.10
BFEH40	BUTTERFLY VALVE, CAST IRON, A126 CL B, , EPDM SEAT, CL 150, LUG, ,	1	10.12.10
BFEH41	BUTTERFLY VALVE, DUCTILE IRON, A536, , EPDM SEAT, CL 150, LUG, ,	1	10.12.10
BFEH42	BUTTERFLY VALVE, CAST IRON, A126 CL B, , EPDM SEAT, CL 150, LUG, , NSF POTABLE WATER	1	10.08.10
BFEH43	BUTTERFLY VALVE, DUCTILE IRON, A536, , EPDM SEAT, CL 150, LUG, , NSF POTABLE WATER	1	10.12.10
CKAE10	CHECK VALVE, CS, A105, PISTON, , CL 600, SW, ,	2	10.12.10
CKAE11	CHECK VALVE, CS, A105, PISTON, , CL 800, SW, STELLITE TRIM,	1	10.12.10
CKAG00	CHECK VALVE, CS, A216 Gr. WCB, SWING, , CL 300, BW, STELLITE TRIM,	1	10.12.10
CKAG01	CHECK VALVE, CS, A216 Gr. WCB, TILT DISC, , CL 300, BW, STELLITE TRIM,	1	10.12.10
CKAH00	CHECK VALVE, CS, A216 Gr. WCB, SWING, , CL 150, BW, BOLTED BONNET,	1	10.12.10
CKAH01	CHECK VALVE, CS, A216 Gr. WCB, SWING, , CL 150, BW, STELLITE TRIM,	1	10.12.10
CKAH20	CHECK VALVE, CS, A216 Gr. WCB, SWING, , CL 150, FLG, ,	1	10.12.10
CKAH21	CHECK VALVE, CS, A216 Gr. WCB, SWING, , CL 150, FLG, STELLITE TRIM,	1	10.12.10
CKBE10	**CHECK VALVE, LOW ALLOY, Gr. 22, PISTON, SPRING LOADED, CL 800, SW, WELDED BONNET,**	**1**	**10.12.10**
CKBE12	**CHECK VALVE, LOW ALLOY, Gr. 22, SWING, , CL 800, SW, BOLTED BONNET,**	**1**	**10.12.10**
CKCE00	**CHECK VALVE, SS, TP304, SWING, STELLITE TRIM, CL 600, BW, ,**	**0**	**9.23.13**
CKCE10	CHECK VALVE, SS, TP304, SWING, STELLITE TRIM, CL 600, SW, ,	1	10.12.10
CKCE12	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 600, SW, ,	2	10.08.10
CKCE14	**CHECK VALVE, SS, TP304, PISTON, STELLITE TRIM, CL 600, SW, ,**	**1**	**10.12.10**
CKCE16	CHECK VALVE, SS, TP304L, PISTON, STELLITE TRIM, CL 600, SW, ,	2	10.08.10
CKCG00	CHECK VALVE, SS, TP304, SWING, STELLITE TRIM, CL 300, BW, BOLTED BONNET,	**1**	**10.12.10**
CKCH02	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 150, BW, BOLTED BONNET,	1	10.08.10
CKCH22	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 150, FLG, BOLTED BONNET,	1	10.08.10
CKEK20	CHECK VALVE, CAST IRON, A126 CL B, SWING, RESILIENT SEAT, CL 125, FLG, , AWWA, NSF, NFPA	1	10.08.10
CKFK10	CHECK VALVE, BRONZE, , SWING, , CL 125, SOLDER JOINT, , NSF	1	10.08.10
GAAE05	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 600, BW, STELLITE TRIM, LOW EMISSIONS	1	10.12.10
GAAE10	GATE VALVE, CS, A105, OS&Y, , CL 800, SW, ,	1	10.12.10
GAAE11	GATE VALVE, CS, A105, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM,	1	10.12.10

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SPEC	DESCRIPTION	REV	DATE
GAAE15	GATE VALVE, CS, A105, OS&Y, , CL 800, SW, STELLITE TRIM, LOW EMISSIONS	1	10.08.10
GAAG00	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM,	1	10.12.10
GAAG05	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM, LOW EMISSIONS	2	10.12.10
GAAH00	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW, ,	1	10.12.10
GAAH01	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM,	1	10.12.10
GAAH05	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM, LOW EMISSIONS	1	10.12.10
GAAH20	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, FLG, ,	1	10.12.10
GAAH21	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, FLG, STELLITE TRIM,	1	10.12.10
GABE02	**GATE VALVE, LOW ALLOY, Gr. 22, OS&Y, PARALLEL DISC, CL 600, BW, ,**	**1**	**10.12.10**
GABE10	**GATE VALVE, LOW ALLOY, Gr. 22, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM, WELDED BONNET**	**1**	**10.12.10**
GACE00	**GATE VALVE, SS, TP304, OS&Y, FLEX WEDGE, CL 600, BW, STELLITE TRIM**	0	9.23.13
GACE10	GATE VALVE, SS, TP304, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM,	1	10.12.10
GACE12	GATE VALVE, SS, TP304L, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM,	2	10.12.10
GACG04	**GATE VALVE, STAINLESS STEEL, TP304, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM**	0	9.23.13
GACH02	GATE VALVE, SS, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM,	2	10.08.10
GACH22	GATE VALVE, SS, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, FLG, STELLITE TRIM,	2	10.08.10
GAEK20	GATE VALVE, CAST IRON, , NONRISING STEM, SOLID WEDGE, CL 125, FLG, , AWWA, NSF, NFPA	1	10.08.10
GAEK21	GATE VALVE, CAST IRON, , PIV, SOLID WEDGE, CL 125, FLG, , AWWA, NSF, NFPA	1	10.08.10
GAEK22	GATE VALVE, CAST IRON, , RISING STEM, SOLID WEDGE, CL 125, FLG, , AWWA, NSF, NFPA	1	10.08.10
GAEK70	GATE VALVE, CAST IRON, , NONRISING STEM, SOLID WEDGE, CL 125, MJ, , AWWA, NSF, NFPA	0	11.10.10
GAEK71	**GATE VALVE, CAST IRON, , PIV, SOLID WEDGE, CL 125, MJ, , AWWA, NSF, NFPA**	**0**	**11.10.10**
GLAE10	GLOBE VALVE, CS, A105, OS&Y, , CL 800, SW, ,	1	10.12.10
GLAE11	GLOBE VALVE, CS, A105, OS&Y, , CL 800, SW, STELLITE TRIM,	1	10.12.10
GLAG00	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, , CL 300, BW, STELLITE TRIM,	1	10.12.10
GLAH00	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, , CL 150, BW, ,	1	10.12.10
GLAH01	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, , CL 150, BW, STELLITE TRIM,	1	10.12.10
GLAH20	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, , CL 150, FLG, ,	1	10.12.10
GLAH21	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, STELLITE TRIM, CL 150, FLG, ,	1	10.12.10
GLBE11	**GLOBE VALVE, LOW ALLOY, Gr. 22, Y-PATTERN, STELLITE TRIM, CL 800, SW, WELDED BONNET,**	**1**	**10.12.10**
GLCE10	GLOBE VALVE, SS, TP304, OS&Y, STELLITE TRIM, CL 600, SW, ,	1	10.12.10

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SPEC	DESCRIPTION	REV	DATE
GLCE12	GLOBE VALVE, SS, TP304L, OS&Y, STELLITE TRIM, CL 600, SW, ,	1	10.12.10
GLCH02	GLOBE VALVE, SS, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, BW, ,	2	10.08.10
GLCH22	GLOBE VALVE, SS, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, FLG, ,	2	10.08.10

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	BALL VALVE, CARBON STEEL, A105, REGULAR PORT, CL 600, SOCKET-WELDING, PTFE SEAT	BAAE10 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BALL VALVE, CS, A105, REGULAR PORT, CL 600, SW, PTFE SEAT									
DESIGN PRESS. (PSIG)	-14.7 to 400									
DESIGN TEMP. (°F)	33 to 200									
DESIGN PRESS. (BARG)	-1.0 to 27.6									
DESIGN TEMP. (°C)	0 to 93									

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B 31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B 31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	MSS SP-110, ASME B16.34
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 600
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socketweld ASME B16.11
BODY & BONNET TYPE	Bolted 3-Piece, Regular Port
BODY MATERIAL	ASTM A105 or A216 Type WCB
BONNET MATERIAL	ASTM A105 or A216 Type WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7, Zinc plated or oxide coated bolts ASTM A194 Gr. 2H, Zinc plated or oxide coated nuts
STEM MATERIAL	UNS S31600, "Type 316"
STEM BUSHING MAT'L	
SEAT MATERIAL	PTFE or TFM 1600
DISC & DISC MATERIAL	Ball Disc: UNS S31600, "Type 316"
ACTUATOR	Locking Handle: Carbon steel, plated for corrosion protection or stainless steel
SEALS (OR PACKING)	Body End Seal: Teflon or graphite coated 316 Stainless steel Stem Packing: Teflon/graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Valve seats shall be self-relieving.
4. Bi-directional shutoff.
1. Maximum leakage rate shall not exceed the limitations of MSS SP-110.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
SVF Flow Controls	R84466ATSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	R8 Series - with locking handle. Weld in place. Does not require disassembly.
Neles-Jamesbury	4CB-2236TT-1	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	4000 Series - with locking handle
Nibco	K-595-CS-R-66-LL	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	with locking handle
Worcester Controls	K4446RGSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	44 Series - Weld in place. Does not require disassembly.
Marwin	7233R-TT-XSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	7000 Series

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					POWER ENGINEERS	MATERIAL SPECIFICATION	BAAE11	REV
						VALVE		1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	BALL VALVE, CARBON STEEL, A105, FULL PORT, CL 600, SOCKET-WELDING, PTFE SEAT		
0	09.25.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	BALL VALVE, CS, A105, FULL PORT, CL 600, SW, PTFE SEAT									
DESIGN PRESS. (PSIG)	-14.7 to 400									
DESIGN TEMP. (°F)	33 to 200									
DESIGN PRESS. (BARG)	-1.0 to 27.6									
DESIGN TEMP. (°C)	0 to 93									

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	MSS SP-72, ASME B16.34
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 600
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socketweld ASME B16.11
BODY & BONNET TYPE	Bolted 3-Piece, Full Port
BODY MATERIAL	ASTM A105 or A216 Type WCB
BONNET MATERIAL	ASTM A105 or A216 Type WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B7, Zinc plated or oxide coated bolts ASTM A194 Grade 2H, Zinc plated or oxide coated nuts
STEM MATERIAL	UNS S31600, "Type 316"
STEM BUSHING MAT'L	
SEAT MATERIAL	PTFE
DISC & DISC MATERIAL	Ball Disc: UNS S31600, "Type 316"
ACTUATOR	Locking Handle: Carbon steel, plated for corrosion protection or stainless steel
SEALS (OR PACKING)	Body End Seal: Teflon or graphite coated 316 Stainless steel Stem Packing: Teflon/graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Valve seats shall be self-relieving.
4. Bi-directional shutoff.
5. Maximum leakage rate shall not exceed the limitations of MSS SP-72.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Neles-Jamesbury	4DB-2236TT-1	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	4000 Series - with locking handle
Worcester Controls	K5946RGSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	59 Series - with locking handle.
Marwin	7233F-TT-XSW	NPS 1/2 (DN 15) thru NPS 1 1/2 (DN 40)	7000 Series

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REV	DATE	DSGN	CHK	APPD			
2	10.12.10	EAP	SMB	STH	POWER ENGINEERS	MATERIAL SPECIFICATION VALVE	BAAH21 REV 2
1	12.15.09	SMB	STH	STH	ENGINEERING STANDARD	BALL VALVE, CARBON STEEL, A105, FULL PORT, TEFLON SEATS, CL 150, FLG, TRUNNION	
0	09.03.09	JDC	STH	STH			SHEET 1 OF 1

FEATURE(S)	BALL VALVE, CS, A105, FULL PORT, TEFLON SEATED, CL 150, FLANGED, TRUNNION									
DESIGN PRESS. (PSIG)	-14.7 to 285	260								
DESIGN TEMP. (°F)	-20 to 100	200								
DESIGN PRESS. (BARG)	-1.0 to 19.7	17.9								
DESIGN TEMP. (°C)	-29 to 38	93								
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)									
FLUID SERVICE	General Service, Geothermal Brine									
VALVE STANDARDS	ASME B16.34, API 6D									
END TO END DIMENSION	API 6D									
PRESSURE CLASS	ASME B16.34: Class 150									
SIZE RANGE	NPS 2 (DN 50) thru NPS 24 (DN 600)									
CONNECTION TYPE	Flanged, RF, ASME B16.5									
BODY & BONNET TYPE	Three Piece: bolted body side entry, Full Port									
BODY MATERIAL	ASTM A105									
BONNET MATERIAL	ASTM A105									
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B7, Zinc plated or oxide coated bolts ASTM A194 Grade 2H, Zinc plated or oxide coated nuts									
STEM MATERIAL	Blow-off proof design, UNS S31600, "Type 316", ASTM A182 F316									
STEM BUSHING MAT'L										
SEAT MATERIAL	RTFE									
DISC & DISC MATERIAL	Trunnion Mounted Ball Disc: ASTM A276 Type 316, UNS S31600, ASTM A182 F316									
ACTUATOR	NPS 2 (DN 50) thru NPS 3 (DN 80): Locking Lever NPS 4 (DN 100) and above: Worm Gear Actuator									
SEALS (OR PACKING)	Body and Stem Seal: RTFE									
INTERNAL COATINGS & LININGS	N/A									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Valve seats shall be self-relieving and spring energized (Single Piston Effect [SPE]).
4. Bi-directional shutoff.
5. Maximum leakage rate shall not exceed the limitations of API 6D and API 598 (bubble tight).

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. NOT FOR FUEL GAS SERVICE

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
FlowTek (Bray Int'l)	F15T-A105-3RRLL	NPS 2 (DN 50) thru NPS 3 (DN 80)	Locking Lever
FlowTek (Bray Int'l)	F15T-A105-3RRGO	NPS 4 (DN 100) thru NPS 24 (DN 600)	Worm Gear Actuator
NEWCO	51F-FS-4TM-1-FP-PT-LD	NPS 2 (DN 50) thru NPS 3 (DN 80)	Locking Lever
NEWCO	51F-FS-4TM-1-FP-PT-GO	NPS 4 (DN 100) thru NPS 24 (DN 600)	Worm Gear Actuator

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	BALL VALVE, STAINLESS STEEL, TP304L, REGULAR PORT, TEFLON SEATED, CL 600, SW, NSF	BACE12 / 1
0	11.06.07	SWQ	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BALL VALVE, SS, TP304L, REGULAR PORT, TEFLON SEATED, CL 600, SW, NSF POTABLE WATER									
DESIGN PRESS. (PSIG)	-14.7 to 400									
DESIGN TEMP. (°F)	33 to 200									
DESIGN PRESS. (BARG)	-1.0 to 27.6									
DESIGN TEMP. (°C)	0 to 93									
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.3 – CATEGORY D FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)									
FLUID SERVICE	General Service									
VALVE STANDARDS	MSS SP-72, ASME B16.34									
END TO END DIMENSION	Manufacturers standard									
PRESSURE CLASS	ASME B16.34: Class 600									
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)									
CONNECTION TYPE	Socketweld ASME B16.11									
BODY & BONNET TYPE	Bolted 3-Piece, Regular Port									
BODY MATERIAL	ASTM A351 Type CF3									
BONNET MATERIAL	ASTM A351 Type CF3									
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B7 or B8 Bolts ASTM A194 Grade 2H or 8 Nuts									
STEM MATERIAL	Stainless Steel UNS S31600 "Type 316"									
STEM BUSHING MAT'L										
SEAT MATERIAL	PTFE									
DISC & DISC MATERIAL	Ball Disc: Stainless Steel UNS S30400, "Type 304"									
ACTUATOR	Locking Handle: Stainless Steel									
SEALS (OR PACKING)	Body End Seal: Teflon or graphite coated 316 Stainless steel Stem Packing: Teflon/graphite									
INTERNAL COATINGS & LININGS	N/A									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Valve seats shall be self-relieving.
4. Bi-directional shutoff.
5. Maximum leakage rate shall not exceed the limitations of MSS SP-72.
6. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
SVF Flow Controls	R76666TTSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	R7 Series - with locking handle
Neles-Jamesbury	4CB-3600TT-1	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	4000 Series - with locking handle
Worcester Controls	4466RGSW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	44 Series - with locking handle. Weld in place. Does not require disassembly.
Marwin	7333R-TT-XSW	NPS 1/2 (DN 15) thru NPS 1 1/2 (DN 40)	7000 Series

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	BALL VALVE, BRONZE, FULL PORT, TEFLON SEATED, CL 600, SOLDER JOINT, NSF	BAFE10 / 1
0	12.02.05	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BALL VALVE, BRONZE, FULL PORT, TEFLON SEATED, CL 600, SOLDER JOINT, NSF POTABLE WATER									
DESIGN PRESS. (PSIG)	-14.7 to 250									
DESIGN TEMP. (°F)	33 to 180									
DESIGN PRESS. (BARG)	-1.0 to 17.2									
DESIGN TEMP. (°C)	0 to 82									
DESIGN CODE(S)	IPC – INTERNATIONAL PLUMBING CODE (2009)									
FLUID SERVICE	General Service, Potable/Domestic Water									
VALVE STANDARDS	MSS SP-110									
END TO END DIMENSION	Manufacturers standard									
PRESSURE CLASS	ASME B16.34: Class 600									
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)									
CONNECTION TYPE	Solder Joint ANSI B16.18									
BODY & BONNET TYPE	2-Piece, Threaded, Full Port									
BODY MATERIAL	ASTM B62 Alloy C83600									
BONNET MATERIAL	Integral with body									
BODY & BONNET BOLTING MATERIAL	N/A									
STEM MATERIAL	ASTM A276 Type 316									
STEM BUSHING MAT'L										
SEAT MATERIAL	RTFE/RPTFE									
DISC & DISC MATERIAL	ASTM A276 Type 316									
ACTUATOR	Handle: ASTM A36, plated for corrosion protection									
SEALS (OR PACKING)	Stem Packing: PTFE									
INTERNAL COATINGS & LININGS	N/A									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of MSS SP-110.
4. Rating of solder end connections shall not exceed the limitations of MSS SP-110.
5. Valve shall conform to NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Stockham	S-206-BR1-R-S	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Crane	9323-S	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Hammond	8313A	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Marwin	633-FTR-W	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	BUTTERFLY VALVE, CAST IRON, A126 CL B, EPDM SEAT, CL 150, LUGGED	BFEH40 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BUTTERFLY VALVE, CAST IRON, A126 CL B, EPDM SEAT, CL 150, LUGGED
DESIGN PRESS. (PSIG)	-14.7 to 175
DESIGN TEMP. (°F)	-20 to 250
DESIGN PRESS. (BARG)	-1.0 to 12.1
DESIGN TEMP. (°C)	-29 to 121
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service (Not approved for steam or Petrochemicals Service)
VALVE STANDARDS	See notes
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)
CONNECTION TYPE	Lugged
BODY & BONNET TYPE	One Piece
BODY MATERIAL	ASTM A126 Class B, ASTM A48 Class 20, See notes
BONNET MATERIAL	Integral with body
BODY & BONNET BOLTING MATERIAL	N/A
STEM MATERIAL	Stainless Steel UNS S31600 "Type 316", UNS S41600 "Type 416"
STEM BUSHING MAT'L	Bronze
SEAT MATERIAL	EPDM
DISC & DISC MATERIAL	Ductile Iron ASTM A536 Gr. 65/45/12 with nickel plating or nylon coated
ACTUATOR	NPS 2 (DN 50) thru NPS 6 (DN 150): Locking Lever NPS 8 (DN 200) thru NPS 12 (DN 300): Gear operated handwheel w/ position indicator
SEALS (OR PACKING)	Stem Packing: NBR, Buna-N or integral with seal
INTERNAL COATINGS & LININGS	EPDM

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional drop-tight shutoff at rated shutoff pressure.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Ductile iron ASTM A395 Class 60/40/18 is an acceptable replacement.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Keystone	AR2	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	Locking lever operator
Keystone	AR2	NPS 8 (DN 200) thru NPS 12 (DN 300)	Gear operator - 221-819 Series
Demco	221xx-5215351	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	NE-C Series, Locking lever operator
Demco	221xx-521535x	NPS 8 (DN 200)	NE-C Series, Gear operator – 22623-213x2 Series with Handwheel
Demco	221xx-511535x	NPS 10 (DN 250) thru NPS 12 (DN 300)	NE-C Series, Gear operator – 22623-213x2 Series with Handwheel
Hammond	6201-01	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	Locking lever operator - 8687 Series
Hammond	6201-03	NPS 8 (DN 200) thru NPS 12 (DN 300)	Gear operator – 8115-24 Series with handwheel and locking device
Bray	31-xx00-11010-119-LO	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	Locking lever operator – Series 1 xx = valve size
Bray	31-xx00-11010-119-GO	NPS 8 (DN 200) thru NPS 12 (DN 300)	Gear operator – Series 4 with handwheel and locking device xx = valve size

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					POWER ENGINEERS	MATERIAL SPECIFICATION	BFEH41	REV
						VALVE		1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	BUTTERFLY VALVE, DUCTILE IRON, A536, EPDM SEAT, CL 150, LUGGED		
0	06.30.06	JDC	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	BUTTERFLY VALVE, DUCTILE IRON, A536, EPDM SEAT, CL 150, LUGGED									
DESIGN PRESS. (PSIG)	-14.7 to 150									
DESIGN TEMP. (°F)	-20 to 250									
DESIGN PRESS. (BARG)	-1.0 to 10.3									
DESIGN TEMP. (°C)	-29 to 121									
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)									
FLUID SERVICE	General Service (Not approved for steam or Petrochemicals Service)									
VALVE STANDARDS	See notes									
END TO END DIMENSION	Manufacturers standard									
PRESSURE CLASS	ASME B16.34: Class 150									
SIZE RANGE	NPS 14 (DN 350) thru NPS 24 (DN 600)									
CONNECTION TYPE	Lugged									
BODY & BONNET TYPE	One piece									
BODY MATERIAL	ASTM A395 Gr. 60/40/18 or ASTM A536									
BONNET MATERIAL	Integral with body									
BODY & BONNET BOLTING MATERIAL	N/A									
STEM MATERIAL	Stainless Steel UNS S30400 "Type 304", UNS S41600 "Type 416"									
STEM BUSHING MAT'L	Bronze									
SEAT MATERIAL	EPDM									
DISC & DISC MATERIAL	ASTM A536 Gr. 65/45/12 with nickel plating or nylon coated									
ACTUATOR	Gear operated handwheel with position indicator									
SEALS (OR PACKING)	Stem Packing: NBR, Buna-N or integral with seat									
INTERNAL COATINGS & LININGS	EPDM									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional drop-tight shutoff at rated shutoff pressure.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Keystone	AR2	NPS 14 (DN 350) thru NPS 24 (DN 600)	Gear operator - 221-819 Series
Hammond	6401-03	NPS 14 (DN 350) thru NPS 24 (DN 600)	Gear operator – 8115 Series with handwheel and locking device
NIBCO	LD-1010	NPS 14 (DN 350) thru NPS 24 (DN 600)	Gear operator – with handwheel and locking device
Bray	31-xx00-11010-390-GO	NPS 14 (DN 350) thru NPS 20 (DN 500)	Gear operator – Series 4 with handwheel and locking device. xx = valve size

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	BUTTERFLY VALVE, CAST IRON, A126 CL B, EPDM SEAT, CL 150, LUGGED, NSF POTABLE WATER	BFEH42 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BUTTERFLY VALVE, CAST IRON, A126 CL B, , EPDM SEAT, CL 150, LUG, NSF POTABLE WATER									
DESIGN PRESS. (PSIG)	-14.7 to 175									
DESIGN TEMP. (°F)	-20 to 250									
DESIGN PRESS. (BARG)	-1.0 to 12.1									
DESIGN TEMP. (°C)	-29 to 121									
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)									
FLUID SERVICE	General Service (Not approved for steam or Petrochemicals Service)									
VALVE STANDARDS	See notes									
END TO END DIMENSION	Manufacturers standard									
PRESSURE CLASS	ASME B16.34: Class 150									
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)									
CONNECTION TYPE	Lugged									
BODY & BONNET TYPE	One Piece									
BODY MATERIAL	ASTM A126 Class B, ASTM A48 Class 20, See notes									
BONNET MATERIAL	Integral with body									
BODY & BONNET BOLTING MATERIAL	N/A									
STEM MATERIAL	Stainless Steel UNS S31600 "Type 316", UNS S41600 "Type 416"									
STEM BUSHING MAT'L	Bronze									
SEAT MATERIAL	EPDM									
DISC & DISC MATERIAL	Ductile Iron ASTM A536 Gr. 65/45/12 with nickel plating or nylon coated									
ACTUATOR	NPS 2 (DN 50) thru NPS 6 (DN 150): Locking Lever NPS 8 (DN 200) thru NPS 12 (DN 300): Gear operated handwheel w/ position indicator									
SEALS (OR PACKING)	Stem Packing: NBR, Buna-N or integral with seal									
INTERNAL COATINGS & LININGS	EPDM									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional drop-tight shutoff at rated shutoff pressure.
3. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Ductile iron ASTM A395 Class 60/40/18 is an acceptable replacement.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Keystone	AR2	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	Locking lever operator
Keystone	AR2	NPS 8 (DN 200) thru NPS 12 (DN 300)	Gear operator - 221-819 Series
Hammond	6201-01	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	Locking lever operator - 8687 Series
Hammond	6201-03	NPS 8 (DN 200) thru NPS 12 (DN 300)	Gear operator – 8115-24 Series with handwheel and locking device

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					POWER ENGINEERS	MATERIAL SPECIFICATION	BFEH43 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	BUTTERFLY VALVE, DUCTILE IRON, A536, EPDM SEAT, CL 150, LUGGED, NSF POTABLE WATER	
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	BUTTERFLY VALVE, DUCTILE IRON, A536, EPDM SEAT, CL 150, LUG, NSF POTABLE WATER									
DESIGN PRESS. (PSIG)	-14.7 to 150									
DESIGN TEMP. (°F)	-20 to 250									
DESIGN PRESS. (BARG)	-1.0 to 10.3									
DESIGN TEMP. (°C)	-29 to 121									
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)									
FLUID SERVICE	General Service (Not approved for steam or Petrochemicals Service)									
VALVE STANDARDS	See notes									
END TO END DIMENSION	Manufacturers standard									
PRESSURE CLASS	ASME B16.34: Class 150									
SIZE RANGE	NPS 14 (DN 350) thru NPS 24 (DN 600)									
CONNECTION TYPE	Lugged									
BODY & BONNET TYPE	One piece									
BODY MATERIAL	ASTM A395 Gr. 60/40/18 or ASTM A536									
BONNET MATERIAL	Integral with body									
BODY & BONNET BOLTING MATERIAL	N/A									
STEM MATERIAL	Stainless Steel UNS S30400 "Type 304", UNS S41600 "Type 416"									
STEM BUSHING MAT'L	Bronze									
SEAT MATERIAL	EPDM									
DISC & DISC MATERIAL	ASTM A536 Gr. 65/45/12 with nickel plating or nylon coated									
ACTUATOR	Gear operated handwheel with position indicator									
SEALS (OR PACKING)	Stem Packing: NBR, Buna-N or integral with seat									
INTERNAL COATINGS & LININGS	EPDM									

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional drop-tight shutoff at rated shutoff pressure.
3. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Keystone	AR2	NPS 14 (DN 350) thru NPS 24 (DN 600)	Gear operator - 221-819 Series
Hammond	6401-03	NPS 14 (DN 350) thru NPS 24 (DN 600)	Gear operator – 8115 Series with handwheel and locking device

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REV	DATE	DSGN	CHK	APPD	POWER ENGINEERS	MATERIAL SPECIFICATION	CKAE10	REV 2
2	10.12.10	EAP	SMB	STH		VALVE		
1	02.11.10	STH	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A105, PISTON, CL 600, SW		
0	08.28.06	SMB	SWQ	STH			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, CS, A105, PISTON, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1480	1360	1310	1265	1205	1135	1100	1060	1015
DESIGN TEMP. (°F)	33 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to102.1	93.2	90.2	87.6	83.9	77.4	75.1	72.7	69.4
DESIGN TEMP. (°C)	0 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	General Service								
VALVE STANDARDS	ASME B16.34, API 602								
END TO END DIMENSION	Manufacturer's standard								
PRESSURE CLASS	ASME B16.34: Class 600								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11								
BODY & BONNET TYPE	Bolted Bonnet – Cap, Piston								
BODY MATERIAL	ASTM A105								
BONNET MATERIAL	ASTM A105								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts								
HINGE & PIN	N/A								
SPRING	ASTM A313 Type 304 or ASTM A638 Grade 660								
SEAT MATERIAL	13% Cr, UNS S41000 Type 410 with Stellite face								
DISC & DISC MATERIAL	Piston, 13% Cr, UNS S41000 Type 410 or ASTM A582 Type 420								
ACTUATOR	N/A								
SEALS (OR PACKING)	304 Stainless steel spiral wound gasket with graphite filler								
INTERNAL COATINGS & LININGS	None								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. Intermediate Class 800 valves meeting the same requirements are acceptable substitutions.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF91D	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	with SS Spring
Vogt	SW710	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAE11 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A105, PISTON, CL 800, SW, STELLITE TRIM	
0	06.15.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, CS, A105, PISTON, CL 800, SW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 1975	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	33 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	0 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)								
FLUID SERVICE	Steam and Condensate								
VALVE STANDARDS	ASME B16.34, API 602								
END TO END DIMENSION	Manufacturer's standard								
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See note 3								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11								
BODY & BONNET TYPE	Bolted Bonnet – Cap, Piston								
BODY MATERIAL	ASTM A105								
BONNET MATERIAL	ASTM A105								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts								
HING & PIN	N/A								
SPRING	300 Stainless Steel								
SEAT MATERIAL	Integral with Stellite facing								
DISC & DISC MATERIAL	Piston, with Stellite facing								
ACTUATOR	N/A								
SEALS (OR PACKING)	300 Series Stainless steel spiral wound gasket with graphite filler								
INTERNAL COATINGS & LININGS	None								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF91E	NPS ¼ (DN 8) thru NPS 2 (DN 50)	with SS Spring
Vogt	SW710FHF	NPS ½ (DN 15) thru NPS 2 (DN 50)	
NEWCO	48S-FS3-RP	NPS ½ (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAG00 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, SWING, CL 300, BW, STELLITE TRIM	
0	08.28.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, SWING, CL 300, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.1	46.6	45.1	43.8	41.9	38.7	37.6	36.4	34.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	General Service – Steam and Condensate								
VALVE STANDARDS	ASME B16.34, API 600								
END TO END DIMENSION	ASME B16.10								
PRESSURE CLASS	ASME B16.34: Class 300								
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)								
CONNECTION TYPE	Buttwelding Ends, ASME B16.25								
BODY & BONNET TYPE	Bolted Cap								
BODY MATERIAL	ASTM A216 Grade WCB								
BONNET MATERIAL	ASTM A216 Grade WCB								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Grade 2H Nuts								
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410								
SPRING	N/A								
SEAT MATERIAL	Seal welded seat ring – Stellite faced								
DISC & DISC MATERIAL	Swing, Carbon Steel, Stellite Faced								
ACTUATOR	N/A								
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5344WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With "HF" Trim (API Trim No. 5)
Newco	33W-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Bxx-1114C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Crane	159½U	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAG01 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, TILT DISC, CL 300, BW, STELLITE TRIM	
0	08.28.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, TILT DISC, CL 300, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.1	46.6	45.1	43.8	41.9	38.7	37.6	36.4	34.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General Service – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Cap, Tilting Disc
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Grade 2H Nuts
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410
SPRING	N/A
SEAT MATERIAL	Seal welded seat ring - Stellite faced
DISC & DISC MATERIAL	Tilting Disc: Stellite Faced
ACTUATOR	N/A
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Pacific	68803-7-WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Powell	3095BWE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	WCB body style, API Trim No. 5

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAH00 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, SWING, CL 150, BW, BOLTED BONNET	
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, SWING, CL 150, BW, BOLTED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Cover, Swing
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B7 bolts ASTM A194 Grade 2H nuts
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410
SPRING	N/A
SEAT MATERIAL	Stainless Steel, 13% Cr UNS S41000 Type 410, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Swing, Carbon Steel with 13% Cr UNS S41000 Type 410 overlay or 13% Cr, UNS S41000 Type 410
ACTUATOR	N/A
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5341WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Newco	31W-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Bxx-0114C-02TY	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Crane	147½XU	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAH01 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, SWING, CL 150, BW, STELLITE TRIM	
0	08.28.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, SWING, CL 150, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	General Service – Steam and Condensate								
VALVE STANDARDS	ASME B16.34, API 600								
END TO END DIMENSION	ASME B16.10								
PRESSURE CLASS	ASME B16.34: Class 150								
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)								
CONNECTION TYPE	Buttwelding Ends, ASME B16.25								
BODY & BONNET TYPE	Bolted Cap, Swing								
BODY MATERIAL	ASTM A216 Grade WCB								
BONNET MATERIAL	ASTM A216 Grade WCB								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Grade 2H Nuts								
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410								
SPRING	N/A								
SEAT MATERIAL	Seal welded seat ring – Stellite faced								
DISC & DISC MATERIAL	Swing, Carbon Steel, Stellite Faced								
ACTUATOR	N/A								
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5341WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With "HF" Trim (API Trim No. 5)
Newco	31W-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Bxx-0114C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Crane	147½U	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAH20	REV
						VALVE		1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, CL 150, FLG		
0	08.28.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, SWING, CL 150, FLANGED								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Flanged, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Cap, Swing
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B7 bolts ASTM A194 Grade 2H nuts
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410
SPRING	N/A
SEAT MATERIAL	Stainless Steel, 13% Cr UNS S41000 Type 410, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Swing, Carbon Steel with 13% Cr UNS S41000 Type 410 overlay or 13% Cr, UNS S41000 Type 410
ACTUATOR	N/A
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5341F	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Newco	31F-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Fxx-0114C-02TY	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Crane	147XU	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKAH21	REV 1
						VALVE		
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CARBON STEEL, A216 GR. WCB, SWING, CL 150, FLG, STELLITE TRIM		
0	08.28.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, CS, A216 Gr. WCB, SWING, CL 150, FLG, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	General Service – Steam and Condensate								
VALVE STANDARDS	ASME B16.34, API 600								
END TO END DIMENSION	ASME B16.10								
PRESSURE CLASS	ASME B16.34: Class 150								
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)								
CONNECTION TYPE	Raised Face, RF, ASME B16.5								
BODY & BONNET TYPE	Bolted Cap, Swing								
BODY MATERIAL	ASTM A216 Grade WCB								
BONNET MATERIAL	ASTM A216 Grade WCB								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Grade 2H Nuts								
HING & PIN	Stainless Steel, 13% Cr UNS S41000 Type 410								
SPRING	N/A								
SEAT MATERIAL	Seal welded seat ring – Stellite faced								
DISC & DISC MATERIAL	Swing, Carbon Steel, Stellite Faced								
ACTUATOR	N/A								
SEALS (OR PACKING)	Corrugated soft iron, soft or mild steel or 300 series stainless steel gasket with graphite filler								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5341F	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With “HF” Trim (API Trim No. 5)
Newco	31F-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Fxx-0114C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Crane	147U	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKBE10 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, LOW ALLOY, GR 22, PISTON, SPRING LOADED, CL 800, SW, WELDED BONNET	
0	06.15.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, LOW ALLOY, GR. 22, PISTON, SPRING LOADED, CL 800, SW, WELDED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 2000	1880	1615	1515	1355	1200	710	467	295
DESIGN TEMP. (°F)	-20 to 200	400	600	700	800	900	1000	1050	1100
DESIGN PRESS. (BARG)	-1.0 to 137.4	129.6	110.2	103.5	93.4	84.5	49.2	28.1	18.4
DESIGN TEMP. (°C)	-29 to 100	200	325	375	425	475	538	575	600
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	Steam								
VALVE STANDARDS	ASME B16.34, API 602								
END TO END DIMENSION	Manufacturers standard								
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See note 3.								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends ASME B16.11								
BODY & BONNET TYPE	Screwed and Seal Welded Cap								
BODY MATERIAL	ASTM A182 Grade F22 Class 3								
BONNET MATERIAL	ASTM A182 Grade F22 Class 3								
BODY & BONNET BOLTING MATERIAL	N/A								
HINGE PIN MATERIAL	N/A								
SPRING MATERIAL	300 Series Stainless steel								
SEAT MATERIAL	Integral seat: Stellite faced								
DISC & DISC MATERIAL	Piston, Stellite faced								
ACTUATOR	N/A								
SEALS (OR PACKING)	N/A								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 1100°F (595°C) is based on ASME B16.34Table 2-1.10 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-45F-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
RP&C	KWB91E	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKBE12 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, LOW ALLOY, GR 22, SWING, CL 800, SW, BOLTED BONNET	
0	08.29.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, LOW ALLOY, GR. 22, SWING, CL 800, SW, BOLTED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 2000	1880	1615	1515	1355	1200	710	467	295
DESIGN TEMP. (°F)	-20 to 200	400	600	700	800	900	1000	1050	1100
DESIGN PRESS. (BARG)	-1.0 to 137.4	129.6	110.2	103.5	93.4	84.5	49.2	28.1	18.4
DESIGN TEMP. (°C)	-29 to 100	200	325	375	425	475	538	575	600
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)								
FLUID SERVICE	Steam								
VALVE STANDARDS	AMSE B16.34								
END TO END DIMENSION	Manufacturers Standard								
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See note 3.								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11								
BODY & BONNET TYPE	Bolted Bonnet – Cap, Swing								
BODY MATERIAL	2 ¼ Cr-Mo, ASTM A182 Grade F22, Class 3								
BONNET MATERIAL	2 ¼ Cr-Mo, ASTM A182 Grade F22, Class 3								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Grade B16 Bolts ASTM A194 Grade 8M								
HINGE PIN MATERIAL	Stainless Steel, 13% Cr, UNS S41000 Type 410								
SPRING MATERIAL	N/A								
SEAT MATERIAL	Pressed in, integral; 13% Cr, UNS S41000 Type 410 with Stellite face								
DISC & DISC MATERIAL	Swing, 13% Cr, UNS S41000 Type 410 or ASTM A743 CA15								
ACTUATOR	N/A								
SEALS (OR PACKING)	304 Stainless Steel spiral wound gasket with graphite filler								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 1100°F (595°C) is based on ASME B31.1 Table A-2 & ASME B16.34 Table 2-1.10.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	HL-65-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Vogt – Flowserve	SWS761	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
					ENGINEERING STANDARD	CHECK VALVE, SS 304, A351 GR. CF8, SWING, , CL 600, BW, STELLITE TRIM,	CKCE00 0
0	09.23.13	JRC	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, SS 304, A351 GR. CF8, SWING, , CL 600, BW, STELLITE TRIM,								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69	60.4	56	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2012) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2012)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 600
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16. 25
BODY & BONNET TYPE	Bolted Bonnet (Cap), Swing
BODY MATERIAL	SS 304, ASTM A351 Gr. CF8 Carbon content is to be 0.04% or higher.
BONNET MATERIAL	SS 304, ASTM A351 Gr. CF8 Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Grade 8 or 8M Nuts
HINGE PIN MATERIAL	Stainless Steel, ASTM A693 Gr 630, UNS S17400 (17-4PH)
SPRING MATERIAL	NA
SEAT MATERIAL	Seal Welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Swing: Stainless Steel 304, Stellite Faced
ACTUATOR	N/A
SEALS (OR PACKING)	Bonnet Seal: SS 316 spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Carbon content is to be 0.4% or higher.
3. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
OIC	4603-BW-U-G	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
VELAN	B XX-2-11-B-11-ND	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Pacific_Crane	680-CF8-U-WE	NPS 2 1/2 (DN 65) thru NPS 20 (DN 500)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCE10	REV
						VALVE		1
1	10.12.10	EAP	SMP	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304, SWING, STELLITE TRIM, CL 600, SW		
0	09.21.07	STH	STH	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, SS, TP304, SWING, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69	60.4	56	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General Service: Corrosive Liquid, Corrosive Gas
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11
BODY & BONNET TYPE	Screwed & Seal Welded Cap, Swing
BODY MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BONNET MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	N/A
HINGE PIN MATERIAL	ASTM A479 Type 304H
SPRING MATERIAL	NA
SEAT MATERIAL	Stellite
DISC & DISC MATERIAL	Swing: Stellite
ACTUATOR	N/A
SEALS (OR PACKING)	N/A
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-67HF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL
VELAN	W-XX-2-11-4W-16-TS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCE12 REV 2
						VALVE	
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304L, SWING, STELLITE TRIM, CL 600, SW	
1	09.21.07	STH	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1200	1020	910	840	785	745	720	705	690
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 82.7	69.6	62.8	58.3	54.9	51.0	49.5	48.6	47.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service: Corrosive Liquid, Corrosive Gas
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11
BODY & BONNET TYPE	Screwed & Seal Welded Cap, Swing
BODY MATERIAL	ASTM A182 Grade F304L
BONNET MATERIAL	ASTM A182 Grade F304L
BODY & BONNET BOLTING MATERIAL	N/A
HINGE PIN MATERIAL	NA
SPRING MATERIAL	ASTM A479 Type 304L
SEAT MATERIAL	Stellite
DISC & DISC MATERIAL	TP304L with Stellite
ACTUATOR	N/A
SEALS (OR PACKING)	N/A
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.3

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-67LF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
VELAN	W-XX-2-11-4W-12-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCE14	REV
						VALVE		1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304, PISTON, STELLITE TRIM, CL 600, SW		
0	09.21.07	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, SS, TP304, PISTON, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69.0	60.4	56.0	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General Service: Corrosive Liquid, Corrosive Gas
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11
BODY & BONNET TYPE	Screwed & Seal Welded Cap, Piston
BODY MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BONNET MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	N/A
HINGE PIN MATERIAL	NA
SPRING MATERIAL	ASTM A479 Type 304H
SEAT MATERIAL	Stellite
DISC & DISC MATERIAL	Piston - Type 304H: Stellite
ACTUATOR	N/A
SEALS (OR PACKING)	N/A
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-47HF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL
VELAN	W-XX-2-03-4W-16-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCE16	REV 2
						VALVE		
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304L, PISTON, STELLITE TRIM, CL 600, SW		
1	09.21.07	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, SS, TP304L, PISTON, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1200	1020	910	840	785	745	720	705	690
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 82.7	69.6	62.8	58.3	54.9	51.0	49.5	48.6	47.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service: Corrosive Liquid, Corrosive Gas
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11
BODY & BONNET TYPE	Screwed & Seal Welded Cap, Piston
BODY MATERIAL	ASTM A182 Grade F304L
BONNET MATERIAL	ASTM A182 Grade F304L
BODY & BONNET BOLTING MATERIAL	N/A
HINGE PIN MATERIAL	NA
SPRING MATERIAL	ASTM A479 Type 304L
SEAT MATERIAL	Stellite
DISC & DISC MATERIAL	TP304L with Stellite
ACTUATOR	N/A
SEALS (OR PACKING)	N/A
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.3

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-47LF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
VELAN	W-XX-2-03-4W-12-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCG00	REV
						VALVE		1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304, SWING, STELLITE TRIM, CL 300, BW, BB	SHEET 1 OF 1	
0	09.21.07	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD				

FEATURE(S)	CHECK VALVE, SS, TP304, SWING, STELLITE TRIM, CL 300, BW, BOLTED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 720	600	495	440	405	355	255	205	165
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 49.6	40.9	34.5	30.2	28.0	24.4	16.9	13.8	11.3
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	AMSE B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet (Cap), Swing
BODY MATERIAL	ASTM A351 Gr. CF8 Carbon content is to be 0.04% or higher.
BONNET MATERIAL	ASTM A351 Gr. CF8 Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Grade 8 or 8M Nuts
HINGE PIN MATERIAL	Stainless Steel, ASTM A479 Gr. 316
SPRING MATERIAL	N/A
SEAT MATERIAL	Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Swing: Stainless Steel 304, Stellite faced
ACTUATOR	N/A
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	No info

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Carbon content is to be 0.04% or higher.
3. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-1114C-11MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCH02 REV 1
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304L, SWING, STELLITE TRIM, CL 150, BW, BB	
0	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 150, BW, BOLTED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	AMSE B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet (Cap), Swing
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Grade 8 or 8M Nuts
HINGE PIN MATERIAL	Stainless Steel, ASTM A479 Gr. 316, ASTM A351 Grade CF3 or equivalent
SPRING MATERIAL	N/A
SEAT MATERIAL	Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Swing: Stainless Steel 304 or 304L, Stellite faced
ACTUATOR	N/A
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	No info

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.1

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-0114C-12MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKCH22	REV
						VALVE		1
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, STAINLESS STEEL, TP304L, SWING, STELLITE TRIM, CL 150, FLG, BB		
0	09.21.07	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	CHECK VALVE, SS, TP304L, SWING, STELLITE TRIM, CL 150, FLANGED, BOLTED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Raised face, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet (Cap), Swing
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Grade 8 or 8M Nuts
HINGE PIN MATERIAL	Stainless Steel, ASTM A479 Gr. 304, ASTM A351 Grade CF3 or equivalent
SPRING MATERIAL	N/A
SEAT MATERIAL	Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Swing: Stainless Steel 304L, Stellite faced
ACTUATOR	N/A
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	No info

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.1

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	F-0114C-12MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKEK20 REV 1
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, CAST IRON, A126 CL B, SWING, RESILIENT SEAT, CL 125, FLG, AWWA, NSF, NFPA	SHEET 1 OF 1
0	04.27.10	RVK	STH	STH			
REV	DATE	DSGN	CHK	APPD			

FEATURE(S)	CHECK VALVE, CAST IRON, A126 CL B, SWING, RESILIENT SEAT, CL 125, FLG, AWWA, NSF, NFPA
DESIGN PRESS. (PSIG)	-14.7 to 175
DESIGN TEMP. (°F)	33 to 125
DESIGN PRESS. (BARG)	-1.0 to 12.1
DESIGN TEMP. (°C)	0 to 51.7
DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2009)
FLUID SERVICE	General Service – Water, Domestic/Potable/Drinking Water, Firewater not for corrosive fluid or petrochemical service
VALVE STANDARDS	AWWA C508 Standard for Swing-Check Valves for Waterworks Service UL Listing and FM approval.
END TO END DIMENSION	AWWA C508, ASME B16.10 Class 125
PRESSURE CLASS	175 psig rated (12.1 barg)
SIZE RANGE	NPS 2 (DN 50) thru NPS 12 (DN 300)
CONNECTION TYPE	Flanged Ends, ASME B16.1 – Class 125 Flat Faced
BODY & BONNET TYPE	Full or Clear Waterway, Bolted Cover
BODY MATERIAL	ASTM A126 Class B
BONNET MATERIAL	NA
COVER MATERIAL	ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
HINGE PIN MATERIAL	Bronze ASTM B61 Alloy 464
SPRING MATERIAL	NA
SEAT MATERIAL	Bronze ASTM B62 Alloy 836
DISC & DISC MATERIAL	Cast iron disc ASTM A126 Class B with rubber insert (Resilient) ASTM D2000 AA705 or Buna-N
ACTUATOR	NA
SEALS (OR PACKING)	Rubber ASTM D2000 AA705 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C508: Epoxy coated in accordance with AWWA C550

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of AWWA C508.
3. UL Listed and FM Approval.
4. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Mueller Co.	A-2122-6	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	
Kennedy Valve Co.	Fig. 126	NPS 4 (DN 100) thru NPS 12 (DN 300)	
MATCO-NORCA	120-U	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	
Clow Valve Co		NPS 4 (DN 100) thru NPS 12 (DN 300)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	CKFK10 REV 1
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	CHECK VALVE, BRONZE, SWING, CL 125, SOLDER JOINT, NSF	
0	12/02/05	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	CHECK VALVE, BRONZE, SWING, CL 125, SOLDER JOINT, NSF									
DESIGN PRESS. (PSIG)	-14.7 to 300	270	175							
DESIGN TEMP. (°F)	-20 to 150	200	250							
DESIGN PRESS. (BARG)	-1.0 to 20.7	18.6	12.1							
DESIGN TEMP. (°C)	-29 to 65.6	93.3	121.1							

DESIGN CODE(S)	IPC - INTERNATIONAL PLUMBING CODE (2006)
FLUID SERVICE	General Service
VALVE STANDARDS	MSS SP-80 Type 3
END TO END DIMENSION	Manufacturer standard
PRESSURE CLASS	MSS SP-80: Class 125
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Solder Joint ANSI B16.18
BODY & BONNET TYPE	Threaded Cap, Swing
BODY MATERIAL	ASTM B62 Alloy C83600
BONNET MATERIAL	ASTM B61 Alloy C92200 or B62 Alloy C83600
BODY & BONNET BOLTING MATERIAL	N/A
HINGE PIN MATERIAL	ASTM B16
SPRING MATERIAL	N/A
SEAT MATERIAL	Integral with body
DISC & DISC MATERIAL	ASTM B16 or ASTM B62 Alloy C83600
ACTUATOR	N/A
SEALS (OR PACKING)	N/A
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Maximum leakage rate shall not exceed the limitations of MSS SP-80.
3. Rating of solder end connections shall not exceed the limitations of MSS SP-80.
4. Valve shall conform to NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Pressure and temperature limitations are controlled by valve material ratings and Alloy Sb5 95-5 solder joint.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Stockham	B-309Y	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Walworth	W406SJ	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAAE05 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 600, BW	
0	09.11.07	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 600, BW, STELLITE TRIM, LOW EMISSIONS								
DESIGN PRESS. (PSIG)	-14.7 to 1480	1360	1310	1265	1205	1135	1100	1060	1015
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 102.1	93.2	90.2	87.6	83.9	77.4	75.1	72.7	69.4
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	Steam, Condensate, Petrochem, Gas
VALVE STANDARDS	AMSE B16.34, API 600, API 622
END TO END DIMENSION	ASME B16.10 – Long Pattern (LP) (NPS 2 1/2 (DN 65) thru NPS 24 (DN 600))
PRESSURE CLASS	ASME B16.34: Class 600
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a
SEAT MATERIAL	Integral seat, backseat and or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite Low Emissions Features: Provide low emissions features to meet 100 PPM testing limitation in accordance with API 622.

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 6 (DN 150) and larger valves.
6. Bypass shall be provided for valves NPS 8 (DN 200) and larger in size in accordance with MSS SP-45, Series A.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Kitz	W600SC LSY	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	See VA01 for Actuator Type LOW EMISSIONS
Kitz	W600SC LSY	NPS 8 (DN 200) thru NPS 24 (DN 600)	Bypass Valve, MSS SP-45, Series A. See VA01 for Actuator Type LOW EMISSIONS
Velan	B-2064C-02TS	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	See VA01 for Actuator Type LOW EMISSIONS
Velan	B-2064C-02TS	NPS 8 (DN 200) thru NPS 24 (DN 600)	Bypass Valve, MSS SP-45, Series A See VA01 for Actuator Type LOW EMISSIONS

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAAE10	REV
						VALVE		
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A105, OS&Y, CL 800, SW		1
0	09.25.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GATE VALVE, CS, A105, OS&Y, CL 800, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1973	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 602
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See Note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A105
BONNET MATERIAL	ASTM A105
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts
STEM MATERIAL	OS&Y: Stainless steel 13% Cr, UNS S41000 Type 410
SEAT MATERIAL	Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite face
DISC & DISC MATERIAL	Solid Wedge: Stainless Steel 13% Cr UNS S41000 Type 410
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: 304 Stainless steel spiral wound gasket with graphite filler Stem Packing: Flexible graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF57D	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	w/ Locking Handle
Walworth	950SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	w/ Locking Handle
Vogt	SW12111	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	w/ Locking Handle

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A105, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM	GAAE11 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A105, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 1973	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 602
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See Note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A105
BONNET MATERIAL	ASTM A105
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts
STEM MATERIAL	Stainless steel 13% Cr, UNS S41000 Type 410
SEAT MATERIAL	Intergral or seal welded seat: Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite face
DISC & DISC MATERIAL	Solid Wedge: Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: 304 Stainless steel spiral wound gasket with graphite filler Stem Packing: Flexible graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF57E	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Vogt	SW12111FHF	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
NEWCO	18S-FS3-RP-LD	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A105, OS&Y, CL 800, SW, STELLITE TRIM, LOW EMISSIONS	GAAE15 / 1
0	09.11.07	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A105, OS&Y, CL800, SW, STELLITE TRIM, LOW EMISSIONS								
DESIGN PRESS. (PSIG)	-14.7 to 1975	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	33 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	0 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam, Condensate, Petrochem, Gas
VALVE STANDARDS	ASME B16.34, API 602, API 622
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See Note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A105
BONNET MATERIAL	ASTM A105
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts
STEM MATERIAL	Stainless steel 13% Cr, UNS S41000 Type 410
SEAT MATERIAL	Intergral or seal welded seat: Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite face
DISC & DISC MATERIAL	Solid Wedge: Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: 304 Stainless steel spiral wound gasket with graphite filler Stem Packing: Flexible graphite Low Emissions Features: Provide low emissions features to meet 100 PPM testing limitation in accordance with API 622.
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF57E	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	LOW EMISSIONS
Vogt	SW12111FHF	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	LOW EMISSIONS
NEWCO	18S-FS3-RP-LD	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	LOW EMISSIONS

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, FLEX WEDGE, CL 300, BW, STELLITE TRIM	GAAG00 / 1
0	09.25.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.1	46.6	45.1	43.8	41.9	38.7	37.6	36.4	34.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a, or equivalent
SEAT MATERIAL	Integral seat, backseat and or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-1064C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite backseat. See VA01 for actuators
Newco	13W-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
2	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, CL 300, BW, STELLITE TRIM, LOW EMISSIONS	GAAG05 / 2
1	05.20.08	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM, LOW EMISSIONS								
DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.1	46.6	45.1	43.8	41.9	38.7	37.6	36.4	34.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam, Condensate, Petrochem, Gas
VALVE STANDARDS	ASME B16.34, API 600, API 622
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 36 (DN 900)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a, or equivalent
SEAT MATERIAL	Integral seat, backseat and or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite Low Emissions Features: Provide low emissions features to meet 100 PPM testing limitation in accordance with API 622.
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-1064C-02TS	NPS 2 1/2 (DN 65) thru NPS 36 (DN 900)	With Stellite backseat. See VA01 for actuators LOW EMISSIONS
Newco	13W-CB3(9)	NPS 2 1/2 (DN 65) thru NPS 36 (DN 900)	See VA01 for Actuator Type LOW EMISSIONS

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 150, BW	GAAH00 / 1
0	12.02.05	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	AMSE B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Grade 2H Nuts
STEM MATERIAL	OS&Y: Stainless Steel 13% Cr UNS S41000 Type 410
SEAT MATERIAL	Stainless steel 13% Cr, UNS S41000, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel with Stainless Steel 13% Cr, UNS S41000 Type 410 overlay or 13% Cr, UNS S41000 Type 410
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5202W	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Newco	11W-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Velan	Bxx-0064C-02TY	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Crane	x-471/2XUF	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAAH01 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 150, BW	
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam and Condensate
VALVE STANDARDS	AMSE B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Grade F6a
SEAT MATERIAL	Backseat and seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5202WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite No. 6 backseat, HF Trim (API Trim 5), See VA01 for Actuator Type
Newco	11W-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Velan	B-0064C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite backseat. See VA01 for ActuatorType

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAAH05 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 150, BW	
0	09.11.07	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM, LOW EMISSIONS								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam, Condensate, Petrochem, Gas
VALVE STANDARDS	AMSE B16.34, API 600, API 622
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Grade F6a
SEAT MATERIAL	Backseat and seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite Low Emissions Features: Provide low emissions features to meet 100 PPM testing limitation in accordance with API 622.
INTERNAL COATINGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5202WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite No. 6 backseat, HF Trim (API Trim 5), See VA01 for Actuator Type LOW EMISSIONS
Newco	11W-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type LOW EMISSIONS
Velan	B-0064C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite backseat. See VA01 for ActuatorType LOW EMISSIONS

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 150, FLG	GAAH20 / 1
0	12.02.05	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, FLG								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	AMSE B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Flanged, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Stainless Steel 13% Cr UNS S41000 Type 410
SEAT MATERIAL	Stainless steel 13% Cr, UNS S41000, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Carbon Steel with Stainless Steel 13% Cr, UNS S41000 Type 410 overlay or 13% Cr, UNS S41000 Type 410
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5202F	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Newco	11F-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Velan	Fxx-0064C-02TY	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Crane	x-47XUF	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAAH21 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, FLEX WEDGE, CL 150, FLG	
0	09.25.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CS, A216 Gr. WCB, OS&Y, FLEX WEDGE, CL 150, FLG, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Raised face, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Grade F6a, or equivalent, See Additional Requirements.
SEAT MATERIAL	Backseat and integral seat or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stellite Faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5202F	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite No. 6 backseat, HF Trim (API Trim 5), See VA01 for Actuator Type
Newco	11F-CB3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type
Velan	F-0064C-02TS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	With Stellite backseat. See VA01 for ActuatorType

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GABE02 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, LOW ALLOY, GR. 22, OS&Y, PARALLEL DISC, CL 600	
0	04.11.06	SMB	KAP	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, LOW ALLOY, GR. 22, OS&Y, PARALLEL DISC, CL 600, BW								
DESIGN PRESS. (PSIG)	-14.7 to 1500	1410	1210	1015	900	535	220	135	80
DESIGN TEMP. (°F)	-20 to 200	400	600	800	900	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 103	97.2	82.6	70.0	63.4	36.9	13.8	8.9	5.7
DESIGN TEMP. (°C)	-29 to 100	200	325	425	475	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	Steam
VALVE STANDARDS	AMSE B16.34
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	AMSE B16.34: Class 600
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Butt Weld Ends, ASME B16.25
BODY & BONNET TYPE	Pressure seal bonnet joint – See Additional Requirements
BODY MATERIAL	ASTM A217 Grade WC9 or ASTM A182 Grade F22 C1-3
BONNET MATERIAL	ASTM A217 Grade WC9 or ASTM A182 Grade F22 C1-3
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y with backseat arrangement: Forged Alloy Steel (13% Cr), ASTM A182 Gr. F6a or equivalent
SEAT MATERIAL	Integral seat or seal welded backseat ring and Backseat - Stellite faced
DISC & DISC MATERIAL	Doubl Disc, Parallel Seat : Stellite Faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Stainless Steel inlay in pressure seal area. Stem Packing: Garlock Style 1303 Dry or Equal
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of MSS SP-61.
5. Bypass shall be provided valves NPS 8 (DN 200) and larger in size in accordance with MSS SP-45, Series A.
6. Ball or antifriction bearing yoke for NPS 6 (DN 150) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Pacific	55406H-7-WC9-WE	NPS 2 1/2 (DN 65) thru NPS 6 (DN 150)	
Pacific	55406H-7-WC9-WE	NPS 8 (DN 200) thru NPS 24 (DN 600)	Bypass Valve, MSS SP-61, Series A

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, LOW ALLOY, GR. 22, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM, WB	GABE10 / 1
0	06.15.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, LOW ALLOY, GR. 22, OS&Y, SOLID WEDGE, CL 800, SW, STELLITE TRIM, WELDED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 2000	1880	1615	1515	1355	1200	710	467	295
DESIGN TEMP. (°F)	-20 to 200	400	600	700	800	900	1000	1150	1100
DESIGN PRESS. (BARG)	-1.0 to 137.4	129.6	110.2	103.5	93.4	84.5	49.2	28.1	18.4
DESIGN TEMP. (°C)	-29 to 100	200	325	375	425	475	538	575	600

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	Steam
VALVE STANDARDS	ASME B16.34, API 602
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.43: Class 800; Intermediate Class, See Note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Screwed and Seal Welded Bonnet, OS&Y
BODY MATERIAL	ASTM A182 Grade F22 Class 3
BONNET MATERIAL	ASTM A182 Grade F22 Class 3
BODY & BONNET BOLTING MATERIAL	N/A
STEM MATERIAL	410 Stainless Steel
SEAT MATERIAL	Integral seat or pressed in seat ring and integral backseat: Stellite Faced
DISC & DISC MATERIAL	Solid Wedge: Stellite Faced
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: 304/316 Stainless steel spiral wound graphite filled gasket Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 1100°F (595°C) is based on ASME B16.34 Table 2-1.10 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-15F-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
RP&C	KWB 57 ES	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
					ENGINEERING STANDARD	GATE VALVE, SS 304, A351 GR. CF8, OS&Y, FLEX WEDGE, CL 600, BW, STELLITE TRIM,	GACE00 0
0	09.23.13	JRC	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, SS 304, A351 GR. CF8, OS&Y, FLEX WEDGE, CL 600, BW, STELLITE TRIM,								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69.0	60.4	56.0	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2012) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2012)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 600
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	SS 304, ASTM A351 Grade CF8 Carbon content is to be 0.04% or higher.
BONNET MATERIAL	SS 304, ASTM A351 Grade CF8 Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: Stainless Steel, ASTM A693 Gr 630, UNS S17400 (17-4PH)
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stainless Steel 304, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Carbon content is to be 0.04% or higher.
5. API 600 Trim 16
6. Maximum leakage rate shall not exceed the limitations of API Standard 598.
7. Ball or antifriction bearing yoke for NPS 6 (DN 150) and larger valves.
8. Bypass shall be provided for valves NPS 8 (DN 200) and larger in size in accordance with MSS SP-45, Series A.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
VELAN	BXX-2064B-11ND	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Pacific_Crane	2655-CF8-U-WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
NEWCO	16W-CF84/3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
OIC	4601-BW-U-G	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GACE10 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, STAINLESS STEEL, TP304, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM	
0	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, SS, TP304, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69.0	60.4	56.0	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)								
FLUID SERVICE	Corrosive Liquid, Corrosive Gas								
VALVE STANDARDS	ASME B16.34								
END TO END DIMENSION	Manufacturers Standard								
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted.								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11								
BODY & BONNET TYPE	Screwed & Welded Bonnet – OS&Y								
BODY MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.								
BONNET MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.								
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts								
STEM MATERIAL	OS&Y: ASTM A479 Gr. F304								
SEAT MATERIAL	Stellite								
DISC & DISC MATERIAL	Solid Wedge: Stellite faced								
ACTUATOR	Handwheel: Malleable iron, steel, Ductile iron								
SEALS (OR PACKING)	Stem Packing: Graphite								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-17HF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL
VELAN	W-XX-2-06-W-16-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GACE12 REV 2
						VALVE	
2	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, STAINLESS STEEL, TP304L, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM	
1	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, SS, TP304L, OS&Y, SOLID WEDGE, CL 600, SW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 1200	1020	910	840	785	745	720	705	690
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 82.7	69.6	62.8	58.3	54.9	51.0	49.5	48.6	47.7
DESIGN TEMP. (°C)	-29 to38	100	150	200	250	325	375	400	425
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)								
FLUID SERVICE	Corrosive Liquid, Corrosive Gas								
VALVE STANDARDS	ASME B16.34								
END TO END DIMENSION	Manufacturers Standard								
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted.								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11								
BODY & BONNET TYPE	Screwed & Welded Bonnet – OS&Y								
BODY MATERIAL	ASTM A182 Grade F304L								
BONNET MATERIAL	ASTM A182 Grade F304L								
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts								
STEM MATERIAL	OS&Y: Forged Alloy Steel, ASTM A479 Gr. F304L								
SEAT MATERIAL	Stellite								
DISC & DISC MATERIAL	Solid Wedge: Stellite faced								
ACTUATOR	Handwheel: Malleable iron, steel, Ductile iron								
SEALS (OR PACKING)	Stem Packing: Graphite								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.3

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-17LF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
VELAN	W-XX-2-06-W-12-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GACG04	REV 0
						VALVE		
0	09.23.13	JRC	STH	STH	ENGINEERING STANDARD	GATE VALVE, SS 304, A351 GR. CF8, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM,		
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GATE VALVE, SS 304, A351 GR. CF8, OS&Y, FLEX WEDGE, CL 300, BW, STELLITE TRIM,								
DESIGN PRESS. (PSIG)	-14.7 to 720	600	495	440	405	355	255	205	165
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 49.6	40.9	34.5	30.2	28.0	24.4	16.9	13.8	11.3
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2012) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2010)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	SS 304, ASTM A351 Grade CF8 Carbon content is to be 0.04% or higher.
BONNET MATERIAL	SS 304, ASTM A351 Grade CF8 Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: Stainless Steel, ASTM A693 Gr 630, UNS S17400 (17-4PH)
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stainless Steel 304, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: SS 316 spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Carbon content is to be 0.04% or higher.
5. Ball or antifriction bearing yoke for NPS 6 (DN 150) and larger valves.
6. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
VELAN	BXX-1064B-11ND	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Pacific_Crane	2355-CF8-U-WE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
NEWCO	13W-CF84/3	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
OIC	4301-BW-U-G	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GACH02 REV 2
						VALVE	
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, STAINLESS STEEL, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, BW	
1	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, SS, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: Forged Stainless Steel, ASTM A479 Gr. F304L or equivalent
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stainless Steel 304L, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.1

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-0064C-12MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GACH22 REV 2
						VALVE	
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, STAINLESS STEEL, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, FLG	
1	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, SS, A351 GR. CF3, OS&Y, FLEX WEDGE, CL 150, FLG, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Raised Face, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Grade 8 or 8M Nuts
STEM MATERIAL	OS&Y: Forged Stainless Steel, ASTM A479 Gr. F304L or equivalent
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stainless Steel 304L, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B31.1 Table A-3 & ASME B16.34 Table 2-2.1

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	F-0064C-12MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CAST IRON, NRS, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA	GAEK20 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CAST IRON, NONRISING STEM, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA									
DESIGN PRESS. (PSIG)	-14.7 to 200									
DESIGN TEMP. (°F)	33 to 100									
DESIGN PRESS. (BARG)	-1.0 to 13.8									
DESIGN TEMP. (°C)	0 to 38									

DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2009)
FLUID SERVICE	General Service – Water, Firewater
VALVE STANDARDS	AWWA C509 – Resilient – Seated Gate Valves for Water Supply Services (2009)
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	200 psig (13.8 barg)
SIZE RANGE	NPS 4 (DN 100) thru NPS 12 (DN 300)
CONNECTION TYPE	Flanged, FF, ASME B16.1 – 125
BODY & BONNET TYPE	Bolted Bonnet, Non Rising Stem (NRS)
BODY MATERIAL	ASTM A126 Class B
BONNET MATERIAL	ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
STEM MATERIAL	Non rising: Bronze
SEAT MATERIAL	AWWA C509
DISC & DISC MATERIAL	Solid Wedge: Rubber encapsulated cast iron (Resilient)
ACTUATOR	NPS 2 (DN 50) Square wrench nut, ASTM A126 Class B
SEALS (OR PACKING)	Rubber ASTM D2000 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C509

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of AWWA C509.
4. UL and FM approval.
5. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Clow Valve Co	F-6102	NPS 4 (DN 100) thru NPS 12 (DN 300)	Style 2640 w/ NPS 2 (DN 50) nut; Left Hand Opening Valve
Mueller Co.	A-2360	NPS 4 (DN 100) thru NPS 12 (DN 300)	Left Hand Opening Valve

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAEK21 REV 1
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CAST IRON, PIV, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA	
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CAST IRON, PIV, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA
DESIGN PRESS. (PSIG)	-14.7 to 200
DESIGN TEMP. (°F)	33 to 100
DESIGN PRESS. (BARG)	-1.0 to 13.8
DESIGN TEMP. (°C)	0 to 38
DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2009)
FLUID SERVICE	General Service – Water, Firewater
VALVE STANDARDS	AWWA C509 – Resilient – Seated Gate Valves for Water Service (2009)
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	200 psig (13.8 barg)
SIZE RANGE	NPS 4 (DN 100) thru NPS 12 (DN 300)
CONNECTION TYPE	Flanged, FF, ASME B16.1 – 125
BODY & BONNET TYPE	Bolted Bonnet, Non Rising Stem (NRS)
BODY MATERIAL	ASTM A126 Class B
BONNET MATERIAL	ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
STEM MATERIAL	Non rising: Bronze
SEAT MATERIAL	AWWA C509
DISC & DISC MATERIAL	Solid Wedge: Rubber encapsulated cast iron (Resilient)
ACTUATOR	NPS 2 (DN 50) Square wrench nut, ASTM A126 Class B
SEALS (OR PACKING)	Rubber ASTM D2000 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C509

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of AWWA C509.
4. UL and FM approval.
5. Supply cast iron PIV connector plate with Fixed Length Post Indicators (PI).
6. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Clow Valve Co	F-6102 w/ PIV	NPS 4 (DN 100) thru NPS 12 (DN 300)	• Valve Style 2640 w/ NPS 2 (DN 50) nut and PIV Connector Plate • Left Hand Opening Valve • PIV Style 2945 • Trench Depth Required
Mueller Co.	P-2360-6	NPS 4 (DN 100) thru NPS 12 (DN 300)	• Left Hand Opening Valve • PIV Type A-20808 and A-20815 extension piece as required • Trench Depth Required

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAEK22 REV 1
						VALVE	
1	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GATE VALVE, CAST IRON, RISING STEM, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA	
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CAST IRON, RISING STEM, SOLID WEDGE, CL 125, FLG, AWWA, NSF, NFPA
DESIGN PRESS. (PSIG)	-14.7 to 200
DESIGN TEMP. (°F)	33 to 100
DESIGN PRESS. (BARG)	-1.0 to 13.8
DESIGN TEMP. (°C)	0 to 38
DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2009)
FLUID SERVICE	General Service – Water, Firewater
VALVE STANDARDS	AWWA C509 – Resilient – Seated Gate Valves for Water Service (2009)
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	200 psig (13.8 barg)
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)
CONNECTION TYPE	Flanged, Flat Faced, ASME B16.1 – 125
BODY & BONNET TYPE	Bolted Bonnet, OS&Y
BODY MATERIAL	ASTM A536 Grade 64-54-10 or ASTM A126 Class B
BONNET MATERIAL	ASTM A536 Grade 64-54-10 or ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
STEM MATERIAL	Bronze
SEAT MATERIAL	AWWA C509
DISC & DISC MATERIAL	Solid Wedge: Rubber encapsulated cast iron (Resilient)
ACTUATOR	handwheel, Cast iron
SEALS (OR PACKING)	Rubber ASTM D2000 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C509

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of AWWA C509.
4. UL and FM approval.
5. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Clow Valve Co	F-6136	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	Style 2639 or 2640 Left Hand Opening Valve
Mueller Co.	R-2360-6	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	Left Hand Opening Valve

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	0
					ENGINEERING STANDARD	GATE VALVE, CAST IRON, NON RISING STEM, SOLID WEDGE, CL 125, MJ, AWWA, NSF, NFPA	GAEK70
0	11.10.10	JRC	SMB	STH			SHEET 1 OF 1
REV	DATE	DSGN	CHK	APPD			

FEATURE(S)	GATE VALVE, CAST IRON, NON RISING STEM, SOLID WEDGE, CL 125, MJ, AWWA, NSF, NFPA									
DESIGN PRESS. (PSIG)	-14.7 to 200									
DESIGN TEMP. (°F)	33 to 100									
DESIGN PRESS. (BARG)	-1.0 to 13.8									
DESIGN TEMP. (°C)	1 to 38									

DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2006)
FLUID SERVICE	General Service – Water, Firewater
VALVE STANDARDS	AWWA C509
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	200 psig (13.8 barg)
SIZE RANGE	NPS 4 (DN 100) thru NPS 12 (DN 300)
CONNECTION TYPE	Mechanical Joint, MJ, AWWA C111/A21.11
BODY & BONNET TYPE	Bolted Bonnet, Non Rising Stem (NRS)
BODY MATERIAL	ASTM A126 Class B
BONNET MATERIAL	ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
STEM MATERIAL	Non rising: Bronze
SEAT MATERIAL	AWWA C509
DISC & DISC MATERIAL	Solid Wedge: Rubber encapsulated cast iron (Resilient)
ACTUATOR	2 in (50 mm) Square wrench nut, ASTM A126 Class B
SEALS (OR PACKING)	Rubber ASTM D2000 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C509

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of AWWA C509.
4. UL and FM approval.
5. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Clow Valve Co.	F-6100	NPS 4 (DN 100) thru NPS 12 (DN 300)	Style 2640 w/ 2 in (50 mm) nut Left Hand Opening Valve
Mueller Co.	P-2360-20	NPS 4 (DN 100) thru NPS 12 (DN 300)	Left Hand Opening Valve w/ 2 in (50 mm) operating nut

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GAEK71 REV 0
						VALVE	
					ENGINEERING STANDARD	GATE VALVE, CAST IRON, PIV NON RISING STEM, SOLID WEDGE, CL 125, MJ, AWWA, NSF, NFPA	
0	11.10.10	JRC	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GATE VALVE, CAST IRON, PIV, NON RISING STEM, SOLID WEDGE, CL 125, MJ, AWWA, NSF, NFPA									
DESIGN PRESS. (PSIG)	-14.7 to 200									
DESIGN TEMP. (°F)	33 to 100									
DESIGN PRESS. (BARG)	-1.0 to 13.8									
DESIGN TEMP. (°C)	1 to 38									

DESIGN CODE(S)	NFPA 24 - STANDARD FOR THE INSTALLATION OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES (2010) UPC - UNIFORM PLUMBING CODE (2006)
FLUID SERVICE	General Service – Water, Firewater
VALVE STANDARDS	AWWA C509
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	200 psig (13.8 barg)
SIZE RANGE	NPS 4 (DN 100) thru NPS 12 (DN 300)
CONNECTION TYPE	Mechanical Joint, MJ, AWWA C111/A21.11
BODY & BONNET TYPE	Bolted Bonnet, Non Rising Stem (NRS)
BODY MATERIAL	ASTM A126 Class B
BONNET MATERIAL	ASTM A126 Class B
BODY & BONNET BOLTING MATERIAL	ASTM A307 Grade B, zinc coated
STEM MATERIAL	Non rising: Bronze
SEAT MATERIAL	AWWA C509
DISC & DISC MATERIAL	Solid Wedge: Rubber encapsulated cast iron (Resilient)
ACTUATOR	2 in (50 mm) Square wrench nut, ASTM A126 Class B
SEALS (OR PACKING)	Rubber ASTM D2000 or Buna-N
INTERNAL COATINGS & LININGS	AWWA C509

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of AWWA C509.
4. UL and FM approval.
5. Comply with NSF (National Sanitation Foundation) standards for drinking water systems.
6. Supply cast iron PIV connector plate w/ adjustable length post indicator.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Clow Valve Co.	F-6100	NPS 4 (DN 100) thru NPS 12 (DN 300)	• Style 2640 w/ 2 in (50 mm) nut Left Hand Opening Valve • PIV Style 2945A (Lockable Lever). • Trench depth required.
Mueller Co.	P-2360-20	NPS 4 (DN 100) thru NPS 12 (DN 300)	• Left Hand Opening Valve • PIV Type A-20806 (Lockable Lever). • Trench depth required.

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					POWER ENGINEERS	MATERIAL SPECIFICATION VALVE	GLAE10 REV 1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A105, OS&Y, CL 800, SW	
0	08.24.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, CS, A105, OS&Y, CL 800, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1973	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)								
FLUID SERVICE	General Service								
VALVE STANDARDS	ASME B16.34, API 602								
END TO END DIMENSION	Manufacturers standard								
PRESSURE CLASS	ASME B16.34: Class 800; Intermediate Class, See note 3.								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11								
BODY & BONNET TYPE	Bolted Bonnet – OS&Y								
BODY MATERIAL	ASTM A105								
BONNET MATERIAL	ASTM A105								
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts								
STEM MATERIAL	OS&Y: Stainless steel 13% Cr, UNS S41000 Type 410								
SEAT MATERIAL	Stainless Steel 13% Cr UNS S41000 Type 410 with Stellite face								
DISC & DISC MATERIAL	Stainless Steel 13% Cr UNS S41000 Type 410 or ASTM A582 Type 420								
ACTUATOR	Handwheel								
SEALS (OR PACKING)	Bonnet Seal: 304 Stainless steel spiral wound gasket with graphite filler Stem Packing: Flexible graphite								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF81D	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Walworth	5520SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Vogt	SW12141	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A105, OS&Y, CL 800, SW, STELLITE TRIM	GLAE11 / 1
0	06.30.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, CS, A105, OS&Y, CL 800, SW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 1973	1810	1750	1690	1610	1515	1467	1415	1350
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 136.2	124.3	120.2	116.8	111.8	103.2	100.2	97.0	92.6
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 602
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34 – 800; Intermediate Class, See Note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A105
BONNET MATERIAL	ASTM A105
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts
STEM MATERIAL	OS&Y: Stainless steel 13% Cr, UNS S41000 Type 410
SEAT MATERIAL	Integral: Stellite faced
DISC & DISC MATERIAL	Stellite faced
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: 304 Stainless steel spiral wound gasket with graphite filler Stem Packing: Flexible graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
RP&C	EF81E	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
Vogt	SW12141FHF	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
NEWCO	Z8S-FS3	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, CL 300, BW, STELLITE TRIM	GLAG00 / 1
0	09.25.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

SPECIAL FEATURE(S)	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, CL 300, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 740	680	655	635	605	570	550	530	505
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 51.1	46.6	45.1	43.8	41.9	38.7	37.6	36.4	34.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General – Steam and Condensate
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	ASME B16.10 thru NPS 12 (DN 300), Manufacturers standard NPS 14 (DN 350) and above.
PRESSURE CLASS	ASME B16.34: Class 300
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB or ASTM A743 Grade CA-28 MWV
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a, or equivalent, See Additional Requirements.
SEAT MATERIAL	Backseat and integral or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Stellite Faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Edwards	318Y	NPS 3 (DN 80) thru NPS 12 (DN 300)	See VA01 for Actuator Type
Velan	B-1074C-02TS	NPS 2 1/2 (DN 65) thru NPS 18 (DN 450)	With Stellite backseat. See VA01 for Actuator Type
Newco	23W-CB3	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLAH00	REV 1
						VALVE		
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, CL 150, BW		
0	09.11.07	SMB	STH	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, CL 150, BW								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Stainless Steel 13% Cr UNS S41000 Type 410
SEAT MATERIAL	Stainless Steel 13% Cr UNS S41000, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Carbon Steel with Stainless Steel 13% Cr UNS S41000 Type 410 overlay or Stainless Steel 13% Cr UNS S41000 Type 410
ACTUATOR	Handwheel: Malleable iron or steel
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or iron gasket, 300 Series Stainless steel spiral wound gasket with graphite filler Stem Seal: Flexible graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5275WE	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	
Newco	21W-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Bxx-0074C-02TY	NPS 2 1/2 (DN 65) thru NPS 16 (DN 400)	
Crane	143½ XU	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLAH01	REV 1
						VALVE		
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, CL 150, BW, STELLITE TRIM		
0	09.25.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, CL 150, BW, STELLITE TRIM								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a, or equivalent, See Additional Requirements.
SEAT MATERIAL	Backseat and integral seat or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Stellite Faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-0074C-02TS	NPS 2 1/2 (DN 65) thru NPS 18 (DN 450)	With Stellite backseat. See VA01 for Actuator Type
Newco	21W-CB3	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLAH20	REV 1
						VALVE		
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A216 GR.WCB, OS&Y, CL 150, FLG		
0	09.25.06	SMB	SWQ	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, CL 150, FLG								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Flanged, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Stainless Steel 13% Cr UNS S41000 Type 410
SEAT MATERIAL	Stainless Steel 13% Cr UNS S41000, Hard Faced or Stellite faced
DISC & DISC MATERIAL	Carbon Steel with Stainless Steel 13% Cr UNS S41000 Type 410 overlay or Stainless Steel 13% Cr UNS S41000 Type 410
ACTUATOR	Handwheel: Malleable iron or steel
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or iron gasket, 300 Series Stainless steel spiral wound gasket with graphite filler Stem Seal: Flexible graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Walworth	5275F	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	
Newco	21F-CB2	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	
Velan	Fxx-0074C-02TY	NPS 2 1/2 (DN 65) thru NPS 16 (DN 400)	
Crane	x-143XU	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLAH21 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, CARBON STEEL, A216 GR. WCB, OS&Y, STELLITE TRIM, CL 150, FLG	
0	09.25.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, CS, A216 Gr. WCB, OS&Y, STELLITE TRIM, CL 150, FLG								
DESIGN PRESS. (PSIG)	-14.7 to 285	260	230	200	170	140	125	110	95
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	650	700	750
DESIGN PRESS. (BARG)	-1.0 to 19.6	17.7	15.8	13.8	12.1	9.3	8.4	7.4	6.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	350	375	400

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	General – Steam and Condensate
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Raised Face, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A216 Grade WCB
BONNET MATERIAL	ASTM A216 Grade WCB
BODY & BONNET BOLTING MATERIAL	ASTM A193 Gr. B7 Bolts ASTM A194 Gr. 2H Nuts
STEM MATERIAL	OS&Y: Forged Alloy Steel (13% Cr) ASTM A182 Gr. F6a, or equivalent, See Additional Requirements.
SEAT MATERIAL	Backseat and integral seat or seal welded seat rings; Stellite faced
DISC & DISC MATERIAL	Stellite Faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: Corrugated soft steel or soft iron, or 300 Series spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.
5. Ball or antifriction bearing yoke for NPS 8 (DN 200) and larger valves.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-1.1 notes.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	F-0074C-02TS	NPS 2 1/2 (DN 65) thru NPS 18 (DN 450)	With Stellite backseat. See VA01 for Actuator Type
Newco	21F-CB3	NPS 2 1/2 (DN 65) thru NPS 12 (DN 300)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION	REV
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, LOW ALLOY, GR. 22, Y-PATTERN, STELLITE TRIM, CL 800, SW, WELDED BONNET	GLBE11 / 1
0	06.15.06	SMB	STH	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, LOW ALLOY, GR. 22, Y-PATTERN, STELLITE TRIM, CL 800, SW, WELDED BONNET								
DESIGN PRESS. (PSIG)	-14.7 to 2000	1880	1615	1515	1355	1200	710	467	295
DESIGN TEMP. (°F)	-20 to 200	400	600	700	800	900	1000	1050	1100
DESIGN PRESS. (BARG)	-1.0 to 137.4	129.6	110.2	103.5	93.4	84.5	49.2	28.1	18.4
DESIGN TEMP. (°C)	-29 to 100	200	325	375	425	475	538	575	600

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008)
FLUID SERVICE	Steam and Condensate
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers standard
PRESSURE CLASS	ASME B16.34: Class 800: Intermediate Class, See note 3.
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16.11
BODY & BONNET TYPE	Screwed and Seal Welded, OS&Y, Y-Pattern
BODY MATERIAL	ASTM A182 Grade F22
BONNET MATERIAL	ASTM A182 Grade F22
BODY & BONNET BOLTING MATERIAL	N/A
STEM MATERIAL	Forged Stainless Steel, ASTM A182 Grade F6a, or equivalent
SEAT MATERIAL	Backseat and integral seat: Stellite Faced
DISC & DISC MATERIAL	Stellite Faced
ACTUATOR	Handwheel
SEALS (OR PACKING)	Bonnet Seal: N/A Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Bi-directional shutoff.
3. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 1100°F (595°C) is based on ASME B16.34 Table 2-1.10 notes.
3. P/T Rating based on ASME B16.34 interpolated values for Intermediate Class 800.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-35F-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	Class 800 (not limited class)
Vogt	SW822FHF	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
NEWCO	28S-F223-WB-Y	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLCE10 REV 1
						VALVE	
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, STAINLESS STEEL, TP304, OS&Y, STELLITE TRIM, CL 600, SW	
0	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, SS, TP304, OS&Y, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1440	1200	995	885	810	710	515	410	330
DESIGN TEMP. (°F)	-20 to 100	200	400	600	800	1000	1100	1150	1200
DESIGN PRESS. (BARG)	-1.0 to 99.3	81.7	69.0	60.4	56.0	48.9	33.8	27.6	22.5
DESIGN TEMP. (°C)	-29 to 38	100	200	325	425	538	600	625	650

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	Corrosive Liquid, Corrosive Gas
VALVE STANDARDS	ASME B16.34
END TO END DIMENSION	Manufacturers Standard
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11
BODY & BONNET TYPE	Screwed & Welded Bonnet – OS&Y
BODY MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BONNET MATERIAL	ASTM A182 Grade F304/F304H Carbon content is to be 0.04% or higher.
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: ASTM A479 Gr. F304
STEM BUSHING MAT'L	
SEAT MATERIAL	Stellite
DISC & DISC MATERIAL	Stellite faced
ACTUATOR	Handwheel: Malleable iron, steel, Ductile iron
SEALS (OR PACKING)	Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-37F-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL
VELAN	W-XX-2-07-4W-16-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	F304H MATERIAL

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					POWER ENGINEERS	MATERIAL SPECIFICATION VALVE	GLCE12 REV 1
1	10.12.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, STAINLESS STEEL, TP304L, OS&Y, STELLITE TRIM, CL 600, SW	
0	08.31.06	SMB	SWQ	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, SS, TP304L, OS&Y, STELLITE TRIM, CL 600, SW								
DESIGN PRESS. (PSIG)	-14.7 to 1200	1020	910	840	785	745	720	705	690
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 82.7	69.6	62.8	58.3	54.9	51.0	49.5	48.6	47.7
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425
DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)								
FLUID SERVICE	Corrosive Liquid, Corrosive Gas								
VALVE STANDARDS	ASME B16.34								
END TO END DIMENSION	Manufacturers Standard								
PRESSURE CLASS	ASME B16.34: Class 600; Intermediate Class 800 may be substituted								
SIZE RANGE	NPS 1/2 (DN 15) thru NPS 2 (DN 50)								
CONNECTION TYPE	Socket-Welding Ends, ASME B16. 11								
BODY & BONNET TYPE	Screwed & Welded Bonnet – OS&Y								
BODY MATERIAL	ASTM A182 Grade F304L								
BONNET MATERIAL	ASTM A182 Grade F304L								
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts								
STEM MATERIAL	OS&Y: Forged Alloy Steel, ASTM A479 Gr. F304L								
STEM BUSHING MAT'L									
SEAT MATERIAL	Stellite								
DISC & DISC MATERIAL	Stellite faced								
ACTUATOR	Handwheel: Malleable iron, steel, Ductile iron								
SEALS (OR PACKING)	Stem Packing: Graphite								
INTERNAL COATINGS & LININGS	N/A								

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-2.3.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Bonney Forge	WL-37LF-SW	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	
VELAN	W-XX-2-07-4W-12-MS	NPS 1/2 (DN 15) thru NPS 2 (DN 50)	

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					POWER ENGINEERS	MATERIAL SPECIFICATION	GLCH02	REV
						VALVE		
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, STAINLESS STEEL, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, BW		2
1	09.21.07	STH	SMB	STH				
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1	

FEATURE(S)	GLOBE VALVE, SS, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, BW								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Buttwelding Ends, ASME B16.25
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: Forged Stainless Steel, ASTM A479 Gr. F304L or equivalent
STEM BUSHING MAT'L	
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Stainless Steel 304L, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-2.1.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
Velan	B-0074C-12MS	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)	See VA01 for Actuator Type

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					POWER ENGINEERS	MATERIAL SPECIFICATION VALVE	GLCH22 REV 2
2	10.08.10	EAP	SMB	STH	ENGINEERING STANDARD	GLOBE VALVE, STAINLESS STEEL, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, FLG	
1	09.21.07	STH	SMB	STH			
REV	DATE	DSGN	CHK	APPD			SHEET 1 OF 1

FEATURE(S)	GLOBE VALVE, SS, A351 GR. CF3, OS&Y, STELLITE TRIM, CL 150, FLG								
DESIGN PRESS. (PSIG)	-14.7 to 275	230	205	190	170	140	110	95	80
DESIGN TEMP. (°F)	-20 to 100	200	300	400	500	600	700	750	800
DESIGN PRESS. (BARG)	-1.0 to 19.0	15.7	14.2	13.2	12.1	9.3	7.4	6.5	5.5
DESIGN TEMP. (°C)	-29 to 38	100	150	200	250	325	375	400	425

DESIGN CODE(S)	ASME B31.1 – NON-BOILER EXTERNAL PIPING (2009) ASME B31.3 – NORMAL FLUID SERVICE PIPING (2008) ASME B31.9 – BUILDING SERVICES PIPING (2008)
FLUID SERVICE	General Service
VALVE STANDARDS	ASME B16.34, API 600
END TO END DIMENSION	ASME B16.10
PRESSURE CLASS	ASME B16.34: Class 150
SIZE RANGE	NPS 2 1/2 (DN 65) thru NPS 24 (DN 600)
CONNECTION TYPE	Raised Face, RF, ASME B16.5
BODY & BONNET TYPE	Bolted Bonnet – OS&Y
BODY MATERIAL	ASTM A351 Gr. CF3
BONNET MATERIAL	ASTM A351 Gr. CF3
BODY & BONNET BOLTING MATERIAL	Stainless Steel, ASTM A193 Gr. B8 Bolts Stainless Steel, ASTM A194 Gr. 8 or 8M Nuts
STEM MATERIAL	OS&Y: Forged Stainless Steel, ASTM A479 Gr. F304L or equivalent
STEM BUSHING MAT'L	
SEAT MATERIAL	Backseat and Seal welded or integral seat; Stellite faced
DISC & DISC MATERIAL	Flexible Wedge: Stainless Steel 304L, Stellite faced
ACTUATOR	See Valve Actuator Specification – VA01 for handwheel and bevel gear sizing requirements.
SEALS (OR PACKING)	Bonnet Seal: 316 SS spiral wound gasket with graphite filler Stem Packing: Graphite
INTERNAL COATINGS & LININGS	N/A

ADDITIONAL REQUIREMENTS

1. Asbestos is not allowed.
2. Lockout/tagout provisions required.
3. Bi-directional shutoff.
4. Maximum leakage rate shall not exceed the limitations of API Standard 598.

NOTES

1. See manufacturer for standard(s) used in the construction of the valve.
2. Maximum temperature of 800°F (425°C) is based on ASME B16.34 Table 2-2.1.

PRE-APPROVED SUPPLIERS

Manufacturers	Model No.	Size Range	Remarks
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July 15, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485121
Control Valves

PROJECT NUMBER:
123374

PROJECT CONTACT:
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Section 485121
Control Valves

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: TONY CLARK

REVISION HISTORY		
DATE	REVISED BY	REVISION
7/15/13	T. Clark	A

SECTION 485121
GENERAL SERVICE CONTROL VALVES

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY THE BOP CONTRACTOR 1
1.3 RELATED SECTIONS 2
1.4 CODES & STANDARDS 2
1.5 DEFINITIONS 3
1.6 SCHEDULE 3
1.7 SYSTEM DESCRIPTION 3
1.8 SUBMITTALS 6
1.9 QUALITY ASSURANCE 7
1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING 7
1.11 SITE CONDITIONS 7

PART 2 - PRODUCTS 8

2.1 MANUFACTURERS 8
2.2 MATERIALS AND WELDING 8
2.3 EQUIPMENT 9
2.4 COMPONENTS 12
2.5 SOUND CONTROL REQUIREMENTS 17
2.6 FABRICATION 17
2.7 SOURCE QUALITY CONTROL 18

PART 3 - EXECUTION 19

3.1 FIELD QUALITY CONTROL 19
3.2 SPARE PARTS 19

PART 4 - ATTACHMENTS 20

4.1 CONTROL VALVE DATASHEET TEMPLATE 20

SECTION 485121
GENERAL SERVICE CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. This specification, including data sheets and Appendices, establishes the requirements for the design, fabrication, testing, preparation for shipment, delivery and performance of listed control valves and their accessories. Reference to other codes, standards, and regulations shall be interpreted as an integral part of this specification.

B. The control valves and their accessories shall be new and unused. Refurbished or used equipment is not acceptable.

C. The BOP 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 BOP Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY THE BOP CONTRACTOR

A. The following equipment, materials and services shall be provided by the BOP Contractor for each control valve set:

1. Control Valves, complete with operators and accessories, listed in the Control Valve Data Sheets.
2. Valve and actuator sizing calculations and selections.
3. Drawings and design data including sizing sheets with noise calculations and product specifications to support facility design, construction and maintenance. Drawings will include tag numbers for the valves being provided.
4. Special tools required for maintenance and adjustments of the control valves, operators, and accessories.
5. Priced list of recommended spare parts for start-up and two years of operation.
6. Outline and schematic drawings for control valves showing mounted actuators.
7. Shop testing and inspection.
8. Cleaning and shop painting of all valves, operators, and accessories.
9. Installation, Operation and Maintenance Manuals for the supplied equipment. This information will be provided in searchable PDF format included with the turnover packages.
10. 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.
11. Supervisors for construction, commissioning and startup
12. Valve C_v curves and stroke speeds (time constants)
13. Offloading equipment and labor
14. Installation of control valves

15. All piping external to the control valves
16. All instrument air tubing to the valves. The final instrument air supply shall be made with a flexible tubing connection.
17. Controls and instrumentation external to the control valve and its accessories
18. Piping thermal and/or acoustic insulation

1.3 RELATED SECTIONS

A. 480020 - Site Conditions

B. 480031 - Combined Cycle Power Island Noise Control Performance

C. 481200 - Combined Cycle Balance of Plant

D. 485975 - General Welding Requirements

1.4 CODES & STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section. 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.

1. Acoustical Society of America (ASA)
2. American National Standards Institute (ANSI)
   a. ANSI FCI 70-2 Control Valve Seat Leakage
3. American Society of Mechanical Engineers (ASME)
   a. ASME B16.10 Face-to-Face and End-to-End Dimensions of Valves
   b. ASME B16.11 Forged Fittings, Socket-Welding and Threaded
   c. ASME B16.25 Butt Welding Ends
   d. ASME B16.34 Valves-Flanged, Threaded, and Welding End
   e. ASME B16.47 Series A from 26” to 60” – Welding Neck and Blind Flanges
   f. ASME B16.5 Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
   g. ASME B31.1 Power Piping
   h. ASME PTC-36 Measurement of Industrial Sound
4. American Society for Non Destructive Testing (ASNT)
   a. SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification
5. American Society for Testing and Materials (ASTM)
   a. ASTM A182 Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
   b. ASTM A216 Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
   c. ASTM A217 Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
   d. ASTM A351 Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
   e. ASTM A494 Castings, Nickel and Nickel Alloy

f. ASTM B564 Nickel Alloy Forgings

6. Factory Mutual (FM)
7. Fluid Control Institute (FCI)
   a. FCI 70.2 Control Valve Seat Leakage
8. International Electrotechnical Commission (IEC)
   a. IEC 60534-8-3 Control Valve Standard, Part 8: Noise Considerations - Section 3: Control Valve Aerodynamic Noise prediction Method
9. Instrumentation, Systems, and Automation Society (ISA)
   a. ISA-75.01 Through ISA-75.25 - Control Valves
10. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)
    a. MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions
    b. MSS-SP-55 Cast Steel Valves
    c. MSS SP-61 Pressure Testing of Steel Valves
    d. MSS-SP-67 Butterfly Valves

1.5 DEFINITIONS

A. Balance of Plant (BOP) Contractor: The party contracted by the City to perform all balance of plant detail design, perform all plant construction efforts, install Contractor's work and coordinate Contractor's and Subcontractor's work on the site specified directly or by reference in 481200, Combined Cycle Balance of Plant.

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.

E. Work: All labor, materials, equipment, services, supplies and apparatus to be furnished by BOP Contractor at the jobsite, and the performance of all operations required for construction, installation, completion, testing, erection, assembly and startup of the facility as described in this Section.

1.6 SCHEDULE

A. For all equipment provided as part of this specification, the schedule contained herewith, or revisions to it as agreed to by the General Manager and BOP Contractor shall be binding. The BOP Contractor shall submit any requested changes to the schedule to the General Manager for approval.

1.7 SYSTEM DESCRIPTION

A. Design Requirements:

1. BOP Contractor shall provide control valves and actuators that are suitable for a minimum design life of 30 years in an outdoor installation. All equipment supplied shall be suitable for outdoor installation and service under the conditions described in Section 480020, Site Conditions.
2. Unless specified otherwise, the control valves shall be capable of continuous, full-load duty at the most severe operating point for at least 16,000 hours with interruptions in service for only minor maintenance and inspection.

B. Performance Requirements:
   1. Vibration and Erosion Limits
      a. Proper control valve selection shall ensure that the required energy can be dissipated without exceeding the maximum vibration levels in the piping system and without exceeding the wear properties of the trim material. BOP Contractor shall select control valve trim design that facilitates maximum reduction of control valve induced vibration, trim wear and noise
      b. Control valve vibration and trim erosion can be reduced by multi-stage multipath trim designs. In order to minimize vibration, BOP Contractor shall select control valves based on Table 12.3 of the ISA Guide, "Control Valves, Practical Guides for Measurement and Control" summarized below:
      c. Liquid Service Applications
         1) The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit velocity below 30 m/sec (100 ft/sec) for single-phase liquids and 23 m/sec (75 ft/sec) for cavitating, flashing, and/or erosive services. BOP Contractor shall specify number of discreet pressure drop stages required and provide body and trim exit velocity calculations with proposal. The calculation basis and results shall be shown for manual or computer calculations.
      d. Gas Service Applications
         1) The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit fluid velocity head (V_h) below 480 kPa (70 psia) for continuous or intermittent duty and 1030 kPa (150 psia) for infrequent duty. Valve trim exit fluid velocity head shall be calculated based on ISA Guide, "Control Valves, Practical Guides for Measurement and Control" as follows:

$$V_h = \text{Kinetic Energy} = \rho_o V_o^2/(2 g_c)$$

Where:

ρ_o = valve trim exit fluid density
V_o = valve trim exit fluid velocity
g_c = gravitational constant in unit of measurement

         2) BOP Contractor shall specify number of discreet pressure drop stages required and provide body and trim exit fluid velocity head calculations with proposal. The calculation basis and results shall be shown for manual or computer calculations.
   2. Cavitation, Choked Flow and Flashing
      a. ISA S75.01, the ISA Guide "Control Valves, Practical Guides for Measurement and Control", and the BOP Contractor's valve cavitation index data shall be used for determining the severity of cavitation, choked flow, or flashing conditions in the control valves. BOP Contractor shall provide a control valve that eliminates cavitation damage.

b. The design of valves in cavitation and flashing service shall be based on Chapter 7 of the ISA Guide, "Control Valves, Practical Guides for Measurement and Control" and include the following techniques for Cavitation-Resistant Valves:
   1) Reduce the pressure in multiple stages
   2) Direct flow away from the valve body and pipe walls
   3) Break the flow into many small streams
   4) Force the flow through multiple turns or tortuous paths

c. The design shall provide a sufficient number of discrete pressure drop stages to maintain the trim exit velocity below 23 m/sec (75 ft/sec) for cavitating and flashing service. BOP Contractor shall specify number of discreet pressure drop stages required and provide body and trim exit velocity calculations with BOP Contractor's proposal. For multi-constituent fluids, special consideration shall be given to the potential for cavitation of the minor components in the fluid.

d. Contingencies on the minimum required control valve cavitation index shall be applied to compensate for inaccuracies in process data and inaccuracies in BOP Contractor's control valve cavitation index data. General Manager shall carefully evaluate BOP Contractor's selection of a control valve that eliminates cavitation.

3. Flow Characteristic
   a. BOP Contractor shall select the control valve flow characteristic to meet the rangeability requirements to provide stable control over the required range of operating conditions.

4. Noise
   a. Refer to Section 480031, Combined Cycle Noise Control Performance for noise measurement, noise emissions limits, and attenuation requirements
   b. The BOP Contractor shall calculate, and furnish as part of the quotation, predicted noise levels for valves.
   c. The BOP Contractor may indicate the noise level with and without the use the insulation thickness as stated in the control valve data sheets and provide a noise credit for insulation.
   d. Noise measurements shall be made in accordance with ASA S1.13 " Measurement of Sound Pressure Levels in Air" at the locations specified in this Section, unless other test codes are specified. All measurements shall be made with sound-measuring equipment meeting ASA S1.4, Type 1 Sound Level Meter, and ASA S1.11 Octave Band Filters Class II.
   e. Noise prediction calculations shall be based on IEC 60534-8-3 objective approach. An enhanced version that incorporates valve exit velocity as one of the controlling factors is preferred.
   f. All equipment shall meet the minimum requirements of OSHA and Cal OSHA.
   g. The overall sound pressure level shall be checked first. If it exceeds the overall noise criterion, then each octave band sound pressure level shall be measured and analyzed to identify the noise source. If the noise source cannot be eliminated except by major modifications or rework, the matter is to be referred to the General Manager for resolution.

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: 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.

1.8 SUBMITTALS

A. Information to be furnished with the Bid.

1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:
    a. Documents for Specific Service Applications
        1) Gas Service:
            a) Body and trim exit fluid velocity calculations, including number of discreet pressure drop stages required, for each specified flow condition; BOP Contractor to also specify body and trim exit fluid velocities expressed in sonic velocity (Mach number).
        2) Liquid Service:
            a) Cavitation index data and choked flow parameter data both as a function of travel specific for the selected control valve and application. The BOP Contractor shall confirm in writing that the selected control valve eliminates cavitation damage.
            b) Size Scale Effect (SSE) and Pressure Scale Effect (PSE) correction data for the cavitation index data.
            c) Body and trim exit fluid velocity calculations, including number of discreet pressure drop stages required, for each specified flow condition.
    b. Filled in “Valve Data Sheets” of this specification showing complete description of the valves proposed.
    c. List of all valves and all other items to be furnished by this Contract. Each item listed shall include at least the specified tag number, Contractor identification or item number, if any, and the name of the item. List shall be sorted by tag number and shall include a cross reference to the valve data sheet number that includes each item.
    d. Calculations of flow coefficients at each condition specified, including percent stem travel, predictions of cavitation or flashing conditions and valve sound pressure level. These may be combined with the valve data sheets.
    e. Manufacturer’s recommended control algorithms
    f. Standard outline drawings of valves showing estimated weight, assembly envelope dimensions, body face-to-face dimensions, and clearances required for maintenance and the interrelationship of various components, details of internal or special features.
    g. Valve upstream and downstream piping design considerations
    h. Flushing trim, steam blowout trim, final trim and hydro-plug details
    i. BOP Contractor recommended start-up spare parts list with prices
    j. BOP Contractor recommended operation spare parts list with prices
    k. Special tools list with prices
    l. Outline drawings of accessory equipment with field connection diagrams showing location, sizes, and types of instrument and control connections (and electrical connections for switches).
    m. Catalog literature, manufacturer's specification sheets, instructions, and other relevant system design information.
    n. The Bidder shall identify any exceptions to this specification, including modifications made to the pre-defined information listed in the attached Valve Data Sheets, or its references and include detailed justification. The BOP Contractor shall notify General Manager of any modifications to his standard design required to meet this specification.

B. Information required after contract award:
   1. Refer to Section 481200, Combined Cycle Balance of Plant for general submittal requirements after contract award.
   2. After the award of contract, the following data and drawings shall be submitted to the General Manager for approval:
      a. Parts identification list shall accompany each set of instructions. This list shall include sectional and/or outline prints or illustrations identifying each numbered part and location relation to the equipment as a whole.
      b. Recommended procedures for accommodating hydro testing and steam blowing
      c. Control Valve nameplate drawings
      d. Any other data or drawings necessary to completely describe the equipment furnished

C. Shop Drawings

   1. Refer to 481200, Combined Cycle Balance of Plant for general shop drawings requirements.

D. Installation, Operation and Maintenance Manuals

   1. Refer to 481200, Combined Cycle Balance of Plant for general installation, operation and maintenance manual requirements.

   2. Equipment operating and maintenance manuals shall contain information such as:

      a. Data Sheets.
      b. Special shipping, handling , and storage instructions.
      c. Lubrication requirements.
      d. Maintenance and repair instructions, including procedures, tolerances,
      e. Special tool or facility needs, etc.
      f. Bill of materials.
      g. Descriptive literature.
      h. Parts Lists (commissioning spares, start up spares, two-year spares, complete parts lists)

1.9 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

1.10 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general packaging, shipping, storage, and handling requirements.

1.11 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following Manufacturers are pre-approved to supply control valves specified under this Section. Additional Manufacturers must be submitted to the General Manager for approval before consideration to include in the BOP Contractor's Proposal.

1. Copes Vulcan
2. Fisher
3. Masoneilan
4. Jamesbury
5. CCI
6. Samson
7. Bray
8. Velan
9. Valtek

2.2 MATERIALS AND WELDING

A. Refer to 481200, Combined Cycle Balance of Plant for general material and welding requirements.

B. All materials to be incorporated in permanent piping systems shall be new, unused, and undamaged.

C. All materials shall be in accordance with the latest ASTM standards or materials listed in ASME B31.1.

D. Valve materials shall be as required by the application.

E. 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 stellite faced for valves where required for proper operation.

F. 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), and Section 485975, General Welding Requirements.

G. All castings shall meet the requirements of MSS-SP-55 internally and externally after machining.

H. The following table defines the materials to be used. Other materials may be acceptable and shall be submitted to the General Manager for acceptance.

Material	Description
Cast iron	ASTM A48 CL 40 or ASTM A126 CL 8

Carbon steel	Forged - ASTM A105 Cast - ASTM A216, Grade WCB/WCC
1-1/4 percent chromium alloy steel	Forged - ASTM A182, Grade F11 Cast - ASTM A217, Grade WC6
2-1/4 percent chromium alloy steel	Forged - ASTM A182, Grade F22 Cast - ASTM A217, Grade WC9
5 percent chromium alloy steel	Forged - ASTM A182, Grade F5 Cast - ASTM A217, Grade C5
Stainless steel	Forged - ASTM A182, Grade F316 Cast - ASTM A351, Grade CF8M
Monel	ASTM A164 Alloy NO4405

(The table does not include all materials necessary for special application control valves.)

2.3 EQUIPMENT

A. General Valve Requirements

1. As far as practicable, maintenance or replacement of wearing parts shall be able to be accomplished with the valves in situ.
2. All valves of similar size and type shall be directly interchangeable.
3. The internal diameter for all isolating valves and the ends of connecting pipes shall be of the same internal diameter.
4. In the case of all welded-in valves, the stub ends of the valves shall project from the valve body a sufficient length to ensure that the welding process will not affect the valve seats.
5. Valve packing shall be asbestos and lead free.
6. Valve selection and materials shall be appropriate to the fluid and operating conditions to ensure long life, maintainability and, where applicable, minimum pressure drop. They shall be well proven in similar service.
7. Gate valves shall not be used for throttling. Welded end valves shall not be used for control valves.
8. Where necessary, all valves shall be provided with flush / blow kits. When a valve must be welded in the pipeline and the weld procedure calls for preheat/post weld heat treat, the valve internals shall either be removed or provided with a statement from the vendor that the internals can remain in the valve during such operations.
9. Valves for Steam Service
    a. For all steam valves there shall be a differential hardness of 50 Brinell between the seating surfaces with the exception of stellite.
10. Valves for Condensate and Boiler Feedwater Service
    a. Amine and other oxygen scavenger chemicals used in boiler feedwater treatment are known to corrode Stellite components. Where Stellite trim is specified, substitute appropriate 400 series stainless steel in boiler feedwater applications.

B. General Control Valve Requirements

1. Actuators shall be suitable for opening and closing each valve against the relevant differential pressure plus a minimum of 20% extra torque to overcome sticking which may occur due to deposition within the valve body.
2. Control valves shall be suitable for outdoor installation. The design, construction and choice of materials shall take into account all operational deviations including pressure surge and thermal shock.
3. Enclosure rating requirements are detailed in the Electrical Requirements for Mechanical Packages.
4. Modulating valve actuators shall have:
    a. A speed of response (both full stroke and small signal) to meet with requirements of the control loop in which they are connected,
    b. A positional accuracy which is repeatable within the limits required for the control loop in which they are connected,
    c. The capability of following the input signal accurately, over the full range of operation.
    d. Rack and Pinion actuators shall not be allowed in modulating applications.
5. For pneumatic actuators, current signals to the control valves shall be converted to pneumatic signals by “smart” current-to-pneumatic converters integral with the positioners.
6. The minimum actuation time for valves from the fully open position to the fully closed position and vice versa shall be as indicated on the data sheets (as required for the service). Actual normal operating speed for modulating valves will be set by the Plant Control System (PCS) PID tuning parameters.
7. For on/off control valves, the vent port on the solenoid shall have a manual throttling (needle) valve so that the valve’s stroke time can be adjusted in the event of loss of PCS signal.
8. On larger throttling valves, volume tanks may be specified on the data sheets instead of a spring return. This volume tank shall provide air to stroke the valve to its fail position mode. The air supply from the positioner shall incorporate a trip valve to switch the positioner’s output to the actuator to the volume tank during a fail position mode. The trip valve vent port shall have a manual throttling (needle) valve so that the valve’s stroke time can be adjusted in the event of loss of PCS signal.
9. Globe type control valves used for modulating service shall be selected such that the control valve operates between 15 and 85 percent 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 percent of full open travel.
10. Valves susceptible to cavitation at any point in the operational range of the valve shall be provided with suitable protection.
11. Valve packing shall be selected for the design conditions of the service intended or as specified in the data sheets.
12. Flanges shall conform to ASME B16.5, Pipe Flanges and Flanged Fittings up to 24” and ASME B16.47 Series A for 26” to 60”. Socket weld connections shall be in accordance with ASME B16.11.

C. Butterfly Valve Requirements
1. Eccentric disc butterfly valves shall be of "balanced torque" type disc usable to the fully open position (90^{o} opening). The overall shaft rating shall be at least 25% above the static pressure as differential across the closed valve. Butterfly valve shafts shall be a one-piece unit extending through the valve disc, or a two-piece shaft extending into the valve disc at least 1 1/2 shaft diameters. Shaft and disc shall be pinned with taper or dowel pins, spliced, or locked together with lugs (no press fits).

2. Butterfly valve contour discs for 90 degree operation are preferred. Support bearings shall be as close to the disc as seals will permit.
3. All soft seat or piston ring design butterfly valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the disc in the closed position. Each valve shall be provided with an external disc position indicator.
4. Butterfly valve construction shall be lugged with tapped holes or flanged; wafer style is not acceptable unless noted otherwise or with prior approval by the General Manager. The threads and other details of fasteners shall comply with ANSI Unified Thread Standard (UTS) for fasteners. Butterfly valves shall not be constructed of cast iron.
5. Shaft shall be 316L, 17-4PH or Nitronic 50 hardened stainless steel with inboard and outboard bearings to be stainless steel, PEEK, or Alloy 6, as required by service conditions or as noted on the data sheets. In cases where the pressure drop across the valve disc is high, where extension bonnets are supplied, or for valves that have special tight shutoff features such as elastomeric lining, outboard bearings shall be of the precision roller-type.
6. The valve disc position shall be indicated by an engraved mark on the end of the shaft.
7. Butterfly valves shall be sized under normal flow conditions for maximum angle opening of 60 degrees.
8. Steam services shall require triple offset design unless otherwise noted on the control valve data sheets. Butterfly valves in other services shall require minimum double offset.

D. Ball Valve Requirements
1. Ball control valves shall rotate through 90 degrees. Metal seats shall be used for steam service. Materials shall be selected such that the seal ring and ball surfaces are wiped clean, without damage, by the shearing action of the seal ring to prevent accumulation of solids.
2. The seal ring shall provide reasonable shutoff when pressure is applied to the body in the reverse direction. When the shut off pressures is higher than 85 psi in the reverse direction, an eccentric plug design shall be used.
3. The ball shaft shall be 316L, Nitronic 50 or 17-4PH hardened stainless steel as a standard or as noted on the data sheets. The ball plug shall be 316L/317 stainless steel with a polished chromium-plated surface as standard. Other trim parts shall be hardened stainless steel unless otherwise specified.
4. A spline-type connection shall be provided between the ball plug and the actuator. Shear pins and keys are not acceptable.
5. The ball plug portion shall be indicated by an engraved marking or mechanical indicator connected to the ball shaft.

E. Valve Sizing
1. Each control valve shall be sized by the manufacturer using their own formula. Each control valve 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 application.
2. The manufacturer's published "CV's" shall be used to determine valve size. Valve sizing calculations shall be based on equations and data by the BOP Contractor, IEC 60534-2-1, or ISA S75.01. Sizing calculations including C_v, noise and cavitation calculations, actuator sizing, stroke speed (both large and small signal), and selection shall be submitted for approval.
3. Valves bodies shall in all cases match the piping pressure and temperature rating specifications as a minimum and the operating point on the valve characteristic, i.e. lift/throughput curve should be within the 60-70% operating range and less than 95%

travel under maximum flow conditions. Control valves shall pass the minimum design flow at no less than 20 percent of valve travel.

4. Noise measurements shall be made in accordance with ASA S1.13 "Measurement of Sound Pressure Levels in Air" at the locations specified, unless other test codes are specified. All measurements shall be made with sound-measuring equipment meeting ASA S1.4, Type 1 Sound Level Meter, and ASA S1.11 Octave Band Filters Class II. All valves shall comply with OSHA noise requirements.
5. Noise prediction calculations shall be based on IEC 60534-8-3 objective approach or ISA S75.17. An enhanced version that incorporates valve exit velocity as one of the controlling factors is preferred. The overall sound pressure level shall be checked first. If it exceeds the overall noise criterion, then each octave band sound pressure level shall be measured and analyzed to identify the noise source. If the noise source cannot be eliminated except by major modifications or rework, the matter is to be referred to the General Manager for resolution.
6. Valve body sizes shall be selected to satisfy the operating and design conditions of the system. Valve body sizes shall not be less than two pipe sizes smaller than the inlet nominal pipe size.

2.4 COMPONENTS

A. Valve Bodies

1. Materials shall be as specified in the data sheet.
2. All materials shall be in accordance with the latest ASTM standards or materials listed in ASME B31.1.
3. All castings shall meet the requirements of MSS-SP-55 internally and externally after machining.
4. Stainless or alloy steel valves will have alloy steel nuts and studs, compatible with the service conditions.
5. For severe erosive service the fluid impact area inside the valve body shall be covered by welded stellite or another acceptable hardfacing.
6. All valves shall be provided with labels or nameplates. These labels shall include in the inscription a valve “name”, or abbreviated description of the valve duty, and a unique plant reference number for the valve.

B. Trim Materials and Stem Packing

1. Control valve trims shall be selected by the BOP Contractor and appropriate to suit resistance, thermal and fluid induced wear.
2. Valve trim shall be of the quick-change type for ease of maintenance. No internal components shall be screwed or welded into the valve bodies or bonnets. Trim shall be designed to provide equal pressurization around the plug in order to minimize vibration and prevent any potential for binding.
3. Hardened or stellite plug rings shall be used for the following applications:
   a. Erosion service
   b. Wet steam service with pressure drop above 75 psi (5.17 bar)
   c. General service with pressure drop greater than 75 psi (5.17 bar)
4. For the above applications valves up to and including 1 1/2” shall have their plugs and seat rings made of solid satellite (except when stated otherwise such as for boiler feedwater service). For larger sizes the plug and seats rings shall be made of stainless steel, ASTM 316 and be completely metal coated with Stellite No. 6.
5. The plug and seat rings for steam service shall be made from stainless steel, AISI 316 and be completely metal coated with Stellite No. 6 or other acceptable hard facing material.

Other stainless steel materials that can be heat treated or hardened to the same or higher hardness as Stellite No. 6 can be used upon General Manager's approval.

C. Gaskets, Packing, and Bonnet

1. Valves shall be provided with Teflon packing. For services with fluid temperatures above 400°F or below 50°F a normalizing bonnet shall be provided to keep the packing box at ambient temperature.
2. Bellow seals shall be used on rising valve stem packing for services with dangerous or poisonous fluids. Suitable valve stem materials shall be used on chlorine service or other services which become corrosive when in contact with a moist atmosphere.

D. Valve Operators

1. All control valves shall be furnished with pneumatic spring opposed diaphragm operators unless an electric or other type operator is better suited for the application or called out on the data sheets.
2. Valve operators with valve action "fail open" or "fail closed" shall be provided with a mechanical spring to fully open or close the valve as applicable in loss of air pressure. Valve operators with valve action "fail in place" shall be provided with a mechanism to hold the valve in position on loss of air pressure. Operators shall be sized sufficiently to achieve the desired "fail" position while the valve is operating at maximum differential pressure.
3. Valve operators and stems shall be adequate to maintain desired process control at 120% of the unbalanced forces occurring under the normal operating flow conditions or 120% of the maximum differential pressure, whichever is greater.
4. Valve actuators shall be sized for the worst case differential pressure. BOP Contractor shall verify that the valve actuator is sized sufficiently to operate the control valves at full pressure drop without any back pressure.
5. Electric Motor Valve Actuators
    a. Electric valve actuators shall be provided with integral contactors, motor thermal cut-out and anti-condensation heaters.
    b. Actuators shall include an integral, dedicated field cable termination compartment separate from the actuator electrical equipment. This field termination compartment shall be dust and water resistant to at least NEMA 4X [or IP 65].
    c. The mechanism shall be designed to prevent over-running or jamming and shall be fitted with limiting devices capable of accurate and fine adjustment. Torque limiting or other devices shall be provided to prevent damage to the mechanism in the event of the valve jamming.
    d. Reversing contactors and limit switches used for actuator control shall be robust and of proven reliability by both type test and commercial operation. Solid state switching may be accepted where conditions permit.
    e. Modulating or on/off actuators requirements are indicated in the data sheets. Electric valve actuators for throttling service shall be provided with "inching" capability.
    f. Motors for Motor Operated Valves shall conform to Section 482610, Low Voltage Motors.
    g. Valves installed in Class 1 Division 1 or Class 1 Division 2 hazardous areas shall be supplied with appropriate non-sparking or sealed components as necessary.

E. Pneumatic Valve Actuators

1. Actuators may be of the piston or diaphragm types to suit particular service requirements.

2. Diaphragm actuators shall be sized to permit full valve stroking against 120 percent of the maximum process differential pressure and spring tension with 3-15 psig air signal to the actuator diaphragm.
3. Design pressure for the air supply shall be 125 psig but operating range shall be from 60-100 psig (4.13-6.89 barg). Air supply is filtered and dried to a moisture dew point of negative (-) 40 °F. All pneumatic components that cannot handle the design pressure shall have a pressure regulator installed upstream. Pressure regulators shall be furnished with filter and pressure gauges.
4. Valve supply pressures for diaphragm actuation without pressure regulator air sets shall be able to handle maximum instrument air pressure.
5. Piston Actuators, where used shall be sized to operate at a normal operating pressure of 80 psig (5.51 barg) down to a minimum operating pressure of 55 psig (3.79 barg).

F. Solenoid Valve Actuators

1. Solenoid operated valves may be used on valves up to 1 ½"" diameter. Valves shall move to the safe position in the event of the loss of power supply. Valves shall be mounted such that the coil is vertical and with the coil on top of the valve.

G. Handwheels
1. Where specified, actuators shall have a handwheel for direct manual operation. The diameter of the handwheel and geared effort shall be such that they are reasonably operable by one person.
2. Handwheels shall be designed not to exceed 40 pounds force under normal operation.
3. A lockable mechanical clutch mechanism shall be provided to inhibit power control of the actuators when the handwheel is operated. The disengagement for hand control shall be clearly indicated and signal remotely to indicate that the normal operation of the actuator is inhibited.
4. Handwheels shall not interfere with the automatic operation of the valve or add friction to the valve actuator

H. End Connections
1. Flanged Connections
   a. Flanged connections shall comply with ASME B16.5. Dimensions of flanges larger than 24" size shall comply with industry standard and shall be specified by the General Manager. Raised face (RF) flanges shall be used for lines rated up to and including ASME Class 300 and up to a design temperature of 150°C (300°F). The gasket contact surface of raised face flanged valves up to and including ASME Class 600 ratings shall be smooth machine-finished.
   b. Ring joint (RTJ) flanges shall be used for lines rated ASME Class 900 and above, and for design temperature conditions exceeding 480°C (900°F). Ring grooves shall comply with ASME B16.20.
   c. Unless otherwise noted, face-to-face dimensions of flanged valves should comply with ASME B16.10. BOP Contractor to advise face-to-face dimensions proposed.

I. Special Tools
1. Manufacturer shall provide one complete set of all special tools required for installation, maintenance, and adjustment of the valves and operators.

J. Identification
1. Each valve is assigned a unique valve number and name by the BOP Contractor, as approved by the General Manager, and shall have a permanent stamped SS metal tag

bearing the valve number and name securely attached to the valve. Each valve shall be legibly marked in accordance with MSS SP-25. For the number and name to use, refer to the data sheets. Tags shall be attached either by welding or riveting to the valve body if the body is large enough to do so. The method of attachment shall not degrade the pressure rating of the valve. Tag attachment to the smaller valve bodies shall be by minimum 20-gauge stainless steel wire. All tags shall be made of stainless steel plate and attached to the valve so as to be visible after valve and insulation installation. 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 accessory item furnished with the valve, but not securely attached to the valve, shall be provided with an identification tag also.
3. Valve tag numbers shall be in the form HPS-PCV-100A where HPS is the "high pressure steam" system name abbreviation, PCV is the instrument type function (PV for open/close and PCV for modulating), 100 is the sequential number identifier, and A is used as the component suffix.
4. Each valve identification tag shall indicate the valve tag number, manufacturer's serial number, type, body material, seat material, bonnet material, and pressure rating.
5. In addition, identification tags for pneumatic control valves shall also show the actuator air signal pressure range, positioner bench setting air signal pressure range, and valve flow characteristics (linear, equal percent, or quick opening).

K. Instrumentation and Control Requirements

1. General
   a. Enclosure NEMA rating requirements are detailed in the General Technical Requirements and Electrical Requirements for Mechanical Packages.
   b. All instrumentation shall be designed to be accurate, simple and reliable.
   c. Materials and construction shall be selected to be compatible with ambient and process conditions, including vibration levels and pressure surges.
2. Limit Switches
   a. Valve position end of travel limit switches shall be provided on all open/close (on/off) valves.
   b. Limit switches shall be factory mounted on the valves with provisions for adjusting the mounting.
   c. Limit switches shall be snap acting, with a DPDT isolated contactor, rated for 5A at 24 VDC. The switches shall be furnished with weatherproof NEMA 4X [or IP 65] or explosion proof housing, as specified. Limit switches shall be independently adjustable for position actuation. To ease installation, and/or to provide electrical isolation for AC and DC wiring requirements, provision shall be made to have a minimum of two (2) or more conduit connections. These connections shall be positioned so that two of these connections are on opposite sides of switch housing.
   d. If specified in the data sheet, a minimum of two sets of limit switches shall be provided for open position feedback and two sets of limit switches shall be provided for close position feedback. This may be accomplished using two (2) sets of single pole double throw (SPDT) or one (1) set of double pole double throw (DPDT) switches.
3. Position Transmitters
   a. Valve position transmitters, when required, shall be factory mounted on the valve and shall produce an electrical DC signal in direct relationship to the position of the control valve stem. The output signal range shall be 4-20 mA DC. The transmitters shall be two-wire transmitters. Position transmitters shall be robustly

coupled to the valve shaft and shall provide position indication with repeatable accuracy of within 1% at all times.

b. Transmitter shall have a temperature rating of 175°F and have field replaceable circuit boards. Transmitter shall be capable of calibration in place in the field.

c. Instrument systems controlling such valves shall be designed to provide for a failsafe condition in the event of control signal loss, electrical, pneumatic or hydraulic supply failures and upon restoration of supply.

4. Positioners and Electro-Pneumatic (I/P) Transducers

a. Positioners shall be the HART smart pneumatic type and shall be provided with pressure gages or LCD display for indicating the air supply, valve operator, and control signal pressures. Positioners shall be designed for a control signal input range of 4-20 mA and shall provide an output signal from 0 psig to the full supply air pressure to the valve operator. Positioners shall not be provided with bypasses.

b. All positioners shall be equipped with filter/regulator air supply sets mounted on the valve yokes or otherwise rigidly mounted. Air sets shall not be supported by pipe nipples from positioners; they may be bolted to control valve yoke. If the positioner can accept the maximum air supply pressure, a filter only shall be provided. All air venting enclosure port(s) shall have stainless steel screens with goose neck vents to protect it from direct exposure to water or dirt. Digital positioners shall be used.

c. All positioners and electro pneumatic converters shall be furnished with three pressure gauges, air supply, signal input and control air output and an air filter regulator set. Input signal shall be 4-20 mA.

d. Pressure gages supplied with positioners which are not enclosed in positioner housing shall have stainless steel or molded plastic case.

e. Electro-pneumatic valve positioners and pneumatic valve positioners with integral electro-pneumatic transducers shall not be used in potentially vibrating service conditions. The I/P transducer shall then be mounted separately from the valve and actuator assembly.

f. The total maximum inaccuracy of the signal conversion in I/Ps, or electro-pneumatic valve positioners, due to any limitation (i.e., repeatability, dead band, resolution, hysteresis, etc.), shall be less than 2.0%.

g. All valve positioners shall be mounted and piped to control valves with a minimum of 3/8” stainless steel tubing and fittings. All volumetric boosters shall have 1/2” stainless steel tubing and fittings.

5. Solenoid Valves

a. Valves shall be selected to incorporate body construction, trim materials, and internal arrangements suitable to the application. Solenoid enclosures shall be NEMA 4X [or IP 65]. 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 125 psig air supply pressure.

c. Solenoid valves shall be 3/8” or larger and 300 series stainless steel. No brass component shall be used.

d. 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.

6. Communication Interface

a. All modulating control valves shall be provided with HART smart positioners set to burst mode with the primary variable being valve position. The PCS will read this information for displaying valve position.

2.5 SOUND CONTROL REQUIREMENTS

A. Refer to Refer to Section 480031, Combined Cycle Power Island Noise Control Performance for noise measurement, noise emissions limits, and attenuation requirements.

B. For all valves, the equivalent "A" weighted sound level, measured three (3) feet downstream of the valve outlet and three (3) feet from the pipe surface shall not exceed 85 dBA. Noise reduction shall be accomplished by source treatment, utilizing trim specifically designed for the service.

C. Calculations of noise shall be done in accordance with the International Standard IEC 534-8-3 and submitted with valve specifications and sizing information.
   1. The BOP Contractor may indicate the noise level with and without the use the insulation thickness as stated in the control valve data sheets and provide a noise credit for insulation. A maximum of 5 dBA credit may be used for the application of insulation for noise reduction.
   2. Noise prediction calculations using enhanced version as per IEC 60534-8-3 objective approach that incorporates valve exit velocity as one of the controlling factors is preferred.

D. The BOP Contractor shall provide the noise level three (3) feet from the pipe both before and after any noise attenuation insulation credit is taken. The BOP Contractor shall use the thermal insulation thickness shown on the data sheet for noise predictions.

E. In-line silencers/diffusers shall be provided, by the BOP Contractor, where applicable to meet noise performance criteria for applications permitted by this Section. Each silencer shall be designed and applied so as to attenuate the noise present at the outlet of the control valve(s) to which it is applied to a level of not greater than 85 dBA as measured three (3) feet from the silencer outlet piping. Each silencer shall be the type and size as required by the application and the service conditions. Silencers shall be complete with drain and other connections and openings as applicable. Each silencer shall be constructed in accordance with ASME code requirements for the pressures and temperatures involved and shall include the ASME code stamp.

F. Diffusers, baffle plates and silencers, either inside the valve body or downstream of the valve, shall not be permitted for the following applications:
   1. Process control/feed regulation
      1) Continuous letdown
      2) Intermittent letdown in daily service
      3) Recirculation in daily service

2.6 FABRICATION

A. 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.

2.7 SOURCE QUALITY CONTROL

A. Tests and Inspection:

1. General

a. Major items supplied under this Contract by BOP Contractor shall be given standard applicable tests at the factory during or at the completion of manufacture, whether manufacture is by BOP Contractor or a third party. A test procedure shall be prepared for each test which shall describe the test to be performed, the applicable item of equipment being tested, the standards and method of testing, and the testing facility's capabilities and shall state a proposed test date. All test procedures shall be submitted to General Manager for review. Successful completion of the test shall be a precondition for shipment of the tested item of Plant. General Manager shall be notified in writing at least three weeks before any final factory test of any major components.

b. All nondestructive testing shall be by personnel qualified to Level II or Level III requirements of SNT-TC-1A of the American Society for Non Destructive Testing.

2. Hydrostatic Tests

a. Control valves shall be subjected to a hydrostatic pressure test to verify shell integrity. Test pressure shall be as required by the fabrication code or standard. Control valve leakage shall be tested in accordance with ANSI/FCI 70.2. No leakage is acceptable through the pressure boundary wall or assembly joints.

B. Inspections

1. When required for a particular valve by the General Manager, BOP 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 reach a Hold Point or shall be ready for independent inspection and testing. Unless General Manager shall advise BOP Contractor not to proceed with the inspection and testing prior to one week before the date which General Manager has stated in its notice, BOP Contractor may proceed and any inspection and tests shall be deemed to have been made in General Manager presence, and BOP Contractor shall forthwith forward to General Manager duly certified copies for the specified of the inspection and test results.

2. The BOP Contractor will establish an inspection plan for the equipment that will include observation by the General Manager of pertinent manufacture and test operations. The BOP Contractor shall cooperate with, and assist as necessary, the General Manager's inspectors. Refer to the General Technical Requirements for additional information about inspections.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Tests:
1. Each valve shall be stroke and leak tested. The stroke test shall be done with its actuator including all its accessories. Each valve shall be stroked from full open to full close then back to full open. The leak test shall be done to verify the seat tightness as specified on the data sheets. These tests shall have a test report.
2. Performance tests shall utilize actual operating parameters for the control valves to the greatest extent practicable. Where actual operating parameters cannot be achieved in the BOP Contractor's test facility, the performance test results shall be prorated to predict performance of the unit under actual conditions. Performance test curves shall be certified to the actual conditions of operation.
3. Performance test may be witnessed by General Manager. When performance test witness is required, BOP Contractor shall notify General Manager three weeks prior to testing. Testing shall be coordinated so that witnessing can be observed in a one week time frame.
4. Certified copies of the performance test curves and data shall be sent to the General Manager for approval within two weeks of the completion of the test (for those valves indicated on the data sheets).
5. All valves furnished under this specification may be field tested by the General Manager or his designee using test procedures as appropriate to the equipment. Field testing will be conducted to establish baseline data for historical field analysis.

3.2 SPARE PARTS

A. BOP Contractor shall supply a recommended start-up and 2-year operational spare parts list for each unique valve. The list shall include part numbers and any other information required for ordering of parts.

PART 4 - ATTACHMENTS

4.1 CONTROL VALVE DATASHEET TEMPLATE

CONTROL VALVE DATA SHEET

	PROJECT	Glenarm Repowering Project		DATA SHEET		OF	
	UNIT	GT-5 Combined Cycle Installation		SPEC			
	P.O.			TAG			
	ITEM			DWG			
	CONTRACT	123374		SERVICE			
	MFR. SERIAL*						

1	Fluid													Crit Press PC					
	SERVICE CONDITIONS	Flow Rate		Units		Max Flow			Norm Flow			Min Flow			Shut-Off				
2				gal/min											—				
3		Inlet Pressure		psig															
4		Outlet Pressure		psig															
5		Inlet Temperature		FL															
6		Spec Wt. / Spec Grav / Mol Wt.													—				
7		Viscosity / Spec Heats Ratio													—				
8		Vapor Pressure P_v													—				
9		Required C_v*													—				
10		Travel*		%											0				
11		Allowable / Predicted SPL*		dBA		85			85			85			—				
12																			
13	LINE	Pipe Line Size and Schedule	In																
14			Out																
15		Pipe Line Insulation																	
16	VALVE BODY / BONNET	Type*																	
17		Size*			ANSI Class														
18		Max Press/Temp																	
19		Mfr & Model*																	
20		Body / Bonnet Matl*																	
21		Liner Material / ID*																	
22		End Connection	In																
23			Out																
24		Flg Face Finish																	
25		End Ext / Matl																	
26		Flow Direction*																	
27		Type of Bonnet*																	
28		Lub & Iso Valve			Lube														
29		Packing Material*																	
30		Packing Type*																	
31																			
32	TRIM	Type*																	
33		Size*			Rated Travel														
34		Characteristic*																	
35		Balanced / Unbalanced*																	
36		Rated		C_v		F_L			X_T										
37		Plug / Ball / Disk Material*																	
38		Seat Material*																	
39		Cage / Guide Material*																	
40		Stem Material*																	
41																			
42																			
43	SPECIALS / ACCESSORIES	NEC Class			Group		Div												
44																			
45																			
46																			
47																			
48																			
49																			
50																			
51																			
52																			

53	ACTUATOR	Type*																	
54		Mfr & Model*																	
55		Size*												Eff Area					
56		On / Off												Modulating	4-20mA (HART)				
57		Spring Action Open / Close																	
58		Max Allowable Pressure*																	
59		Min Required Pressure*																	
60		Available Air Supply Pressure: 80 psig																	
61		Max	125 psig										Min	60 psig					
62		Bench Range*											/						
63		Actuator Orientation																	
64		Handwheel Type																	
65		Air Failure Valve											Set At						
66																			
67	POSITIONER	Input Signal	4-20 mA, 0-100% Open																
68		Type*	HART Smart Valve Positioner																
69		Mfr & Model*																	
70		On Incr Signal Ouptut Incr / Decr*																	
71		Gauges	Supply & Output										By-Pass						
72		Cam Characteristic*																	
73																			
74	SWITCHES	Type	Included with positioner										Quantity						
75		Mfr & Model*																	
76		Contacts / Rating																	
77		Actuation Points																	
78		Position Transmitter: 4-20 mA, 0-100% Open																	
79	AIRSET	Mfr & Model*																	
80		Set Pressure*																	
81		Filter	Yes										Gauge						
82																			
83	TESTS	Hydro Pressure*																	
84		ANSI / FCI Leakage Class																	
85																			
86																			

Rev	Date	Revision	Orig	App

* Information supplied by manufacturer unless already specified

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October 14, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485956

Plant Fire Prevention & Protection

PROJECT NUMBER:
123374

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POWER ENGINEERS

Section 485956
Plant Fire Prevention & Protection

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *SAM BYDA*

REVISION HISTORY		
DATE	REVISED BY	REVISION
08/09/2013	T. Clark	A
10/14/2013	T. Clark	B

SECTION 485956
PLANT FIRE PREVENTION & PROTECTION

TABLE OF CONTENTS

PART 1 - GENERAL 3

1.1 SUMMARY 3
1.2 FURNISHED BY BOP CONTRACTOR 4
1.3 FURNISHED BY OTHERS 6
1.4 RELATED SECTIONS 6
1.5 CODES AND STANDARDS 6
1.6 DEFINITIONS 7
1.7 RESPONSIBILITIES 8
1.8 SYSTEM DESCRIPTION 10
1.9 SUBMITTALS 11
1.10 QUALITY ASSURANCE 12
1.11 PACKAGING, DELIVERY, STORAGE, AND HANDLING 12
1.12 SITE CONDITIONS 12
1.13 SCHEDULE 12
1.14 WARRANTY 12

PART 2 - PRODUCTS 12

2.1 GENERAL FIRE PROTECTION ENGINEERING 13
2.2 FIRE PROTECTION DESIGN BASIS DOCUMENT 14
2.3 FIRE PREVENTION & PROTECTION PLAN 15
2.4 FIRE RISK CONTROL PROGRAM 15
2.5 FIRE EMERGENCY PLAN 16
2.6 FIRE BRIGADE REQUIREMENTS 16
2.7 RELIABLE WATER RESOURCE DOCUMENT 16
2.8 FIRE PROTECTION SYSTEMS AND EQUIPMENT DESIGN AND SPECIFICATION 17
2.9 WATER BASED FIRE SUPPRESSION SYSTEM REQUIREMENTS 18
2.10 CHEMICAL BASED FIRE SUPPRESSION SYSTEMS REQUIREMENTS 20
2.11 INERT GAS SYSTEMS REQUIREMENTS 20
2.12 FIRE DETECTION, ALARM, & ANNUNCIATOR SYSTEMS REQUIREMENTS 20
2.13 CONTAINMENT AND DRAINAGE REQUIREMENTS 21
2.14 MATERIAL REQUIREMENTS 22
2.15 MANUFACTURERS 22
2.16 SOURCE QUALITY CONTROL 22

PART 3 - EXECUTION 23

3.1 QUALITY CONTROL, VALIDATION AND CERTIFICATION 23

PART 4 - ATTACHMENTS 25

4.1 BOP CONTRACTOR DATA REQUIREMENTS 25
4.2 FIRE SUPPRESSION AREAS 26
4.3 GENERAL MANAGER FURNISHED DRAWINGS AND DOCUMENTS 27

PART 1 - GENERAL

1.1 SUMMARY

A. The specifications in this Section cover engineering and professional services required for the evaluation, design basis preparation, and development of documents necessary for establishing fire prevention and fire protection compliance with California state and local codes and NFPA 850 recommendations for the design, construction, operation, and protection of fossil fueled steam electric generating plants and combustion turbine electric generating plants. Requirements are included for obtaining installation permits by the Pasadena Fire Department and Building Department by the BOP contractor, acceptance, procurement, supply, handling, management, installation, testing, and certification of complete and functional fire prevention and protection systems within the plant boundaries.

B. The specifications described herein are intended as the minimum requirements for supply of an integrated fire protection system designed under the direction of a qualified Fire Protection Engineer and installed by a qualified Fire Protection Contractor specializing in fire protection systems, certified and licensed by the Authority Having Jurisdiction to work on the Site and familiar with local requirements.

C. It is not the intent to specify completely herein all details and requirements of the design and construction of the complete and functional systems and equipment. However, the systems and equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation up to the guarantee performance throughout the design life, in a manner a consistent with good utility practices and acceptable to the General Manager and Authority Having Jurisdiction (AHJ).

D. The BOP 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.

E. The Scope of Work under this Section includes the development of the following documents for implementation by the BOP Contractor:

1. Fire Protection Design Basis Document (DBD)

    a. Define NFPA 550 “Fire Safety Objectives”
    b. Develop NFPA 551 “Fire Risk Assessment” (FRA)
    c. Identify Stakeholders
    d. Identify requirements from reference documents identified in California and local codes and NFPA 850 including:

        1) Codes
        2) Standards
        3) Regulations
        4) Other references of best practices

e. Review and evaluate General Manager provided General Plant Design data for incorporation into the DBD including:

1) Plant Arrangement and feature definition/description
2) Life Safety
3) Construction Materials
4) Smoke and Heat Venting, Heating, Ventilating, and Air Conditioning
5) Containment and Drainage
6) Emergency Lighting
7) Lightning Protection

2. Fire Prevention and Protection Plan (FPPP)

a. Fire Risk Control Program
b. Fire Emergency Plan.
c. Fire Brigade approach
d. Reliable Water Resource Document

3. Fire Protection Systems and Equipment Design and Specification

a. Fire Protection System configuration drawings
b. Systems Equipment and Design and Specification

1) Water Based Fire Suppression Systems
2) Chemical Based Fire Suppression Systems
3) Inert Gas Systems
4) Fog Water Mist Fire Suppression Systems
5) Fire Detection, Alarm, and Annunciation Systems
6) Containment, Curbing, and Drainage

F. Verify, inspect, and certify that the Fire Prevention and Protection Systems meet Design Basis Document and Fire Prevention and Protection Plan developed by the BOP Contractor and approved by the General Manager and AHJ. This scope includes validation and certification procedure requirements

1.2 FURNISHED BY BOP CONTRACTOR

A. The BOP Contractor shall perform a formal fire hazard analysis. This analysis will be reviewed and accepted by the General Manager, General Manager's insurance agent and the AHJ. The approved fire hazard analysis will be used to finalize the project scope.

B. The BOP Contractor shall complete the evaluation, design basis preparation, and development of documents for the design, procurement, fabrication, installation, and testing of the specified equipment, including but not limited to the following:

1. Fire Protection Engineering

a. Fire Protection Design Basis Document (DBD)
b. Fire Prevention and Protection Plan

c. Interface with the PWP Fire Department for flow testing to establish basis of design. A static pressure test using a calibrated gauge along with a flow test shall be performed (using a pitot tube) to determine residual pressure. These tests will be used to define the basis of fire water system design.

2. Fire Suppression Systems and Equipment Design

   a. Water Supply
   b. Yard Mains, Hydrants, and Building Standpipes
   c. Portable Fire Extinguishers
   d. Fire Suppression Systems and Equipment
   e. Fire Detection, Alarm, and Annunciation System
   f. Fire-Signaling Systems
   g. All required signage and labeling

3. Installation of Systems and Equipment
4. Performance testing of Systems and Equipment at factory and certificates of results
5. Drawings and design data to support facility design, construction and maintenance
6. Validation, inspection Certificates and quality control documentation listed in this Section
7. Field inspection and testing

C. The BOP Contractor shall furnish the following documentation as part of the balance of plant scope and in support of the fire protection system:

1. Drawings and design data to support facility design, construction and maintenance of the new plant including:

   a. New Plant Arrangement and feature/equipment definition/description
   b. Classified hazardous area drawing
   c. Life Safety Plans
   d. Construction Materials
   e. Smoke and Heat Venting, Heating, Ventilating, and Air Conditioning data
   f. Containment and Drainage
   g. Emergency Lighting
   h. Lightning Protection

D. The BOP Contractor shall implement the execution of the following activities:

1. Fire Protection Engineering specialized design
2. Procurement of Fire Suppression Systems and Equipment
3. Installation of Fire Suppression Systems and Equipment
4. Performance testing of Fire Suppression Systems and Equipment at factory and certificates of results.
5. Inspection certificates and quality control documentation listed in this Section
6. Field inspection and testing (Hold Points determined by General Manager)

1.3 FURNISHED BY OTHERS

A. The General Manager shall furnish the following for products developed by the Seller:

1. Equipment design information for items provided under 481100 Combined Cycle Power Island Equipment to support overall plant fire protection system design.
2. Flow tests outside of the fence line will be performed by Pasadena Fire Department.
3. Existing buildings and equipment arrangement drawings
4. Available site existing firewater system drawings
5. Available site existing underground utilities drawings
6. Gas Turbine Generator enclosure and PIE Contractor supplied fire protection system within the Gas Turbine Generator enclosure.
7. Site existing fire protection documents (if available)
8. Tie-point drawing for existing site connections.

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

C. Section 485100.01, Pipe Material Specifications

D. Section 485956.30, Fire Alarm System

E. Section 485996.10, Firewater Underground Piping, Valves, and Hydrants

F. Section 485996.25, Fire Water Sprinkler Systems

1.5 CODES AND STANDARDS

A. The BOP Contractor's design shall comply with the current editions, at the date of notice to proceed, of relevant internationally recognized codes, standards and regulations and applicable codes, standards, and regulations for the Site.

B. State and local law shall take precedence where conflicts exist between, codes, standards, and this Section. The General Manager shall retain approval of conflict resolution between standards. Deviations from relevant standards shall only be implemented with the written approval of the General Manager.

C. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. CalARP – California Accidental Release Prevention Program
2. California Code of Regulations Title 24 California Occupational Health and Safety Administration (CalOSHA)

3. National Fire Protection Association (NFPA): Use where the City of Pasadena standards do not provide a higher standard. NFPA is only to be used in design if the 2010 CBC directs you to use this code. State of California and local codes take precedence over NFPA.

    a. NFPA 10 - Standard for Portable Fire Extinguishers
    b. NFPA 12 - Standard on Carbon Dioxide Extinguishing Systems
    c. NFPA 12A - Standard on Halon 1301 Fire Extinguishing Systems
    d. NFPA 13 - Standard for the Installation of Sprinkler Systems
    e. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems
    f. NFPA 15 - Standard for Water Spray Fixed Systems for Fire Protection
    g. NFPA 16 - Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
    h. NFPA 17 - Standard for Dry Chemical Extinguishing Systems
    i. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances
    j. NFPA 51B - Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
    k. NFPA 72 - National Fire Alarm and Signaling Code
    l. NFPA 550 – Guide to the Fire Safety Concepts Tree
    m. NFPA 551 - Guide for the Evaluation of Fire Risk Assessments
    n. NFPA 601 - Standard for Security Services in Fire Loss Prevention
    o. NFPA 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response,
    p. NFPA 750 - Standard on Water Mist Fire Protection Systems
    q. NFPA 850 – Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations
    r. NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems

4. Pasadena, California – Code of Ordinances, Title 14 Buildings and Construction
5. Underwriters Laboratories (UL)

1.6 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Pasadena Fire Department / Fire Marshal, City of Pasadena or its agent. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

B. Fire Marshal: A person designated to provide delivery, management, and/or administration of fire protection and life safety related codes and standards, investigation, education, and/or prevention services for local, county, state, provincial, federal, or private sector jurisdictions as adopted or determined by that entity.

C. Fire Protection Contractor: One who contracts on predetermined terms to provide labor and materials and who is responsible for performance of a construction job in accordance with construction documents or the person or company responsible for fulfilling an agreed upon contract.

D. Fire Protection Engineer: Engineer who is assigned safety system oversight and design for fire protection system(s). Professional services of an engineering nature, as defined by State law, if applicable, that is required to be performed or approved by a person licensed, registered, or certified to provide those services. All plans and specifications to be submitted to the Pasadena Fire Department for approval shall bear the seal of a registered California Professional Engineer.

E. Fire Risk Assessment (FRA): A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences. Other documents may use other terms, such as fire risk analysis, fire hazard, hazard analysis, and fire hazard analysis assessment, to characterize fire risk assessment as used in NFPA 551.

F. BOP Contractor: The party employed by the City to oversee construction efforts, install Power Island Contractor's work and coordinate Contractor's and Subcontractor's work on the site specified directly or by reference in 481200, Combined Cycle Balance of Plant including the Fire Protection Contractor and Fire Protection Engineer.

G. Others: Personnel, companies, or contractors who are not specifically mentioned in this Section

H. City: The City of Pasadena, California

I. 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.

A. Stakeholders: An individual, a group of individuals, or an organization that is perceived to affect or be affected by the fire hazards associated with the facility being evaluated. Stakeholders include those who have a financial, personnel safety, public safety, or regulatory interest in the fire risk, such as the public (e.g., neighbors, community groups, and first responders), employees, General Manager/investor(s), operator, insurer, regulator(s), and design team. The Stakeholders identified under this Section initially include the General Manager, A&E Engineer, Fire Protection Engineer, General Manager's Insurance Company, State of California, Los Angeles County, City of Pasadena, and AJH.

1.7 RESPONSIBILITIES

A. Authority Having Jurisdiction (AHJ):

1. Review and accept DBD.
2. Review and accept FPPP.
3. Review and approve the fire prevention and protection systems and equipment design.
4. The permits issued for work packages will include a requirement for witness testing and acceptance of the fire protection system.
5. See "Stakeholders" for additional responsibilities.

B. Fire Protection Contractor:

1. Procurement and storage of materials related to fire prevention and protection systems required to install the fire prevention and protection systems as required by the contract documents.

2. Installation, inspection, testing, and quality control of the fire protection systems as required by the contract documents.
3. Assembly of documents required for permitting, submittal review, and testing reports.
4. There may be multiple Fire Protection Contractors installing the various fire suppression and protection systems. These contractors have the same responsibilities and shall coordinate activities with the site BOP Contractor.

C. Fire Protection Engineer:

1. Develop the DBD for review and acceptance.
2. Develop the FPPP for review and acceptance.
3. Design and integrate the required fire protection systems for the project including specifications for the procurement, installation, submittals, inspection, and testing of the fire protection equipment complying with state and local codes and regulations and this Section including:

    a. Fire Suppression Systems and Equipment Design and Specification
    b. Installation of Systems and Equipment Specification
    c. Drawings and design data to support facility design, construction and maintenance

4. Review and accept submittals pertaining to the fire protection system,
5. Validation, inspection Certificates, and quality control documentation listed in this Section including:

    a. Inspecting fire protection equipment,
    b. Witness testing of the fire protection equipment

6. Review and accept construction documents for the containment of flammable and combustible liquids, drainage systems required for fire protection, materials of construction related to fire protection of buildings and equipment, and separation distances between buildings and equipment.
7. Coordinate thrust block design and sizing with the site A&E Engineer for unrestrained underground piping systems.
8. See “Stakeholders” for additional responsibilities.

D. BOP Contractor:

1. Develop overall project construction and commissioning schedule.
2. Integrate the fire prevention and protection systems and equipment with the Power Island Equipment (PIE) and Balance of Plant (BOP) equipment for the project.
3. Integrate Fire Protection Contractors site work within the overall project schedule.
4. Documentation control and distribution: Responsible for controlling and distributing current project documents to the General Manager and subcontractors under their jurisdiction.
5. Review and comment on fire protection documents prepared by the Fire Protection Engineer and Contractor.
6. Review fire protection documents and drawings for interferences, electrical and instrumentation needs, separation distances underground piping, and other required code and project needs.

E. Architectural and Engineering Engineer (BOP Contractor):

F. General Manager:

1. Supply existing documents for fire protection, underground utilities, and structures to the BOP Contractor for review by the Fire Protection Engineer,
2. Review, comment, and accept fire protection documents prepared by the Fire Protection Engineer and Contractor:

    a. DBD
    b. FPPP
    c. Fire Suppression Systems and Equipment Design and Specification
    d. Installation of Systems and Equipment Specification

3. Coordinate release of fire protection documents and drawings to the site General Contractor and the site A&E Engineer.
4. Review and accept fire prevention and protection systems and equipment.
5. Witness testing and acceptance of the fire protection system.
6. See "Stakeholders" for additional responsibilities.

G. General Manager's Insurance Agent:

1. Review, comment, and accept fire protection systems designed by the Fire Protection Engineer:

    a. DBD,
    b. FPPP,
    c. Fire Suppression Systems and Equipment Design and Specification
    d. Installation of Systems and Equipment Specification
    e. Inspect and accept fire prevention and protection systems and equipment.

2. See "Stakeholders" for additional responsibilities.

H. Stakeholders:

1. Establish goals and objectives and evaluate whether the recommendations of NFPA 850 are adequate to meet those goals and objectives. The criteria for acceptability of the level of fire protection shall consider the perspective of the various stakeholders.
2. Review and accept the DBD and FPPP.

1.8 SYSTEM DESCRIPTION

A. Design Requirements:

1. The DBD, FPPP, and the fire prevention and protection systems and equipment for the power generating station shall be site specific and designed to comply with NFPA 850, the state and local codes and standards and accepted by the General Manager, General Manager's Insurance Agent, and approved by the AHJ as applicable.
2. A list of fire suppression areas and anticipated fire suppression methods are listed in the Attachments to this Section. Alternatives or deviations must be pre-approved by the General Manager.

B. Reliability:

1. The fire prevention and protection systems for the power generating station shall be considered reliable when the systems water resource(s), materials of construction, main and ancillary equipment, installation, and testing meet the required specific NFPA standards, state and local codes and standards, and verified/witnessed and accepted by the General Manager and the AHJ.

1.9 SUBMITTALS

A. Information to be furnished with the Bid:

1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish the information requested and return the following documents:

   a. Experience and education of the Fire Protection Engineer.
   b. Projects executed within the last 5 years that demonstrate the capabilities of the Fire Protection Engineer and Firm to meet the design challenges of the this project.
   c. Sample of a typical Fire Protection Design Basis Document
   d. Sample of a typical Fire Prevention and Protection Plan
   e. Sample of the water based system and equipment drawings and specifications. Include aboveground and buried systems and equipment.

B. Information required after Contract Award:

1. After the award of contract, the following data and drawings shall be submitted to the General Manager for review and acceptance:

   a. Fire Protection Design Basis Document
   b. Fire Prevention and Protection Plan
   c. Specifications for required fire prevention and protection systems and equipment
   d. Fire Prevention and Protection System drawing
   e. Fire Prevention and Protection System P&IDs

C. Drawings

1. Refer to Section 481200, Combined Cycle Balance of Plant for general drawing requirements.
2. Additionally, 3 hardcopy sets of California Professional Engineer stamped drawings need to be submitted for permitting to the City Permitting Department along with a .pdf electronic version of the drawings on one CD-ROM of the submitted files with each submission.

D. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.

1.10 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. BOP Contractor shall submit for review, comment, and acceptance to the Stakeholders the Fire Protection Design Basis Document and Master Fire Prevention & Protection Plan. Each document shall be considered a Hold Point until accepted by the stakeholders.

C. Qualifications

1. The Fire Protection Engineer shall be licensed to practice in the state where the project site is located, and is competent with the implementation of NFPA 850 recommendations for electric generating plant fire prevention and protection systems.
2. The Fire Protection Contractor shall be licensed for contract section scope.

D. Regulatory Requirements: The BOP Contractor shall comply with state and local codes and regulations. The BOP Contractor shall submit documents prepared under this Section to the AHJ for review and acceptance or approval.

1.11 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.12 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

1.13 SCHEDULE

A. The BOP Contractor shall submit a Submittal Document Schedule to include review and comment times.

B. All permitting packages will be sent to the City Permitting Department then distributed to the appropriate department within the City for an estimated 8 week review process.

1. The City Building Department requires 8 weeks for permit drawing review.
2. PFD requires 4-6 weeks for permit drawing review.

1.14 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL FIRE PROTECTION ENGINEERING

A. The fire protection systems designed under this specification shall be hydraulically calculated.

B. Provide fire suppression system specifications as required by the Fire Protection Design Basis Document.

C. Review General Manager plant equipment specifications and documents identified in the Attachments for fire protection design comments. This review is to allow the Fire Protection Engineer to give supplemental design comments to reduce the fire based on the materials of construction.

D. Compressed air required for the fire protection systems operation shall be provided by the Power Island Equipment Contractor in close proximity to the air connection for installation by the Fire Protection Contractor. If a local receiver tank is required, this shall be supplied by the BOP Contractor.

E. Unless otherwise specified, procurement and/or installation specifications or sections furnished shall include at a minimum, the following:

1. Description and scope of supply
2. Performance requirements
3. Material and product requirements
4. Installation requirements
5. Inspection requirements and reports
6. Quality assurance requirements
7. Testing requirements and reports
8. Flushing requirements and reports
9. Acceptance criteria
10. Warranty

F. Documentation provided by the BOP Contractor and Fire Protection Engineer shall include the following submittals as required in support of the fire protection design:

1. Quality Assurance/Control Submittals
2. Operation and Maintenance Manuals
3. Design Data
4. Test Reports and Certificates for installed systems, such as contractor “A” and “U” sheets.
5. Hydraulic Calculations
6. Equipment sizing calculations
7. Fire protection drawings
8. Material/component Data Sheets
9. Manufacturer’s Instructions
10. Manufacturer’s Field Reports
11. Contract Closeout Submittals
12. Project Record Documents

2.2 FIRE PROTECTION DESIGN BASIS DOCUMENT

A. The fire protection design basis document shall document compliance with NFPA 850 and state and local regulations including the CalARP regulations and local requirements for the fire prevention and protection needs of the project. NFPA 850 is a prescribed method for fire prevention and protection for an electric generating station. This prescribed methodology requires a fire risk evaluation to determine its validity for the project.

B. Use NFPA 850 Fire Protection Design Process to evaluate, assess, and determine the fire protection and prevention needs of the project, including:

1. Use of Fire Risk Assessment in evaluating plant specific considerations regarding design, layout, and anticipated operating requirements. The evaluation is to result in a list of recommended fire prevention features to be provided based on acceptable means for separation or control of common and special hazards, the control or elimination of ignition sources, and the suppression of fires.
2. Use of Process Safety Management (PSM) techniques for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

C. Evaluate the recommendations of NFPA 850 against the requirements of the Stakeholders to ensure they are adequate to meet those goals.

D. NFPA 551 “Guide for the Evaluation of Fire Risk Assessment (FRA)” shall be used for evaluating the different fire risks. The fire safety concepts tree in NFPA 550, Guide to the Fire Safety Concepts Tree, shall be used to provide a comprehensive overview of the concepts or systems that are to be considered in the FRA.

E. The Fire Protection Design Basis Document (DBD) shall contain, as a minimum, the following information:

1. Plant name
2. Plant location
3. Fire protection engineer
4. Table of contents
5. Stakeholders and Stakeholders requirements
6. General fire protection philosophy (e.g., passive versus active protection)
7. Assumptions
8. Site-specific information (e.g., environmental conditions)
9. Source documents (e.g., adopted codes, standards, regulations, insurance requirements)
10. Plant layout (e.g., hazard separation, fire barriers, drainage)
11. Water supply (e.g., underground mains, hydrants)
12. Hazards (e.g., transformers, turbine lube oil, fuels, storage, cooling towers)
13. Operational and administrative controls
14. Site Fire Protection Area Drawing(s)
15. Fire Hazard Assessment to include but not limited to:

    a. Equipment requiring fire suppression
    b. Buildings requiring fire suppression.
    c. Plant Site Combustibles inventory
    d. Types of fire suppression required for buildings and equipment

e. Fire ratings for buildings
f. Separation distances required between equipment and buildings
g. Fire detection, alarm and annunciation.
h. Combustion material management,
i. Containment and Drain systems
j. Life safety
k. Fire Brigades

2.3 FIRE PREVENTION & PROTECTION PLAN

A. This document is to identify, integrate, and link as required the fire prevention and protection systems and equipment required for the project based on the Fire Protection Design Basis Document. This document is to address as a minimum the following systems and documents:

1. Fire Risk Control Program
2. Fire Emergency Plan
3. Fire Brigade approach
4. Reliable Water Resource Document
5. Fire Protection Systems and Equipment

    a. Fire Prevention Systems and measures
    b. Water Based Fire Protection Systems
    c. Chemical Based Fire Suppression Systems
    d. Inert Gas Systems
    e. Fire Detection, Alarm, and Annunciation Systems
    f. Containment, Curbing, and Drainage

B. The FPPP is to enable flow of information or data, and coordination between contractors, suppliers, designers, installers, inspectors, General Manager, General Manager's Insurance Agent, and AHJ to ensure a reliable, functioning system that meets state and local codes and regulations and is acceptable to the AHJ and General Manager.

2.4 FIRE RISK CONTROL PROGRAM

A. Develop a written plant fire risk control program which includes the following:

1. Management Policy and Direction
2. Fire safety information for employees and contractors. This information shall include, as a minimum, familiarization with fire prevention procedures, plant emergency alarms and procedures, and how to report a fire. This shall be included in employee/contractor orientation.
3. Document regularly scheduled plant inspections including provisions for handling of remedial actions to correct conditions that increase fire hazards.
4. A description of the general housekeeping practices and the control of transient combustibles. Transient combustibles that are a significant risk during a fire situation, especially during outages.
5. Control of flammable and combustible liquids and gases in accordance with appropriate NFPA standards.

6. Control of ignition sources including smoking, grinding, welding, and cutting. (See NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work.)
7. Fire prevention surveillance. (See NFPA 601, Standard for Security Services in Fire Loss Prevention.)
8. Fire report, including an investigation and a statement on the corrective action to be taken. (See NFPA 850 Annex B.)
9. Fire hazards of materials located in the plant or storage areas identified in accordance with NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response, and applicable material safety data sheets (MSDS).
10. Testing, Inspection, and Maintenance.
11. Impairments
12. Management of Change.
13. Emergency Response Personnel
14. Special Fire-Fighting Conditions.

2.5 FIRE EMERGENCY PLAN

A. A written fire emergency plan shall be developed, and, as a minimum, this plan shall include the following:

1. Response to fire alarms and fire systems supervisory alarms
2. Notification of personnel identified in the plan
3. Evacuation of employees not directly involved in fire-fighting activities from the fire area
4. Coordination with security forces or other designated personnel to admit public fire department and control traffic and personnel
5. Fire preplanning that defines fire extinguishment activities
6. Periodic drills to verify viability of the plan
7. Control room operator(s) and auxiliary operator(s) activities during fire emergencies.

2.6 FIRE BRIGADE REQUIREMENTS

A. The City of Pasadena Fire Department is the primary responder in event of a fire. The General Manager will not have a full time onsite fire brigade.

2.7 RELIABLE WATER RESOURCE DOCUMENT

A. This document shall evaluate the water required for firefighting needs and determine if the available supply is reliable and meets the state and local codes and regulations or determine if supplemental water source(s) is required. The document shall take into account:

1. Reliability of water source
2. Capacity of water source
3. Reliance on water-based fire protection systems
4. Availability of alternate and backup sources
5. Consequences of a loss, in terms of property loss and loss of generation
6. NFPA 850, Chapter 6.2 shall be used to define the 2-hr total firefighting water demand.

7. Where the water source is found deficient, this document is to recommend as part of the Fire Protection Design Basis Document, an alternative or supplemental water source meeting the site needs.

2.8 FIRE PROTECTION SYSTEMS AND EQUIPMENT DESIGN AND SPECIFICATION

A. Develop and certify site specific design, drawings, specifications and documentation for the procurement, supply, handling, management, installation, testing, and certification of complete and functional fire prevention and protection systems within the plant boundaries.

B. Include systems and equipment as defined by the Fire Protection Design Basis Document and accepted by the AHJ.

C. When completed by the BOP Contractor and Fire Protection Contractor, the fire prevention and protection systems and equipment for the power generating station shall be tested as required by the construction documents, specific NFPA standards, state and local codes and standards and verified/witnessed by the General Manager and the AHJ. The tests shall demonstrate the systems meet or exceed the design requirements.

D. Fire Protection System configuration drawings

1. Fire Area Plan Drawings shall demonstrate the plan to limit the spread of fire, protect personnel, and limit the resultant consequential damage to the plant. Fire areas shall be separated from each other by fire barriers, spatial separation, or other approved means. Determination of fire area boundaries shall be based on consideration of the following:

    a. Types, quantity, density, and locations of combustible material,
    b. Location and configuration of plant equipment,
    c. Consequence of losing plant equipment,
    d. Location of fire detection and suppression systems.

2. The Firewater Distribution System drawings shall include at a minimum:

    a. Firewater loop, risers and standpipe locations, valves: PIV or otherwise, fire hydrants, and monitors.
    b. Background site boundary, equipment, buildings, and roads.

3. Fire Protection P&ID(s) showing:

    a. Water Based Fire Suppression Systems - firewater loop, risers, standpipe locations, valves: PIV or otherwise, fire hydrants, and monitors.
    b. Chemical Based Fire Suppression Systems – Storage, Distribution, Dispensing, Monitoring
    c. Inert Gas Systems – Storage, Distribution, Dispensing, Monitoring
    d. Water Mist Fire Protection Systems - Storage, Distribution, Dispensing, Monitoring

E. System and equipment procurement and/or installation specifications for the following as applicable:

1. Fire Protection Systems and Equipment — General Requirements
2. Water Based Fire Suppression Systems

    a. Water Supply
    b. Yard Mains, Hydrants, and Building Standpipes
    c. Portable Fire Extinguishers
    d. Fire-Signaling Systems
    e. Sprinkler Systems

3. Chemical Based Fire Suppression Systems

    a. Storage
    b. Distribution
    c. Dispensing
    d. Monitoring and detection system

4. Inert Gas Systems

    a. Storage
    b. Distribution
    c. Dispensing
    d. Monitoring and detection system

5. Water Mist Fire Protection Systems

    a. Water and compressed gas storage
    b. Distribution
    c. Dispensing
    d. Monitoring and detection system

6. Fire Detection, Alarm, and Annunciation Systems
7. Containment, Curbing, and Drainage

2.9 WATER BASED FIRE SUPPRESSION SYSTEM REQUIREMENTS

A. The following requirements are for water based fire protection or suppression systems. Documents are required for those outlined in the Fire Protection Design Basis Document and the Fire Prevention and Protection Plan.

B. The Fire Protection Contractor will be responsible for detail design of the water suppressed areas. The Fire Protection Contractor will perform flow calculations, produce installation drawings showing line sizes, supports, detail location and types of heads, and then fabricate and install this system.

C. FIREWATER PUMP AND TANK REQUIREMENTS

1. The firewater main piping connects to the City’s pressurized firewater distribution system so pumps and storage tanks are not required for this project.

D. UNDERGROUND FIREWATER MAINS AND APPURTENANCES REQUIREMENTS

1. Underground Fire Mains shall comply at a minimum with NFPA 24 (materials shall be UL listed and FM approved), state and local codes and regulations.
2. Design Requirements

    a. Fire hydrant shall be Jones Fire Hydrant wet type barrel approved by the General Manager and the AHJ.
    b. Underground firewater piping shall use cement lined ductile iron pipe with bell and spigot push on type joints. For detailed pipe specifications refer to Section 485100.01, Pipe Material Specifications and P&IDs provided with Section 481200, Combined Cycle Balance of Plant. No preference on type of restraining mechanism.
    c. Monitors will be required where the AHJ deems areas needing fire protection would be hazardous to enter during a firefighting event or where the Fire Protection Design Basis requires it use.
    d. Where thrust blocks are required, the Fire Protection Engineer shall coordinate with the BOP Contractor for sizing and spacing requirements, location, and interferences. The Fire Protection Engineer shall review and accept the final thrust block configuration.

E. FIREWATER MAINS AND STANDPIPES REQUIREMENTS

1. Fire mains and standpipes to comply with NFPA 14, NFPA 15, and as required by the state and local codes and regulation. The materials shall be UL listed and FM approved.
2. Design Requirements

    a. Fire hose type and locations in stairwells, corridors, or other location required for firefighting.
    b. Pressures and flows available at the stand pipes.
    c. Piping systems shall be protected from the effects of an earthquake in accordance with NFPA and state and local codes and regulations.
    d. Monitors will only be required if the AHJ deems the areas needing protection are in an area that would be too hazardous to enter during a fire fighting event.

F. FIREWATER SPRINKLER PIPING REQUIREMENTS

1. The sprinkler systems shall be in accordance with NFPA 13. Selection of system configuration shall be determined in the DBD (wet, dry, actuated by manual operation, thermo-bulbs, fusible links, or other preaction systems). Sprinkler piping designed under this section shall comply with NFPA 13 requirements, state and local codes and regulations.
2. Design Requirements

    a. Water spray fixed systems application rates shall be sized per NFPA 15 to control burning, exposure protection, and transformer protection.
    b. The system demand shall include the simultaneous hydraulic demand from sprinklers and water spray nozzles on the system.
    c. Water spray fixed systems shall be protected from the effects of an earthquake per NFPA, state and local codes and regulations.

G. FOAM WATER SYSTEM PIPING REQUIREMENTS

1. Foam-water sprinkler and foam-water spray systems shall comply with NFPA 16, state and local codes and regulation.
2. Water spray fixed systems shall be protected from the effects of an earthquake per NFPA, and state and local codes and regulations.

H. WATER MIST REQUIREMENTS

1. Water mist systems shall comply with NFPA 750, state and local codes and regulation.
2. Water spray fixed systems shall be protected from the effects of an earthquake per NFPA, state and local codes and regulations.
3. Portable water mist fire extinguishers shall not be used.

2.10 CHEMICAL BASED FIRE SUPPRESSION SYSTEMS REQUIREMENTS

A. Chemical based fire suppression systems to comply with NFPA 17, NFPA 2001, state and local codes and regulation.

B. This includes both fixed nozzle type and hand hose lines for dry-chemical based systems.

C. Clean agent fire extinguishing systems shall be selected over CO2 systems for occupied areas or areas where the accumulation of CO2 presents a life safety hazard.

D. Portable fire extinguishers shall comply with NFPA 10.

E. Chemical based fire suppression systems shall be protected from the effects of an earthquake per NFPA, and state and local codes and regulations.

2.11 INERT GAS SYSTEMS REQUIREMENTS

A. Inert Gas systems shall comply with NFPA 12, NFPA 12A, state and local codes and regulation.

B. FM-200 clean agent fire extinguishing systems shall be selected over CO2 for occupied areas or areas where the accumulation of CO2 presents a life safety hazard.

C. Inert gas fixed systems shall be protected from the effects of an earthquake per NFPA, state and local codes and regulations.

2.12 FIRE DETECTION, ALARM, & ANNUNCIATOR SYSTEMS REQUIREMENTS

A. The Fire Protection Engineer shall design a fire detection, alarm, and annunciation system providing an automatic actuation signal to fixed water spray systems and shall be designed in accordance with NFPA 72, National Fire Alarm and Signaling Code, state and local code and regulations. The design shall include but not limited to the following:

1. Central Fire Alarm Panel installed in the GT-5 Control Room: The GT-5 Central Alarm Panel shall provide individual alarm point input identification with keyed override of individual point malfunction to allow system reset and silencing. The GT-5 Central Fire Alarm Panel shall be linked to the remote equipment in the fire protection system control panel and to other fire suppression equipment on site and display individual point identifications associated with the remote system inputs.
2. Link existing fire alarm systems in the B-3 Control Room to the GT-5 Central Fire Alarm Panel. See the Tie-point location plan for existing fire alarm connection points. The Fire Protection Engineer shall determine the type of connection required to connect to the existing systems.
3. Fire Detection/Sensing equipment shall be installed as required by the Fire Protection Design Basis Document and as accepted by the General Manager, General Manager's Insurance Agent, and AHJ.
4. Audible and Visual fire alarm indication shall be installed as required by the Fire Protection Design Basis Document and as accepted by the General Manager, General Manager's Insurance Agent, and AHJ.
5. A Remote Fire Alarm Panel shall be installed in the PDC that is redundant to the Central Fire Alarm Panel installed in the GT-5 Control Room and fully functional to control all fire protection and annunciation systems when the Central Fire Alarm Panel is disconnected or out of service.
6. Fire detection/sensing panel installed in the Control Room shall provide input for up to a minimum of ten alarms from the GT-5 Central Fire Alarm Panel.
7. A 120 VAC UPS power source shall be provided that is capable of 120 minutes sustainability. Additional back-up power and/or power conversion, as required by the BOP Contractor provided equipment or the Codes in effect, shall be furnished by the BOP Contractor.

B. The plant operators will call the Pasadena Fire Department for dispatch of the Fire Brigade in event of fire. The Fire Protection Engineer includes provisions to automate this process to link to the Pasadena Fire Department fire warning system.

C. BOP Contractor shall create and submit documents necessary to obtain approvals, certifications, and/or authorizations required by authorities and agencies providing oversight of fire protection systems installed in the project locations. The BOP Contractor is singularly responsible for obtaining authorizations and approvals and shall include that of the AHJ as well as the General Manager's Insurance Agent.

2.13 CONTAINMENT AND DRAINAGE REQUIREMENTS

A. Containment Design

1. Include review of construction drawings and make recommendations or comments on curbing and containment of flammable or combustible liquids and materials. Containment and curbing is to comply with state and local codes, and the Fire Protection Design Basis Document. The review is to include but not limited to size of containment for the equipment, liquid, or material, location of containment, separation between equipment and building or equipment and equipment.

2. All containment basins shall be set to be able to drain to grade via a normally closed valve and have a sump for pumping out to a truck should the water be contaminated. Note, Los Angeles County Sanitation District advised containments greater than 400 square feet draining to sanitary sewer will require rain covers.
3.

B. Drainage

1. Include review of construction drawings for fire areas of the plant for removal of liquids directly to safe areas for flammable or combustible liquids without flooding of equipment and without endangering other areas. The review to comply with state and local codes, and the Fire Protection Design Basis Document. Drainage and prevention of equipment flooding or fire spread shall be accomplished by one or more of the following:

a. Floor drains with traps
b. Floor trenches
c. Open doorways or other wall openings
d. Curbs for containing or directing drainage
e. Equipment pedestals
f. Pits, sumps, and sump pumps

2.14 MATERIAL REQUIREMENTS

A. Piping materials and fittings shall comply with NFPA standards. State and local codes and standards as applicable and as identified on the Drawings.

B. Components and hardware supplied shall be FM Global approved and/or UL listed.

C. Materials other than those specified shall require approval prior to use.

D. Supplied materials shall be new, clean, free from defect and meet the requirements of the referenced standards.

2.15 MANUFACTURERS

A. FM Global approved and/or UL Listed products.

B. Fire Hydrants – Jones Fire Hydrant (match existing site model)

2.16 SOURCE QUALITY CONTROL

A. Documents shall comply with state and local codes and regulations.

B. Coordinate, manage and incorporate requirements of the Stakeholders, Fire Protection Design Basis Document, Fire Prevention and Protection Plan, state and local codes and regulations, and the AHJ in documents for procurement, supply, handling, management, installation, testing, and certification of complete and functional fire prevention and protection systems within the plant boundaries.

C. Fire Protection Engineer shall verify and certify design, drawings, specifications and documentation meet the requirements of the Stakeholders, Fire Protection Design Basis Document, Fire Prevention and Protection Plan, state and local codes and regulations, and the AHJ.

D. The AHJ shall be provided one set of design documents for review and acceptance.

E. Non-Destructive Examinations

1. NDE methods, acceptance criteria, and additional general requirements shall be in accordance with the applicable fabrication code and this specification.
2. Visual examination shall be by personnel certified to AWS QC1 requirements. 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.

F. Testing

1. Certificates and records of shop tests shall be submitted to the General Manager for acceptance at least one week before shipment.

PART 3 - EXECUTION

3.1 QUALITY CONTROL, VALIDATION AND CERTIFICATION

A. The BOP Contractor shall submit to the General Manager a procedure to validate and certify that the final fire prevention and protection systems is designed, installed, and tested based on the BOP Contractor prepared documents. The procedure is to include:

1. List of hydraulic calculation that shall be reviewed
2. List of drawing to be reviewed
3. List of specifications or documents to be reviewed
4. Listing of Hold Point inspections
5. List of tests that will be conducted and witnessed for design verification and certification.
6. Final verification and certification report documenting the final design disposition:

    a. Noncompliance report
    b. Resolution/disposition of non-compliance.
    c. Verification and certification of design.

7. On-site support: BOP Contractor to provide on-site support for the following activities:

    a. BOP Contractor will be required to notify PFD 72 hours before any testing requiring PFD witness is performed.
    b. Fire Prevention and Protection System witness testing
    c. Fire protection system walkdown. This will include both above ground and underground installations.
    d. Support PFD certification of fire lines.

e. Door fan tests for closed fire suppression system testing such as the gas turbine enclosure and the PDC as required by the equipment manufacturer, the FPPP and AHJ.

B. The BOP Contractor shall validate document acceptance by the Stakeholders.

C. BOP Contractor's Fire Protection Engineer shall verify and certify installed Fire Prevention and Protection Systems meet the requirements of the Stakeholders, Fire Protection Design Basis Document, Fire Prevention and Protection Plan, state and local codes and regulations, and the AHJ.

D. AHJ to establish Hold Points for Execution of project.

E. The Fire Marshal will inspect all installations of underground fire loop, hydrostatic testing, flushing, and flow tests as well as all aboveground fire piping, hydrostatic testing, flushing, flow tests, gas detection, hazardous material piping, tanks with hazardous materials and controls for these tanks.

F. PFD will witness all hazardous material system testing.

END OF SECTION 485956

PART 4 - ATTACHMENTS

4.1 BOP CONTRACTOR DATA REQUIREMENTS

	Document	**Schedule**	**Action**
With Bid			
	Sample Fire Protection Design Basis Documents	With Bid	For review
	Sample Fire Prevention and Protection Plan	With Bid	For review
After award of Contract			
	Submittal Document Schedule	2 weeks	For review
	Fire Protection Design Basis Document	4 weeks	For review
	Master Fire Protection & Suppression Plan	6 weeks	For review
	Design Criteria and Specifications	Listed Below	Listed Below
	Water Based Fire Suppression Systems design and specifications	12 weeks	For review
	Chemical Based Fire Suppression Systems design and specifications	12 weeks	For review
	Inert Gas Systems design and specifications	12 weeks	For review
	Fire Detection, Alarm, and Enunciation Systems design and specifications	12 weeks	For review
	Containment, Curbing, and Drainage design and specifications	8 weeks	For review
	Equipment Specification Review	To be coordinated with General Manager	For Review
	Validation and Certification Procedure	8 weeks	For Review
	Validation and Certification Report	2 weeks after final test completion	For Information
	Firewater System drawing	8 weeks	For Review
	Firewater P&ID	8 weeks	For Review

4.2 FIRE SUPPRESSION AREAS

BUILDING	AREA DESCRIPTION	FIRE SUPPRESSION TYPE
Gas Turbine Package	Gas Turbine and Generator compartment	On-board self contained CO2 system
	Mineral lube oil skid	Deluge system with air pilot line
	Auxiliary skid enclosure	Water mist system
Steam Turbine Enclosure	Acoustic enclosure	Pre-action water spray system with 180˚F high temp fusible link heads at ceiling
	Steam turbine, generator and bearings	Pre-action water spray system with temperature rate of rise detection and fusible link heads
	Lube oil skid	Deluge system with air pilot line
Heat Recovery Boiler (OTSG)	Outdoor installation	None required
Fuel Gas Compression and metering areas	Four side acoustic wall, no roof	None required if not contained within a building
Power Distribution Center	Prefabricated electrical building on concrete piers	
	Switchgear and battery storage	FM200 dry agent
	Area underneath building with cable trays and building penetrations	Dry pipe water sprinkler system with smoke detection and fusible link heads
Cooling Tower	Fiberglass structure with <25 flame spread rating	Wet sprinkler system
Generator Step-Up Transformer	No FR3 fluid	Fire separation walls as required. No active fire suppression system.
Auxiliary Transformers	No FR3 fluid	Fire separation walls as required. No active fire suppression system.
Control Building	Administrative Office Space	Wet pipe sprinkler system, CO2 handheld extinguishers as required by code
	GT-5 Control Room	Smoke detection and water mist system
	Under floor cabling (computer floor in control room and DCS/Server Room)	Wet pipe sprinkler system
	DCS and Server Room	Smoke detection, water mist system
	DCS and Server Room under floor cabling	Wet pipe sprinkler system
Maintenance Building (south side of State Street)	Maintenance workshop	Wet pipe sprinkler system
	Basement and bunker	Wet pipe sprinkler system
Welding Shop (south side of State Street)	Hot work area	Wet pipe sprinkler system
CEMS Enclosure	Air emissions analyzer equipment	Smoke detection only
Water Sampling Enclosure	Water and steam analyzer equipment	Smoke detection only

4.3 GENERAL MANAGER FURNISHED DRAWINGS AND DOCUMENTS

Document No	Company	Document Title/Description	Rev	Notes
Existing buildings and equipment arrangement drawings				
20001-M-001		Overall Site Plan Gas Turbine Generator Units 3 and 4		Need complete document Title Block
FP1 of	Tyco Fire & Security Simplex Grinnell	Glenarm Plant Fire Protection Drawing		Need complete document Title Block
As-Built Survey Information	Coory Engineering	Storm Drain Line and Electrical Conduit Trench		
		Site existing underground utilities		Later
		Tie-point drawing for existing site connections.		Later
		Containment and Drainage		Later
		Emergency Lighting		Later
		Lightning Protection		Later
Plans				
		Life Safety Plans		Later
Documents				
		Construction Materials		Later
		Smoke and Heat Venting, Heating, Ventilating, and Air Conditioning data		Later
		Site existing fire protection documents (if available)		Later
New Plant Arrangement and feature/equipment definition/description				
M1-1-1	Power Engineers	General Arrangement, Gas Turbine – Axial exhaust (GT-5 CC)		
M6-1-1	Power Engineers	LM6000 Configuration Elevation		
A2-1	Power Engineers	Control Building, Main Floor Plan		
A3-1	Power Engineers	Control Building, Exterior Elevations		
A4-1	Power Engineers	Control Building, Building Elevations		
E1-2	Power Engineers	PDC Building Layout		
	Power Engineers	PWP Maintenance, Main Floor Plan		
	Power Engineers	PWP Maintenance, Welding Shop Floor Plan		
	Power Engineers	PWP Maintenance, Mezzanine		
	Power Engineers	PWP Maintenance, Welding Shop Exterior Elevations		
	Power Engineers	PWP Maintenance, Sections		
Documents				
	Power Engineers	Equipment Definition and Descriptions		

August 9, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485956.30

Fire Water Sprinkler Systems

PROJECT NUMBER:
123374

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Section 485956.30
Fire Water Sprinkler Systems

PREPARED FOR: PASADENA WATER & POWER
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REVISION HISTORY		
DATE	REVISED BY	REVISION
08/09/2013	T. Clark	A

SECTION 485956.30
FIRE WATER SPRINKLER SYSTEMS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 1
1.3 FURNISHED BY OTHERS 2
1.4 RELATED SECTIONS 2
1.5 REFERENCES 3
1.6 DEFINITIONS 3
1.7 SYSTEM DESCRIPTION 4
1.8 SUBMITTALS 5
1.9 QUALITY ASSURANCE 7
1.10 DELIVERY, STORAGE, AND HANDLING 7
1.11 SITE CONDITIONS 7
1.12 WARRANTY 7

PART 2 - PRODUCTS 8

2.1 MATERIALS 8
2.2 COMPONENTS 8
2.3 FABRICATION 9
2.4 SOURCE QUALITY CONTROL 9

PART 3 - EXECUTION 9

3.1 EXAMINATION 9
3.2 INSTALLATION 10
3.3 APPLICATION 12
3.4 FIELD QUALITY CONTROL 16
3.5 ADJUSTING AND CLEANING 16
3.6 DEMONSTRATION 18
3.7 PROTECTION 21
3.8 SPARE PARTS 21
3.9 SCHEDULES 21

PART 4 - ATTACHMENTS 22

4.1 APPENDIX A 22

SECTION 485956.30
FIRE WATER SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The specifications in this Section cover the minimum requirements for the procurement, supply, handling, management, shop and field fabrication, installation and testing of fire protection risers, standpipes, sprinkler piping and fittings, feed mains, and cross mains installed on site.

B. Products to be installed but not included in this Section:

1. Fire alarm and annunciation system
2. Chemical based fire suppression systems
3. Inert gas systems
4. Water mist fire suppression systems
5. Underground fire mains (to grade) with associated fire hydrants and monitors
6. Fire detection, alarm, and annunciation systems

C. The specifications described herein are intended as the minimum requirements for supply of an integrated fire protection system designed under the direction of a qualified Fire Protection Engineer and installed by a qualified Fire Protection Contractor specializing in fire protection systems, certified and licensed by the Authority Having Jurisdiction (AHJ) to work on the Site and familiar with local requirements.

D. It is not the intent to specify completely herein all details of design and construction of the equipment/systems. Equipment and systems supplied 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 BOP Contractor's guarantee in a manner acceptable to the General Manager and AHJ.

E. This Section does not outline all the documents and certifications required by the state and local laws and regulations for installation of the Firewater Sprinkler Systems. The BOP Contractor shall prepare, make available, and submit drawings and documents as required by local and state laws and regulations for review and approval. Where it is unclear to the drawings and documents required, the BOP Contractor shall contact the Authority Having Jurisdiction and the Fire Marshal for clarification.

1.2 FURNISHED BY BOP CONTRACTOR

A. The BOP Contractor shall complete the evaluation, design basis preparation, and development of documents for the design, procurement, fabrication, installation, and testing of the Fire Water Sprinkler System, including but not limited to the following items:

1. Sprinkler and deluge systems at locations identified in Section 485956, Fire Prevention and Protection and other locations as identified through the Fire Prevention and Protection Plan.
2. Sprinkler pipe and fittings
3. New hose houses and equipment if required by PFD.
4. Heated freeze protection doghouses for the sprinkler and deluge piping and valves.

5. The fire extinguisher system
6. Installation of Systems and Equipment
7. Performance testing of Systems and Equipment at factory and certificates of results
8. Drawings and design data to support facility design, construction and maintenance
9. Validation, inspection Certificates and quality control documentation listed in this Section

B. Installation shall include, but is not limited to, the following:
1. Equipment foundations and pads.
2. Labor and construction materials for the installation of the piping systems and supports specified.
3. Material, parts, and piping components required for piping.
4. Loading, transporting and unloading of piping materials from the job site storage to the work area.
5. Locating and protection of existing above ground and underground utilities as necessary.
6. Coordination of existing system outages for tie-in connections.
7. Removal, relocation, reinstallation/replacement and testing of piping sections required for tie-in to existing systems.
8. Installation of piping connections and tie-ins required for system operation including contract interface tie-in connections, vents, and drains as shown on the installation drawings.
9. Contamination control for piping systems and equipment
10. Reports and documentation as specified and required in this Section.
11. Field inspection and testing required by the AHJ to obtain necessary certification.

1.3 FURNISHED BY OTHERS
1. Rated water supply flow rate and pressure defined at the fire water connection tie point.
2. Compressed air supply for instrument and service air requirements.
3. Detail information on existing buildings and equipment, if available.
4. Water at the site of suitable quantity and pressure for testing. Any reuse of test water and its disposal shall be mutually agreed upon by BOP Contractor and the General Manager.

1.4 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

C. Section 485072, Coating for Piping and Tanks

D. Section 485080, Piping and Equipment Insulation

E. Section 485101, General Piping Requirements

F. Section 485102, Pipe Identification

G. Section 485956, Plant Fire Prevention and Protection

H. Section 485975. General Welding Requirements

1.5 REFERENCES

A. The BOP Contractor's design shall comply with the current editions, at the date of notice to proceed, of relevant internationally recognized codes, standards and regulations and applicable codes, standards, and regulations for the Site.

B. State and local law shall take precedence where conflicts exist between, codes, standards, and this Section. The General Manager shall retain approval of conflict resolution between standards. Deviations from relevant standards shall only be implemented with the written approval of the General Manager.

C. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. CalARP – California Accidental Release Prevention Program
2. California Code of Regulations Title 24 California Occupational Health and Safety Administration (CalOSHA)
3. National Fire Protection Association (NFPA): Use where the City of Pasadena standards do not provide a higher standard. NFPA is only to be used in design if the 2010 CBC directs you to use this code. State of California and local codes take precedence over NFPA.

    a. NFPA 13 - Standard for the Installation of Sprinkler Systems
    b. NFPA 15 - Standard for Water Spray Fixed Systems for Fire Protection

4. California Code of Regulations Title 24 – California Fire Code

5. Pasadena, California – Code of Ordinances, Title 14 Buildings and Construction

6. Underwriters Laboratories (UL)

1.6 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Pasadena Fire Department / Fire Marshal, City of Pasadena or its agent. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

B. Fire Marshal: A person designated to provide delivery, management, and/or administration of fire protection and life safety related codes and standards, investigation, education, and/or prevention services for local, county, state, provincial, federal, or private sector jurisdictions as adopted or determined by that entity.

C. Fire Protection Contractor: One who contracts on predetermined terms to provide labor and materials and who is responsible for performance of a construction job in accordance with construction documents or the person or company responsible for fulfilling an agreed upon contract.

D. Fire Protection Engineer: Engineer who is assigned safety system oversight and design for fire protection system(s). Professional services of an engineering nature, as defined by State law, if

applicable, that is required to be performed or approved by a person licensed, registered, or certified to provide those services. All plans and specifications to be submitted to the Pasadena Fire Department for approval shall bear the seal of a registered California Professional Engineer.

E. Fire Risk Assessment (FRA): A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences. Other documents may use other terms, such as fire risk analysis, fire hazard, hazard analysis, and fire hazard analysis assessment, to characterize fire risk assessment as used in NFPA 551.

F. BOP Contractor: The party employed by the City to oversee construction efforts, install Power Island Contractor's work and coordinate Contractor's and Subcontractor's work on the site specified directly or by reference in 481200, Combined Cycle Balance of Plant including the Fire Protection Contractor and Fire Protection Engineer.

G. Others: Personnel, companies, or contractors who are not specifically mentioned in this Section

H. City: The City of Pasadena, California

I. 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.

J. Stakeholders: An individual, a group of individuals, or an organization that is perceived to affect or be affected by the fire hazards associated with the facility being evaluated. Stakeholders include those who have a financial, personnel safety, public safety, or regulatory interest in the fire risk, such as the public (e.g., neighbors, community groups, and first responders), employees, General Manager/investor(s), operator, insurer, regulator(s), and design team. The Stakeholders identified under this Section initially include the General Manager, A&E Engineer, Fire Protection Engineer, General Manager's Insurance Company, State of California, Los Angeles County, City of Pasadena, and AJH.

1.7 SYSTEM DESCRIPTION

A. Sprinkler systems are those water application systems covered by NFPA 13 *Standard for the Installation of Sprinkler Systems*. The systems can be wet or dry and can be actuated by manual operation, thermo-bulbs, fusible links, or other pre-action systems as allowed and specified by NFPA 13. Sprinkler piping installed under this section shall be a complete, operable assembly complying with all NFPA 13 requirements and state and local codes and regulations.

1. Design Requirements

a. All design requirements of NFPA 13 shall be followed except where conflict exists with state and local codes.

b. The fire protection systems supplied under this specification shall be hydraulically calculated, complete in all respects, and ready for operation.

c. The fire protection systems shall include all relevant work to create a functional system.

d. Air compressors required for the fire protection systems operation are provided by others. The BOP Contractor is responsible for routing compressed air distribution piping and verifying sufficient pressure and capacity for reliable operation. Any additional local air receivers will be provided by BOP Contractor.

e. The fire protection system shall include freeze protection where necessary for any valves and piping exposed to freezing conditions.

f. Water spray fixed systems application rates shall be sized per NFPA 15, Chapter 7 to control burning, exposure protection, and transformer protection, as required.

g. The system demand shall include the simultaneous hydraulic demand from all sprinklers and water spray nozzles on the system.

h. The detection systems providing an automatic actuation signal to fixed water spray systems shall be designed in accordance with NFPA 72, National Fire Alarm Code.

i. Water spray fixed systems shall be protected from the effects of an earthquake per NFPA.

2. Performance Requirements:

a. The site fire protection system shall comply with the aforementioned codes and will be approved by the General Manager, General Manager's insurance agent and the authority having jurisdiction.

1.8 SUBMITTALS

A. Information to be furnished with bid:

1. Proposal shall be prepared in accordance with 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish all the information requested on the attached datasheets and in addition provide the following documentations:
   a. MSDS for hazardous materials, lubricants, cleaning and coating products.

B. Information required after Contract Award:
1. After the award of contract, the following data and drawings shall be submitted to the General Manager for review and acceptance:
   a. Final Design Piping and Instrumentation Drawings (P&ID):
      1) Each portion of the fire protection system described in the system descriptions sections shall have its own individual drawings.
      2) The contractor will size all piping, equipment, and valves and show their arrangement in the fire protection drawings.
      3) The fire protection drawings will show all instrumentation required for system functionality.

   b. Calculations:

1) The design of the new fire protection sprinkler / deluge systems shall be based on calculations of a quality to meet the NFPA 13 or 15 calculation requirements.
2) Fire protection calculations shall be stamped and sealed by a Professional Engineer licensed in the state of California.

c. Product dimensional drawings and catalog data sheets showing product description, service application and limitations, listing information, product dimensions, bill of material, location and dimensions of accessories or operators and product weight.
d. Product Installation Instructions describing standard and/or special installation methods.
e. Requirements for protection of sensitive piping components, instruments, electrical or control devices, or other equipment.
f. Descriptive literature including a parts list.
g. List of suggested spare parts.
h. List of special tools required to perform maintenance on the systems.
i. Data Sheets for required adjustments or settings after installation.

C. Information required after installation:

1. Test Reports:

a. NDE reports
b. Pressure Test reports
c. Functional Test reports
d. Flushing reports
e. Contractor “A” and “U” sheets

2. Contract Closeout Submittals: Submit Certified Data and Documents identified on the Submittal Schedule.

3. Project Record Documents: Submit Record Drawings and Documents required by the AHJ that record final certified data for products, designs, and installation that reflect the final systems as-installed.

D. Drawings:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general drawing requirements.

2. Three hardcopy sets of California Professional Engineer stamped drawings, documents, and calculations will need to be submitted for permitting to the City Permitting Department along with a .pdf electronic version of the drawings on one CD-ROM of the submitted files with each submission. The BOP Contractor should plan on one revision of such documents to incorporate the AHJ’s comments/requirements.

E. Operation and Maintenance Manuals

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.

F. Schedule:

1. Refer to the attached BOP Contractor Submittal Schedule.

1.9 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. The General Manager reserves the right to examine any procedures referred to in the BOP Contractor's Quality Program manual and to audit against the requirements of the Quality Program at any time.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.11 SITE CONDITIONS

A. Refer to 480020 Site Conditions for general site conditions affecting products on site.

1.12 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials and fittings shall comply with NFPA 13, 15, and 24 as applicable and as identified on the Drawings.

B. Equipment, components and hardware supplied shall be listed by FM Global and/or UL.

C. Materials other than those specified must be approved prior to use.

D. Product consistency: Supply items consistent in manufacture, model and style for items that are used in quantity such as valves, piping components, specialties, accessories, special fittings, etc.

E. 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.

2.2 COMPONENTS

A. General:

1. Listed Components and Materials as defined by NFPA shall be used. Unlisted components and materials are prohibited.

2. The FM Global, UL or other approval markings shall not be removed or obscured during the fabrication/installation process.

3. Tags shall be provided for all valves, components, equipment pieces, and other specialty piping components. Tags shall be 1½″ diameter, 20 gauge round stainless steel stamped with the valve number or component number in $^{3}/_{16}$″ letters and securely wired to the valve or component.

B. Wet Pipe Systems

1. Fire protection in areas that are at elevated temperatures during normal operation shall use spray heads with high temperature fusible links (180˚F unless otherwise specified).

C. Dry Pipe Pre-action Systems

1. Each pre-action system shall have a check type alarm valve, compressed air supply, approved sprinkler heads, detectors, strainers, piping, fittings, and accessories necessary for fire detection, annunciation and actuation of the respective system.

2. Dry pipe pre-action systems shall be used where incidental water discharge during operation may result in equipment damage or where frost protection is not provided and there is danger of frost.

3. Compressed air charge on dry pipe systems shall be supplied with dry, filtered air from the instrument air header with pressure regulator supplied with the pre-action spray system to maintain proper air pressure in the pipe.

4. Dry pipe pre-action system discharge is initiated by a control signal from the fire alarm control panel based on flame, smoke or temperature in the protected area. Fusible links shall also be provided appropriate for the operating temperature of the protected area.

5. The pre-action valve must be locally reset after actuation has occurred.

D. Deluge Systems

1. Actuation of all deluge systems shall be by dry pilot detection systems.

2. Upon actuation of a deluge valve, water shall immediately flow through the open spray nozzles. A deluge valve must be locally reset after actuation has occurred.

2.3 FABRICATION

A. Fabrication, assembly, examination, inspecting shall comply with NFPA 13, 14, and 15.

B. Fabrication of fire hose houses, frost protected doghouses, and fire extinguisher mounting brackets shall be of good workmanship, substantial, durable, and capable of surviving in an industrial environment.

2.4 SOURCE QUALITY CONTROL

A. Refer to Section 481200 Combined Cycle Balance of Plant for general source quality control, test, and inspection requirements.

B. Product Line certifications verifying listing and FM Global approval and/or UL listing shall be submitted as part of the submittal process.

C. Shop fabrications:

1. Shop Pressure Testing of pre-fabricated piping spools does not preclude the requirement to perform a field hydrostatic test at completion of installation work.
2. Piping materials shall be listed. Components shall bear the FM Global Approval marking. Markings shall not be obscured or covered by shop fabrication work and shall be clearly visible on the completed piping spool.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting installation work for the fire protection system, installation work performed by others must be substantially completed. The Fire Protection Contractor shall coordinate with the BOP Contractor to ensure the installation work is substantially complete and the installation

of the fire protection system piping can begin. The Fire Protection Contractor shall examine the general area and ascertain that the fire protection system can be installed without rework due to the ongoing work by other onsite subcontractors.

3.2 INSTALLATION

A. Contamination Control:

1. Prevent entry of foreign matter during handling, assembling, erecting and tie-in. Use compressed air, vacuum, cloth, water, and other means to remove dirt and other foreign matter from interior of piping before and after final connections are made.

2. Piping shall not be allowed to lay unprotected without the ends covered during installation or in staging. Inspection of pipe openings shall be maintained as part of the contractor's quality control plan.
3. When performing final tie-ins to existing and new piping which requires cutting, grinding, drilling and other operations that may introduce dirt, chips, and debris into the pipe interior, expanding pipe plugs shall be installed in the pipe where possible to prevent contamination spread. Plugs shall be equipped with lanyards which extend outside the pipe end to prevent the plug from being inadvertently left in the pipe. No other objects such as rags, cardboard, paper, etc., shall be used in lieu of these plugs. Where it is not possible to install pipe plugs, a work plan shall be developed that describes how cleanliness shall be maintained.
4. Permanently installed strainers shall be provided for each pipe riser to prevent debris from clogging sprinkler heads.

B. Flanged Assembly:

1. Flanges and couplings shall be arranged to allow for assembly of spools as shown on the piping Drawings.
2. Flanged joints shall be made up in such a manner as to avoid uneven loading of the gasket. Gasket compounds shall not be used. The length of stud bolts shall be in accordance with ASME B16.5 for steel flanges ½" through 24" NPS.
3. Flange gaskets shall be compressed only once. Replace gasket with new if flange joint has been loosened or disassembled.
4. Bolt Torque Requirements: Torque bolts and stud bolts to gasket manufacturer's recommendations.
5. Limitations of Flange Facings: Flat-faced brass, cast iron, ductile iron and non-metallic flanges shall be bolted to a flat-faced companion flanges with full-faced gasket.
6. Where insulating flange kits are to be installed, care shall be taken to not damage the bolt sleeves and gasket.

C. Threaded Assembly:

1. Teflon thread tape is allowed for threaded joints with design temperature below 400 F. Joint compound shall be applied only to male threads.
2. Copper or zinc shall not be contained in joint compounds for austenitic stainless and alloy threaded piping joints. Only nickel based thread compound material shall be applied to the stainless and alloy threads.

3. Galvanized or coated pipe that is threaded onsite shall have cold galvanized or other General Manager approved protective coating applied to the bare metal surface after assembly.
4. Seal welding: Threaded joints shall be seal welded only when specified on Drawings. When seal welding is required, the following applies:

    a. Threaded joints shall be made up dry; cutting oil shall be removed and no Teflon tape or joint compound applied to the threads.
    b. Threaded joints shall be tightened prior to welding to assure full thread engagement.
    c. Seal welds shall meet the welding and size requirements for socket welding components and be completed in accordance with an approved WPS by qualified welders.

D. Grooved Assembly:

1. Grooved Joints: Comply with manufacturers written instructions.
2. Flexible couplings: Install with the pipe groove completely concealed and then exposed to the maximum extent possible on alternating joints to allow for expansion and contraction.
3. Gaskets: Lubricate with Manufacturer’s approved lubricant prior to assembly.
4. Grooved couplings: Shall be Manufacturer-supplied components and bolt sets. Torque coupling bolts to Manufacturer’s specifications.

E. Valve Assembly:

1. Install in accordance with the Manufacturer's written instructions.
2. Welded valves: Install in the closed position.
3. Valves with soft seats: Remove seat prior to welding and reinstalled after completion of installation.
4. Install with stems oriented as indicated on Drawings.
5. If orientation is not specified, valve handwheels shall be located in the vertical direction for horizontal lines and to provide best access for operation without blocking access ways for vertical lines. Valve stem and handwheels shall be oriented such that pinch points are avoided.

F. Welded Pipe:

1. Use full lengths of pipe wherever possible. Short lengths with couplings will not be permitted. Cut pipe to exact measurement and install without springing and forcing. Remove burrs, fins and irregular end formed when cutting pipe.
2. Seal welded pipe threads shall comply with the designated code for socket welded fittings.
3. Mechanical piping connections shall be installed for equipment, regulating valves and wherever necessary for dismantling of piping and removal of valves and other items requiring maintenance. Flanges and unions may be considered as mechanical piping connections.

G. Tie-ins:

1. Piping:

a. The General Manager shall be notified 5 days in advance prior to tie-in of a new system segment into the existing system.
b. The Contractor shall provide additional fire protection watches as required if a portion the existing fire protection system must be disabled to tie-in new work.
c. Once begun, tie-in work is to be completed rapidly as possible to minimize downtime of the fire protection system.
d. Inspect tie-in location on the existing pipe for wear, corrosion, damage and other signs of distress prior to start of work. If tie-in location is not suitable for the tie-in, an alternate tie-in location or method shall be determined and submitted for approval. Tie-in and extensions of existing piping will require additional inspections to verify suitability of existing material.
e. Protect open ends of pipe by capping and plugging whenever there is a delay in pipe installation and at the end of each day. Cap future connections.
f. Hot tapping locations and procedure shall require approval by the Engineer.

2. Equipment:

a. Piping and piping components shall not transmit loads in excess of manufacturers allowable to installed equipment.
b. Welds made to equipment connections shall be in accordance with the equipment manufacturer's written installation and welding instructions.
c. Equipment piping shall be installed by one of two methods:

1) The piping shall be installed starting at the equipment flanges/nozzles, then worked towards the pipe tie-in. Supports shall be fit or adjusted to reduce dead load forces and moments at equipment nozzles. Spring supports shall retain travel stops during this fit-up adjustment. Adjustment of spring settings to align pipe connections is prohibited.
2) The piping shall be installed up to a break point between the nearest pipe support and the equipment. The remainder of piping shall then be fitted between the equipment nozzle and this break point. It is essential that the fitting be done accurately to avoid external loading on the equipment connections.

d. Before and after tightening bolting to equipment flanges, ensure that the piping flanges are concentric and parallel with the equipment flanges. A minimum of force shall be used to match the flange faces.
e. Pipe supports shall be adjusted to provide appropriate alignment of piping.

3.3 APPLICATION

A. General:
1. Inspect each component before installation. Components with visible damage shall be rejected and replaced with non-defective components.
2. Installed piping shall maintain an accurate and uniform slope where lines are pitched for drainage. Pockets due to changes in elevation shall be avoided. Where pockets are unavoidable, provide vent/drain valve connection.
3. Equipment and piping components shall be protected against damage from weld spatter, slag, excessive heat, metal filings and incidental contact that can cause damage.

4. Verify and inspect that equipment openings, i.e., nozzles, are covered and protected from debris entering and damaging the equipment.
5. Cold springing and forcing of piping for the purpose of joint makeup is not permitted unless specified on the installation drawings or procedures.
6. Welding grounds shall not be installed on mechanical equipment (pumps, compressors, etc.), equipment baseplates, or routed through equipment. Install grounding straps where required.
7. Removal of protective coverings for equipment is prohibited until final tie-ins are ready to be made.
8. Use of chains and wire rope slings to move stainless steel or alloy piping is prohibited. Use of nylon slings is required.
9. The piping installation shall be coordinated with other trades and other subcontractors working on the same area and be in accordance with the CalOHSA.
10. Plugging of abandoned or decommissioned lines shall be completed by the installation of a pipe cap, plug or blind flange as appropriate for each line.
11. Existing lines shall not be cut, operated/decommissioned or disturbed prior to identification of the service, condition of the utility and authorization from the General Manager.
12. At the completion of installation, the contractor shall supply and deliver all special tools required for maintenance and adjustments for the Fire Protection system and accessories.

B. Sleeves and Penetrations:

1. Install piping through sleeves and penetrations as shown on installation drawings.
2. Sleeves are to be provided where pipe lines pass through floors and walls. Where sleeves are not provided in the original construction, obtain approval and satisfactorily perform cutting and installation or core drilling as required.
3. Sleeves shall be standard weight carbon steel pipe having minimum internal diameter 2 inches larger than OD of bare pipe and 2 inches larger than OD of pipe insulation, unless otherwise indicated. Wall sleeves shall be flush on both sides of wall, and floor sleeves shall extend 2 inches above floor, except where otherwise indicated and necessary to suit location and piping function. For piping with flanges, opening shall be 2 inches larger than flange OD (including insulation).
4. Flashing shall be applied and sealed as necessary to weatherize the penetration.
5. Fire-stopping shall be applied as necessary to maintain the fire-rating of the original wall or floor.

C. Piping:

1. Includes designed, field routed piping, and field supported piping.
2. Install tags on valves and other piping components after installation. Verify that valves and piping components installed by others, which have been previously tagged, are in compliance with the Drawings and in the proper orientation if orientation is not shown on drawings.
3. Field routed piping shall be limited to 2” and smaller. Piping shall follow existing pipe routes and pipe racks where possible without obstructing the installation of other piping shown on Drawings. Piping and piping components shall be installed to provide access to valves, equipment, and meet the requirements of OHSA. Avoid pockets resulting from changes in elevation. Where pockets occur, provide a drain connection with a valve and plug at the low point and a vent connection with a valve and plug at the high point.

4. Pipe connections to heads shall not come off of the bottom of wet pipe systems to prevent rust from settling in the head and limiting flow. Connections shall come off of the top or side of the pipe as approved by the AHJ.
5. Head location and spacing shall not only be based on spray coverage, but also the aesthetic aspect of the installation, such as in hallways or office spaces.

6. Pipe Spacing:
   a. Clearance between any two adjacent pipes (bare or insulated) shall be a minimum of 5 inches, except for deluge system pilot lines.
   b. Pipe spacing shall have a minimum of 2 inches clearance between flange and adjacent pipe (bare or insulated).
   c. The minimum distance between staggered flanges shall be 12 inches. If this is not possible the minimum clearance shall be 2 inches between stud bolt ends.
   d. Clearance shall be increased when movement is expected due to thermal movement

7. Pipe Support:

   a. Pipe Spans: Unsupported spans of piping shall not exceed the applicable code allowable stress values, piping spans listed in MSS SP-69 and as required to support localized loads such as valves.
   b. Pipe supports shall be installed as shown on installation drawings. Temporary supports are permitted to facilitate piping installation provided that they are completely removed upon completion.
   c. Piping supports shall meet the requirements of NFPA 13.
   d. Pipe supports shall be field located per NFPA codes.
   e. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
   f. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
   g. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes.
   h. Variable and constant load hangers and supports shall be installed in the cold position with travel stops installed, if applicable.

8. Pipe Labeling and Identification:

   a. Main and branch lines shall be marked after completion of painting and/or insulation.
   b. Markers shall consist of labels identifying the fluid service and directional flow arrows. Apply a directional arrow at each label to show direction of flow of fluid in line. Where flow is in both directions, provide a double headed arrow.
   c. Refer to Section 485102, Pipe Identification for specific requirements on labeling and identification.

9. Coatings:

   a. Piping, valves and piping components / accessories shall be coated and corrosion protected as indicated on the Drawings.
   b. Fire Protection spray nozzles shall not be painted or coated.

c. Stainless steel or copper shall not be painted or coated.
d. Refer to Section 485072, Coating for Piping and Tanks for specific requirements on coatings for piping systems.

10. Frost Protection:

a. Piping, valves and piping components shall be insulated for frost protection as indicated on the installation drawings and P&IDs. Dry fire protection piping shall not be insulated.
b. Refer to Section 485080, Piping and Equipment Insulation for specific requirements on insulating piping systems.

11. Valves:

a. In line globe valves shall be installed for normal flow, so that applied system pressure is under the bridge-wall marking.
b. Each valve accessory item furnished with the valve, but not securely attached to the valve, shall also be provided with an identification tag.
c. Valve tag numbers shall be in the form 5FPS-VXXX where 5 is the unit number, FPS is the fire protection system identifier, and VXXX is the sequential valve number shown on the BOP Contractor fire protection drawings.
d. Each control valve identification tag shall indicate the valve tag number from the BOP Contractor fire protection drawings, manufacturer's serial number, type, body material, seat material, bonnet material, and pressure rating.
e. In addition, identification tags for any pneumatic control valves shall also show the actuator air signal pressure range, positioner bench setting air signal pressure range, and valve flow characteristics (linear, equal percent, or quick opening).
f. Solenoid valves shall be selected to incorporate body construction, trim materials, and internal arrangements suitable to the application. Solenoid enclosures shall be NEMA 4. Solenoid coils shall be Class H high temperature construction and shall be suitable for continuous duty.
g. Limit switches, when required, shall be factory mounted on the valves with provisions for adjusting the limit switch +/- 0.5 inches along the axis of the valve stem.
h. Limit switches enclosures/bodies shall be weather tight and NEMA 4 rated.

12. Instruments:

a. Instruments shall be tagged with the instrument number the BOP Contractor fire protection P&ID.
b. All fire protection pressure indicating gauges shall be designed in accordance with UL standards.
c. Instruments shall be installed with lines that continuously slope back to the process piping with a high point vent next to the instrument.
d. Instruments shall be mounted for ease of maintenance and calibration.
e. Instruments shall be securely mounted and protected from the effects of vibration.

3.4 FIELD QUALITY CONTROL

A. Obtain and provide General Manager approved Shop Drawings, product data, quality control submittals, test reports, certificates, and Manufacturer instructions.

B. Examination and Inspection:

1. Examination and inspections shall be completed during the fabrication, installation and erection process to confirm compliance with NFPA.
2. Weld examination shall comply with the NFPA code. Documentation of examinations shall be made available for review upon request prior to submittal. Defects found in examined piping components and workmanship shall be repaired or replaced and re-examined prior to Pressure Testing.
3. Inspect erected piping for compliance with the Drawings and Manufacturer instructions.
4. Review test reports for compliance with NFPA requirements.

C. Pressure Testing: Shall comply with an approved procedure.

D. Functional Testing: Shall comply with an approved procedure.

3.5 ADJUSTING AND CLEANING

A. Adjustments

1. Adjust the air pressure in the dry sprinkler pipes as necessary from a self contained air bottle with pressure regulator.

B. Final Cleaning

1. Pipe interior cleaning and flushing requirements are described in the project specific Section for the service as designated on the installation drawings.
2. Piping interior shall be cleaned per NFPA requirements. Piping shall receive a flow pattern test.
3. Comply with an approved cleaning and flushing procedure.
4. The Cleaning and Flushing procedure shall address the following:

    a. Permanent equipment, in-line equipment and instrumentation protection
    b. Equipment, in-line equipment and instrumentation cleaning procedure where manufacturers' procedure is not available.
    c. Control valve protection and cleaning
    d. Equipment strainers
    e. Flushing media
    f. Flushing velocity
    g. Circulation through piping system
    h. Draining of flushing media
    i. Reinstallation of components, instruments, and in-line equipment
    j. Disposition of used media
    k. Reconnection to equipment
    l. Final service fluid filling or corrosion protection of flushed line
    m. Cleaning Report

5. General Procedure:
   a. Refer to Section 485101, General Piping Requirements for flushing and cleaning codes.
   b. Flushing through spray nozzles is prohibited. Spray nozzles shall be removed from the system during flushing of the piping segment leading to spray nozzle.
   c. Lines with control valves will be flushed through the bypass where installed. Otherwise, control valves shall be replaced with a pipe spool piece during the flush and then reinstalled.
   d. Instrumentation in the system will be valved off or removed, when valve isolation is not possible, a plug installed in its place.
   e. Orifice plates, nozzles, annubars and other in-line components shall be removed prior to flushing.
   f. Prior to filling the piping system, a system walkdown shall be completed to verify that the system is ready for flushing. The walkdown shall verify that permanent piping components and pipe supports are properly installed and adjusted. System valving is lined up for the flush. Lines requiring additional supports or restraints during flushing shall be prepared for the flush.
   g. Prior to the initial starting of flushing pumps, the inlet piping will be flushed to waste. Pump head tanks and other vessels supplying pump suctions will be inspected and, if necessary, hand cleaned and rinsed to waste prior to filling with flushing media.
   h. When pump suction is from another system, it must be ascertained that the upstream has been cleaned and the suction piping disconnected and flushed to waste prior to pump starting.
   i. As a minimum fire protection general piping flushing and cleaning shall be completed to cleaning code C02 with an acceptance code of F02. Individual spray nozzles can be cleaned to code C05 when removed from the system. Air piping can be flushed to code C05 with an acceptance code of F03. Where this requirement is determined unsuitable for the intended service, the Engineer shall determine the cleaning and acceptance requirements.
   j. The main header of a system shall be flushed first with branch lines isolated, except as required to obtain a flushing path. Branch lines shall be flushed separately to obtain the maximum flow and cleaning effectiveness. Long vertical lines, where possible, will be flushed in the direction of gravity.
   k. Cleaning will continue until the system is rendered clean, to be determined by the inspection of temporary strainers and screens. Strainers and screens shall be free from visible particulate matter.
   l. Care will be taken not to spray, splash or flood electrical connections, equipment and undermine foundations during the flushing operation. Use hoses and temporary piping to direct flushing media to waste and bypass equipment. Disposition of used media shall follow an approved procedure.
   m. At the conclusion of the flushing operations, temporary piping, strainers, fittings, and connections shall be removed and the permanent piping and piping components installed. Connections to equipment shall be re-established.
   n. After flushing operations are terminated, the system will be drained, rinsed and filled with the process fluid or shall be corrosion protected with an approved procedure.
   o. Cleaning and flushing report shall be submitted.

3.6 DEMONSTRATION

A. The Fire Protection Contractor shall notify General Manager five working days prior to conducting fire protection tests and demonstrations to make arrangements for Fire Marshal and PFD to witness the test/demonstration. The work shall not be deemed complete until General Manager accepts the work after a demonstration test.

B. Heated Doghouse Freeze Protection Testing: Comply with an approved procedure demonstrating the capability to prevent freezing of the fire protection piping.

1. Heater capacity shall be verified.

2. Required doghouse insulation shall be verified to be in place.

3. Weather sealing shall be verified to be in place.

4. Adequate room to perform required maintenance and instrument calibration shall be verified.

C. Fire Extinguisher Accessibility: Fire extinguishers shall be located in accordance NFPA 14 and Authority Having Jurisdiction (Fire Marshal). Quantity of extinguishers shall be as required by PFD.

D. Pressure Testing

1. Pressure testing shall comply with NFPA requirements.
2. BOP Contractor will perform all required tests to demonstrate operability of the fire protection system to the AHJ and representatives of General Manager to obtain all required permits based on the Fire Protection System functionality.
3. Piping shall be pressure tested after inspection and before painting, insulation and concealment unless otherwise noted on the Drawings.
4. Types of tests required and test pressures for various piping services shall be as shown in the Drawings.
5. Coordinate test and furnish labor, materials, tools, instruments, testing media, and equipment necessary to carry out the tests and repair leaks.
6. Provide fittings for fill, drain and venting during filling, relief valves, pumps and test gauges required for completion of the pressure test.
7. Comply with an approved Pressure Test procedure and provide notifications:

    a. Within 30 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent test and inspection operations. The General Manager may, within 30 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection. For example: Inspection of the layout and installation of piping around the turbine / generator bearings may be selected as a hold point.
    b. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing.

c. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any inspection at the premises of the BOP Contractor or the General Manager.

8. The Pressure Test procedure shall address the following:

a. Itemize the scope of piping and components being tested (including line numbers)
b. Test pressure and test temperature range
c. Inspection pressure (if different from test pressure)
d. Method for developing and controlling test pressure
e. Method for over pressurization protection
f. Test fluid
g. Test duration
h. Temporary fittings, connections, bypasses and restraints/supports
i. Location of test gauges
j. Other specifics for the test
k. Documentation of tests including date and certification of results by examiner.

9. General Procedure:

a. Before testing, remove non-pressure parts or parts not designed for test pressure such as instruments and specialties.
b. Replace non-pressure parts after initial test and retest piping at operating pressure with water or air as appropriate for the system.
c. Equipment which is not to be included in the test shall be either disconnected from the piping or isolated by test blinds or blanks. Test blinds and blanks shall meet the piping system specification for appropriate pressure class.
d. Springs and constant load supports shall be pinned or have travel stops installed prior to filling the system. Pins or travel stops shall be removed after the system has been drained and prepared for service.
e. Test gauges used shall be calibrated for accuracy prior to installation and be of proper range so that test pressure is within the middle third of the range or scale.
f. The test fluid shall be water unless otherwise approved or shown on the Drawings.
g. Test piping when ambient air conditions are approximately constant (within a 20°F range).
h. Piping shall not be pressure tested when piping temperature is below 40°F or over 180°F.
i. While piping is under test, care shall be taken that excessive pressure does not occur due to increase of ambient temperature.
j. Perform pressure testing of piping after the piping and test fluid temperatures have stabilized within the approved testing temperature range.
k. When piping is pressure tested, slowly bring each spool piece, group or line up to pressure (approximately 100 psi per minute), isolate or shut off test pump or pressurizing system at intermediate intervals of test pressure to ensure pipeline integrity during test.
l. Actual test pressure shall not exceed 2 percent of approved maximum test pressure. Pressure relieving devices shall be installed to protect from over-pressurization.
m. Each test shall be conducted over a time period required to allow for proper inspection/evaluation of the piping and each connection being tested, but not less than 10 minutes.

n. During the test period there shall be no visual leakage. Changes in test pressure on recording pressure gauge or visual gauge reading shall be accounted for.
o. Leaks shall be repaired and the lines re-tested. Lines modified after testing shall be re-tested.
p. The Pressure Test Record Form from NFPA 13, Chapter 16 shall be used to record test results.
q. Submit documentation of completed tests within one working day of the respective test.

10. Non-pressurized Lines Procedure: Lines and systems which are open to the atmosphere and have an atmospheric design pressure (such as the discharge from drains and vents) do not require pressure testing. Lines shall be examined and leak-tested as follows:

    a. Visually examine joints for conformance to fabrication, assembly, and erection requirements.
    b. Fill lines with water and note height of fluid. Let stand for 2 hours.
    c. Visually check joints for leaks.
    d. Check water level with original mark.

11. Repair or replace test sections not meeting test criteria. Retest lines or test sections until test requirements are met. During system tests, retest the system until an acceptable system is attained. Repairs shall comply with the standards of the original construction.
12. For minor repairs, revisions or additions to piping systems that are made after acceptance of a completed system pressure test, retest only the affected portion of the system. Where the affected portion of the system cannot be isolated for retest, retest the entire system. Leak examination for air systems shall utilize a Gas and Bubble Test or other approved sensitive leak test method.
13. After inspection and/or testing, BOP Contractor shall forward to the General Manager duly certified copies of the inspection and test results.

E. Functional and Performance Tests

1. BOP Contractor will perform all required tests to demonstrate operability of the fire protection system to the AHJ and the General Manager/General Manager's representative and obtain all required permits based on the Fire Protection System functionality.
2. The equipment installed per this specification shall be subjected to functional and performance tests in the BOP Contractor's shop to the greatest extent possible to verify the BOP Contractor's performance guarantees. The performance test for Contract purposes shall be executed at the final installation by the BOP Contractor in accordance with a test procedure developed by the BOP Contractor and approved by the AHJ and the General Manager/General Manager's representative.
3. The Fire Protection systems are to be field-tested. During these tests any defective valve or appurtenance shall be adjusted and corrected, or removed and replaced.
4. The functional and performance tests shall comply with an approved procedure and notifications shall be given prior to testing.

    a. Within 30 days after Notice to Proceed the BOP Contractor shall submit to the General Manager for review an inspection and test plan which shall include pertinent test and inspection operations. The General Manager may, within 30 days of receipt of the inspection and test plan, and in consultation with the BOP Contractor, select a range of points as a mandatory hold point for inspection.

b. The BOP Contractor shall give the General Manager at least five working days prior notice in writing of the date on and the place at which any equipment shall reach a mandatory hold point or shall be ready for independent inspection and testing.
c. BOP Contractor shall give (and cause third parties to give) any representative, designated by the General Manager, full cooperation and assistance in any inspection at the premises of the BOP Contractor or the General Manager.

5. The performance of the functional and performance testing of the new fire protection systems shall not disable, or make inoperable, the existing fire protection systems.
6. After inspection and/or testing, BOP Contractor shall forward to the General Manager duly certified copies of the inspection and test results.

3.7 PROTECTION

A. Completed work that has not been tested and accepted shall be protected from damage from adjacent construction activities in close proximity. Particular care should be taken where permanent barriers, shields, or other equipment has not been installed and the completed work is exposed to other construction activities.

3.8 SPARE PARTS

A. The Fire Protection contractor shall provide all spare parts for startup, pressure testing, and functional testing.

B. The BOP Contractor shall provide a spare stock of sprinklers to the General Manager as required by NFPA 13, Chapter 6.

3.9 SCHEDULES

A. The Fire Protection Contractor shall show all schedules on the Fire Protection drawings. i.e. pipe schedule, painting schedules, hardware, panels, etc.

PART 4 - ATTACHMENTS

4.1 APPENDIX A

	Submittal Description[4]	*Copies for Review*			*Certified Copies*		
		Submit To		*Date Req'd*	*Submit To*		*Date Req'd*
		Contr	*Engr*[2]		*Contr*	*Engr*[3]	
1.	**Administrative Submittals**						
	Contract Closeout Submittals				X		10DFC
2.	**Drawings & Calculations**						
	P&IDs	X	X	4ARO	X		10DFC
	Installation drawings	X	X	6ARO	X		10DFC
	Sizing calculations	X	X	4ARO	X		10DFC
	Isometric Drawings	X		6ARO	X		10DFC
	Spool Drawings	X		6ARO	X		10DFC
3.	**Manufacturer's Standard Data**						
	1.5B: Catalog Data Sheets	X		4ARO	X		10DFC
4.	**Field Installation, Erection and Placing Instructions or Procedures**						
	Pipe Storage and Protection Procedure	X		4ARO			
	Pipe Bending Procedure	X		4ARO			
	Pipe Installation, Cleaning and Testing	X		4ARO			
	Manufacturer Instructions	X		4ARO	X		10DFC
5.	**Product Data**						
	Dimensional Drawings	X		4ARO			
	MSDS	X		4ARO			
6.	**Inspection, Test Reports and Certificates of Compliance**						
	Welding Procedure Specifications	X		4ARO			
	Non-Destructive Examination Requirements	X		4ARO			
	Personnel Qualification Testing	X		4ARO			
	NDE Reports				X		10DFC
	Pressure Test Reports				X		10DFC
	Flushing Reports				X		10DFC
	Welder Performance Qualification Records	X		1PTC			
	NDE Personnel Qualification records	X		1PTC			
	Certificates of UL Listed & FM Global Approved Products	X		1PTC	X		10DFC
	Material Test Reports	X		1PTC			
7.	**Operations and Maintenance Data Manual**						
	Operation and Maintenance Data	X		4ARO	X	X	10DFC
8.	**Record Documents**						
	Project Record Documents				X	X	10DFC
9.	**Warranties and Guarantees**						
	Warranty	X			X		10DFC

August 12, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 489596.10

Fire Alarm and Signaling Systems

PROJECT NUMBER:
123374

PROJECT CONTACT:
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Section 489596.10
Fire Alarm and Signaling Systems

PREPARED FOR: PASADENA WATER & POWER
PREPARED BY: *SAM BYDA*

REVISION HISTORY		
DATE	REVISED BY	REVISION
08/12/2013	T. Clark	A

SECTION 485956.10
FIRE ALARM AND SIGNALING SYSTEMS

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY BOP CONTRACTOR 2
1.3 RELATED SECTIONS 3
1.4 DEFINITIONS 4
1.5 SYSTEM DESCRIPTION 5
1.6 SUBMITTALS 6
1.7 QUALITY ASSURANCE 8
1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING 9
1.9 SITE CONDITIONS 9
1.10 WARRANTY 9
1.11 SOFTWARE SERVICE AGREEMENT 9

PART 2 - PRODUCTS 9

2.1 MANUFACTURERS 9
2.2 SYSTEMS OPERATIONAL DESCRIPTION 10
2.3 COMPONENTS 11
2.4 ACCESSORIES 16
2.5 SOURCE QUALITY CONTROL 16

PART 3 - EXECUTION 16

3.1 EXAMINATION 16
3.2 PREPARATION 16
3.3 ERECTION 16
3.4 INSTALLATION 17
3.5 APPLICATION 17
3.6 FIELD QUALITY CONTROL 19
3.7 ADJUSTING AND CLEANING 20
3.8 DEMONSTRATION 20
3.9 SPARE PARTS 21
3.10 SCHEDULES 21

PART 4 - ATTACHMENTS 22

SUBMITTAL REQUIREMENTS SCHEDULE 22

SECTION 485956.10
FIRE ALARM AND SIGNALING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers the minimum requirements for the procurement, supply, handling, management, shop and field fabrication, assembly, erection, installation, examination, and testing of the Fire Alarm and Signaling Systems for the project.

B. The Fire Alarm and Signaling Systems contractor scope of supply and installation shall be in accordance with Section A above and as a minimum, encompass the following:

1. Centralized Fire Alarm and Signaling Panel installed in the Control room.
2. Link all existing Fire Alarm and Signaling Systems to the Centralized Fire Alarm and Signaling Panel.
3. Fire Detection/Sensing equipment.
4. Audible and Visual Fire Alarm and Signaling indications.
5. Remote fire detection/sensing equipment installed if required.

C. Products installed but not furnished under this Section:

1. Wet sprinkler fire suppression systems, chemical fire suppression systems, inert gas fire suppression systems and water mist fire suppression systems.
2. Modifications and additions to the existing fire water system including the associated hydrants, stand pipes, and sprinklers.
3. Combustion Turbine-Generator fire detection and suppression systems.
4. Dedicated phone line.
5. 110 VAC, 220 VAC, and 440 VAC electrical power supply.
6. Existing B-3 Fire Alarm and Signaling Systems.

D. The specifications described herein are intended as the minimum requirements for supply of an integrated fire protection system designed under the direction of a qualified Fire Protection Engineer and installed by a qualified Fire Protection Contractor specializing in fire protection systems, certified and licensed by the Authority Having Jurisdiction (AHJ) to work on the Site and familiar with local requirements.

E. It is not the intent to specify completely herein all details and requirements of the design and construction of the complete and functional systems and equipment. However, the systems and equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation up to the BOP Contractor's guarantee in a manner acceptable to the General Manager and AHJ.

F. This section does not outline the documents and certifications required by the state and local laws and regulations for installation of the Fire Alarm and Signaling Systems. The BOP Contractor shall prepare, make available, and submit drawings and documents as required by local and state laws and regulations for review and approval. Where it is unclear to the drawings and documents required, the BOP Contractor shall contact the Authority Having Jurisdiction and the Fire Marshal for clarification.

1.2 FURNISHED BY BOP CONTRACTOR

A. Contractor shall provide the General Manager with the complete system installation, testing, and training. Contractor's installation shall comply with references listed herein.

B. BOP Contractor shall create and submit all documents necessary to obtain approvals, certifications, and/or authorizations required by authorities and agencies providing oversight of Fire Alarm and Signaling Systems installed in the project locations. The contractor is singularly responsible for obtaining all authorizations and approvals and shall include that of the local Fire Marshall as well as the General Manager's insurer.

C. BOP Contractor's installation shall comply with the information supplied on the design drawings.

D. Meet all requirements of state of California and local codes, NFPA, FM, Cal-OSHA, and NEMA for electrical work.

E. Install control panel and component spacing in accordance with NEMA Industrial Control Standards.

F. Stand-alone alarm system covering all areas with one control panel located in Control Room. The Local and Remote Control Room Fire Alarm Panels will be connected via an IP Network Infrastructure VLAN provided by others.

G. Link the existing B-3 Fire Alarm and Signaling Systems to the Centralized Fire Alarm and Signaling Panel. See the Tie-point location plan for existing fire alarm connection points.

H. Fire Detection/Sensing equipment to be installed as required by the Fire Protection Design Basis Document and as approved by the General Manager and General Manager's Insurance Agent, and AHJ.

I. Audible and Visual fire alarm indication to be installed as required by the Fire Protection Design Basis Document and as approved by the General Manager and General Manager's Insurance Agent, and AHJ.

J. Provide a remote station signal transmitter in the PDC that is electrically supervised and is capable of transmitting alarm and trouble signals over telephone lines to a central station receiver.

K. Fire Protection, Detection, and Alarms for all protected areas.

L. Manual alarms at all fire exits.

M. Supervisor for installation and commissioning through approval of completed system by General Manager, Fire Marshal, and AHJ.

N. Separate optional price for recommended startup, commissioning, and two years spare parts list.

O. Software support and upgrade service for two years after project completion.

P. Wiring diagrams and schematics.

Q. Modbus Point lists (for communications to the Plant Control System).

R. Test reports including material certification reports.

S. Installation, operation and maintenance manuals.

T. Design, supply and install cable and conduit for Fire Protection System.

All required signage and identification

1.3 RELATED SECTIONS

A. Section 480020, Site Conditions

B. Section 481200, Combined Cycle Balance of Plant

C. Section 485956, Plant Fire Prevention and Protection

D. Section 485996.10, Firewater Underground Piping, Valves, and Hydrants

E. Section 485996.25, Fire Water Sprinkler Systems

F. CODES AND STANDARDS

G. The BOP Contractor's design shall comply with the current editions, at the date of notice to proceed, of relevant internationally recognized codes, standards and regulations and applicable codes, standards, and regulations for the Site as described in Section 480020 Site Conditions.

H. State and local law shall take precedence where conflicts exist between, codes, standards, and this Section. The Engineer shall resolve the conflict. Deviations from relevant standards shall only be implemented with the written approval of the General Manager.

1. California Code of Regulations Title 24 California Occupational Health and Safety Administration (CalOSHA)
2. Pasadena, California – Code of Ordinances, Title 14 Buildings and Construction
3. National Fire Protection Association (NFPA): Use where the City of Pasadena standards do not provide a higher standard. NFPA is only to be used in design if the 2010 CBC directs you to use this code. State of California and local codes take precedence over NFPA.
    a. NFPA 10 – Standard for Portable Fire Extinguishers
    b. NFPA 12 – Carbon Dioxide Extinguishing Systems
    c. NFPA 13 – Standard for the installation of Sprinkler Systems
    d. NFPA 14 – Standard for the installation of Standpipe and Hose Systems
    e. NFPA 15 – Water Spray Fixed Systems for Fire Protection
    f. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
    g. NFPA 30 – Flammable and Combustible Liquids Code
    h. NFPA 37 – Stationary Combustion Engines and Gas Turbines
    i. NFPA 54 – National Fuel Gas Code
    j. NFPA 68 – Explosion Venting
    k. NFPA 70 – National Electrical Code

l. NFPA 72 – National Fire Alarm and Signaling Code
m. NFPA 72E – Automatic Fire Detectors
n. NFPA 80 – Fire Doors and Windows
o. NFPA 90B Warm Air Heating and Air Conditioning Systems
p. NFPA 101 – Life Safety Code
q. NFPA 850 –Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

4. UL - Underwriters Laboratory, Standards as applicable.
   a. UL 38 –Manual Signaling Boxes for Fire Alarm Systems
   b. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
   c. UL 464 - Audible Signaling Appliances
   d. UL 521 – Heat Detectors for Fire Protective Signaling Systems
   e. UL 864 - UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
   f. UL 1480 – Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
   g. UL 1971 - Visual Notification Appliances

1.4 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Fire Marshal, City of Pasadena or its agent. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

B. Fire Marshal: A person designated to provide delivery, management, and/or administration of fire protection and life safety related codes and standards, investigation, education, and/or prevention services for local, county, state, provincial, federal, or private sector jurisdictions as adopted or determined by that entity.

C. Fire Protection Contractor: One who contracts on predetermined terms to provide labor and materials and who is responsible for performance of a construction job in accordance with construction documents or the person or company responsible for fulfilling an agreed upon contract.

D. Fire Protection Engineer: Engineer who is assigned safety system oversight and design for fire protection system(s). Professional services of an engineering nature, as defined by State law, if applicable, that is required to be performed or approved by a person licensed, registered, or certified to provide those services. All plans and specifications to be submitted to the Pasadena Fire Department for approval shall bear the seal of a registered California Professional Engineer.

E. Fire Risk Assessment (FRA): A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences. Other documents may use other terms, such as fire risk analysis, fire hazard, hazard analysis, and fire hazard analysis assessment, to characterize fire risk assessment as used in NFPA 551.

F. BOP Contractor: The party employed by the City to oversee construction efforts, install Power Island Contractor’s work and coordinate Contractor’s and Subcontractor’s work on the site

specified directly or by reference in 481200, Combined Cycle Balance of Plant including the Fire Protection Contractor and Fire Protection Engineer.

G. Others: Personnel, companies, or contractors who are not specifically mentioned in this Section

H. City: The City of Pasadena, California

I. 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.

A. Stakeholders: An individual, a group of individuals, or an organization that is perceived to affect or be affected by the fire hazards associated with the facility being evaluated. Stakeholders include those who have a financial, personnel safety, public safety, or regulatory interest in the fire risk, such as the public (e.g., neighbors, community groups, first responders), employees, General Manager/investor(s), operator, insurer, regulator(s), and design team. The Stakeholders identified under this Section initially include the General Manager, A&E Engineer, Fire Protection Engineer, General Manager's Insurance Company, State of California, Los Angeles County, City of Pasadena, and AJH.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. The Fire Protection Contractor services shall provide the design, supply, installation, and testing of the integrated, complete and operable Fire Alarm and Signaling Systems approved by the Authority Having Jurisdiction and General Manager. The Fire Alarm and Signaling Systems shall be tied into plant, dry contact, fire alarm or trouble indications provided by the Power Island Equipment Contractor, in addition to those fire alarm or trouble detection sources supplied by the BOP Contractor. Existing alarm system shall be tied into the new Fire Alarm and Signaling Systems. This system shall also initiate protective action as required, and shall be tied into strategically placed manual pull stations throughout the facility. This system shall provide the local alarms and alerts described as well as operator selectable activation providing automatic dial out contact of minimum of four programmable phone numbers.
1. Equipment and design shall be compliant with all applicable state of California and local codes and regulations.
2. System power is a 120 VAC, 60 Hz, UPS power source capable of 120 minutes sustainability provided by the BOP Contractor for the Fire Protection Contractor's equipment power source. Additional back-up power and/or power conversion, as may be required by the Fire Protection Contractor's equipment or the Codes in effect, shall also be furnished by the BOP Contractor.
3. Noncoded, UL-certified and FM Global-placarded addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
4. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.
5. Where feasible, wiring shall be routed to local panels in the field and data links to the main fire control panel shall be used to minimize the amount of wiring required for the system installation.
6. The alarm and annunciating system shall comply with state and local codes and regulations.

7. Manually actuated alarm-initiating devices shall be located per the state and local codes and regulations.
8. Items included are:

    a. Fire-alarm control unit.
    b. Manual fire-alarm boxes.
    c. Remote fire detection panel.
    d. System smoke detectors.
    e. Heat detectors.
    f. Notification appliances.
    g. Remote annunciators.
    h. Addressable interface device.
    i. System Printer

B. Performance Requirements:

1. The system shall properly annunciate and report all actuations from all reporting stations.
2. Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7-02.

1.6 SUBMITTALS

A. Information to be furnished with the Bid:
1. Proposal shall be prepared in accordance with Section 481200, Combined Cycle Balance of Plant. BOP Contractor shall furnish the information requested and return the following documents:
    a. Qualifications: Perspective suppliers and subcontractors for the work described herein must submit documentation attesting to their qualification to perform such work.
    b. MSDS for hazardous materials, lubricants, cleaning and coating products.

B. Information required after Contract Award:
1. After the award of contract, the following data and drawings shall be submitted to the General Manager for review and acceptance:
    a. Product Catalog Data Sheets with product description and service application and limitations.
    b. Product Dimensional Drawings showing product dimensions, bill of material, location and dimensions of accessories or operators and product weight.
    c. Plans, sections, and elevations to show critical dimensions that relate to placement and support of detector housings.
    d. Alarm signaling-service equipment panel layout, grounding schematic, single-line connection diagram, and interconnect wiring drawings.
    e. Plans to indicate final outlet locations showing each addressable device. Show the size and route of each cable and associated conduits.
    f. Voltage drop calculations for notification appliance circuits.
    g. Battery-size calculations if required by the contractors design.
    h. Performance parameters and installation details for each detector, reporting station, visual and audible alarms, and annunciators in the facility expansion, verifying that each item is listed for complete range of air velocity, temperature, and humidity possible.

i. Descriptive literature including a parts list and suggested spare parts.
j. A listing of special tools required to perform maintenance on the systems.
k. The BOP Contractor shall submit all drawings and design data to support facility design, construction, maintenance, and permitting requirements.
l. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components from the manufacturer.
   1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Closeout Documentation

1. Certificate of Acceptance of the Fire Alarm and Signaling Systems by the authority having jurisdiction after successful testing.
2. Certified Data and Documents identified on the attached Submittal Schedule.
3. Submit Record Drawings and Documents that record final certified data for products, designs and installation.

D. Shop Drawings:

1. Refer to Section 481200, Combined Cycle Balance of Plant for general drawing requirements.
2. Additionally, 3 hardcopy sets of California Professional Engineer stamped drawings need to be submitted for permitting to the City Permitting Department along with a .pdf electronic version of the drawings on one CD-ROM of the submitted files with each submission.
3. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm and Signaling Systems" Chapter in NFPA 72.
4. Shop Drawings shall be prepared by persons with the following qualifications:

   a. Trained and certified by a manufacturer in fire-alarm system design.
   b. NICET certified fire-alarm technician, Level IV minimum.
   c. Licensed or certified as required by the AHJ.

E. Delegated design submittal: For smoke and heat detectors include analysis data signed and sealed by the qualified professional fire protection engineer responsible for their preparation.

1. Drawings shall show the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design calculations are required which indicate the requirements for selecting the spacing and sensitivity of the detection, in order to complying with NFPA 72.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Refer to Section 481200, Combined Cycle Balance of Plant for general operation and maintenance manual requirements.

2. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
4. Record copy of site-specific software.
5. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

6. Manufacturer's required maintenance related to system warranty requirements.
7. Abbreviated operating instructions for mounting at fire-alarm control unit.
8. Software and Firmware Operational Documentation for PC based systems:
    a. Software operating and upgrade manuals.
    b. Program Software Backup: On magnetic media or compact disk, complete with data files.
    c. Device address list.
    d. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. The Fire Protection Contractor shall have a current certificate of competence for Sound, Intercommunication and Electrical Alarm Systems from the State of California.

C. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this project.

D. Installer Qualifications:

1. Installation shall be by personnel certified by NICET as fire-alarm Level II or Level III technician acting under the supervision of a Level IV technician.
2. Installation shall be by personnel licensed by the State of California.

E. Source Limitations for Fire Alarm and Signaling Systems and Components: Obtain Fire Alarm and Signaling Systems from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. NFPA Certification: Obtain certification according to NFPA 72 by the AHJ and/or the following entities:
1. Nationally Recognized Testing Laboratory

2. UL-listed alarm company.
3. Display NFPA 72 certification in the form of a placard by an FM Global-approved alarm company.

1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

1.9 SITE CONDITIONS

A. Reference Section 480020, Site Conditions.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by General Manager or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Do not proceed with any interruption of fire-alarm service without the General Manager's written permission.
2. Notify the General Manager no fewer than 72 hours in advance of any proposed interruption of Fire Alarm and Signaling service.

1.10 WARRANTY

A. Refer to Section 481200, Combined Cycle Balance of Plant for general warranty requirements.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days notice to General Manager to allow scheduling and access to system and to allow General Manager to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All Manufacturers shall manufacture FM Global Approved products.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. The following System Operational Description shall be used unless otherwise defined in the project Fire Prevention and Protection Plan.

B. Fire-alarm signal initiation shall be by one or more of the following devices or systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Fire Water Flow monitor switch
6. Dedicated equipment protection systems (CTG's by others)
7. Verified automatic alarm operation of smoke detectors.
8. Either automatic sprinkler system water flow or dry spray header air pressure drop.
9. Remote Fire Control Panels as required

C. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Activate voice/alarm communication system.
4. Activate preaction sprinkler system.
5. Record events in the system memory.

D. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Operator push button switch.
2. Valve Supervisory switch.
3. Low-air-pressure switch of a dry-pipe sprinkler system.

E. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciators.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and initiate contact output to the plant control system. Record the event in system memory.

2.3 COMPONENTS

A. Components such as catalog items shall all be listed when required by the NFPA codes and standards.

B. Components such as catalog items that do not require listing or FM Global approval and are procured for use per this Section shall be substantial, durable, and capable of surviving in an industrial environment.

C. Central Fire Alarm and Signaling Panel

1. Provide input connections to the Central Fire Alarm and Signaling Panel for alarm status signals from the sprinkler system, chemical fire suppression, and water mist fire suppression systems and the GTG fire suppression systems. The Central Alarm Panel shall identify four zones consisting of; the plant hydrant system, PDC, and Combustion Turbine Generators.
2. The Central Alarm Panel shall provide a minimum of four form C dry contact outputs rated at 120 VAC for connection to the General Manager's auxiliary equipment. Outputs shall be programmable to activate on individual room or zone fire detection.
3. The Centralized Fire Alarm and Signaling Panel shall be installed in the GT-5 Control Room. The centralized alarm panel shall provide individual alarm point input identification with keyed override of individual point malfunction to allow system reset and silencing. The Centralized Fire Alarm and Signaling Panel shall be linked to the remote equipment located in the fire pump house/room if required, and to other fire suppression equipment on site and display individual point identifications associated with the remote system inputs.

D. Fire-Alarm Control Unit

1. General Requirements for Fire-Alarm Control Unit:

a. The control unit and software shall comply with UL 864 requirements for discrete electrical control units and accessories for fire alarm systems to be employed in accordance with NFPA Standards used in combination with other appliances and devices to form a commercial fire alarm system.
b. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

1) System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
2) Include a real-time clock for time annotation of events on the event recorder.

c. Addressable initiation devices that communicate device identity and status.

1) Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
2) Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

d. Addressable control circuits for operation of mechanical equipment.

2. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

    a. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
    b. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

3. Circuits:

    a. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

        1) Initiating Device Circuits: Style D.
        2) Notification Appliance Circuits: Style Z.
        3) Signaling Line Circuits: Style 7.
        4) Install no more than 50 addressable devices on each signaling line circuit.

    b. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

        1) Initiating Device Circuits: Style C.
        2) Notification Appliance Circuits: Style X.
        3) Signaling Line Circuits: Style 4.5.
        4) Install no more than 50 addressable devices on each signaling line circuit.

    c. Serial Interfaces: one RS-232 port for printers.

4. Smoke-Alarm Verification:

    a. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
    b. Activate an NRTL -listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
    c. Record events in system memory.
    d. Sound general alarm if the alarm is verified.
    e. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

5. Notification Appliance Circuit: Operation sound in selectable patterns that may be used for specific zone notification. Contractor to verify with General Manager sound pattern requirements for matching the existing facility alarm.
6. Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.

7. Record of Events: Provide a computer USB connectable data connection to download records and information in memory. On request, supervisory, and trouble events, identification of zone, device, and function, type of signal (alarm, supervisory, or trouble) and date and time of occurrence shall be available. Commands initiate the retrieval of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events. The historical log shall be capable of storing a minimum of 800 events of which a minimum of 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
8. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

E. Manual Fire-Alarm Pull Boxes

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

    a. Single-action mechanism, breaking plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
    b. Station Reset: Key- or wrench-operated switch.
    c. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
    d. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

F. System Smoke Detectors

1. General Requirements for System Smoke Detectors:

    a. Comply with UL 268; operating at 24-V dc, nominal.
    b. Detectors shall be two-wire type.
    c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
    d. 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.
    e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
    f. Integral Visual-Indicating Light: Light-emitting diode (LED) type indicating detector has operating and power-on status.
    g. Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and

alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

1) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
2) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
3) Provide multiple levels of detection sensitivity for each sensor.

2. Photoelectric Smoke Detectors:

a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1) Primary status.
2) Device type.
3) Present average value.
4) Present sensitivity selected.
5) Sensor range (normal, dirty, etc.).

G. Heat Detectors

1. General Requirements for Heat Detectors: Comply with UL 521.
2. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

a. Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

3. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 ºF. Except the Turbine Generator bearing housing heat detector shall actuated by a temperature that exceeds 600 ºF.

a. Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

H. Notification Appliances

1. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
2. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

a. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

3. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
4. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
5. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 meters) from the horn, using the coded signal prescribed in UL 464 test protocol. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1 inch (25 mm) high letters on the lens.

   a. Rated Light Output: 75 cd.
   b. Mounting: Wall mounted unless otherwise indicated.
   c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   d. Flashing shall be in a temporal pattern, synchronized with other units.
   e. Strobe Leads: Factory connected to screw terminals.
   f. Mounting Faceplate: Factory finished - red.

6. Voice/Tone Notification Appliances:

   a. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
   b. High-Range Units: Rated 2 to 15 W.
   c. Low-Range Units: Rated 1 to 2 W.
   d. Mounting: flush, semi-recessed, or surface mounted and bidirectional.
   e. Matching Transformers: Tap range matched to acoustical environment of speaker location.

I. Addressable Interface Device

1. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
2. Integral Relays: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown, use as DCS input/interface, and actuation of preaction systems.

J. Device Guards

1. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

   a. Factory fabricated and furnished by manufacturer of device.
   b. Finish: Paint of color to match the protected device.

K. Identification: Tags shall be provided for all components, equipment pieces, and other specialty components. Tags shall be 1½″ diameter, 20 gauge round stainless steel stamped with the component number in $^{3}/_{16}$″ letters and securely wired to the component.

2.4 ACCESSORIES

A. Accessories shall all be listed when required by the NFPA codes and standards.

B. Accessories that do not require NFPA listing or FM Global approval and procured for use per this Section shall be substantial, durable, and capable of surviving in an industrial environment.

2.5 SOURCE QUALITY CONTROL

A. Examination and Inspection performed at the source plant, mill, factory, or shop to obtain the required NFPA and FM Global approval is sufficient.

B. Product Line certifications verifying NFPA listing and FM Global approval shall submitted as part of the submittal process.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting installation work for the fire protection system, installation work performed by others must be substantially completed. All required permits / approvals have been obtained from the AHJ and General Manger. The Fire Protection Contractor shall coordinate with the BOP Contractor to ensure the installation work is substantially complete and the installation of the Fire Alarm and Signaling Systems can begin. The Fire Alarm and Signaling Systems Contractor shall examine the general area and ascertain that the Fire Alarm and Signaling Systems can be installed without rework.

3.2 PREPARATION

A. At mobilization, the Fire Protection Contractor shall establish a local work center to minimize delays in transporting materials, tools, components, testing equipment, etc. The Fire Protection Contractor’s work center shall have a secure area for the protection of high value items.

B. The Fire Protection Contractor, to the maximum extent possible, shall stage materials and tools required to install the fire protection system installed by this Section.

3.3 ERECTION

A. Furnish, fabricate, assemble, install, examine, and demonstrate operability of:

1. The Fire Alarm and Signaling Systems.

B. The Work shall include, but is not limited to, the following:

1. Labor and construction materials except as specified otherwise herein, for the installation of the new Fire Alarm and Signaling Systems.
2. Material, parts, conduits, stanchions, supports, foundations, and pads.

3. Coordination of existing system outages for tie-in connections.
4. Removal, relocation, reinstallation/replacement and testing of existing items required for tie-in to existing systems.
5. Installation of wiring and tie-ins required for system fire alarm reporting and annunciation including contract interface tie-in connections shown on the installation drawings.

3.4 INSTALLATION

A. The Fire Protection Contractor shall formally notify the General Manager in writing prior to removing any existing fire protection system from service or disabling any portion of the existing fire protection system.

B. Erection shall include the complete installation of the new integrated Fire Alarm and Signaling Systems including field fabrication, assembly, examination, inspection and testing as required by NFPA 72.

C. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service. If any existing fire protection equipment is de-commissioned by the new work, then note this equipment as existing fire-alarm equipment "NOT IN SERVICE" until removed from the building. Note: Existing Broadway cooling tower fire protection and detection must remain in service as long as the cooling towers are intact.

3.5 APPLICATION

A. General:

1. Install components and accessories in accordance with manufacturers' written instructions.
2. Inspect each component before installation. Components with visible damage shall be rejected and replaced with non-defective components.
3. Verify and inspect that equipment openings, i.e., ventilation holes/slots are covered and protected from debris entering and damaging the equipment.
4. Cold springing and forcing of components and accessories for the purpose of joint makeup is not permitted unless specified on the installation drawings.
5. Welding grounds shall not be installed on mechanical equipment (pumps, compressors, etc.), equipment baseplates, or routed through equipment. Install grounding straps where required.
6. Installed components and accessories shall maintain a uniform slope where pitched for drainage, i.e. roof lines of hose houses and heated doghouses. Pockets or water traps shall be avoided. Where pockets are unavoidable, provide vent/drain valve connection.
7. Install grounding straps where required.
8. Removal of protective coverings for equipment is prohibited until final connections are ready to be made.
9. The components and accessories installation shall be coordinated with other trades and other subcontractors working on the same area and be in accordance with Cal-OSHA standards.

10. Existing lines, conduits, or wires shall not be cut, operated/decommissioned or disturbed prior to identification of the service, condition of the utility and authorization from the General Manager.
11. At the completion of installation, the contractor shall supply and deliver all special tools required for maintenance and adjustments for the Fire Alarm and Signaling Systems and accessories.

B. Sleeves and Penetrations:

1. Install conduit through sleeves and penetrations as shown on drawings.
2. Sleeves are to be provided where conduits pass through floors and walls. Where sleeves are not provided in the original construction, obtain approval and satisfactorily perform cutting and installation or core drilling as required.
3. Sleeves shall be standard weight carbon steel pipe having minimum internal diameter 2inches (50 mm) larger than OD of bare conduit unless otherwise indicated. Wall sleeves shall be flush on both sides of wall, and floor sleeves shall extend 2 inches (50 mm) above floor, except where otherwise indicated and necessary to suit location and piping function.
4. Flashing shall be applied and sealed as necessary to weatherize the penetration.
5. Fire-stopping shall be applied as necessary to maintain the fire-rating of the original wall or floor.

C. Electrical conduits shall be adequately supported by use of racks, stanchions, clips, or hangers as required by NFPA 70.

D. Conduit Labeling and Identification: Provide the conduit labeling and identification as directed by Project Documents.

E. Comply with NFPA 72 for installation of fire-alarm equipment.

F. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 meters).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to NFPA 72, Chapter 5 and explanatory material in Appendix A.
5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

G. Remote Status and Alarm Indicators: Install near each smoke/fire/heat detector that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1.83 meters) above the finished floor.

K. Equipment Removal: After acceptance of the fire alarm system, remove any existing disconnected fire-alarm equipment and wiring.

L. Connections:

1. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 meter) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

M. Identification:

1. Identify system components, wiring, cabling, and terminals. Comply with Project requirements for identification.
2. Install framed instructions in a location visible from fire-alarm control unit.

N. Grounding:

1. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

A. Examination and Inspection: Examination and inspections shall be completed during the fabrication, installation and erection process. Field tests shall be witnessed by the General Manager and the AHJ.

B. Fire Alarm Reporting and Annunciating Testing: Comply with an approved procedure demonstrating all reporting stations operate correctly and all alarms are properly annunciated.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Obtain the required approved submittals including Product Data, Shop Drawings, Quality Control Procedures, Test Reports and Project Record Documents.

3.7 ADJUSTING AND CLEANING

A. Adjustments:

1. Perform all adjustments and calibrations required to make the system operable.
2. Provide qualified representative to train General Manager's maintenance personnel to adjust, operate, and maintain fire-alarm system.

B. Final Cleaning:

1. At completion of work, the work areas surrounding the Fire Alarm and Signaling system, cabinets and components shall be swept out and cleaned of all construction debris from the Fire Alarm and Signaling system installation work.
2. All protective films and covers shall be removed after acceptance by the General Manager.

3.8 DEMONSTRATION

A. The Fire Protection Contractor shall notify the General Manager, AHJ, and the BOP Contractor 72 hours prior to conducting fire protection tests and demonstrations to allow arrangements to be made to witness the test/demonstration. The work shall not be deemed complete until the General Manager and AHJ accepts the work after a demonstration test.

B. Contractor to notify the Pasadena fire Department (PFD) 72 hrs before any testing, requiring PFD witnessing, is performed.

C. Fire Alarm Reporting and Annunciating Testing: Comply with an approved procedure demonstrating all reporting stations operate correctly and all alarms are properly annunciated.

D. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the Fire Alarm and Signaling equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

1. Every manual pull station shall be tested.
2. Every automatic fire protection device shall be tested.
3. Every alarm flashing light / strobe shall be tested.
4. Every Fire Alarm and Signaling annunciating device shall be tested.
5. A walkdown of the plant shall verify the fire alarm can be heard / noticed above ambient noise conditions (85 dBA).

E. Flow tests outside of the project site fence line shall be performed by PFD. The Fire Marshal will inspect all installations of the underground fire loop, hydrostatic testing, flushing, flow tests, etc. as well as all aboveground fire piping, hydrostatic testing, flushing, flow tests, gas detection, hazardous material piping, tanks with hazardous materials and controls for these tanks, etc

3.9 SPARE PARTS

A. The Fire Protection contractor shall provide all spare parts for startup and functional testing.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but a minimum of 1 unit for each type.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but a minimum of 1 unit for each type.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no less than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no less than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

3.10 SCHEDULES

A. The Fire Protection Contractor shall show all schedules on the Fire Protection drawings, i.e. painting schedules, hardware, panels, detectors, etc.

B. Fire Protection Contractor schedules shall be coordinated, i.e. a fire detector selected on one schedule shall be verified for fit and function for a device selected in a panel selected on a separate schedule.

END OF SECTION 485956.10

PART 4 - ATTACHMENTS

SUBMITTAL REQUIREMENTS SCHEDULE

	Submittal Description	*Copies for Review*		*Certified Copies*	
		Data after Bid	*Date Req'd*		*Date Req'd*
1.	**Administrative Submittals**				
	Contract Closeout Submittals			X	10DFC
	Quality Control Manual	X	4ARO		
2.	**Drawings**				
	Installation Detail Drawings	X	6ARO	X	10DFC
	Electrical one-line Drawings	X	4ARO	X	10DFC
	Electrical Loop Diagrams	X	6ARO	X	10DFC
	Logic Diagram	X	4 ARO	X	10DFC
3.	**Manufacturer's Standard Data**				
	Catalog Data Sheets	X	4ARO	X	6ARO
4.	**Field Installation, Erection and Placing Instructions or Procedures**				
	Manufacturer Instructions	X	4ARO	X	10DFC
5.	**Product Data**				
	Dimensional Drawings	X	6ARO	X	10DFC
	Material Safety Data Sheets (MSDS)	X	4ARO		
6.	**Inspection, Test Reports and Certificates of Compliance**				
	Functionality Testing	X	6ARO		
	Functional Test reports			X	10DFC
	Certificates of UL Listed Products			X	10DFC
	Material Test Reports	X	1PTC		
7.	**Operations and Maintenance Data Manual**				
	Operation and Maintenance Data	X	4ARO	X	10DFC
8.	**Record Documents**				
	Project Record Documents			X	10DFC
	Software Documentation and Backup copy			X	2 DFC
9.	**Warranties and Guarantees**				
	Warranty			X	10 DFC

September 9, 2013

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Section 485072
Coatings for Piping and Tanks

PROJECT NUMBER:
123374

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Section 485072
Coatings for Piping and Tanks

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REVISION HISTORY		
DATE	REVISED BY	REVISION
9/9/2013	T. Clark	A

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 RELATED SECTIONS 1
1.3 CODES AND STANDARDS 1
1.4 DEFINITIONS 3
1.5 SUBMITTALS 3
1.6 PRODUCT OPTION 4
1.7 QUALITY ASSURANCE 4
1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING 4
1.9 SITE CONDITIONS 5

PART 2 - PRODUCTS 5

2.1 MANUFACTURERS 5
2.2 MATERIALS 5

PART 3 - EXECUTION 11

3.1 GENERAL 11
3.2 GENERAL REQUIREMENTS 11
3.3 SURFACE PREPARATION 12
3.4 APPLICATION 12
3.5 SPILLS AND CLEAN-UP 13
3.6 FIELD QUALITY CONTROL 13

APPENDIX A MATERIAL SPECIFICATION 15

APPENDIX B SUBMITTAL REQUIREMENTS SCHEDULE 19

SECTION 485072
COATINGS FOR PIPING AND TANKS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification Section covers the procurement, supply, handling, management, preparation, application and testing of coatings for piping and tanks for the Project.

B. Refer to the coating code listed on M9-3 Piping Line List and datasheets provided with the tank specifications for coating requirements of individual pipes and tanks.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Special Conditions included in Contract Documents, apply to this Section.

B. Section 480020 - Site Conditions

C. Section 481200 - Combined Cycle Balance of Plant

D. Section 485172 – Field Fabricated Tanks

E. Section 485173 – Shop Fabricated Tanks

F. Section 485972 – Mechanical Installation Requirements

1.3 CODES AND STANDARDS

A. Refer to 481200, Combined Cycle Balance of Plant for general codes and standards applicable to the project. The following codes and standards apply to the specific equipment supplied under this Section.

1. ASME – American Society of Mechanical Engineers

a. ASME A13.1, Scheme for the Identification of Piping Systems

2. ASTM – American Society for Testing and Materials

a. ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings
b. ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
c. ASTM D16, Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products
d. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials
e. ASTM D1000, Standard Test Methods for Pressure-Sensitive Adhesive Coated Tapes Used for Electrical and Electronic Applications

3. AWWA – American Water Works Association

    a. AWWA C105, Polyethylene Encasement for Ductile Iron Pipe Systems
    b. AWWA C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines Enamel and Tape-Hot Applied
    c. AWWA C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
    d. AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
    e. AWWA C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
    f. AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines
    g. AWWA C222, Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

4. BSSA - British Stainless Steel Association

    a. SSAS4.01, Introduction to Corrosion Resistance
    b. SSAS5.80, Paint Coating Stainless Steel

5. IAPMO – International Association of Plumbing and Mechanical Officials

    a. IAPMO IS 13-2006, Installation Standard for Protectively Coated Pipe
    b. IAPMO PS 37-1990, Black Plastic PVC or PE Pressure-Sensitive Corrosion Preventive Tape

6. SSPC – Steel Structures Painting Council

    a. SSPC-PA 1, Shop, Field and Maintenance Painting
    b. SSPC-PA 2, Method for Measurement of Dry Paint Thickness with Magnetic Gauges
    c. SSPC-SP 1, Solvent Cleaning
    d. SSPC-SP 2, Hand Tool Cleaning
    e. SSPC-SP 3, Power Tool Cleaning
    f. SSPC-SP 6, Commercial Blast Cleaning
    g. SSPC-SP 7, Brush-off Blast Cleaning
    h. SSPC-SP 10, Near-White Blast Cleaning
    i. SSPC-VIS 1, Pictorial Surface Preparations Standards for Painting Steel Surfaces
    j. SSPC-VIS 2, Standard methods of evaluating Degree of rusting on Painted Steel Surfaces

7. NACE – National Association of Corrosion Engineers

    a. NACE RP-02-74, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
    b. NACE RP-01-88, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
    c. NACE SP-0109-2009, Field Application of Bonded Tape Coatings for External Repair, Rehabilitation, and Weld Joints on Buried Metal Pipelines

8. NAPCA – National Association of Pipe Coating Applicators

a. NAPCA Bulletin 1-65-94, Recommended Specification Designations for Coal Tar Enamel Coatings

1.4 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

B. The words "Project Documents" refers to Drawings, Related Sections and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

C. 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.

D. City: The City of Pasadena, CA

E. 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.

F. 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

A. Submit the following for review in accordance with requirements of Section 481200, Combined Cycle Balance of Plant.

B. Product Data:

1. Primers, intermediate and finishing products for coatings and accessory materials.
2. Material Safety Data Sheets (MSDS).

C. Samples: Two each, 12-inch x 12-inch samples, illustrating range of colors and textures available for each surface finishing product scheduled.

D. Quality Control Submittals:

1. Surface preparation, substrate conditions, paint and coating application, re-coat time, and curing procedures.
2. Temperature and humidity requirements for the storage and application of coatings.
3. Qualification of applicators.
4. Inspection and testing of surface preparation and coating application.

E. Test Reports:

1. Dry film thickness (DFT) test reports
2. High-voltage spark testing (holiday testing)

F. Manufacturer's instructions for storage, surface preparation, application and curing.

G. Contract Closeout Submittals: Certified data and documents identified on the Submittal Requirement Schedule as shown in Appendix A.

H. Project Record Documents: Record Drawings and documents showing final certified data for products and installation.

I. Warranty: Product warranty certificates.

1.6 PRODUCT OPTION

A. Submit product options and substitutions in accordance with Project Documents.

B. Substitution of proposed material after approved submittal will not be allowed without re-submittal and re-approval.

1.7 QUALITY ASSURANCE

A. Refer to Section 481200, Combined Cycle Balance of Plant for general quality assurance requirements.

B. If conflicts exist between documents, the Engineer shall determine requirements.

C. Comply with approved submittal documents and procedures.

D. Qualifications:

1. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years' documented experience.
2. Subcontractor: Company specializing in performing the work of this Section; who has specialized in applying specialty coatings similar to that required for this Project and has a minimum five years' documented experience; who is approved, authorized, or licensed by the coatings Manufacturer to apply Manufacturer's product; and whose completed work is eligible to receive the standard coating Manufacturer's warranty.

1.8 PACKAGING, DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 481200, Combined Cycle Balance of Plant for general delivery, storage, and handling requirements.

B. Container label to include Manufacturer's name, type of coating, brand name, lot number, manufacture date and shelf life, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Deliver products to site in sealed, labeled, and dated containers; inspect to verify acceptability.

D. Store coating materials in a ventilated area at a minimum temperature of 45°F and a maximum of 90°F, as required by Manufacturer's instructions.

E. Maintain materials in good, as-delivered condition until installation at the job site.

F. Unused materials shall be returned at the end of each workday to the storage area.

1.9 SITE CONDITIONS

A. Refer to Section 480020, Site Conditions for general site conditions affecting products on site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following products are pre-approved for this project.

1. Ameron International
2. Carboline

2.2 MATERIALS

A. Coatings shall have a consistency capable of being readily and uniformly spread as a homogeneous coat. They shall have good flow and brushing properties, and be capable of drying or curing free of streaks or sags.

B. Accessory Materials: Thinners, accelerators, and other materials shall meet the Coatings Manufacturer recommendations

C. Coatings shall be applied in accordance with Coating Manufacturer written Product and Application Data Sheet Instructions.

D. Material Classification: See Appendix B for Class Specification.

1. CLASS A1 – General Purpose Coatings:

a. Service Temperature: Ambient to 180°F max.
b. Chemical Resistance: Good
c. Outdoor Requirement:

1) Weather: Good
2) UV protection
3) Airborne particulate-resistant
4) Abrasion-resistant
5) Corrosion protection

2. CLASS D1 – Moderate Temperature Coatings:

a. Service Temperature: Ambient to 400°F max.
b. Outdoor Requirement:

1) Weather: Severe
2) UV Protection: Moderate
3) Airborne particulate-resistant

3. CLASS E1 – Condensation Control Coating:

a. Service Temperature: Ambient to 90°F max.
b. Chemical Resistance: Mild
c. Outdoor Requirement:

1) Weather: Mild
2) UV protection
3) Abrasion-resistant

4. CLASS F1 – Galvanized Coatings: Shall be fabricator-applied. Where touch-up is required, cold-galvanizing coating shall be applied in accordance with ASTM A780.
5. CLASS H1 – High Temperature Coatings:

a. Service Temperature: Ambient to 1000°F max.
b. Outdoor Requirement:

1) Weather: Severe
2) UV Protection: Moderate
3) Airborne particulate-resistant

6. CLASS NC – No Coating Required
7. CLASS S1 – Special Service Coating, Immersion Service:

a. Service Temperature: Ambient to 250°F max.
b. Immersion Service: Water, deionized water, brine, petroleum processes
c. Chemical Resistance: Mild chemical and hazardous waste as approved by manufacturer.
d. Outdoor Requirement: None
e. Abrasion-resistant
f. Electrical Inspection: NACE RP-02-74 testing of the inner-layer prior to application of the outer-layer.
g. Electrical Inspection: NACE RP-01-88 testing of the outer-layer.

8. CLASS S2 – Special Service Coating, Immersion potable water service:

a. Immersion Service: Water
b. 140°F maximum service temperature
c. 3-4 coats at 4-6 mils per coat for 12-24 mil DFT
d. Approved for potable water service
e. Electrical Inspection: NACE RP-02-74 testing of the outer-layer.

9. CLASS U1 – Underground Coal-Tar Exterior Coatings for Steel and Ductile Iron Piping:

a. Extend coating 6 inches above finished surface elevation where piping continues aboveground.
b. Provide 6-inch coating set-back on pipe sections for weld preparation
c. Service Temperature Range: -20°F to 160°F
d. Underground direct soil and moisture contact
e. Pipe sections shall have the pipe ASTM material identification markings re-stenciled on finish coat and be supplied with Certificates of Compliance or Material Test Reports to provide for material identification.
f. Coating and tape coating systems are to be selected by the coating Manufacturer to work as a complete system. Substitution of coating system components is prohibited.
g. Straight sections: AWWA C203 with additional exterior protection system – coal-tar enamel, glass-fiber outerwrap, and bonded outerwrap (NAPCA-TGF-3).

    1) Surface Preparation: SSPC SP-6
    2) Primer: AWWA C203 Type B (fast-drying, synthetic)
    3) Coal-tar Enamel: AWWA C203 Type II
    4) Bonded outerwrap: (inner mat)
    5) Bonded outerwrap (outer mat)
    6) Finish Coat: Water-emulsion latex paint – color neutral
    7) Electrical Inspection: AWWA C203

h. Special Sections, Connections, Fittings, Joints, and Coating Repairs: AWWA C209 with anti-corrosion and mechanical protection layers.

    1) Shall be coated after welding or assembly using a cold-applied tape coating system meeting AWWA C209 and Manufacturer's installation instructions/specifications.
    2) Surface Preparation: SSPC SP-6
    3) Adhesive: AWWA C209 compatible with selected Type II tape and supplied by the same manufacturer as the tape.
    4) Anti-corrosion Tape: AWWA Type II, 0.030-inch minimum thick, 50% spiral overwraps.
    5) Mechanical Protection Tape: AWWA Type II, 0.015-inch minimum thick, 50% spiral overwraps.
    6) Tape-Coating-System Thickness: 0.090-inch minimum.
    7) Electrical Inspection: AWWA C209

10. CLASS U2 – Polyethylene Encased Buried Cast Iron Soil Pipe: ASTM A74 X3.
11. CLASS U3 – Underground Tape Coatings for Steel Piping:

    a. Extend coating 6 inches above finished surface elevation where piping continues aboveground.
    b. Provide 6-inch coating set-back on pipe sections for weld preparation
    c. Service Temperature Range: -20°F to 160°F
    d. Underground direct soil and moisture contact
    e. Pipe sections shall have the pipe ASTM material identification markings re-stenciled on finish coat and be supplied with Certificates of Compliance or Material Test Reports to provide for material identification.
    f. Tape coating systems are to be selected by the coating Manufacturer to work as a complete system. Substitution of coating system components is prohibited.

g. Straight Sections: AWWA C214.

1) Surface Preparation: SSPC SP-6
2) Liquid adhesive
3) Inner-Layer (Corrosion Protection): 0.020-inch minimum, 50% spiral overwrap
4) Outer-Layer (Mechanical Protection): 0.030-inch minimum, 50% spiral overwrap
5) Tape-Coating – System Thickness: 0.100-inch minimum
6) Electrical Inspection: NACE RP-02-74 testing of the inner-layer prior to application of the outer-layer.

h. Special Sections, Connections, Fittings, Joints, and Coating Repairs: AWWA C209 with anti-corrosion and mechanical protection layers.

1) Shall be coated after welding or assembly using a cold-applied tape coating system meeting AWWA C209 and Manufacturer's installation instructions/specifications.
2) Surface Preparation: SSPC SP-6
3) Adhesive: AWWA C209 compatible with selected Type II tape and supplied by the same manufacturer as the tape.
4) Anti-corrosion Tape: AWWA Type II, 0.030-inch minimum thick, 50% spiral overwraps.
5) Mechanical Protection Tape: AWWA Type II, 0.015-inch minimum thick, 50% spiral overwraps.
6) Tape-Coating-System Thickness: 0.090-inch minimum.
7) Electrical Inspection: AWWA C209

12. CLASS U4 – Underground Epoxy Coatings for Carbon Steel Piping:

a. Extend exterior coating 6 inches above finished surface elevation where piping continues aboveground.
b. Provide 6-inch coating set-back on pipe sections for weld preparation
c. Service Temperature Range: -20°F to 160°F
d. Underground direct soil and moisture contact
e. Pipe sections shall have the pipe ASTM material identification markings re-stenciled on finish coat and be supplied with Certificates of Compliance or Material Test Reports to provide for material identification.
f. Apply interior lining and exterior coating in accordance with:

1) ANSI/AWWA C210-03: Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
or
2) ANSI/AWWA C213-03: Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

g. Field repairs for AWWA C210 systems shall be in accordance with AWWA C210.
h. Field repairs for AWWA C213 systems shall be in accordance with AWWA C210 or AWWA C213.

13. CLASS U5 - Urethane Coatings for Steel and Alloy Piping:

a. Extend exterior coating 6 inches above finished surface elevation where piping continues aboveground.
b. Provide 6-inch coating set-back on pipe sections for weld preparation.
c. Service Temperature Range: -20°F to 160°F
d. Underground direct soil and moisture contact
e. Pipe sections shall have the pipe ASTM material identification markings re-stenciled on finish coat and be supplied with Certificates of Compliance or Material Test Reports to provide for material identification.
f. Surface preparation and application of exterior coating in accordance with manufacturer and AWWA C222 guidelines.

1) Pre-clean surfaces per SSPC-SP1 to remove dirt, grease, oil, or other contaminants using only solvents that do not leave a residue
2) Blast clean only when ambient temperature is at least 5˚F (3˚C) above the dew point.
3) Blast clean per SSPC-SP10 with angular profile using clean media appropriate for the substrate and coating to be applied and contaminant free compressed air.

a) Stainless steel requires non-metallic blast media such as alumina or silicon carbide.

4) Achieve a minimum anchor pattern of 2.5 mils or greater if required by the coating manufacturer.
5) Maintain atmospheric control of contaminants for the period between grit blasting and application of coatings (include 60 minutes dwell time for stainless steels).
6) Apply coating only when metal temperature is at least 5˚F (3˚C) above the ambient dew point an within the ambient temperature range prescribed by the coating manufacturer.
7) Exterior surface application minimum coating thickness shall be minimum 25 mils or as recommended by the coating manufacturer for special service applications.
8) Inspection:

a) Test dry film thickness by measuring per SSPC-PA2.
b) Test electrical conductivity per NACE RP-0188 with 100 V/mil minimum voltage. Holidays in the coating shall be marked and repaired.
c) Test adhesion at two locations per shift per ASTM D4541. Minimum acceptable test strength is 1500psi. If one location fails adhesion test, test two more locations from that shift. If one of those locations fails, systematically test all coating applied that shift.

9) Field Repairs:

a) Prepare surfaces to be coated by the same methods listed above.
b) Abrade 1-2” of coated surface on each side of area to repair or from edge of holdback.
c) Field applied coating material must be compatible with original coating.

g. Additional approved coating systems for compressed air and water systems (not for fuel gas):

1) Shop applied coatings

a) PPG Amerloc 2: 8-10 mils per coat, 16-20 mil total thickness
b) PPG Amerloc 2/400 GFK: 8-10 mils per coat, 16-20 mil total
c) thickness
d) Carboline Polyclad 777: 30 mil total thickness

2) Field applied touch up and repair coating

a) PPG Amerloc 2: 8-10 mils per coat, 16-20 mil total thickness
b) PPG Amerloc 2/400 GFK: 8-10 mils per coat, 16-20 mil total
c) thickness
d) Carboline Polyclad 777R: 30 mil total thickness
e)

14. CLASS U6 – Underground Tape Coatings for Copper Piping:

a. Extend coating 6 inches above finished surface elevation where piping continues aboveground.
b. Provide 6-inch coating set-back on pipe sections for solder or brazing preparation
c. Service Temperature Range: -55°F to 175°F
d. Underground direct soil and moisture contact
e. Pipe sections shall have the pipe ASTM material identification markings re-stenciled on outer surface and be supplied with Certificates of Compliance or Material Test Reports to provide for material identification.
f. Tape coating systems are to be selected by the coating Manufacturer to work as a complete system. Substitution of coating system components is prohibited.
g. Tape wrap material: PVC. Tape for field application shall comply with IAPMO PS 37-90.
h. Tape wrap thickness: 0.010-inch minimum.
i. Surface preparation and application of tape wrap in accordance with manufacturer guidelines, NACE SP0109-2009, and IAPMO IS 13-2006. Primer shall be supplied by the same manufacturer as the tape.
j. Testing: Test coating per ASTM D1000

E. Colors: Safety colors shall be as per ASME A13.1.

1. Firewater: Safety Red (Ameron color RD-2)
2. Combustible Fluids: Safety Yellow (Ameron color YE-3)
3. Potable Water: White (Ameron color WH-2)
4. High Temperature: Aluminum
5. All Others: Grey (Ameron color GR-3)

PART 3 - EXECUTION

3.1 GENERAL

A. Furnish, store, apply, examine, and test coatings.

B. The Work shall include items as specified herein including, but not limited to, the following items:

1. Labor and construction materials, except as specified otherwise herein, for the application of coating specified under this Specification.
2. Material and components required for coating systems as specified herein.
3. Ventilation and environmental control equipment for temperature and humidity.
4. Lighting.
5. Loading, transporting and unloading of coating materials from the job site storage to the work area.
6. Compressed air-supply, tools, connectors and hoses if required.
7. Electric generators, electric tools, hand tools, and other miscellaneous tools.
8. Rigging equipment, components, and roller stands.
9. Consumables and coatings necessary to complete job.
10. All labor and materials for temporary scaffolding necessary for the Work to be accomplished.
11. Temporary work enclosures as required for completion of work including storage of material and installation of weather protection.
12. Temporary buildings, trailers, tool trailers, etc. for offices, locker/change rooms and bathrooms.
13. Safety gear, equipment, and supplies and compliance with the Installer's safety practices.
14. Communication devices (radios, phones, etc.) and equipment.
15. Reports and documentation as specified and required under this Specification.
16. Waste management, control and disposal procedure.

C. Clean-up and removal of trash to designated receptacles or disposal area on a daily basis or as additionally directed.

3.2 GENERAL REQUIREMENTS

A. Precautions shall be employed when cleaning surfaces and applying coatings to protect adjacent surfaces from over-spray, drips, and blast particulate from hitting or entering components and mechanical equipment. Coating which is applied, over-sprayed, dropped, or otherwise permitted to get on any object or surface other than to which it is being applied, shall be removed immediately. Coating installer shall repair or replace damaged surfaces or items.

B. Comply with Manufacturer's recommendations and instructions for mixing, storing, applying, and using of products.

C. Touch-up and Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Surfaces to be prepared to SSPC-SP 3. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

D. Surfaces shall be kept clean and dry during coating application. Protect the incomplete coating work from weather, dirt, and possible damage.

E. Coating materials shall not be removed from shipping containers until ready for use. Returned to similar containers that will protect from dirt and moisture at the end of each workday. Two part mixtures shall be disposed at the end of the pot life.

F. Fumes shall not be allowed to build up. Areas where coating works are to be completed shall be ventilated to remove fumes.

G. Concentration of combustible fumes shall be maintained below 10% of the lower explosive limit (LEL).

H. Temporary Removal of Installed Work: During the course of work, removal and reinstallation or replacement of certain floor grating or other items which have previously been installed may be necessary or of major advantage. Removal/installation of such items shall be by the Contractor. Contractor shall provide temporary barriers, markers and signage to guard areas around removed grating until work is complete and grating is reinstalled.

3.3 SURFACE PREPARATION

A. Verify that the piping or tank is ready for coating.

B. Examine surfaces prior to commencement of work. SSPC-VIS 1 and VIS 2 shall be used to determine the degree of surface preparation required.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Examine previously coated surfaces for holidays and adequate dry film thickness.

E. Preparation of the surface shall be according to class specification and Manufacturer's recommendation.

F. Surface shall be free of moisture. The dew point shall be 5°F or higher than the surface and its surroundings, and the temperature shall stay within specified application limits until recoat time is reached.

G. For stainless steels allow minimum 60 minutes dwell time between abrasive grit blasting (or removal of passive oxide layer) and application of coating in a clean atmospherically controlled environment free of airborne or external contaminants with ambient and metal temperatures at least 5˚F above dew point.

3.4 APPLICATION

A. Provide environmental control during surface preparation, coating application, and curing.

B. Mixing of materials shall be completed in an area where containment of spills is controlled. Spill control shall be accomplished by use of a sheet metal drip pan, plastic barrier, or other impermeable barrier.

C. Apply products in accordance with Manufacturer's instructions.

D. Apply each coat to uniform finish and thickness.

E. Apply each coat one shade darker than preceding coat unless otherwise approved.

F. Allow applied coat to cure to specified recoat time, based on curing temperature, before next coat is applied.

3.5 SPILLS AND CLEAN-UP

A. Spills shall be contained, properly cleaned, and disposed of within 30 minutes of spill.

B. Collect waste material that may constitute a fire hazard, place in metal containers. Empty cans, waste and cleaning materials shall be disposed of twice daily and not allowed to accumulate.

C. Coverings, rags, coating materials and equipment, cleaning fluids and equipment, scaffolding used and safety equipment shall be removed from site before contract is closed out.

3.6 FIELD QUALITY CONTROL

A. Surfaces that are to be finished shall be subject to visual inspection. Those surfaces to receive an epoxy coating will also be inspected for dry film thickness. Refer to SSPC-PA-2 or other approved dry film thickness method of measuring dry coating thickness.

B. Visual Inspection: Examine finished surfaces with the aid of a hand-held electric light or other light source to illuminate surface to a light level of at least 80 foot-candles. The surface shall be free of rough or irregular particles when lightly brushed with the palm or fingers of the hand. The coating shall be of adequate thickness to completely mask the color or markings of the substrate material or previous coating. The finished surface shall be free from sags or runs in the coating material, and shall be continuous over the entire finished surface without cracks, chips, or other irregularities.

C. Surfaces that are to receive an epoxy coating finish shall be inspected in a manner to physically measure the wet or dry film thickness. Non-destructive methods of testing are preferred; however, if destructive methods are employed, the test site shall be touched up to repair the finished surface to its original finished condition after the destructive test is completed. Film thickness (either wet or dry) shall average no more or less than 20 percent of the specified thickness. Testing shall be of sufficient frequency to ensure uniformity over the area to be coated with testing being completed a minimum of once every 25 square feet.

1. Wet surfaces shall be inspected for defects such as skips, foreign inclusions, fish eyes, runs, curtains, gassing, bubbling, or dry spray. Areas of defect should be corrected immediately.
2. Dry or cured surfaces shall be checked for uniform hardness, absence of wrinkling, lifting, cracking, checking, or blistering. Areas of defect should be repaired. Pinholes and skips should be touched up.

D. Electrical Testing: As specified by AWWA.

E. Obtain the required approved submittals including Product Data, Quality Control Procedures, Test Reports and Project Record Documents.

END OF SECTION 485072

APPENDIX A
MATERIAL SPECIFICATION

MATERIAL CLASS (TABLE 1)*

	CLASS A1	CLASS D1	CLASS E1	CLASS F1	CLASS H1	CLASS S1	CLASS S2	CLASS U5
Surface Preparation	**5**	**4**	**4**	**3**	**7**	**4**	**6**	**7**
PRIMER								
DFT	2.5	2.5	2.5	3	2.5	2.5	------	------
No. of Components	2	2	2	2	2	2	------	------
Percent Solids	79	62	62	55	79	62	------	------
Shelf Life – months	12	9	9	9	12	9	------	------
Recoat Time – hrs	24	24	24	24	24	24	------	------
Cure Time – hrs	24	24	24	24	24		------	------
1st COATING								
DFT	------	3	4	------	------	5-6	4-6	10-15
No. of Components	------	2	2	------	------	3	2	2
Percent Solids	------	54	63	------	------	74	64	100
Shelf Life – months	------	12	12	------	------	24	12	12
Recoat Time – hrs	------	16	.5	------	------	16	8	2
Cure Time – hrs	------	24	1.3	------	------	2	------	1
2nd COATING								
DFT	------	------	------	------	------	------	4-6	------
No. of Components	------	------	------	------	------	------	2	------
Percent Solids	------	------	------	------	------	------	64	------
Shelf Life – months	------	------	------	------	------	------	12	------
Recoat Time – hrs	------	------	------	------	------	------	8	------
Cure Time – hrs	------	------	------	------	------	------	------	------
FINISH COATING								
DFT	4	3	4	------	2	5-6	4-6	10-15
No. of Components	1	2	2	------	1	3	2	2
Percent Solids	40	54	63	------	48	74	64	100
Shelf Life – months	24	12	12	------	12	24	12	12
Recoat Time – hrs	2	16	.5	------	4	16	8	2
Cure Time – hrs	6	24	1.3	------	2	14 days	6 days	1
Min. Appli'n Temp.	40	50	20	------	40	32	50	45
Max. Appli'n Temp.	120	110	120	------	120	120	100	120

***See Manufacturer's Product Data and Application Sheets for all mixing, installation and recoat time requirements. See reference standard requirements for CLASS U1, U2, U3, U4 coating systems.**

SURFACE PREPARATION LEGEND

1. SSPC-SP 1, Solvent Cleaning
2. SSPC-SP 2, Hand Tool Cleaning
3. SSPC-SP 3, Power Tool Cleaning
4. SSPC-SP 5, White Blast Cleaning
5. SSPC-SP 6, Commercial Blast Cleaning
6. SSPC-SP 7, Brush-off Blast Cleaning
7. SSPC-SP 10, Near-White Blast Cleaning

SECTION 485072
COATINGS FOR PIPING AND TANKS

CLASS PRODUCTS

A. CLASS A1 – General Purpose Coating System
   1. Not for immersion service
   2. Pre-Approved Manufacturers:
      a) Carboline
         1) Primer – Primer – Carbozinc 11 VOC Inorganic Zinc Primer
         2) 1st Coat - None
         3) 2nd Coat - None
         4) Finish Coat - Carbocrylic 3359 DTM

B. CLASS D1 – Moderate Temperature Coating System
   1. Not for immersion service
   2. Pre-Approved Manufacturers:
      a) Ameron International
         1) Primer – Dimetcote 9 Inorganic Zinc Primer
         2) 1st Coat - Ameron VyGuard V9 Epoxy Novolac
         3) 2nd Coat - None
         4) Finish Coat - Ameron VyGuard V9 Epoxy Novolac

C. CLASS E1 – Condensation Control Coating System
   1. Not for immersion service
   2. Pre-Approved Manufacturers:
      a) Ameron International
         1) Primer – Dimetcote 9 Inorganic Zinc
         2) 1st Coat – Amercoat 370 Epoxy
         3) 2nd Coat –None
         4) Finish Coat – Amercoat 370 Epoxy

D. CLASS F1 – Galvanized Coating System
   1. Not for immersion service
   2. Pre-Approved Manufacturers:
      a) Ameron International
         1) Primer – Ameron VyGuard Galvakote
         2) 1st Coat – None
         3) 2nd Coat – None
         4) Finish Coat - None

E. CLASS H1 – High Temperature Coating System
   1. Not for immersion service
   2. Pre-Approved Manufacturers:
      a) Carboline
         1) Primer – Carbozinc 11 Inorganic Zinc Primer
         2) 1st Coat - None
         3) 2nd Coat - None
         4) Finish Coat – Thermaline 4700 Aluminum

F. CLASS S1 – Special Service Coating, Immersion Service
   1. For immersion service
   2. Pre-Approved Manufacturers:
      a) Carboline
         1) Primer – Carboline approved for Plasite 7156
         2) 1st Coat – Plasite 7156
         3) 2nd Coat –None
         4) Finish Coat – Plasite 7156

G. CLASS S2 - CLASS S2 – Special Service Coating, Immersion potable water service
   1. For immersed potable water service
   2. Pre-Approved Manufacturers:
      a) Ameron International
         1) Primer – Amercoat 90HS
         2) 1st coat – Amercoat 90HS
         3) 2nd coat – Amercoat 90HS
         4) Finish Coat – Amercoat 90HS

H. CLASS U1 – Underground Coal-Tar Exterior Coating for Steel and Ductile Iron Piping
   1. Underground direct soil and moisture contact
   2. Pre-Approved Manufacturers:
      a) AWWA C203 - Reilly Industries, Inc.
         1) Primer: AWWA C203 Type B (fast-drying, synthetic) - Reilly #122 Synthetic Primer
         2) 1st Coat - Coal-tar Enamel: AWWA C203 Type II - Reilly AWWA., Type II, Enamel (Fully-Placticized)
         3) 2nd Coat - Fiberglass Inner Mat: Centurion 50-12 Fiberglass Mat
         4) 3rd Coat: Same as 1st coat
         5) 4th Coat - Coal-tar Saturated Outerwrap: DURAMAT HD Pipeline Outerwrap
         6) Finish Coat: Water-emulsion latex paint - color white
      b) AWWA C209 - Tyco Polyken
         1) Primer (Adhesive): Polyken 1027
         2) 1st Coat - Anti-corrosion Tape: Polyken 930-30
         3) Final Coat - Mechanical Protection: Polyken 954-15

I. CLASS U3 – Underground Tape Coating for Steel Piping
   1. Underground direct soil and moisture contact
   2. Pre-Approved Manufacturers:
      a) AWWA C214 - Tyco Polyken
         1) Primer: Polyken 1019 (1029)
         2) 1st Coat - Anti-corrosion Tape: Polyken 989-20
         3) Final Coat - Mechanical Protection: Polyken 955-30/956-30
      b) AWWA C209 - Tyco Polyken
         1) Primer (Adhesive): Polyken 1027
         2) 1st Coat - Anti-corrosion Tape: Polyken 930-30
         3) Final Coat - Mechanical Protection: Polyken 954-15

J. CLASS U4 – Underground Epoxy Coatings for Steel Piping
   1. Underground direct soil and moisture contact
   2. Pre-Approved Manufacturers:
      a) AWWA C214 - Tyco Polyken
         1) Primer: Polyken 1019 (1029)
         2) 1st Coat - Anti-corrosion Tape: Polyken 989-20
         3) Final Coat - Mechanical Protection: Polyken 955-30/956-30
      b) AWWA C209 - Tyco Polyken

K. CLASS U5 - Urethane Coatings for Steel, Stainless Steel and Alloy Piping:

   1. Underground direct soil and moisture contact
   2. Pre-Approved Manufacturers
      a) Shop applied coatings
         1) Carboline Polyclad 777: 3 mil anchor profile, 30 mil total thickness for padded backfill
      b) Field applied touch up and repair coating:
         1) Carboline Polyclad 777R: 2.5 mil anchor profile, 30 mil total thickness for padded backfill, 45˚F min substrate temperature, 110-120˚F cartridge temperature, apply by roll, brush or spray.

APPENDIX B
SUBMITTAL REQUIREMENTS SCHEDULE

		Equipment No.
SUBMITTAL REQUIREMENTS SCHEDULE COATINGS FOR PIPING AND TANKS	Client	Requisition No.
	Contract	Specification No.
The following Submittals must be furnished to the entity noted under "Submit To" by the dates indicated (Engr = Engineer)	Location	File No.

	Submittal Description[4]	*Data with Bid* Submit To		*Copies for Review* Submit To			*Certified Copies* Submit To		
		Owner	*Engr*[1]	*Owner*	*Engr*[2]	*Date Req'd*	*Owner*	*Engr*[3]	*Date Req'd*
1.	**Administrative Submittals**								
	Contract Closeout Submittals						X		10DFC
2.	**Manufacturer's Standard Data**								
	Catalog Data Sheets	X		X		2ARO	X	X	10DFC
3.	**Product Data**								
	Primers, intermediate and finishing products for coatings and accessory materials	X		X		2ARO	X	X	10DFC
	MSDS	X		X		2ARO			
4.	**Samples and Mock-ups**								
	Product Samples			X		2ARO			
5.	**Quality Control**								
	Surface preparation, substrate conditions, paint and coating application, re-coat time, and curing procedures.	X		X		2ARO			
	Temperature and humidity requirements for the storage and application of coatings	X		X		2ARO			
	Qualification of applicators	X		X		2ARO	X	X	10DFC
	Inspection and testing of surface preparation and coating application	X		X		2ARO			
6.	**Inspection, Test Reports and Certificates of Compliance**								
	Dry film thickness (DFT) test reports			X		2ARO			
	High-voltage spark testing (holiday testing)			X		2ARO			
	Personnel Qualification Testing			X		2ARO			
	NDE reports						X		10DFC
	Certificates of UL Listed Products						X		10DFC
	Material Test Reports			X		1PTC			
7.	**Record Documents**								
	Project Record Documents						X	X	10DFC
8.	**Warranties and Guarantees**								
	Warranty	X							

SPECIAL NOTES:

1. Indicates submittal by Contractor requiring Engineer's review to allow technical evaluation of bids.
2. Indicates submittal by Contractor requiring Engineer's review prior to proceeding with fabrication or construction activities for work covered by submittal.
3. Indicates submittal by Contractor required for Engineer's use as a record document.
4. Quantity of prints/copies/media required for each type of submittal is defined in the Project Documents.

SCHEDULE ABBREVIATIONS (see Special Guidelines below for use):

ARO = Weeks After Order Received by Subcontractor/Supplier
AAR = Weeks After Review (defined as date review comments received by Subcontractor/Supplier from Contractor/Engineer
DFC = Days After Completion (completion is defined contractually completion of work)
PTC = Weeks Prior To Construction (initiation of fabrication in Supplier's shop or work in field)
PTS = Weeks Prior To Shipment (date of shipment from Supplier's shop)

Design Criteria
Pasadena Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Item	Criteria	Description	Revision	Comments
1.0	**Project Definition**			
1.1	Name	Glenarm Repowering Project (GT-5 Combined Cycle Installation)	A	
1.2	Type	Combined Cycle Power Plant (1 x 1)	A	With ability to run dry in a 1x0 mode, or full STG bypass mode.
1.3	Owner	Pasadena Water & Power (PWP)	A	
1.4	Owner Engineer	Power Engineers Inc. (PEI)	A	
1.5	Permitting	Power Engineers Inc. (PEI), Worley Parsons (WP), Environmental Management Professionals (EMP), PCR and Pasadena Water & Power (PWP). The BOP contractor will need to coordinate with the City Building Department for all construction related permits. BOP contractor will need to submit CA PE stamped plans for approval and expect at least eight weeks for the City to review the plans. Also, any provisions specified in the Air Permit or CEQA/EIR will need to be closely adhered to by the BOP contractor. The BOP contractor shall be required to obtain the Certificate of Occupancy from the Building Department and the Fire Department for the buildings prior to Mechanical Completion. The Fire Department requires 72 hours notification for all inspections.	B	CEQA by PCR, Air Permit by EMP, Support documents by PEI as requested.
1.6	Power Island Equipment - GTG Providers	General Electric (GE) LM6000 PG Sprint	B	
1.7	BOP Design Engineer	TBD	A	
1.8	BOP Contractor	TBD	A	
1.9	Interconnect Utility	Pasadena Water & Power (PWP) 34.5 kV Switchyard. A second power source, 17kV, shall be brought to site to provide early commissioning power and provide a permanent secondary source of power should the main GSU be out of service. The existing 2400V electrical services on the Broadway site will remain in operation after the B-3 plant is shut down. The BOP contractor will need to ensure that its work does not disrupt or damage this service.	B	Final demarcation to be discussed with PWP. For conduit sizing purposes, all high voltage underground cable (34.5kV and 17kV) shall be aluminum.
1.10	Fuel Source	Natural Gas - Southern California Gas Company (SCGC) (Sempra Energy Utility). New Meter to be installed off of tap for GT 1 & 2. BOP Contractor shall make a connection with this meter to bring a pulse signal back to the GT-5 control system.	B	PWP/ and SEMPRA need to schedule the interconnect.
1.11	Contract Approach	Owners Engineer Preliminary Design, Major Work Authorization, Power Island Equipment Contract, Balance of Plant (BOP) RFP and Contract	A	
1.12	Owner Furnished Equipment	Power Island Equipment (PIE) including Combustion Turbine Generator (GTG), Once Thru Steam Generator (OTSG), Steam Turbine Generator (STG), Condenser, Cooling Tower, Generator Step Up (GSU) Transformer, Boiler Feed Pumps (BFP), Circulating Water Pumps (CWP), Condensate Pumps (CP) Power Island Auxiliaries, Chiller, Inlet Air Heating Skid, Gas Compressors, Air Compressors, Condensate Polisher, Turbine Bypass Valves, Continuous Emissions Monitor, Auxiliary Boiler, Aux Boiler Steam Superheater.	B	

Item	Criteria	Description	Revision	Comments
1.13	Reference Documents	Original Owners Engineering documents, Permitting Support and Gas Turbine Generator Configuration (PEI - 118788), Design Criteria, Pasadena City Standards, Pasadena Fire Department Standards and California Building Code (CBC)	B	
2.0	**Technology Definition**			
2.1	Cooling Technology	Counter-Flow 2-Cell Evaporative Cooling Tower and Water Cooled Tube and Shell Surface Condenser with 2X100% vacuum pumps Air Removal System. Three 50% Auxiliary Cooling Water pumps will supply cooling water to a single shell and tube heat exchanger, which will then in turn exchange cooling water for the Bearing Cooling Water (BCW) system, a closed cooling system supplying cooling water to the lube oil systems, gas compressors, etc. (see P&IDs).	B	Both vacuum pumps are required for startup, one pump used for maintaining vacuum during operation.
2.2	Waste Water Technology	1. Drains from the inlet filter house and process drains in the plant will be pumped directly to the cooling tower for make-up. See P&IDs 2. All wastewater from GT-3, GT-4 and GT-5 will be directed to the new Glenarm wastewater storage tank, before discharge to the Glenarm weir. Keep original route of GT3 & 4 as alternate and provide GT5 alternate route directly to outfall. 3. Blowdown from GT-3 and GT-4 cooling towers will be sent to the new Glenarm wastewater storage tank from the pressurized lines off the chillers (BD9004-2”-AB2B on Chemic Engineers’ P&IDs 20001-3-050 and 20001-4-050). Note that the Chemic Engineers’ P&IDs show this as a 2” line, but PWP indicated this is a 1” line. Keep original route as alternate discharge... 4. The existing Oil-Water Separator will also discharge to the new Glenarm wastewater storage tank. . Keep original route as alternate discharge. 5. The new Glenarm wastewater tank will drain to the Glenarm weir. The control system for the discharge needs further discussion. The Glenarm weir maximum permitted discharge rate remains at 191 gpm. 6. Wastewater from GT-1 and GT-2 will continue to discharge directly to the Glenarm weir. 7. A sump is needed to pump the contents of the Glenarm historical fountain to the GT-5 cooling tower 8. The equipment drains sump for unit GT-5 will need a high-high level sensor as indicated on the P&IDs. 9. The existing OWS needs a new high-high level alarm with signal sent to control room. 10. Location of GT-5 drains sumps (process drains and equipment drains sumps) to be determined by the BOP contractor. The drains sump for GT-5 needs a high-high level sensor. 11. The new GT-5 demineralized water storage tank will primarily be filled from the GT-3 and GT-4 demineralized water tank (tank 157B, PWP indicated a spare nozzle is available) using new forwarding pumps. The backup method for filling the GT-5 demineralized water	B	

Item	Criteria	Description	Revision	Comments
		tank will be from the 157B tank fill line (DW4004-4"-GC2Q on Chemic Engineers' P&ID 20001-040). 12. The new GT-5 demineralized water tank will be stainless steel. 13. The new Glenarm wastewater storage tank will be epoxy-lined carbon steel. 14. Waste water produced as part of the gas turbine water wash process will be collected separately in a tank to be removed of offsite by truck.The last chance or final fuel gas filter will trap any residual impurities in the gas that have passed by filters near the gas compressors. The liquids captured in this final filter will be sent to a separate drains tank to be removed offsite by truck.Clean rain water that is collected into secondary containments will be tested and if determined to be free of oil shall be surface drained to the storm water system.HVAC drains shall not be allowed to run on site paving but should be run to plant drains. The CEMS shall have an equipment drain. Drains from flash tanks shall be quenched with service water (flow controlled by control valve and temperature element on flash tank vessel) to prevent damage to underground drain piping.Water flow to the off-site sewer system will need to be retained in an outfall box due to the County restrictions.		
2.3	Steam Cycle Water Treatment Philosophy	Specification No. ES-1000 from IST defines the water quality the OTSG requires. Ammonia and Hydrazine are recommended chemical additives for control pH and O2 respectively. Another plant has used Nalco 352 and Nalco Elimin-Ox and then Ashland Americor and Ashland Mekor 6701.	B	Refer to specification 485952.06 for chemical injection details
2.4	Steam / Water Sampling	A steam / water sample panel will be provided to verify the boiler feedwater, steam and condensate are within compliance with the once through boiler vendor's specifications. Any cooling of samples will need to be accounted for per the sample panel vendor. Cation conductivity is the most important water quality factor. Dissolved oxygen and pH will need to be continuously monitored as well. The sample panel shall have provisions to take grab samples. The steam / water sample panel will be located inside the water lab building south of the OTSG. The architectural drawings do not indicate this, but there will need to be provisions to access the back of the sample panel, preferably with some type of hinged door. Final details will be predicated on the building design and sample panel selection.	B	Refer to specification
2.5	Project Specific Technology	Once Through Steam Generator, Condensate polishing, provisions for auxiliary boiler, rotary screw gas compressors, three winding transformer,	A	
3.0	**Project Schedule**			
3.1	PIE Contract Awarded	September 16, 2013	B	
3.2	BOP Full Notice to Proceed	TBD	A	
3.3	Construction Mobilization	TBD	A	
3.4	Existing Equipment and Structures Demolition Complete	TBD	A	

Item	Criteria	Description	Revision	Comments
3.5	Gas Supply Modifications Complete	TBD	A	
3.6	Utility Back Feed	TBD	A	
3.7	Mechanical Completion	TBD	A	
3.8	Commercial Operation	TBD	A	
3.9	Work Hours	Work hours are dependent on the City requirements referenced in A.1	C	A link for the requirements is provided in A.1.
4.0	**Economic Parameters**			
4.1		TBD	B	
4.2		TBD	B	
4.3	Energy Worth ($ per kWh)	TBD	B	
4.4	Evaluation Period (years)	30	B	
4.5	Discount Rate (% annual)	TBD	A	
4.6	Fuel Cost ($ per MMBTU HHV)	TBD	A	
4.7	Fuel Cost Escalation (% annual)	TBD	A	
5.0	**Plant Operating Profile**			
5.1	Gross Power Output	Cannot exceed 71 MW gross output at any ambient condition	B	
5.2	Nominal Net Heat Rate	7129 BTU/kWh, LHV	B	GE guarantee point of 67MW, 75F, 50% RH
5.3	Estimated Auxiliary Power	TBD	A	
5.4	Optimization basis	TBD	A	
5.5	Load Range	TBD	A	
5.6	Load Profile	TBD	A	
5.7	Capacity Factor	TBD	A	
5.8	Annual Operation	8760 hours per year	B	
5.9	Annual Duct Firing	N/A	A	
5.10	Start/Stop Cycles	750 Annual Plant 5 Daily Maximum 365 cold, 365 Warm and 20 Hot	B	
5.11	Start/Stop Cycles	Plant Cold Start: 120 min after shutdown > 24 HR Plant Hot Start: 66 min after shutdown < 8 HR (See GE startup curves)	B	120 min cold start in air permit 66 min hot start in GE proposal
5.12	Start/Stop Cycles	Plant Stop: 60 min	B	60 min shutdown in air permit 30 min shutdown in GE proposal

Item	Criteria	Description	Revision	Comments
5.13	Start/Stop Cycles	Unit Start (to emissions compliant): 40 MIN Cold, 40 MIN Warm, 20 MIN Hot Unit Stop (from emission compliant): 6 MIN	B	Needs to reflect permits
5.14	Start/Stop Cycles	The gas turbine generator must have a 10 minute start capability. A 10 minutes start is defined as a cold start to full power in 10 minutes or less.	A	
5.15	Start/Stop Cycles	See PIE Contract	A	
5.16	Start/Stop Cycles	30-Years Continuous Duty Service	A	
5.17	Start/Stop Cycles	Unit Specific HP Steam Bypass Systems. Operating Modes: Unit Startup, 1 X 0 to 1 X 1 Transition, STG Trip (momentary ERV operation allowed), and Continuous 1 X 0 operation.	B	
5.18	Start/Stop Cycles	1 X 0 to 1 X 1 Transition Using Steam Bypass	A	
5.19	Start/Stop Cycles	Winter Outage	A	
5.20	Start/Stop Cycles	Existing Station - No Changes	A	
5.21	Start/Stop Cycles	1 X 0 or 1 X 1	A	
5.22	Start/Stop Cycles	GTG(s): 0.80 Lagging and 0.90 Leading at the generator terminals within normal ambient design conditions, up to 40C ambient temperature without exceeding Class B generator temperature rise. STG: 0.85 Lagging and 0.95 Leading at the generator terminals within normal ambient design conditions, without exceeding Class B generator temperature rise.	B	
5.23	Start/Stop Cycles	Auxiliary Boiler will be included in the project scope. The auxiliary transformer will need to be sized to account for this load.	B	
5.24	Start/Stop Cycles		A	
5.25	Start/Stop Cycles		A	
6.0	**Building Requirements**			
6.1	Administration Building	Glenarm Building will require preservation to satisfy the conditions of the EIR. A preservation scope is being developed by a third party.	C	
6.2	Control Room	Existing in B-3. New to be constructed as part of the new Control Building. Control Building will control GT-1, GT-2, GT-3, GT-4 and GT-5 and house the fire alarm control panel	B	Space will be provided for occasional operation at the PDC work station.
6.3	Maintenance Shop	The existing "Pump Shop" will be renovated to become the new Maintenance Shop. Refer to new architectural drawings and specs and fire protection specs for scope.	B	
6.4	Warehouse Building	No new Warehouse building is planned at this time.	A	
6.5	Water Lab	A water lab building south of the OTSG will be provided to include the steam water sample panel in one room with a water lab room adjacent to it. A restroom and storage area will also be included. The lab will include chemical resistant counter, sink with chemical resistant drains, ventilation hood, cabinets, refrigerator for storing samples.	B	
6.6	LEED and CalGreen	All buildings on site must adhere to LEED / CalGreen requirements plus 20% greater efficiencies.	B	

Item	Criteria	Description	Revision	Comments
		All buildings will require a Title 24 Analysis.		
6.7	Existing Building Protection	Both the Glenarm Building to the north of the GT-5 site and Pacific Electric building to the south of the site are considered buildings of historical significance. The BOP contractor shall ensure provisions are made to protect these structures from damage either by impact or vibratory compaction equipment. The Glenarm structure shall be adequately protected during demolition and overexcavation/backfill activities.	B	
7.0	**Guarantee Conditions**			
7.1	Plant Performance	75F, 50% Relative humidity, 751 ft AMSL, 67MW net output. Refer to GE heat balances for performance testing conditions and guarantees.	B	
7.2	Power Block Performance	Per GE conformed specs and heat balances.	B	
7.3	Balance of Plant Equipment Performance	The BOP Contractor shall guarantee auxiliary loads of the equipment they are supplying as part of their proposal. Also, the BOP contractor shall review the GE requirements for steam, feedwater and condensate flows and assure the piping will not affect the PIE performance.	B	
7.4	Auxiliary Power	2240kW PIE aux loads, BOP to quote and Guarantee auxiliary power loads with their proposal	C	
7.5	Air Emissions	2.0 ppmvd NOx, 2.0 ppmvd CO, 2.0 ppmvd VOC, 5.0 ppmvd NH3 slip, 4.0 lbs/hr PM. Referenced to 15% O2.	B	
7.6	Noise Emissions	Per specification provided by Emery Tuttle for PIE equipment. BOP shall conform their equipment as well.	B	
7.7	Interconnect Piping Loss Allowance	HP Steam: 26.9 psig and 2.8F	B	Values are from GE's proposal 75F, 50% RH guarantee case heat and mass balance diagram
8.0	**Site Conditions**			
8.1	Survey	Survey for the project site has been performed by Coory Engineering, (562) 868-8266. Data has been provided in California State Plan Coordinates which will be converted to UTM by Coory for emission locations for air quality modeling. The survey data will be converted to a plant coordinate system consistent with the system used for Units 3&4. A topographic survey has been performed and used as the background for the grading plan... BOP contractor shall be required to perform their own site survey of existing features, locate interface points and perform its own survey during installation.	B	
8.2	Geotech	Geotechnical Investigation performed by Hydrologue for the Unit GT-5 Generating Station, Pasadena, California, Reports performed to date have been provided as an attachment. They describe requirements for soils overexcation and recompaction, testing, foundation types, site paving requirements, thermal resistivity and conductivity.	C	Seyed Morteza Mortazavi at (626) 585-9696
8.3	Location	43 East State Street, Pasadena, California	A	
8.4	Site Area	The Glenarm facility (west of the railroad tracks) is approximately 6.5 acres. GT-5 site is roughly 2.0 acres.	B	
8.5	Land Use	The project vicinity includes a mix of land uses with commercial and single-family residential uses to the west across Fair Oaks Avenue; multi-family residential uses to the south; Blair High	A	

Item	Criteria	Description	Revision	Comments
		School, Allendale Elementary School, Pasadena Public Library (Allendale Branch), and Allendale Park to the east of the Broadway site across the Pasadena Freeway; and, PWP's dispatch and distribution station and other commercial uses to the north across Glenarm Street.		
8.6	Setbacks	None Required by City Code	A	
8.7	Flood Plain	TBD	A	
8.8	Elevation	751 FT Above Mean Sea Level (AMSL). Finish floor elevations and equipment foundations shall be nominally four inches above finish grade. This will vary depending on requirements such as the PDC, Steam Turbine, GSU, etc... 100 year rain events must also be taken into consideration for final concrete elevations.	B	Refer to C3-1 for final grades.
8.9	Existing Grade	Predominately Flat. Existing topo shown on the C3-1 grading plan.	C	. Note that grades at GT 3 & 4 were not well thought out and result in drastic grade changes around some of the equipment. The BOP Contractor shall ensure that this is not repeated at GT-5.
8.10	Climate	Hot, Dry and Dusty with Low Precipitation	A	
8.11	Soil	The site consists of manmade fill to a depth of approximately 5 to 7 feet below grade consisting of brown fine to coarse clayey silty sand and fine to coarse micaceous silty sand in a moist and moderately loose to moderately compact condition. Beneath the man made fill, mottled brown/gray/black silty clayey sand in moist and moderately loose condition extending to approximately 10 feet below grade. Site will need to be overexcavated and recompacted in accordance with the Geotech report.	C	A representative from Hydrologue must be on site during the overexcavation activities. Also, BOP contractor shall be responsible for having an archeologist and paleontologist on site for pre-excavation meeting and as necessary upon discovering artifacts.
8.12	Soil Percolation	TBD	A	
8.13	Soil Resistivity	Refer to Geotech reports	B	
8.14	Groundwater	Ground water was not encountered in boreholes advanced to 50 feet below grade from past geotechnical investigations.	A	
8.15	Frost Depth	Not applicable	A	
8.16	Dust Loading	Not applicable	A	
8.17	Existing Structures	Glenarm Power Plant Turbine Building (3-Story) Structure north of the plant site, unreinforced brick framed Pacific Electric building (trolley maintenance facility) south of the project. Both buildings need to be protected from damage during construction	B	
8.18	Identification (tagging)	Equipment identification scheme (tagging) shall be coordinated with Owner standards. The power island equipment shall be provided with a dual tagging system to support coordination with Owner standards. #1/A equipment shall be on the North/West side & #2/B equipment shall be on the South/East side. The units shall follow provided P&IDs as the preferred tagging system.	B	This needs to match GT 3 & 4 for left to right, front to back, top to bottom, etc. BOP contractor needs to match the tagging system of 3 & 4 as close as possible. PWP will have final approval on BOP Contractor's tagging

Item	Criteria	Description	Revision	Comments
		Pipe identification shall be per ANSI A13.1 including color coded flow arrows and system abbreviation.		system. Follow tagging system started on the provided P&IDs
9.0	**Meteorological Data**			
9.1	Historical Weather Data Source	See Site Conditions Document 480020	B	
9.2	Annual Average Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.3	Summer Design Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.4	Summer Peak Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.5	Winter Design Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.6	Winter Peak Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.7	Monthly Average Temperature (Corresponding Relative Humidity)	See Site Conditions Document 480020	B	
9.8	Annual Precipitation		B	
9.9	Wind Rose		B	
9.10	Pan Evaporation Rate	See Site Conditions Document 480020	B	
9.11	Solar Insulation	See Site Conditions Document 480020	B	
10.0	**Ambient Design Conditions**			
10.1	Ambient Condition Design Basis	Normal Conditions: The plant shall be capable of operation over the design load range with permitted emissions levels within the ambient temperature and humidity conditions without any reduction in design performance or reliability. Extreme Conditions: The equipment shall be designed to withstand and operate within the ambient temperature and humidity conditions without damage or life degradation:	A	
10.2	Normal Design Ambient Conditions	See Site Conditions Document 480020	B	
10.3	Extreme Design Ambient Conditions	See Site Conditions Document 480020	B	
10.4	Transformer Ambient Temperature	Transformers shall be designed for a 24-hour average ambient temperature of 40C and maximum temperature of 50C. Transformers shall have required capacity based upon the 55C winding temperature rise rating.	A	
10.5	Occupancy Classification	The new Control Building and PDC will be considered as occupied buildings. The Control Building will be an F-1 classification, category H	B	
10.6	Seismic Design	See Site Conditions Document 480020	B	
10.7	Wind Design	See Site Conditions Document 480020	B	

Item	Criteria	Description	Revision	Comments
10.8	Design Storm	See Site Conditions Document 480020	B	SWPPP needs to be updated to reflect the new site arrangement. SWPPP for construction by BOP contractor.
10.9	Runoff Coefficient	0.9	A	
10.10	Storm Water Retention	No storm water retention. All rainfall will be directed by surface flow to existing or new storm drain inlets and catch basins and directed to the municipal storm water system. Note: BOP shall provide a SWPPP and work with PWP to update the SUSMP permit documents as part of its scope	B	
10.11	Off-Site Watershed	Not Applicable	A	
10.12	Snow Load	Not Applicable	A	
10.13	Free Water Surface Evaporation	TBD	A	This is listed in the site conditions.
10.14	Noise	Refer to Specification 480031	B	
10.15	Winterization	Freeze protection is not required.	B	
10.16	Dynamic Loads	These loads shall be considered the dynamic forces from a rotating or vibrating mass in equipment operation and shall be applied in accordance with the manufacturer's specifications, criteria, or recommendations, and industry standards.	A	
10.17	Crane Loads	These loads shall be considered for maintenance of the facility: crane weight, lifting capacity and impact loadings. Impact loadings shall be determined from AISC "ASD/LRFD 13th Edition - Steel Construction Manual". Any area where crane loads could impact the underground utilities, such as the storm drain piping or circulating water piping, underground duct banks, etc., the loads shall be distributed as required by bridging with precast concrete plates, thickened reinforced sections, etc.	B	
10.18	Vehicle Loads	Underground piping, conduits, trenches, sumps, electrical pull boxes/vaults and foundations accessible to truck traffic shall be designed for HS 20-44 truck wheel loads per the AASHTO Standard Specifications for Highway Bridges.	A	
10.19	New Structures Live Loads	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). Elevated floors: a) Uniform Load, 100 pounds per square foot. b) Equipment, storage, or lay down weight (without uniform load). Ground floor (floor at grade): a) Uniform Load, 250 pounds per square foot. b) Equipment, storage, or lay down weight (without uniform load).	A	

Item	Criteria	Description	Revision	Comments
		c) Administrative Areas Uniform Load, 100 pounds per square foot.		
11.0	**HVAC Design Conditions**			
11.1	Equipment	HVAC systems shall be N+1 redundant. HVAC systems for enclosed spaces shall be packaged units installed at ground level. Battery Room: Induced draft ventilation	A	
11.2	Temperature	Occupied: 75°F Summer, 70°F Winter, +/- 3°F Variance Unoccupied (workshop): 80°F Summer, 65°F Winter, +/- 5°F Variance Electrical Module: 75°F Summer, 65°F Winter, +/- 5°F Variance Battery Room: 75°F Summer, 65°F Winter, +/- 5°F Variance These temperatures need to be maintained based on the extreme maximum/minimum defined in the Site Conditions document.	A	
11.3	Humidity	Occupied: Maximum 50% RH Un-occupied: All other spaces no control	A	
11.4	Ventilated Area	14°F rise above ambient temperature	A	
11.5	Particulate Filtration	High Efficiency (80%-90%): Control Room, Electronic and Electrical Equipment Rooms Medium Efficiency (55%-65%): CEMS Shelter Other: Particle filtration based on equipment requirements	A	
11.6	Gaseous Filtration	Not Applicable	A	
11.7	Hazardous Areas	HVAC packages associated with Electrical Distribution Centers (PDC) battery rooms shall be suitable for Class 1 Division 2 environments.	A	
11.8	Outdoor Electrical Panels	Electrical panels containing electronic devices located external to environmentally controlled areas shall be equipped with N+1 redundant conditioning equipment.	A	
11.9	HVAC Efficiency	HVAC will require a high efficiency system per LEED or Cal Green. The City is held to a standard that is 20% higher than required for a private/commercial entity.	A	
12.0	**Site Arrangement**			
12.1	Equipment Layout	Refer to Site Plan and General Arrangement	A	
12.2	Building Layout	The new Control Building shall be provided as shown on drawing A1-2-1, A1-3-1, A4-1, A9-1 and A9-2... The Maintenance Shop shall be renovated per drawing A2-1-1, A2-2-1, A2-2-2, A2-3-1, A2-4-1, A2-5-1, the Welding Shop shall be provided per A2-1-1, A2-4-1, A3-2-1 and A3-3-1. The Water Lab building shall be provided per drawing A4-1, A4-2-1, A4-3-1, A9-1 and A9-2.	B	
12.3	Weather Protection	Outdoor equipment skids shall be supplied as outdoor rated equipment. Any local PLC interface panels shall be protected as required from direct sun exposure with shade structures. The new NH3 skid by the B-3 storage tank shall be sheltered like the existing skid.	C	
12.4	Operations Access	Perimeter roadways around the power block shall be suitable for large semi-trucks for access within the plant site. Outdoor equipment shall be arranged for close approach with vehicles (or electric carts). Stairs and platforms shall be provided to support all normal operation and maintenance activities. Permanent ladder access shall be for secondary egress only.	B	

Item	Criteria	Description	Revision	Comments
12.5	Maintenance Access	Outdoor equipment shall be accessible by mobile crane without disassembly of permanent structures. The exception to this shall be the STG acoustical enclosure provided by GE. The STG enclosure shall be supplied from the PIE vendor with overhead doors and removable sections for maintenance. The STG will also be provided with some platforms for access to equipment. Fire protection piping installed in this enclosure shall not impede access areas. Equipment located underneath piperacks shall be supplied with monorails and manual trolleys to service equipment such as the boiler feedwater pumps.	B	
12.6	Piping and Raceway Routing	Outdoor piping and raceway shall be routed underground to maintain clear access around equipment, except where permanent structures are available and suitable for support, such as the pipe bridge. The piping between the main power block area and the gas compressor/chiller area shall be supported on a pipe bridge to span the access road. The access road will contain the relocated storm drain piping, which is relatively shallow. The pipe bridge shall be high enough to permit crane access (at least 16'-0" high over the roadway). The piperack in the power block area shall have at least 10'-0" clearance underneath to allow forklift access. Fuel gas piping shall be routed entirely outdoors and underground where possible Any above ground piping shall be protected by bollards or other permanent means. The pipe rack shall be sized to accommodate a future gas line that will run to GT 1 & 2. The final rack design must be approved by the General Manager. Aqueous ammonia piping shall be routed entirely outdoors. It may be run in double wall piping whether underground or in trenches . The ammonia piping shall be double wall piping with both SS carrier and containment piping and low point drains/leak detection per the piping service index and specs. There will be a maximum 90 day interim period where B-3 is permitted to and must remain on line while commissioning GT-5. During this time, GT-5 will use a temporary connection to the GT-3 & GT-4 19% aqueous ammonia tank and the pumping skid will be set in a temporary (or permanent – coordinate with the General Manager) location. The B-3 tank fill line will be modified to become the GT-5 supply line to prevent the need to run a new double wall stainless steel piping system through the 42" Glenarm-Broadway culvert/tunnel. The B-3 tank will be filled by cross tying the GT 3 & 4 ammonia tank fill line at a location in close proximity to both the B-3 and GT 3 & 4 tanks. A new three-way valve will be supplied to prevent filling both tanks at the same time. Additionally, the existing isolation valves will be used to control flow to the tanks. A new control valve shall be supplied at B-3 tank as well. The existing tank vapor recovery/vent lines will still be utilized when tank filling. The current B-3 fill line will need to be cut at the Glenarm tunnel vault, the line to the filling station capped, and a new line run to the GT-5 vaporization skid. Drawings SKM1-7, 8 and 9 were developed to illustrate the Existing, Interim and Final piping and ammonia skid configurations. The existing pipe fill and vent evacuation systems with air operated diaphragm pumps will remain in place to clear the lines when not in use. All instrumentation on the existing B-3 tank will be replaced with new. Indoor piping and raceway shall be routed below the floor level/platforms or overhead to maintain	C	

Item	Criteria	Description	Revision	Comments
		clear access around equipment.		
12.7	Temporary Infrastructure	Refer to C3-4 for possible allocation of temporary construction laydown, parking, and trailer space. There may be areas within existing structures for construction activities, with coordination between PWP operations and the BOP Contractor. A temporary site access shall be provided and utilized for all construction traffic. Appropriate personnel access restrictions shall be implemented within the plant site, since the adjacent power blocks will be operating during the construction period. Temporary fencing shall be placed between GT1 and 2 and GT3 and GT4 to restrict worker access into operating areas.	B	
13.0	**Utility Interconnects**			
13.1	Electric (generation)	The current air permit application is based upon replacing the B-3 output of 71 MW with GT-5 output of 71 MW. The output from GT-5 will be via a single three winding transformer, taking power from both the GTG and the STG, with 34.5kV cables being routed underground through the GT-5 site in a new duct bank, intersecting with an existing underground vault that is currently taking the 34.5kV cables from GT 3 & 4. The new feeders from GT-5 will be pulled from the three winding transformer back to a temporary location in the Receiving Station, north of Glenarm Street. After B-3 is decommissioned, the cable will then be relocated to the B-3 interconnect location. See Electrical drawings E6-1, E6-10, SKE-6-1 and SKE-2 for details.	B	For conduit sizing purposes, all high voltage underground cable (34.5kV and 17kV) shall be aluminum.
13.2	Electric (alternate)	A secondary 17kV power feed will be brought in from the Distribution Center north of Glenarm Street. This secondary power feed will be used to support commissioning and to provide an alternate means of permanent power to the plant should the GT-5 GSU be out of service. A new duct bank will be routed from the existing duct bank / trench to the 17kV transformer to be located by the Power Distribution Center. See Electrical drawings E6-1, E6-10, SKE-6-1 and SKE-2 for details.	B	
13.3	Natural Gas	The existing PWP gas service is supplied by Southern California Gas Company (SEMPRA) via a metering station along the west property boundary with a Low Pressure (150 PSIG). The project equipment (GTG) has a minimum fuel gas pressure requirement of per the PIE conformed specifications, approximately 725 PSIA (at the GTG skid interface). PIE Contractor to provide final value.	C	All areas servicing fuel gas will need to be classified as hazardous with appropriate electrical provisions, seals, anti-sparking devices, etc.
13.4	Demineralized Water	The existing PWP demineralized water system located on the Broadway site will be utilized for all demin water production. Distribution system will be expanded as shown on the P&IDs for GT-5 make-up. A new set of forwarding pumps will be located at the existing GT 3 & 4 demin tank to send water to a new demin tank at the GT-5 site. If the GT 3 & 4 tank is out of service, water will be supplied directly from the Broadway site by bypassing the tank and new pumps.	B	
			B	
13.6	Potable Water	The existing PWP potable water system will be expanded to accommodate the needs of GT-5. safety showers and eye wash stations. Eye wash stations shall be anti-scald and will have a circulating water skid located at the GT-5 site.	B	

Item	Criteria	Description	Revision	Comments
13.7	Raw Water	A totalizing flow meter shall be added to the Unit GT-5 cooling tower raw water makeup line.	B	Raw water is the City water supply. A raw water source shall be provided for demin water trailers on the Glenarm property.
13.8	Waste Water	The current PWP waste water discharge is sent to the local sewer at a controlled rate. This will need to be continued in accordance with the LA County Waste Water Permit. Refer to water balances contained within the LA County Permit documents and P&ID's for further detail.	B	
13.9	Sanitary Sewer	A new sanitary sewer connection will need to be made for the Control Building and water lab. A connection exists in State Street and at the southeast corner of the Glenarm Building as indicated on the Tie Point drawing, MM1-1-6. At least one lift station is required to mate to the sanitary sewer interface. Others will be required if necessary.	C	
13.10	Compressed Air	The new Unit GT-5 compressed air system will consist of 2x100% compressors driers, coolers and will be routed to all users required for the GT-5 project. The system will be cross tied to the existing systems. Two 100 gallon air receivers will be provided by the BOP contractor in the GT3 & 4 area. Location to be coordinated with PWP.	B	
13.11	Voice Communication	Existing station system expanded as required. BOP contractor shall provide all necessary raceways in the new buildings and in the maintenance and welding buildings. PWP will furnish and install the new phone system.	B	Relocation to Control Building.
13.12	Data Communication	Existing station system expanded as required. PWP will provide data communication to each new and renovated area in BOP Contractor supplied conduit.	B	Relocation to Control building
13.13	Intercom Communication	Existing station system expanded as required. PWP will provide data communication to each new and renovated area in BOP Contractor supplied conduit.	B	Relocation to Control Building
13.14	Electrical Interconnect Metering	Permanent revenue metering located at generator terminals (gross) and high-side of associated auxiliary transformer for both units (GT-5 and ST-5), with both local and remove indications (via PCS).	A	
13.15	Automatic Generator Control (AGC)	AGC is required for this project.	C	
13.16	State Street Cables	The conglomerate of cables on State Street will need to be reworked by PWP.	C	
14.0	**Temporary Utilities -**			
14.1	Temporary Electric	Temporary Service provided by PWP, at no charge to the BOP Contractor. BOP Contractor shall make distribution from the PWP provided service at the NE corner of the Pacific Electric (PE) Building. PWP will remove the existing overhead 4kV line back to the pole by the PE building, set a bank of transformers and a riser to provide 480VAC power for the BOP Contractor to distribute on site as needed.	C	
			B	
14.3	Temporary Water	Process water for construction related activities such as dust control, wash out, pipe cleaning, flushing and hydro shall be from City water on site. Demin water for steam blow activities shall be provided through the existing demin system on site..	B	From City water.
14.4	Construction Waste Water	Waster water produced as a product of flushes, etc., shall be disposed of in accordance with local and state regulations. The Glenarm weir will be the most suitable choice for disposing of waste	B	

Item	Criteria	Description	Revision	Comments
		water, as long as the water does not exceed permitted limits. Any hydrotest water or water that could be contaminated will need to be disposed of offsite.		
14.5	Telephone	Service provided by BOP Contractor as needed.	B	
14.6	Data	Service provided by BOP Contractor as needed.	B	
15.0	**Major Equipment**			
15.1	Gas Turbine Generator	One (1) General Electric (GE) LM6000 PG SPRINT aeroderivative gas turbine	B	Part of the PIE
15.2	Once Thru Steam Generator	One (1) Once Thru Steam Generator (OTSG) - vertical type, single pressure, forced-circulation.	A	Part of the PIE
15.3	Steam Turbine Generator	One (1) Shin Nippon 13-15MW single-casing condensing turbine with HP admission and horizontal exhaust to the condenser. A silenced targeted steam blow will be performed by the BOP contractor to the satisfaction of the STG vendor and PWP. Final blown targets shall be transmitted to PWP and Shin Nippon for record. The STG will be supplied with one free standing acoustical enclosure. Ventilation will be provided by the PIE Contractor. Lighting shall be supplied by the BOP Contractor meeting requirements for similar operating areas. A preliminary sketch of this enclosure, ATCO SK-01, has been included in section A.3. The BOP Contractor shall coordinate all penetrations through this enclosure with the PIE Contractor. All penetrations shall be sealed by the BOP Contractor with matching siding material. No loads may be supported from the enclosure without the PIE Contractor's approval. The space allocation within this building shall be coordinated for the new piperack, any additional platforms, maintenance access of the STG equipment, the condensate pumps, lube oil, servicing of the lube oil purifier, etc.	B	Part of the PIE
15.4	Condenser	One (1) water cooled steam surface condenser.	A	Part of the PIE
15.5	Fuel Gas Compressor	Two (2) 100% rotary screw fuel gas compressors.	A	Part of the PIE
15.6	Cooling Tower	One (1) 2-cell induced draft, counter-flow evaporative cooling tower. Cooling tower will be a fiberglass field erected tower built from flame retardant materials to avoid fire protection.	B	Part of the PIE, erection by BOP.
	Aux Cooling System	The auxiliary cooling system will be via three 50% pumps with fixed speed motors. Heat transfer will be through a shell and tube heat exchanger mated to a bearing cooling loop servicing the various components needing cooling. A strainer shall be installed upstream of the shell and tube exchanger to limit fouling.	C	
15.7	Auxiliary Boiler	An electric auxiliary boiler shall be supplied by the PIE contractor to maintain steam seals on the STG and condenser for rapid start-up. The PDC will be designed to accommodate the electrical needs for the aux boiler, and the auxiliary transformer will be sized to account for this load. The aux boiler will shut down upon admission of steam to the gland seals on the STG, so the electrical bus will need to account for all BOP loads running as well as the aux boiler.	B	
15.8	GSU Transformer	One (1) oil-filled outdoor station type three-winding power transformer will be supplied. Transformer will be equipped with offline tap changers. Low side connections will be via bus duct and high side via cable to an underground duct bank.	B	Part of the PIE
16.0	**Availability and Reliability**			

Item	Criteria	Description	Revision	Comments
16.1	General Philosophy	The selection of equipment and design of systems shall be based upon maintaining a high-degree of availability and reliability, with proven design concepts and equipment providing successful, reliable continuous operation in the United State power generation industry for a minimum of 5-years, unless otherwise approved by the Owner.	A	
16.2	Plant Level Philosophy	Plant level (common) equipment and systems, which upon failure would cause an outage of entire plant, shall be provided with N+1 redundancy, and designed to be isolated and maintained during plant operation.	B	
16.3	Unit Level Philosophy	Unit level (non-common) equipment and systems, which upon failure would allow continued degraded operation of the plant, shall be designed for minimum impact to the plant upon failure.	B	
16.4	Switchgear Arrangement	Plant level switchgear shall be provided in double-ended configuration suitable for single-ended operation under normal continuous and transient plant operating conditions (startup for example).	B	
16.5	Control Systems	Primary control systems shall be provided with redundant for power supplies, control processors and communication links, and designed to be maintained on-line. In addition, primary control systems shall be partitioned to isolate failures at the unit level. Supervisory control systems shall be designed to not impact primary control systems upon failure.	A	
16.6	Space Conditioning Equipment	HVAC systems shall be provided with N+1 redundancy.	A	
17.0	**Air Emissions**			
17.1	Air Quality Permit Requirements	Combustion Turbine Generator Evaporative Cooling Tower	B	
17.2	Stack Arrangement	Stack 125 FT Tall and 10.17 ft inside diameter. The stack shall be round with a transition from square to round just above the top exhaust plenum of the OTSG. Platforms shall be supplied to service the CEMS ports and the stack damper.	B	
17.3	Exhaust Parameters	GE Project Emissions Data Spreadsheet	B	
17.4	Combustor Emissions Controls	Water Injection for NOx control	A	
17.5	Uncontrolled (raw) Emissions	To be provided by gas turbine generator vendor	A	
17.6	NOx (limit and control technology)	2.0 ppmvd (referenced to 15% oxygen, 1 hr rolling average)	B	
17.7	CO (limit and control technology)	2.0 ppmvd (referenced to 15% oxygen, 1 hr rolling average)	B	
17.8	VOC (limit and control technology)	2.0 ppmvd (referenced to 15% oxygen, 1 hr rolling average)	B	
17.9	NH3 Slip (limit)	5.0 ppmvd (referenced to 15% oxygen, 1 hr rolling average)	B	
17.10	PM10 (limit)	PM10 Guarantee - 4 lb/hr	B	
17.11	CO2 (estimate)	938 lb/MW-hr, net	B	
17.12	Startup and Shutdown Emissions	See GE Emissions Data Spreadsheet	B	
17.13	Commissioning Operating Hours Allowance	200 hours	B	
17.14	Catalyst Life (temperature limitations)	The SCR catalyst shall have a design life of 5 years and the CO catalyst shall have a design life of 6 years. Two dilution air fans are provided to reduce flu gas temperature to below 750F	B	

Item	Criteria	Description	Revision	Comments
		during OTSG dry run periods.		
17.15	Exhaust Path Purge Philosophy	Gas turbine applications with an OTSG and/or SCR must have an exhaust air purge of at least 5 air changes, 5 minute purge time minimum, per NFPA 85 2011 Section 8.8.4.2.1 a & b. For these applications GE AEP applies a standard exhaust purge time of 15 minutes. This 15 minutes covers HRSG and system volumes up to 24,031 cu ft at standard site conditions. For gas turbines with gas fuel applications that need rapid start to full load GT Purge Credit can be offered in accordance to NFPA 85 2011 Section 8.8.4.6.	B	See GE's position paper on LM6000 Gas Turbine Engine Purge Times
17.16	Cooling Tower PM10 (limit)	Current permit allowance 2.34 tons per year based upon 31,500 GPM, 905 mg/liter TDS, 4 COC and 0.0010% Drift. New permit allowance 2.60 tons per year based upon 35,000 GPM, 905 mg/liter, 8 COC and 0.0005% drift. **(Need to Confirm)**	A	
17.17	Emissions Monitoring Systems	Dedicated CEMS module per stack.	B	
17.18	Permitted Operations Allocation		A	
18.0	**Power Sources and Demands**			
18.1	Normal Power	The normal power source for each unit is backfeed through the GSU transformer.	A	
18.2	Alternate Power	From 17kV alternate source connected to the Distribution Center	B	
18.3	Black Start Power	A black start generator will not be included as part of the GT-5 project.	B	
18.4	Standby Power		B	
18.5	125 Vdc Critical Power	All plant batteries, except batteries required for the fire alarm control panel in the control building, will be supplied by the BOP Contractor and located in the battery room within the PDC. Gel Cell Batteries shall be provided. A battery backed inverter system shall be supplied for emergency lube oil pump operation and control systems. The STG will be supplied with a dedicated power distribution and control module, which will include the critical power supply for the emergency lube oil pump (125 Vdc).	C	
18.6	120 Vac Critical Power	The plant shall be provided with a critical power 125 Vdc battery system for BOP control loads. The battery bank shall be sized for a minimum 2-hour backup time. The battery system shall be equipped with 2x100% battery charges sized to recharge the batteries within 8-hours while operating at design capacity. Batteries shall be Gel Cell. The plant shall be provided with a critical power 120 Vac N+1 inverter package to support the PWP DCS systems. The inverter system shall be sized for 200% normal operating critical loads, but shall have a minimum 30 KW capacity. The plant critical power equipment shall be installed within an environmentally controlled space	C	

Item	Criteria	Description	Revision	Comments
		located within the turbine building.		
18.7	24 Vdc Critical Power	All plant batteries, except batteries required for the fire alarm control panel in the control building, will be supplied by the BOP Contractor and located in the battery room within the PDC.	C	
19.0	**Fire Protection**			
19.1	Design Fire Water Flow	Existing Fire water pressure must be evaluated to determine if a fire pump house will be required with primary electric or diesel pumps. Refer to City of Pasadena flow test report dated September 12, 2013.	B	
19.2	Fire Water Source	There will be an extension of the municipal fire water supply located on site. PWP will relocate the backflow preventers on site to allow for a greater turning radius into the site from State Street. The BOP contractor will be responsible for extending the line from the location indicated on the M1-1-6 Tie Point drawing.	B	
19.3	Fire Water Yard Loop	Existing fire water yard loop will be extended to cover new equipment associated with GT-5. The fire loop shall be constructed of cement lined ductile iron piping with thrust blocks meeting the requirements of the Pasadena Fire Department.	C	8" block valve at State Street used for 3 &4. . A new fire loop will be installed as part of the BOP scope of work. PWP Fire Department has performed flow tests and are included in Section A.2 for BOP Contractor's design.
19.4	Fire Hydrants	PFD uses Jones Fire Hydrants, wet type, for their fire water systems. BOP contractor shall supply the same size and type. Final quantity of hydrants shall be as approved by fire department...	B	
19.7	Gas Turbine and Generator Fire Protection	Gas Turbine and Generator – will be protected by its own on-board CO2 self-contained type system. The GTG auxiliary package will be protected by water systems. Refer to fire protection specifications.	B	Fire protection will have 24VD supply from PDC provided by BOP
19.8	Steam Turbine and Generator Fire Protection	Steam Turbine and Generator – will be protected by a pre-action water spray type system with rate of heat rise detectors on the bearings and separate system at the ceiling.	A	
19.9	Steam Turbine Lube Oil System Fire Protection	Steam Turbine Lube Oil System – will be protected by the same system as the STG or deluge system.	A	
19.10	OTSG Fire Protection	Heat Recovery Boiler (OTSG) – none.	A	
19.11	Fuel Gas Compressors Fire Protection	Fuel Gas compression and metering areas – none. This will need to be revisited should the compressors be contained within a building for noise attenuation.	B	
19.12	PDC Building Fire Protection	Power Distribution Center Building (PDC) – Prefabricated electrical building on concrete piers. PFD considers the PDC as an occupied building and a dry agent/FM-200 type fire suppression system will be required inside the PDC The area beneath the PDC will require a dry closed head system or deluge system with pilot air actuation. A door fan test will be performed by the BOP contractor to demonstrate the PDC is air-tight enough to allow the dry agent fire suppression media to work properly.	B	
19.13	Cooling Tower Fire Protection	Cooling Tower – . PFD requires the cooling tower be protected by a dry pilot type fire protection system.	B	

Item	Criteria	Description	Revision	Comments
19.14	GSU and Aux. Transformers Fire Protection	Generator Step-Up and Aux. Transformers – No fire protection, fire separation walls as required.	A	
19.15	Control Building & Office Areas Fire Protection	Control Building – Office Areas – Hi-Fog water mist protection system will be used for the entire control building.	B	
19.16	Control Room Fire Protection	Control Room – Smoke detection. Hi-Fog water mist protection system will be used for the entire control building. Under floor wet pipe system for under floor cabling. PFD recommended water mist systems instead of CO2 as a suppression system in computer or electrical areas.	B	
19.17	Control Building PCS & Server Room Office Areas Fire Protection	Refer to the fire protection specifications as there is more than one type of protection required for this building.	B	
19.18	Maintenance Building Fire Protection	Maintenance Building – Wet pipe sprinkler. Basement, wet pipe sprinkler.	B	
19.19	Water Lab Building Fire Protection	The water lab will require a wet pipe fire water suppression system.	B	
19.20	CEMS Fire Protection	Continuous Emissions Monitoring System – Smoke detection only.	A	
19.21	Fire Water Pipes	Cement lined ductile iron pipes for the fire water system.	B	
19.22	Fire Alarm Panel	A new fire alarm panel will be mounted in the new Control Room and all existing plant fire systems will be routed to this panel.	A	
20.0	**Hazardous Material**			
20.1	Flammable Gas	The PWP fuel source is natural gas. The onsite distribution system is primarily underground. There is no natural gas storage on-site. The natural gas service to the GT-5 project will be via a new connection to GT 1&2's fuel gas riser with a separate meter installed meeting the requirements of the LM6000 PG An emergency shutoff valve will be added to this connection as part of this project. As part of the commissioning of the fuel gas system, no gas blows will be allowed. Only compressed air blows will be permitted on site. The gas system air blow will be a targeted blow with acceptance criteria meeting the requirements of the PIE vendor's specifications.	B	All areas servicing fuel gas will need to be classified as hazardous with appropriate electrical provisions, seals, anti-sparking devices, etc.
20.2	Flammable Liquid	BOP Contractor shall supply a fire rated storage cabinet to be installed in the Maintenance Building.	B	Defined by flame spread rating.
20.3	Combustible Liquid	The plant rotating equipment will have lube oil and hydraulic oil systems. The plant GSU and auxiliary transformers will be filled with insulating oils.	A	
20.4	Toxic Gases and Liquids	PWP will use 19% aqueous ammonia for emissions controls. The BOP Contractor shall provide ammonia vapor / leak detectors at the GT-5 ammonia vaporization skid. Other toxic materials stored on-site, including water treatment chemicals and CEMS calibration gases, are not considered to pose a significant health risk due to relatively small quantities, lower toxicity and infrequent handling.	B	Any vessel containing hydrocarbons, lube oil, transformer oil, chemicals, etc., shall be installed in a double wall tank (with leak detection) or secondary containment. The containment needs to be sized for a 50 year storm event plus the contents of the primary container. Areas designated to have fire protection need to have the secondary containments sized for the maximum

Item	Criteria	Description	Revision	Comments
				vessel size, plus 24 hours / 50 year storm event, plus ten minutes of fire protection water spray.
20.5	Banned Materials	See Title 40 CFR Chapter 1 Part 355.50 Appendix A: List of Extremely Hazardous Substances	A	
20.6	Hazardous Material Regulations	Need to follow CAL-OP Regulations.	A	
20.7	Closed Fire System Testing	A door fan test will be required for closed fire system testing, such as in the gas turbine enclosures and the Power Distribution Center (PDC).	A	
21.0	**Waste Generation**			
21.1	Demolition	The Unit B-3 boiler will be abandoned in place, including the existing STG, condenser, deaerator, GSU transformer and cooling tower. Some of the existing electrical switchgear will need to be retained for existing plant systems fed from the Broadway side. The existing storm water drain running through the Glenarm property will need to be relocated to allow for the new plant. New piping will be routed and the existing storm drain piping will be demolished and hauled off site. Some existing underground piping, duct banks, tunnels, circulating waste piping, and foundations will need to be relocated/demolished and removed from site. Of significant consideration will be the underground structure south of the Glenarm building where the abandoned circulating water piping previously routed to a cooling tower. The BOP contractor will need to seal off the piping penetrations through the Glenarm Building.	C	This is defined in greater detail within the A.1 document.
22.0	**Regulatory Agencies**			
22.1	State Siting	CEQA and South Coast Air Quality Management District (permitted for 71 MW gross for original B-3 unit , and subsequently revised from boiler and STG to 1X1 with output gross of 71 MW, based upon the matching existing gross output).	A	
22.2	Electrical Interconnect	City of Pasadena 34.5 kV distribution center. PWP coordinating changes with SCE as necessary.	A	
22.3	Air Quality	South Coast Air Quality Management District (SCAQMD),	A	
22.4	Water Quality	Los Angeles County Sanitation District	B	
22.5	Building Department	City of Pasadena Planning Department,	A	
22.6	Public Works	City of Pasadena Public Works Department	A	
22.7	Fire Protection	City of Pasadena Fire Department,	A	
22.8	State Environmental Protection	CEQA and EPA	C	
22.9	State Roadway Interface	California Department of Transportation,	A	
23.0	**Design Codes and Laws, Ordinances, Regulations and Standards (LORS)**			
23.1	Federal Laws	All applicable	A	
23.2	Occupational Safety and Health	Cal OSHA (Title 8)	A	

Item	Criteria	Description	Revision	Comments
23.3	State Building Codes	2013 California Building Codes (Title 24) California Public Utilities Commission General Orders	B	
23.4	State Professional Registration	All project related professional activates, including off-site equipment manufacturing activities, shall be performed in compliance with appropriate state professional registration requirements, and stamped by professionals registered in good standing in the state of California.	A	
23.5	City Amendments, Ordinances and Standards	All applicable	A	
23.6	County Amendments, Ordinances and Standards	All applicable	A	
23.7	ASME Boiler and Pressure Vessel Design Codes	Section I: Power Boilers (2007 edition including Part PHRSG requirements) Section II: Materials Section V: Non-Destructive Testing Section VIII: Pressure Vessels Division I Section IX: Welding Qualifications	A	
23.8	ASME Piping Design Codes	ASME B31-1 Power Piping	A	
23.9	Turbine Water Induction Protection	The design shall comply with ASME TDP-1 Recommended Practices for the Prevention of Water Damage to Steam Turbines Used for Electric Power Generation	A	
23.10	Turbine Steam Bypass Design	The design shall comply with ANSI/ISA-S77.13.01-1999 Fossil Fuel Power Plant Steam Turbine Bypass System.	A	
23.11	ASME Power Test Codes	PTC-1 General Instructions PTC-4.4 Gas Turbine HRSG PTC-6 Steam Turbines PTC-6.2 Steam Turbines in Combined Cycle PTC-12.1 Closed Feedwater Heaters PTC-12.2 Steam Surface Condensers PTC-12.3 Deaerators PTC-12.5 Single Phase Heat Exchangers PTC-19.1 Test Uncertainty PTC-22 Gas Turbines PTC-23 Atmospheric Water Cooling Equipment PTC-25 Pressure Relief Devices PTC-30 Air Cooled Heat Exchangers PTC-30.1 Air Cooled Steam Condensers PTC-36 Industrial Sound PTC-46 Overall Plant Performance	B	
23.12	General Standards	ANSI: American National Standards Institutes ASNT: American Society of Nondestructive Testing ASTM: American Society for Testing and Materials California Code of Regulations Title 24 FM: Factory Mutual ISO: International Standards Organization	B	

Item	Criteria	Description	Revision	Comments
		NIST: National Institute of Standards and Technology NFPA: National Fire Protection Association – Note Pasadena Fire Department states this will be the minimum suggested guidelines. PFD is more restrictive. OSHA: Occupational Safety and Health Administration CalOSHA – California Occupational Safety and Health Administration SSPC: The society for Protective Coatings UL: Underwriters Laboratory		
23.13	Civil and Structural Standards	AASHTO: American Association of State Highway and Transportation Officials ACI: American Concrete Institute AISC: American Institute of Steel Construction AISI: American Iron and Steel Institute ASCE: American Society of Civil Engineers CMAA: Crane Manufacturers Association of America CRSI: Concrete Reinforcing Steel Institute ICC: International Code Council RCSC: Research Council on Structural Connections TMS: The Minerals, Metals and Materials Society	A	
23.14	Architectural Standards	AMA: American Medical Association BHMA: Builders Hardware Manufacturers Association MBMA: Metal Building Systems Members SDI: Steel Deck Institute SJI: Steel Joist Institute Standards SMACNA: Sheet Metal and Air Conditioning Contractors National Association Title 24	B	
23.15	Mechanical Standards	ABMA: American Boiler Manufacturers Association AFBMA: Anti-Friction Bearing Manufacturers Association AGMA: American Gear Manufacturers Association AMCA: Air Movement and Control Association API: American Piping InstituteAHRI: Air-Conditioning, Heating and Refrigeration Institute ASA: Acoustical Society of America ASHRAE: American Society of Heating Refrigeration and Air-Conditioning Engineers ASME: American Society of Mechanical Engineers AWS: American Welding Society AWWA: American Water Works AssociationCAGI: Compressed Air and Gas Institute CTI: Cooling Technology Institute EJMA: Expansion Joint Manufacturers Association HEI: Heat Exchange Institute HI: Hydraulic Institute MSS: Manufacturers Standardization Society NAAMM: National Association of Architectural Metal Manufacturers NACE: National Association of Corrosion Engineers	A	

Item	Criteria	Description	Revision	Comments
		PFI: Pipe Fabrication Institute RMA: Rubber Manufacturers Association TEMA: Tubular Exchanger Manufacturers Association TIMA: Thermal Insulation Manufacturers Association.		
23.16	Electrical and Controls Standards	ISA: Instrumentation, Systems and Automation Society AEIC: Association of Edison Illuminating Companies ICEA: Insulated Cable Engineers Association IEEE: Institute of Electrical and Electronics Engineers IEC: International Electrotechnical Commission IES: Illuminating Engineers Society IPCEA: Insulated Power Cable Engineers Association MCAA: Measurement, Control and Automation Association NEC: National Electric Code CEC: California Electrical Code NEMA: National Electrical Manufacturers Association NESC: National Electrical Safety Code SAMA: Scientific Apparatus Makers Association	B	
23.17	Edition and Conflicts	Unless specifically referenced in the permit, the applicable edition shall be the most current issue with addenda of the code or standard in effect at the date of contract execution, unless noted otherwise. Codes and standards are referenced to establish minimum requirements for quality and safety in facility design and operation. In the event a conflict occurs the more stringent requirements shall govern. In the case of fire codes, the authority having jurisdiction (fire marshal) shall have the final rule on the applicable code for each plant fire protection design element.	A	
24.0	**Procurement Criteria**			
24.1	Project Name	Pasadena Glenarm Repowering Project (GT-5 Combined Cycle Installation)	A	
24.2	Owner Contact	Mr. JASON P. MILLER ENGINEER, Pasadena Water & Power, Pasadena Glenarm/Broadway Generating Station, 85 East State Street, Pasadena California 91105, (626) 744-6276 Office, (626) 744-4491 Fax, JPMILLER@cityofpasadena.net	B	
24.3	Engineer Contact	TBD	A	
24.4	Contractor Contact	TBD	A	
24.5	Site Contact and Physical Address	TBD	A	
24.6	Heavy Delivery Access		A	
24.7	Submittal Documents	TBD	C	
24.8	Submittal Language	English	A	
24.9	Submittal Units	US Customary System	A	
24.10	Submittal Format	Review Submittals: Three (3) hardcopies and PDF Electronic Final Submittals: Three (3) hardcopy and electronic Final drawings will be supplied in the latest version of AutoCAD	B	

Item	Criteria	Description	Revision	Comments
24.11	Pasadena Submittal Review Cycle	20 working days	A	
24.12	Manuals	Custom manuals (supply specific) shall be provided in both hardcopy and searchable electronic format (Microsoft Applications, AutoCAD, or PDF). For all equipment supplied by the BOP Contractor. All manuals shall be searchable.	B	Not less than sixty (60) Days prior to the anticipated Substantial Completion Date, BOP Contractor will prepare in bound volumes and deliver to City five (5) sets of bound, and two (2) sets in electronic format (CD's) manuals for the operation and maintenance of the Equipment (the "Operation and Maintenance Manuals").
24.13	Quality Control	ISO 9000 or Equivalent	A	
24.14	Warrantee	See Contract	A	
24.15	Shipment Terms	See Contract	A	
24.16	Spare Parts	Supplier shall provide a priced spare parts list for both startup and 2-year operation at delivery, with pricing valid for 90-days.	A	
24.17	External Finish Coat Color	Final coating color as approved by Owner	A	
25.0	**Civil Criteria**			
25.1	Soil Compaction	Soil compaction shall be per the geotech report. All soils work will be performed under the supervision of a third party testing firms. Hydrologue shall be used for the overecavation and backfill operations. Surcharge on the Glenarm Building basement wall shall be considered as part of the BOP Contractor's design responsibility.	C	
25.2	Grading and Drainage	Grading and drainage shall be designed to incorporate all relevant local, regional and state requirements. The design shall minimize earthwork, provide for the collection and infiltration of on-site storm water, provide positive drainage from buildings and structures, provide adequate soil coverage above underground utilities, and support gravity drainage with low runoff velocities whenever possible. Ground level foundation TOC shall be minimum 6" above final grade, or as required to prevent flooding. Note: Grading and drainage design should be complete prior to issuing any underground drawings for construction. This will assure adequate coverage and projection of subsurface utilities above finish grade. All pipe flanges shall be designed to project 1'-0" above finish paving elevation to allow stud removal. Grading shall not have abrupt sloping surfaces (reference GT-3 & 4) All roadways and site surfacing that must be penetrated to install or relocate underground utilities shall be saw cut and replaced with the same material / thickness, etc.	C	As part of the BOP Contractor's scope of work, the existing storm water piping will need to be relocated to allow space for the new plant equipment. The existing storm drain is rectangular reinforced concrete culvert with an ID of 6'-0" x 4'-0", OD of 8'-0 x 6'-0". Existing drop inlets for GT 3 & 4 shall be protected and retained or relocated if necessary.

Item	Criteria	Description	Revision	Comments
25.3	Roadways	Roadways shall be design for HS-20-44 loads, or greater as required by specific conditions.	B	.
25.4	Surfacing	Match existing materials The site will be surfaced with asphalt and that surfaces around the power island will be concrete. Other areas not adjacent to the power island may be surfaced with gravel. All surfacing shall meet CalTrans and City of Pasadena standards at a minimum. The Geotech report also provides information regarding thicknesses.	B	Refer to C3-3 for site surfacing.
25.5	Fencing	Any additional security fencing required will be industrial chain link fence. 8 feet high with three strands of barbed wire on top. The west side of the property shall be protected with a 10'-0" high concrete wall with access gates as illustrated on the site plans. This wall will need to be coordinated with existing trees at the property boundary. It is envisioned that the fence will have cast in place columns/posts with precast panels inserted between, similar to Stonetree Fence. The cast in place portion will need to bridge some root balls where trees will remain. Also note that a free standing 10-0" tall cast in place concrete wall will be placed north of the control building to protect occupants form the gas compressor area.	B	
25.6	Gates	Fenced areas shall be provided with separate man way gates and maintenance vehicle access gates. Additional site access gates will be required along Fair Oaks Avenue. A new gate shall be constructed across State Street as shown on C1-3 utilizing the mesh material taken down between GT 3 & 4 and the new GT-5 site.	C	Gates along Fair Oaks will be constructed 10 gauge plate, reinforced at locking areas, with tubular framing support structure. Gates shall be of a rolling design that can be opened by one operator. Paint gates to match the concrete color.
25.7	Security	Expand on existing security system. New screens will be provided in the control room to see the new areas, and cameras will be installed as necessary to cover the plant.	B	
25.8	Landscaping	Not applicable	A	
26.0	**Structural Criteria**			
26.1	Soil Allowable Bearing Pressures	Refer to Final Geotechnical Engineering Report.	B	
26.2	Design Loads	Per California Building Code (2013CBC)	A	
26.3	Structural Concrete and Reinforcing	Concrete Strength 4,000 PSI minimum (28-Day), Reinforcing Strength 60,000 PSI Grade 60.	A	
26.4	Foundations	See Recommendations from final Geotechnical Engineering Report. All major equipment shall be supported on mat type foundations, or cast in place friction drilled piers/piles per the Geotech report. It is anticipated that after following the overexcavation and compaction in controlled 12" loose lifts, most foundations will be mat type foundations and drilled piers in tighter spaces, such as for the piperack.	B	Top of concrete elevations shall allow for an inch of structural non-shrink grout. All exposed foundations shall be designed to slope precipitation away. Floor drains shall be supplied under the chiller skids and the GTG auxiliary skids piped to the equipment drains sump

Item	Criteria	Description	Revision	Comments
26.5	Containment	Spill collection and containment (or overflow sumps) shall be provided for potential hazardous liquid spill quantities of 55 GAL or greater. Containment design shall be based upon 110% hazardous liquid quantity, plus design 24-hour 50 year storm event (outdoor containment areas only), plus 10-minutes fire suppression water (if applicable). Containment pits shall be designed with a low-point sump to support manual removal of hazardous or contaminated liquid (storm water will be allowed to evaporate). In addition, containment pits subject to firewater shall be designed with a submerged "inverted siphon" overflow to allow water to escape in the event of prolonged firewater delivery. Containment shall be designed for the worst case single component failure. Containments will have drain valves to grade to allow storm water to drain freely (drain valves need to have "T" handles to the top of the containment), if deemed free of containments. This will require all containment tops of concrete to be above finish grade. If a containment must be below grade, a permanently installed sump pump will be provided. The elevation of the GSU and aux transformers shall be that they can be drained to grade with a flow valve, but also to the plant waste water system if necessary. The GSU and aux transformer containments shall be supplied with full circumferential galvanized steel grating with access stairs. All access platforms and stairs in the plant shall be constructed of welded structural steel, hot dipped galvanized.	B	See also 25.7 Any tank containing hazardous materials shall be equipped with high and high-high level indication to control room.
26.6	Structural Steel	All structural steel shall be hot dipped galvanized sized to accommodate the design loads. To the greatest extent possible, clips and attachments for pipe supports will be made at the steel fabricator prior to galvanizing to limit the use of spray on galvanizing.	B	???
26.7	Equipment Access	Stairs and platforms shall be provided for access to areas requiring frequent inspection, operation or maintenance. Vertical ladders shall only be provided for infrequent access or alternate egress path. Platforms shall be provided for the package mandoors on the GTG extending to grade, keeping in mind the maintenance access required for the monorail. Removable sections and removable handrail shall be used in these areas. The filter house will be supplied with a ladder and access platforms as part of the PIE contract. The top of steel (top of grating) elevation shall allow approximately one half inch below the bottom of the GTG doors for clearance. The platform for the GTG package shall be one continuous platform wrapping around the skid. Platforms shall also be provided with landings at the top of the stairs to access the man doors on the GTG auxiliary packages. Handrails shall be sufficiently wide to clear the mandoors with at least one foot of space on either side of the doorways. The OTSG will be supplied with platforms as will the STG. All other areas needing to be accessed for normal operation and start-up shall be supplied with platforms. The full extent of the platforms supplied by the STG vendor is not known at this time. Details to be provided by STG vendor. The BOP contractor shall supply remaining platforms as necessary. Stairs and platforms to stairs will be provided at the PDC for access to mandoors and outside equipment access areas for maintenance. Platforms shall facilitate removal of individual PDC components for repair and maintenance. All transformer containment areas will have structural steel and grating similar to what was provided for GT 3 & 4, covering the entire containment area.	B	

Item	Criteria	Description	Revision	Comments
		Permanently installed shop fabricated and hot dipped galvanized stairs will be provided to access the GSU / Aux transformer area.		
26.8	Platforms, Guardrails, Stairs and Ladders	Design Live Load shall be 100 PSF or 1000 pounds concentrated (whichever is greater). All components shall be hot-dip galvanized. Guardrails shall be minimum 42-inch high 3-rail design with maximum 12-inch mid-rail and 6-foot post spacing. Stairs shall have minimum 12-inch handrail extensions at the top and bottom. Ladders shall be provided with non-slip rungs, safety cages and swing gates as required by applicable codes and regulations.	A	Need to verify preferences with owner…3 rail -vs.- 2 rail, and galv. -vs.-epoxy paint…
	Cooling Tower Foundation	The cooling tower foundation shall use epoxy coated reinforcing steel and PVC water stop at all cold joints. Vertical and horizontal expansion joints with water stop shall be installed to limit concrete cracking. The circulating water pump pit shall be designed to meet the requirements of the American Institute of Hydrology to prevent the possibility of pump cavitation. The pump pit will have individual chambers for each circulating water and auxiliary cooling water pump. Each chamber shall have channels set in the concrete to all for installation of cooling tower screens. Each chamber will have one set of channels for the primary screen and one for a secondary screen to be installed when removing the primary screen for cleaning. This will allow the pump to remain in operation while the screen is being cleaned. A permanently installed structural steel monorail structure with electric hoist shall be installed to facilitate removal of the screens. An area to the west of the pump pit will be provided for cooling tower screen washdown shall be provided. The monorail shall extend over this area so all washdown can be accomplished without the need for a crane. The washdown pit will be a weir type structure designed to retain solids, but allow water to spill over and then run to the plant equipment drains lift station. See C3-1 for sump and proposed drain routing.	B	
	Fire Walls	Fire separation walls shall be provided for the GSU transformer, the auxiliary transformers and the area north of the new control building to separate it from the gas compression equipment.	B	Final height and design to be determined by discussions with the Pasadena Fire Department and the GSU size.
27.0	**Architectural Criteria**			
27.1	Building Construction	Both the control building and water lab building will be a metal skin pre-engineered type building. Refer to architectural drawings and specifications for further details.	B	HVAC shall be a heat pump and hot water heaters shall be electric. HVAC and lighting shall be high efficiency.
27.2	Architectural Finishes	Refer to architectural drawings and specifications for further details.	B	
27.3	Building Insulation	Refer to architectural drawings and specifications for further details.	B	
	Water Lab	Refer to the architectural drawings. Provide a refrigerator in the water lab to store water samples.	B	
28.0	**Mechanical Criteria**			
28.1	Equipment Sizing	Suitable margins shall be included in the design of each piece of equipment; however, unduly large margins shall not be used as a substitute for good engineering design. Equipment shall be properly sized and shall operate near its design point under normal operating conditions.	A	

Item	Criteria	Description	Revision	Comments
28.2	Pressure Vessels	Minimum wall thickness: 3/8", Minimum Carbon steel corrosion allowance: 1/16"	B	
28.3	Heat Exchangers	Stainless steel material required for all "steam cycle" heat exchangers (no copper based material). Performance requirements shall be per applicable standards.	B	
28.4	Water Management	Good quality clean water shall be returned to cooling tower basin, including steam drains, and collected condensate from the GTG inlet air chiller coils. Poor quality water drains shall be routed to the waste water discharge system, including cooling tower blowdown, water treatment rejects and oil water separator effluent. Contact water (possible exposure to oil) shall be either routed to the plant oil water separator or allowed to evaporate in outdoor containment areas. Contaminated water shall be collected for off-site disposal. These include GTG wash water, some equipment drains, fuel gas scrubber drains, and the oil section of the oil water separator.	B	
28.5	Vents and Drains	Vents and drains shall be installed as required on equipment and piping to allow venting of trapped air and draining of water for freeze protection. All vents and drains shall be accessible from permanent access structures. These will not necessarily be located on piping drawings and will be the responsibility of the contractors to locate and supply.	A	
28.6	Pumps	Pumps shall be selected based upon coordinating the design operating conditions and best efficiency operating point on the pump characteristic curve. Pumps shall be capable of accepting at least the next size smaller and larger impeller size, when available. Pump installation shall be designed with permanent inlet Y-strainers (element may be removed after startup), suction/discharge isolation valves and pressure gauges and discharge check valve for parallel pumps. Pumps shall be provided with dedicated minimum flow recirculation lines as required.	A	
28.7	Tanks	Tanks shall be sized appropriate for both continuous operation and intermittent conditions. Tank nozzle connections shall be analyzed for seismic loading. Large tanks shall be provided with gauge boards with level transmitters (Varec or equal).	A	
28.8	Piping Sizing	Piping size shall be based upon maximum transient flow rates and pressure drop calculations to support equipment requirements. (Design velocities will consider flow accelerated corrosion).	C	Pipe sizing needs to account for the noise emissions generated by the velocity of the fluid or gas in the pipeline.
28.9	Piping Materials	Design shall be based upon carbon steel piping unless design requirements indicates otherwise. Use of chrome-moly pipe fittings for erosion-corrosion resistance is acceptable. Buried metallic piping, including carbon steel, copper, stainless steel, cast iron and ductile iron materials, shall be coated and wrapped with suitable corrosion resistant materials. Exposed FRP or PVC piping shall be provided with UV protection. Ammonia piping shall be installed in a double walled pipe with leak detection installed at low points every 300 feet. . Waste water piping shall be single wall suitable for the service.	B	A complete piping specification will be developed as part of the BOP scope of work.
28.10	Piping Design	Piping shall be designed for the intended service based on temperature and pressure conditions, as well as applicable ambient conditions, static loads, hydro test loads, seismic loads, reactions, dynamic time-force reactions, and the effects of supports, anchors and terminal point loads and movements. High energy piping (greater than 250 F operating temperature) regardless of size shall be appropriately analyzed for thermal flexibility based upon a detailed routing and support design.	B	See pipe material listed on P&IDs and Section 485100.01 Piping Specification for detailed requirements

Item	Criteria	Description	Revision	Comments
28.11	Insulation	Equipment insulation shall be ceramic fiber blankets with appropriate weather proofing. High temperature above ground piping insulation shall be calcium silicate with aluminum cladding (ASTM B209 Alclad 3004 stucco embossed pattern with moisture barrier). Piping susceptible to corrosion under insulation (CUI) shall be protected per NACE RP0198 recommendations. Insulation thickness shall be based on heat loss considerations. Chilled water piping shall be insulated with flexible elastomeric or polyisocyanurate silicate and aluminum cladding (ASTM B209 Alclad 3004 stucco embossed pattern with moisture barrier) to prevent heat gain and condensation formation. Insulation shall meet OSHA personnel protection requirements (external piping and surfaces within personnel reach shall not exceed 140F). Insulation shall be suitable for use in California. Anti sweat insulation required for inside of buildings or conditioned spaces.	B	See Section 485080 Piping and Equipment Insulation for detailed specifications
28.12	Valves	Valves shall be provided in accordance with the pressure and temperature rating specified by the manufacturer. Valve body and trim materials of construction shall be in accordance with applicable ASTM standards. Valve body material of construction shall generally be equivalent to the associated piping. Valves in throttling service shall be provided with design characteristics and materials of construction that resist erosion of valve seats. Globe type valves shall be sized for an operating range from 20% to 90% open. Ball and butterfly type valves shall be sized for an operating range from 20% to 60% open. In-line throttling valves shall be installed with isolation valves and a full-flow controllable bypass valve to permit on-line maintenance, unless not advisable from a process or safety perspective. See valve specifications for specific requirements. Flat seat valves are not allowed.	B	See P&IDs and Section 485100.03 Valve Specification for detailed requirements
28.13	Valve Operators	Valves shall be located for convenient operation from either grade or platform. Manual valve operators shall be lever, hand wheel or gear type. Lever operators shall be limited to quarter turn valves size 6" or smaller. Gear operators shall be provided for valves size 12" or larger (8" or larger for butterfly valves), and shall be capable of being operated from full-open to full-closed (and vice versa) within 15 minutes. Manual valve operators shall be operable by one person.	A	
28.14	Valve Actuators	Control valve actuators shall be designed for the specific installation environment and process conditions, including ambient temperatures, frequency of operation, speed of operation, process static and dynamic characteristics and valve torque and seating characteristics. All control valve actuators shall be provided with local manual override functionality, unless not advisable from a process or safety perspective.Pneumatic valve actuators shall be provided for control valves in modulating service, or that require failsafe positioning. Pneumatic actuators shall be designed for 125 psig instrument air pressure but operating range shall be from 60-100psig. Actuators shall be provided with integral pressure regulation and moisture filtration.Electrical actuators shall only be provided for control valves in positioning or on/off service. Electrical valve operators shall be 480V 3-phase self-contained motor operators or 125Vdc solenoid actuators.	B	

Item	Criteria	Description	Revision	Comments
28.15	Coatings	Surfaces to be painted shall be free of rust, mill scale, dirt, oil, grease, deteriorated paint or other surface contaminants, which shall be removed by acid pickling, blasting, wire brush or other mechanical means. Coatings shall be applied in strict compliance with manufacture recommended coating system. Primer coat shall be applied the same day as surface cleaning. Steel surfaces shall generally be coated with a zinc rich primer. All outdoor structural steel and platforms, stairs and ladders shall be hot-dip galvanized.	B	See Section 485072 Coatings for Piping and Tanks
28.16	Welding	Welding qualifications, processes, materials, workmanship and inspections shall conform to ASME B31.1 Piping Code ASME Section IX Welding and Brazing Qualifications, and AWS D1.1 Structural Welding Code.	B	See Section 485975 General Welding Requirements
28.17	Process Instrument Taps	Pressure Taps - 3/4" socket well, Thermo Wells - 1" socket weld	A	
29.0	**Electrical Criteria**			
29.1	Equipment Sizing	Suitable margins shall be included in the design of each piece of equipment; however, unduly large margins shall not be used as a substitute for good engineering design. Equipment shall be properly sized and shall operate near its design point under normal operating conditions. Bus ratings shall support the available source capacity plus 10% margin for sustained under-voltage operation.	A	
29.2	Voltage Drop	Under normal operating conditions, the medium voltage distribution system shall maintain voltage within 95% to 105% of nominal voltage rating. Under normal operating conditions, the low voltage distribution system shall maintain voltage within 95% to 105% of nominal voltage rating. The power distribution system shall be capable of starting the largest driven load on an otherwise fully loaded system without exceeding a 20% voltage drop.	A	
29.3	Bus Duct	Bus duct shall be designed in accordance with ANSI C37.23 and rated for maximum load at 95% under voltage during maximum ambient temperature conditions.	A	
29.4	Generator Breakers	Generator breakers shall be designed in accordance with IEEE Std. C37.010 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on Symmetrical Current Basis and IEEE Std. C37.20.2 IEEE Standard for Metal-Clad Switchgear. Generator breakers shall be rated for maximum load at 95% under voltage during maximum ambient temperature conditions. Generator breakers not designed to be removed during maintenance activities shall be provided with a grounding switch on the generator side of the interrupter and an isolation switch on the transformer side of the interrupter. Voltage transformers (VT) shall be provided for synchronization and metering on the transformer and generator sides of the interrupter as well as for the bus itself.	A	Generator breakers will be located in the Power Distribution Center (PDC).
29.5	Auxiliary Transformers	Auxiliary transformers shall be sized for the maximum single-ended switchgear operating load, plus 10% for future growth. Liquid-immersed transformers shall be delta-wye OA/FA rated for 65 C winding temperature rise with less-flammable insulating fluid. Dry type transformers shall be rated for 115 C winding temperature rise. Transformers shall be provided with two 2½ percent taps above rated voltage and two 2½ percent taps below normal voltage. All transformers shall be provided with condition monitoring to mitigate the risk of failure. The neutral of 13.8-4.16 KV transformers shall be high-resistance grounded. The neutral of 4160-480 V transformers shall be solidly grounded.	B	Please review highlighted text and verify if client wants to pay for such a feature.

Item	Criteria	Description	Revision	Comments
29.6	Medium-Voltage Switchgear and Motor Control	Medium-voltage switchgear shall be single-ended, rated at 13.8 KV nominal or 4160 V nominal. Ampacity and short circuit capabilities will be provided consistent with distribution system requirements. The medium-voltage switchgear lineups shall be located indoors, use vacuum interrupters, rated to continuously distribute the full auxiliary load and have provisions and space to be extended a minimum of 1 vertical section on each end. The medium-voltage motor contactors shall be rated NEMA Class E2, use vacuum contactors, provided with solid-state motor protection relays.	B	All equipment should have run time Hour meters.
29.7	Low-Voltage Switchgear	Low-voltage switchgear shall be single-ended, rated at 480 V nominal voltage. Ampacity and short circuit capabilities will be provided consistent with distribution system requirements. The low-voltage switchgear lineups shall be located indoors, use air-break power circuit breakers, rated to continuously distribute the full auxiliary load and have provisions and space to be extended a minimum of 1 vertical section on each end.	A	
29.8	Low-Voltage Motor Control	Low-voltage motor control centers shall be rated at 480 V, three-phase, 3-wire designed to supply 480 V non-motor loads, motor loads from 1/2 HP to 200 HP and lighting/distribution panel transformers. Non-motor loads shall be provided with thermal-magnetic molded case breakers. Motor loads shall be provided with padlocked magnetic-only molded case breakers (motor circuit protector), three-pole contactor, three-phase solid-state thermal overload elements and control power transformer with HOA control circuit. Each low-voltage motor control center shall be installed indoors and provided with a minimum 20% spare equipped space for future growth (including 10% assorted spare starters and breakers) and have provisions and space to be extended a minimum of 1 vertical section.	B	All equipment should have run time Hour meter. Low Voltage MCC's for the Gas Turbine and Steam Turbine will be located in the PDC. The BOP contractor will need to coordinate having these installed with the turbine vendors.
29.9	Arc-Flash Resistant Design	Both medium and low voltage switchgear and medium voltage motor control shall be provided with arc-flash resistant Type 2 or 2B design as defined in ANSI C37.20.7.	A	
29.10	Protective Relaying	The protective relaying philosophy shall prevent and minimize damage to equipment, minimize the effect of disturbances with proper protective device coordination, minimize loss of power generation, protect personnel in the event of electrical faults, provide redundancy and/or backup protection in event of a relay failure and comply with ANSI/IEEE standards for protection of power generation and substation equipment.	B	Coordinate design with PWP.
29.11	Metering	In addition to the plant revenue metering, permanent auxiliary power metering shall be provided on the distribution buses to support performance monitoring and operating load balancing with both local and remote (via the PCS) indication.	B	Coordinate design with PWP
29.12	Instrument Transformers	The continuous thermal current rating factor (RF) shall be 1.25 minimum. Burden and saturation calculations shall be performed to avoid saturation conditions. Voltage and current transformers for metering circuits shall have an accuracy class of 0.3 at a burden of B0.5 in accordance with IEEE standards.	A	
29.13	Motors	Motors rated above 200 HP shall be 4000 V, rated between 1/2 and 200 HP shall be 460 V, and rated below 1/2 HP shall be 110 V single-phase. Motors shall be sized for continues duty at design ambient conditions for no less than 115% of the maximum driven load without encroaching on the service factor under normal operating conditions. Motors shall also be sized for the driven equipment starting acceleration requirements. Motors shall be designed with Class F insulation for Class B temperature rise. Motors rated 10 HP or above shall be provided with	B	Input required for motor space heater requirements. Also require Premium Efficiency discussion>

Item	Criteria	Description	Revision	Comments
		space heaters rated for 240 Vac but sized and energized at 120 Vac. Medium voltage motors shall conform to NEMA TEFC or WPII criteria, and be equipped with winding temperature sensors to support thermal capacity protection. Low voltage motors shall conform to NEMA TEFC Premium Efficiency criteria.		
29.14	Battery System	Battery systems shall be sized based upon IEEE 485 and 1184. Batteries shall be gel cell type for stationary applications. Battery systems shall be provided with 2 x 100% battery chargers capable of recharging the battery bank from 50% discharge within 12-hours during normal load conditions. Battery rooms shall be equipped with spill containment, forced ventilation and explosion proof lighting.	C	Refer to provided battery specification in A.2. Batteries supplied in the PDC will be sized to accommodate the major equipment loads as well as UPS emergency plant loads.
29.15	Grounding	Grounding shall be provided to ensure life safety and equipment protection in accordance with IEEE Std 142 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems. Ground conductor burial depth shall be 18" (or per study requirements). Minimum ground conductor size shall be 4/0. The control system ground shall be isolated from the equipment grounding system. Grounding for Substation design shall be in accordance with IEEE Std 80 IEEE Guide for Safety in AC Substation Grounding	A	
29.16	Lighting	Outdoor area lighting shall include roadway lighting, egress lighting around equipment and security lighting around the perimeter of the site. Outdoor area lighting shall be full-cutoff type conforming to night sky (dark sky) regulations. Outdoor equipment lighting shall be industrial type angled and hooded toward the equipment to minimize light trespass off-site. All outdoor lighting shall be automatically controlled in logical groups by photocell using lighting contactors with independent HOA functionality. Elevated equipment lighting shall additionally be controlled through local manual switches. Illumination levels shall be per IES standards.	B	
29.17	Lightning Protection	Lightning protection shall be provided in accordance with lightning protection codes NFPA 780 Standard for the Installation of Lightning Protection Systems and IEEE 998 IEEE Guide for Direct Lightning Stroke Shielding of Substations.	A	
29.18	Cathodic Protection	Buried metallic piping systems shall be provided with a passive cathodic protection system, unless soil conditions require active cathodic protection. The exterior bottom of steel tanks installed on-grade (ring wall foundation) shall be provided with a cathodic protection system per the recommendations of NACE RP0193-2001.	B	Refer to Geotech report. States the soils are “moderately corrosive” based on resistivity testing. Piping and conduit penetrating concrete shall be coated. All underground piping shall be coated and may require sacrificial anodes. BOP to design.
29.19	Freeze Protection	Freeze protection is not required for this project.	C	
29.20	Enclosures	Indoor dry locations - NEMA 12 Indoor wet locations - NEMA 4 Outdoor locations - NEMA 4 (due to hot dusty environment) Corrosive locations - NEMA 4X stainless steel or fiberglass	A	
29.21	Circuit Separation	Raceway systems shall provide the following circuit separation as a minimum: medium voltage power circuits, low voltage power circuits, control and metering circuits, and low-level signal circuits.	A	

Item	Criteria	Description	Revision	Comments
29.22	Direct Buried	Not allowed	A	
29.23	Duct Banks	Underground duct banks shall consist of minimum 2" plastic conduit (type DB PVC) or rigid galvanized steel (RGS) conduit encased in reinforced "red" concrete. RGS conduit shall be used within duct banks where required for electromagnetic interference (noise) immunity. RGS long radius elbows shall be used for all duct bank risers. All below grade RGS conduit shall be wrapped and encased in concrete. Each duct bank shall be provided with a minimum 20% spare ducts, or at least one spare duct of each size and type, whichever is greater. Refer to provided electrical drawings for additional details.	B	Conduits shall be routed underground in duct banks to the greatest extent possible.
29.24	Cable Tray	Cable trays shall be aluminum ladder tray for power and control cables, and covered solid bottom tray for low-level signal cables. Cable tray shall be covered when routed under platform grating or vertical within 6 feet of floor level.	A	Confirm with Owner
29.25	Conduit	Conduit shall be rigid steel galvanized (RGS), EMT can be used within finished office area walls or block walls only. Conduits in corrosive environments (cooling tower) shall be schedule 80 PVC. Liquid-tight flexible metallic conduit shall be used for connection with all potentially removable components, motors and other vibrating equipment, or where required to support movement or expansion. Conduit shall be routed parallel or perpendicular to dominant surfaces and piping using right angle bends in a neat and visually attractive fashion supporting maintenance access to equipment and devices. Conduits shall be equipped with drains.	A	
29.26	Cable	Medium-voltage cables shall be shielded with EPR 90/105 C insulation. Low-voltage cables shall have minimum 600V class XHHW-2 insulation rated for a 90 C operating temperature and suitable for installation in wet or dry locations, indoors or outdoors in duct bank, cable tray or conduit. Conductors shall be annealed minimum 7-strand copper. Control cable shall have an overall shield with drain wire. Instrumentation cable shall have an overall shield and individual pair/triad shields with drain wire. Cat 5 for < 300 feet, fiber for > 300 feet on control systems.	B	
29.27	Lighting Efficiency	The Lighting system will require a high efficiency system per LEED or Cal Green. The City is held to a standard that is 20% higher than required for a private/commercial entity.	A	
29.28	PDC Building	Electrical PDC Building will be an elevated building on concrete column piers with cables entering from below. The PDC will house all of the MCC's and batteries for the GTG as well as the turbine control panels and DCS/PCS system.	B	
29.29	Convenience Receptacles	A minimum of 12 convenience receptacles shall be located throughout the operating area. One will be located at the exhaust stack platform to support stack testing, one on each level of boiler platform, all turbine deck elevations, including filter house, near any containment area for sump pump, and near areas at grade frequently maintained. All receptacles need to be GFCI.	B	
29.30	Welding Receptacles	A minimum of six 480V welding receptacles with local disconnects shall be supplied in the operating areas of the plant. Final location to be coordinated with PWP. At least one will be located on the OTSG and one in the STG enclosure.	B	
30.0	**High-Voltage Criteria**			
30.1	High-Voltage Equipment	High voltage system is 34.5kV. PWP has upgraded the switchyard breakers in the Distribution Center north of the Glenarm Building. Three winding GSU will step up from 13.8kV to 34.5. Generator breakers at 13.8kV will be in the PDC. Output from new GSU will be routed through a	C	

Item	Criteria	Description	Revision	Comments
		combination of new duct bank and existing underground ductbank to the switchyard / distribution center. The BOP contractor will need to install the raceway/ductbank necessary to connect the GSU output to the existing vault located to the west of GT 3 & 4's GSU's. 17kV power will also be brought to site from an area north of Glenarm Street. Existing tunnels and trenches may be used to bring this source to site. The interconnecting ductbank/raceway required to bring the power up to the 17kV transformer and PDC will be by the BOP contractor. A new precast vault/pull box shall be installed at the NE corner of the Glenarm Building for the 17kV system.		
30.1	Electrical Raceway	Single phase circuits shall be routed through non-ferrous metal conduit due to potential inductive heating. Where cable is not routed through existing tunnels, trenches or duct banks, new duct banks shall be installed. No direct burying of cable of any voltage shall be permitting.	B	
	Islanding Mode	The GT-5 power plant shall be designed to operate in isochronous / islanding mode, able to deliver power to the City of Pasadena, should the PWP connection to SCE be severed. The Power Island Equipment is being supplied with the capability of operating in this mode. The BOP Contractor shall coordinate with the City to determine what control logic will need to be implemented to operate in this fashion.	B	
31.0	**Controls Criteria**			
31.1	Failsafe Design	The instrumentation and control design shall be generally failsafe with normally energized signals and components, so that system failures are evident.	B	
31.2	Plant Control System (PCS)	Hybrid PLC/DCS style control system with redundant components per industry practice. The plant control system shall include operator control stations, engineering control station, data historian, performance monitor, sequence of events (SOE), GPS time synchronization, discrete input voltage 24Vdc, 125Vdc,120Vac (as necessary), discrete output interposing relays (10A), analog input 4-20mA, and analog output 4-20mA (isolated).	B	Refer to supplied PCS specification, control system architecture drawings and plant control philosophy.
31.3	PCS Data Network	The control system network shall be a fiber based Ethernet self-healing ring or star topology with redundant HMI servers.	B	
31.4	Circuit Breaker Control	Momentary close and trip contacts wetted from circuit breaker 125 VDC power source. Remote control (via control room DCS and mimic panel switches) shall be provided for medium and low voltage MAIN and TIE breakers only (not feeder breakers). Local manual control shall be provided at the breaker, for close (test position only) and trip.	A	
31.5	Motor Control	Maintained run contact wetted from 120 VAC control power transformer (low voltage motors). Medium voltage motors will use momentary run/stop contacts wetted with 125vdc. Motor control signals typically include Running (DI), Run (maintained/momentary DO), Auto (from an HOA switch, DI), and fault (no control power or overload activated, DI).	B	
31.6	Plant Protection Panel	The plant shall include a hardwired interlock panel with manual emergency stop pushbuttons for gas turbine generator trip, steam turbine generator trip, ammonia supply emergency shutoff valve and plant fuel gas emergency shutoff valve.	A	
31.7	Local Manual Operating Stations	In general, the plant equipment shall be controlled only through the plant control system or equipment stand alone control systems. Local manual control stations separate from the switchgear/MCC panels which bypass interlocks within the plant control systems shall not be	B	

Item	Criteria	Description	Revision	Comments
		incorporated into the design. Electrical circuit breakers shall be provided with local manual trip functionality only.		
31.8	Status Indications	RED - Running, Closed GREEN - Stopped, Open	A	
31.9	Instrumentation	Instruments shall be selected based upon the specific application and standard industry practice. Transmitters shall be smart HART communication enabled with integral valve manifold. Transmitters are preferred over switches.	B	All transmitters shall be Yokagawa.
31.10	Instrument Installation	Instrument installation shall support visual observation and safe maintenance activities at the instrument location from ground level or permanent platforms, and process connections shall be designed as appropriate for the specific process fluid conditions.	A	
31.11	Process Impulse Lines	Instrument impulse lines shall be stainless steel 1/2" OD tubing with 0.065" wall thickness conforming to ASTM A213 Type 316, unless otherwise required by process conditions. All impulse lines shall be insulated and/or heat traced as required for personnel and freeze protection.	A	
31.12	Foundation Field bus	Not applicable	A	
31.13	Vibration Monitoring	Vibration monitoring shall be provided by the equipment supplier for balance of plant large rotating equipment, including the boiler feed pumps and cooling tower fans. Vibration monitoring shall be standalone and suitable for the application, and provide both high level alarm and very high level trip signals.	A	

PASADENA WATER AND POWER

September 12, 2013

Mr. Jason Miller
Pasadena Water and Power
85 East State Street
Pasadena, California 91105

Subject: Fire Flow Results for 85 East State Street

Dear Mr. Miller:

In response to your request for information on water pipeline pressure and fire flow at 85 East State Street, a fire flow test was conducted on fire hydrant number 420-31 on September 10, 2013 and the results are as follows:

Fire Hydrant number 420-31:

Static Pressure:	75	psi
Flow Pressure:	68	psi
Pitot:	60	psi
Total Observed Flow:	1307	gpm
Flow at 20-psi residual:	3978	gpm

Fire hydrant number 420-31 is located on the north curb of State Street, at the north east corner of State Street and Fair Oaks Avenue. The residual pressure was taken at fire hydrant 420-31.

If you have any questions, please contact Linette Vasquez, Senior Utility Service Planner, at (626) 744-7064.

Sincerely,

Richard Thompson
Utility Services Planning Supervisor
Pasadena Water and Power Department

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

December 09, 2013

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

Section 480033
Combined Cycle Balance of Plant
Noise Control Performance

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123374

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POWER ENGINEERS

Combined Cycle Balance of Plant Noise Control Performance

PREPARED FOR: PASADENA WATER & POWER
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TABLE OF CONTENTS

PART 1 SUMMARY OF REQUIREMENTS 1

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

PART 2 GUARANTEED NOISE LEVELS 2

2.1 IN-PLANT LOCATIONS 3
2.2 COMMUNITY LOCATIONS OUTSIDE THE PLANT 3

PART 3 OBLIGATION TO PERFORM, LIQUIDATED DAMAGES, AND PENALTIES 4

PART 4 NOISE CONTROL PERFORMANCE AND TESTING PROCEEDURES 4

4.1 GENERAL SUMMARY 4
4.2 IN-PLANT NOISE PERFORMANCE FOR BALANCE OF PLANT EQUIPMENT 5
4.3 COMMUNITY NOISE PERFORMANCE FOR BALANCE OF PLANT EQUIPMENT 6
4.4 NOISE MEASUREMENT SYSTEM REQUIREMENTS 8
4.5 NOISE CORRECTIONS FOR MEASUREMENTS INSIDE AND OUTSIDE THE PLANT 9
4.6 GUARANTEED NOISE PERFORMANCE AT IN-PLANT LOCATIONS 9
4.7 GUARANTEED NOISE PERFORMANCE AT COMMUNITY LOCATIONS 10
4.8 TOLERANCE FOR TEST MEASUREMENTS 10
4.9 NOISE CONTROL GUIDELINES FOR BALANCE OF PLANT EQUIPMENT 10

PART 5 BOP CONTRACTOR SUBMITTAL FORMS 14

PART 6 NOISE PERFORMANCE ACCEPTANCE TEST REPORT 11

PART 7 REFERENCE STANDARDS AND PROCEDURES 11

PART 8 ABBREVIATIONS, ACRONYMS, AND DEFINITIONS 13

PART 9 EXHIBITS 15

COMBINED CYCLE BALANCE OF PLANT
NOISE CONTROL PERFORMANCE

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.

The GT5 Gas Turbine Repowering Project has been divided into two contracts: (1) the *Power Island Equipment* contract (*PIE*), and (2) the *Balance of Plant* contract (*BOP*). The *PIE* contract was purposely designed to include all of the major noise producing equipment so that its noise performance could be the responsibility of the *PIE* contractor with little or no interference from the equipment noise in the *BOP* contract. The results of a noise analysis conducted by the *PIE* contractor have revealed that they are at or very near the noise limit at one or more sensitive receptor locations and have used all available technology to reduce the noise levels from the *PIE*. Therefore, it is imperative that the *BOP* equipment noise levels in the surrounding community are far below the noise levels of the *PIE* so that there is no increase in the *PIE* noise performance caused by the *BOP* noise. In order to insure that the *BOP* equipment noise will cause no measureable increase in the *PIE* noise, the *BOP* noise performance criteria will need to be 20 decibels lower than the *PIE* noise performance criteria at all locations in the community. To meet the noise performance objectives of the GT-5 power generation system, The *BOP Contractor* will need to exercise great care and concern in selecting components and designing the systems to insure that the equipment in this contract meets the noise performance requirements. It will not be a simple task that can easily be achieved, and more than likely will require an acoustical expert's assistance to guide the *BOP Contractor* in this effort. The *BOP Contractor* must insure and guarantee that there will be no measureable increase in the *PIE* noise performance at locations either inside or outside the power plant. The following sections describe the noise control requirements for the *BOP* contract:

Noise producing equipment in the *BOP* contract shall not exceed a noise level of 70 dBA inside the plant (near field) when measured at a standard distance of three feet from the noise producing equipment and while operating simultaneously with other equipment in the *BOP* contract. Noise emanating from the piping systems in the *BOP* contract shall not exceed a noise level of 55 dBA inside the plant (near field) when measured at a standard distance of three feet. In addition, the noise levels outside the plant (far field) at selected sensitive locations shall be required to meet stringent noise limits. If the noise requirement at far field locations outside the plant necessitates the near field noise emissions be lower than those specified above, then the noise level requirements at the far field locations outside the plant shall take precedence over the near field noise requirements inside the plant. 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 as described in Sections 4.2 when measured at a standard distance of three feet from the noise producing equipment. 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. The maximum noise levels for each location outside the plant are described in Sections 4.3 and 4.7, are listed on SUBMITTAL FORM B, and mapped on Exhibit A.

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 power generation system. Corrections for the background noise shall be treated as described in Section 4.5 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 determine if the *BOP 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 two weeks following completion of the GT-5 power generation performance and air emissions tests. The noise measurement procedures will be as described 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 provided to the *BOP Contractor* within two weeks of completing the tests. *BOP Contractor* comments on the results of the Noise Performance Acceptance Test shall be submitted to the Owner no later than two weeks after receipt of the test report. The City and *BOP Contractor* shall provide their own authorized representatives to witness all noise level measurements. No measurement will be recorded without the City's and *BOP Contractor's* representatives in attendance.

1.5 CORRECTIVE WORK

The *BOP Contractor* shall pay for whatever additions, modifications, or replacement of equipment as may be necessary to achieve compliance with the noise control specifications and guaranteed performance. The *BOP Contractor* shall pay for labor, materials, and delivery of any corrective work (including disposal, if necessary) as necessary to satisfactorily complete the work so that it complies with the specifications and guarantees. If corrective work is required, the *BOP Contractor* shall be responsible for all subsequent costs and fees for a consultant to retest the noise performance of the power generation system. The subsequent test shall be scheduled on a mutually agreed date between the City and the *BOP Contractor*. No measurement will be recorded without the City's and *BOP Contractor*'s representatives in attendance.

PART 2 GUARANTEED NOISE LEVELS

2.1 IN-PLANT LOCATIONS

The *BOP* equipment shall be warranted and guaranteed by the *BOP Contractor* not to exceed the Maximum Sound Pressure Level Average (L_{EQ}) shown on SUBMITTAL FORM A when measured at 3 feet from the equipment as described in Section 4.2. The guaranteed noise level of the *BOP* equipment shall be 70 dBA or lower for any and all noise producing mechanical equipment and 55 dBA or lower for noise emanating from piping systems. These noise limit requirements shall be further reduced as necessary to meet the noise requirements at the fourteen receptor locations outside the plant shown on SUBMITTAL FORM B. The guaranteed noise level shall apply to each noise producing piece of equipment in the *Balance of Plant* contract while operating simultaneously with other equipment in this contract. A guaranteed noise level shall be provided for each piece of noise producing equipment and provided on SUBMITTAL FORM A. The piping systems in the *Balance of Plant* contract shall also include a noise guarantee on SUBMITTAL FORM A. Although noise emanating from the piping systems may be caused or excited by *Power Island Equipment* that the piping is attached to, it shall be the responsibility of the *BOP Contractor* to control the noise that emanates from the piping system so that it meets the requirements in these specifications.

2.2 COMMUNITY LOCATIONS OUTSIDE THE PLANT

When operating as a composite system, all components in the *BOP* contract shall be warranted and guaranteed by the *BOP Contractor* not to exceed the maximum sound pressure level average (L_{EQ}) at each location listed on SUBMITTAL FORM B in Part 5 of this specification when measured as described in Section 4.3. The receptor locations listed on the submittal form 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 *PIE* noise, 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 Section 4.3E.

PART 3 OBLIGATION TO PERFORM, LIQUIDATED DAMAGES, AND PENALTIES

Noise Guarantees are a Performance Item. *BOP Contractor* is obligated to cure any failure to perform and there will be no buy-down of such failure to meet the Guaranteed Noise Level requirements. See Section VIII, "Damages Due to Noise Performance Deficiency", of the City's RFP for further description of this obligation.

PART 4 NOISE CONTROL PERFORMANCE AND TESTING PROCEEDURES

4.1 GENERAL SUMMARY

The GT-5 Balance of Plant System (*BOP* system) 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 8 of this specification.

The *BOP Contractor* shall submit *Guaranteed Noise Performance* data (near field) with their proposal as described in Sections 4.6 and Part 5 of this specification for the Balance of Plant package associated with the GT-5 power generation system. In addition, the *BOP Contractor* shall submit *Guaranteed Noise Performance* data (far field) as described in Sections 4.7 and Part 5 of this specification for each of the receptor locations outside the plant. The *BOP Contractor* shall demonstrate compliance with the noise performance requirements upon initial system start-up and successive system runs of the *Balance of Plant* equipment thereafter. 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 each piece of noise producing equipment in the *Balance of Plant* contract while operating simultaneously with all other equipment in this contract. The noise shall be referred to as the *Balance of Plant Equipment Noise*. The noise level performance requirements and measurement procedures shall apply as follows:

A. In-Plant Noise Level Performance:

The *Balance of Plant Equipment Noise* shall not exceed a maximum sound pressure level average (L_{EQ}) specified in the proceeding sections. Except where specified, the in-plant measurement distance shall be 3 feet from major noise-producing sources. 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 unavoidable *pre-existing plant noise* shall be removed from the measured levels of the *Balance of Plant Equipment Noise* by mathematical calculation using the methods described in Section 4.5. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the *Balance of Plant*. The *BOP Contractor* shall guarantee and be responsible for meeting their *Balance of Plant Equipment Noise* level guarantees according to SUBMITTAL FORM A for in-plant measurement locations. The *Guaranteed Noise Performance* shall be demonstrated in the

Noise Performance Acceptance Tests. The community noise performance requirements described in Sections 4.3 shall take precedence over the in-plant noise performance requirements if the community noise requirements necessitate the in-plant noise levels to be lower.

B. Community Noise Level Performance:

The *Balance of Plant Equipment Noise* shall not exceed the maximum sound pressure level averages (L_{EQ}) shown on SUBMITTAL FORM B in the surrounding community. The *Balance of Plant Equipment Noise* shall not contain audible tones at any community location as described in Section 0. *PIE* and existing power plant equipment shall not be operating during the *Noise Performance Acceptance Tests* for GT-5 *BOP* equipment. 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* shall be removed from the measured levels of the *Total System Noise* by mathematical calculation using the methods described in Section 4.5. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the *Balance of Plant*. The *BOP Contractor* shall guarantee and be responsible for meeting their *Balance of Plant Equipment Noise* level guarantees according to SUBMITTAL FORM B for community locations. The *Guaranteed Noise Performance* shall be demonstrated in the *Noise Performance Acceptance Tests*. The in-plant noise performance requirements described in Sections 4.2 shall not take precedence over but shall be in addition to the community noise level performance requirements.

4.2 IN-PLANT NOISE PERFORMANCE FOR BALANCE OF PLANT EQUIPMENT

A. Maximum Noise Limits:

All major noise-producing equipment in the *BOP* contract shall not exceed a maximum sound pressure level average (L_{EQ}) of 70 dBA. Noise emanating from the piping systems in the *BOP* contract shall not exceed a noise level of 55 dBA. The guaranteed noise level shall be for each piece of equipment and measured as specified in part 4.2B. The noise shall be measured as an energy-averaged L_{EQ} with a 3-decibel exchange rate on an integrating sound level meter. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the *Balance of Plant*.

B. Measurement Locations:

The noise limit requirements shall apply at a distance of 3 feet from major noise-producing equipment regardless of the height above ground level. 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 levels tabulated for each measurement location.

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:

Noise measurements shall be made with the GT-5 *Balance of Plant* equipment operating prior to the start-up of or without the inclusion of the GT-5 *Power Island Equipment Noise*. P*re-existing plant noise* from existing power generation systems shall not be present during any measurements of the GT-5 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* shall be measured at each location and shall be used to correct the measurements of the *Balance of Plant* as described in Section 4.5. Noise measurements shall not be permitted if the constant wind speed exceeds 5 mph at any measurement location.

E. Measurement of Interconnecting Piping and Valves:

The interconnecting piping and valves in the *BOP* contract in most cases will be connected to other equipment in the *PIE* contract. The *PIE* will generate noise and vibration that excites and causes the interconnecting piping to produce noise by transference. To measure the noise performance of the *BOP* piping, the PIE shall be operated at its *worst-case load condition* so that the piping noise is excited. The noise emanating from the *BOP* piping will be measured with a highly sophisticated *sound-intensity measurement system* that is capable of distinguishing noise between other sources in the *PIE* contract. This will permit an accurate measurement of the *BOP* piping while the *PIE* is operating at the same time. This type of measurement is suitable for near field measurements within the plant. The noise performance from all piping systems will be measured compositely. The noise performance from all piping in the *BOP* contract combined will be required to meet the 55 dBA standard when measured at 3 feet from any portion of piping.

4.3 COMMUNITY NOISE PERFORMANCE FOR BALANCE OF PLANT EQUIPMENT

A. Maximum Noise Limits:

The Balance of Plant Equipment *Noise* level shall not exceed the maximum sound pressure level averages (L_{EQ}) at the locations listed on SUBMITTAL FORM B and mapped on Exhibit A. The *Balance of Plant Equipment Noise* shall be measured as an energy-averaged L_{EQ} with a 3-decibel exchange rate on an integrating sound level meter. *PIE* and existing power plant equipment shall not be operating during the *Noise Performance Acceptance Tests* for the GT-5 *BOP* equipment. 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* shall be measured together at each location before the *Balance of Plant Equipment Noise* measurements, and shall be used to correct the measurements of the *Balance of Plant Equipment Noise* as described in Section 4.5. No adjustments or exceptions shall be allowed for contributions from multiple noise sources associated with the *Balance of Plant*.

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 25 feet from any large, flat, sound reflective surface such as buildings or walls whenever practical. The *Balance of Plant Equipment 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:

Noise measurements shall be made with the GT-5 *Balance of Plant* equipment operating prior to the start-up of or without the inclusion of the GT-5 power island equipment noise. P*re-existing plant noise* from existing power generation systems shall not be present during any measurements of the GT-5 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* shall be measured at each location and shall be used to correct the measurements of the Balance of Plant as described in Section 4.5. Noise measurements shall not be permitted if the constant wind speed exceeds 5 mph at any measurement location.

E. Audible Tones:

The Balance of Plant 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 *Balance of Plant Equipment 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 *Balance of Plant Equipment Noise* level at the measurement location in the community is within nine decibels (below) the *background noise*, or higher. The *Balance of Plant Equipment 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* shall be checked to see if tonal noise is present. If tonal noise is present in the isolated measurement of the *background noise* alone, appropriate calculations shall then be performed and reported to determine if the *Balance of Plant Equipment Noise* contains tonal noise. If the overall average A-weighted noise level of the *Balance of Plant Equipment 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.

4.4 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. The measurement system shall also be capable of measuring the sound intensity and sound power levels of noise sources. 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 sound-intensity measurement/controller probe equipped with phase-matched microphones and preamplifier system;
C. a 3.5-inch diameter microphone windscreen;
D. a one-third octave-band filter set from 25 Hz to 20 kHz;
E. selectable A and Linear weighting networks;
F. exchange rate setting of 3 decibels;
G. capable of measuring the average noise level (L_{EQ}); and
H. capable of measuring six statistical noise levels simultaneously (L_{01} through L_{99}, L_{MAX}, and L_{MIN}).
I. capable of measuring sound intensity, sound power, and residuals.

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 for normal noise measurements, and a sound-intensity acoustic calibrator for intensity measurements. Both types of calibrators shall have NIST traceability and shall be used to calibrate the measurement system 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. 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 of measurements 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_{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 Part 6 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.

4.5 NOISE CORRECTIONS FOR MEASUREMENTS INSIDE AND OUTSIDE THE PLANT

Prior to start-up of the GT-5 Power Island equipment, the *background noise* (BGN) and the *Balance of Plant Equipment Noise* (BOP) shall be measured separately at each measurement location within the plant. The measurements shall be corrected and averaged as shown below. When the measured *background noise* is more than 17 decibels below the measured *Balance of Plant Equipment Noise* at any location, no correction is necessary for that measurement location. Otherwise, the measured *Balance of Plant Equipment Noise* levels shall be corrected using the formulas below so that the *background noise* is removed by calculation:

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

Where:

L_{BGN} = the measurement of the *background noise* at a location within the plant.
$L_{BGNBOP}MEAS$ = measurement of the *Balance of Plant Equipment Noise* at a location within the plant which will include the background noise at that location.
$L_{BOP}CORR$ = the corrected *Balance of Plant Equipment Noise* level at a location within the plant with the *background noise* removed by calculation. The $L_{BOP}CORR$ has the same definition as the *Balance of Plant Equipment Noise* level and must comply with the requirements in Section 4 and the guaranteed noise levels in SUBMITTAL FORM A and FORM B.
LOG_{10} = the common logarithm (base 10).
dBA = the abbreviation for decibels, A-weighted.

The results of the *BOP* equipment measurements both inside and outside the plant shall not be averaged.

Example:

L_{BGN} = 67.5 dBA

$L_{BGNBOP}MEAS$ = 73.0 dBA

$L_{BGN}CORR = 10 \times LOG_{10}(10^{(73.0/10)} - 10^{(67.5/10)})$

$L_{BOP}CORR$ = <u>71.6 dBA</u> *(corrected Balance of Plant Equipment Noise with background noise removed by calculation)*

4.6 GUARANTEED NOISE PERFORMANCE AT IN-PLANT LOCATIONS

The *BOP Contractor* shall submit a statement of guarantee for the noise level performance of the Balance of Plant noise producing equipment. The *Guaranteed Noise Performance* for each piece of equipment in the *BOP* contract including the interconnecting piping system, shall be provided on SUBMITTAL FORM A in Part 5 of this specification.

SUBMITTAL FORM A shall be submitted for each of the following:

- Auxiliary transformers
- HVAC equipment on the PDC building (including power ventilators if present)
- HVAC equipment on the new Control Building (including power ventilators if present)
- HVAC equipment on the new Water Lab Building (including power ventilators if present)
- New HVAC equipment on the existing maintenance building (including power ventilators if present)
- Steam drains tank exhaust (equipped with noise silencer)
- Demineralization water forwarding pumps
- Waste water forwarding pumps
- All lift station pumps (measured at 5 feet above ground for these in-ground pumps)
- Condensate pumps
- New demineralization water pumps at the existing GT-3 and GT-4 tank
- All chemical injection pumps
- Water shell and tube heat exchanger
- Potable water skid
- All interconnecting piping and valves. Note: the piping systems shall be categorized according to their predicted noise emissions (based on a piping noise analysis) with a separate submittal form provided for each pipe noise category.

4.7 GUARANTEED NOISE PERFORMANCE AT COMMUNITY LOCATIONS

The *BOP Contractor* shall submit a statement of guarantee for the noise level performance at each of the fourteen locations in the community as shown on Exhibit A. The *Guaranteed Noise Performance* shall provide all information shown on the attached SUBMITTAL FORM B. 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 has been determined. Distances to each receptor location and the ground elevations at each receptor are shown on the submittal forms for informational purposes.

4.8 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 submitted by the *BOP Contractor* for near-field (in plant) and far-field (community) locations.

4.9 NOISE CONTROL GUIDELINES FOR BALANCE OF PLANT EQUIPMENT

Although noise emanating from the piping systems may be caused or excited by *Power Island Equipment* that the piping is attached to, it shall be the responsibility of the *BOP Contractor* to control the noise that emanates from the piping system so that it meets the requirements in these specifications. With interconnecting piping systems, noise (and vibrations along the piping that results in noise) takes on unusual and often disregarded characteristics. Piping and valve noise if left untreated and properly designed for will cause undesirable effects and noise levels that are excessive to the project's noise performance requirements. The following pipe noise characteristics are important and must be considered by the *BOP Contractor* when designing the piping system for this *BOP* contract:

- Pipe noise is most often caused by the equipment that the piping is connected to, discontinuities in the flow (e.g., valves, bends, transitions, etc.), rapid pressure pulsations in the flow media due to equipment actions (pumps, compressors, etc.) and structural connections to vibrating mechanical equipment. In some cases, one type can dominate over the other. In other cases, both phenomena can be present and significant.
- Discontinuities along a pipe (bends, tees, size changes, etc,) create impedance changes that result in some acoustic and vibratory energy being reflected in the opposite direction while the remaining energy continues propagating down the pipe.
- Pipe noise will propagate upstream and downstream from a noise source or discontinuity.
- Pipe acoustical energy propagating with the flow (downstream) tends to move away from the pipe wall and toward the centerline of the pipe.
- Pipe acoustical energy propagating against the flow (upstream) tends to move away from the pipe center and toward the wall of the pipe.
- Pipe noise and the accompanying vibration are often propagated to supporting structures, which can radiate significant noise out from the support structure.
- Pipe noise has a "ring frequency" associated with the geometry of the pipe. At this frequency, more noise is radiated by the pipe itself in addition to the “break-out” noise from within the pipe.
- In anticipation of the need for pipe wrapping and lagging, adequate spacing between adjacent piping must be included in the design.
- Pipe noise is typically reduced by isolating the piping with decoupling isolators from the noise and vibration producing equipment that it is attached to, and using isolators to isolate the piping from structural support connections. In addition, the use of pipe wrapping and lagging (for liquid and gas pipes) and the use of in-line silencers (for gas pipes) are effective in reducing pipe noise. A combination of these methods will be needed for this project where untreated piping noise is expected to be above 70 dBA.
- The entry-end portion of piping that is equipped with an in-line acoustic silencer will need acoustical wrapping on that portion of piping prior to the silencing affect of the silencer.
- Pipe stands that are vibration isolated should be considered for piping with significant surface vibration.
- Pipe racks may need to be enclosed in an acoustical enclosure that is decoupled from the supporting structures and encases all the piping in one long acoustical container.

The following are important considerations for the *BOP Contractor* to give serious attention to in order to achieve the noise performance requirements for the *Balance of Plant* noise:

A. *Balance of Plant* Equipment Noise (other than piping and valve noise):

All noise producing equipment in the *BOP* contract, including transformers, HVAC equipment, steam exhaust on the steam drain tank, various pumps, heat exchanger, and potable water skid are required to meet a near field noise performance of 70 dBA or less at a distance of 3 feet from the equipment or noise source. The noise performance will require the use of one or more of the following measures in order to achieve this requirement:

1. ultra-low noise equipment that offers the best available technology for noise performance from the manufacturer with low noise options for transformers, pumps, motors, and various HVAC equipment;
2. acoustical treatments such as acoustic panels, silencers, and vibration isolators; and/or
3. complete equipment and piping enclosures; appropriate ventilation and fire code requirements will be necessary for rotating equipment and electrical equipment that is fully enclosed.

B. *Balance of Plant* Piping System Design Considerations:

The following guidelines for piping design considerations will be necessary in order to achieve the required noise performance:

1. The noise level of all piping that produces significant noise or vibration (i.e., noise levels that are expected to be more than 70 dBA at 3 feet, unabated) will be decreased significantly if the mass (pipe wall thickness) is increased by a minimum of 80%. Increasing the pipe mass will help reduce the radiated pipe noise.
2. For piping that is connected to *Power Island Equipment* that causes the piping to produce significant noise and vibration, such noise and vibration will be greatly reduced if the *PIE* is de-coupled from the piping with isolation type connectors. These are comprised of appropriate flexible materials to minimize transmitted structure-borne noise and vibration along the pipe from the *Power Island Equipment*.
3. Noise from gas piping connected to noise producing equipment will be greatly reduced if acoustic noise silencers that provide a minimum of 25 dB dynamic noise insertion loss are provided to minimize the noise propagation inside the pipe through the gas media.
4. Valve noise will be greatly reduced if ultra-low noise valves with a 70 dBA noise rating are used on all piping systems that are expected to produce more than 70 dBA at 3 feet (unabated); valve trim shall be optimized for maximum attenuation, appropriate flow conditions, and reasonable service life.
5. All piping that that is expected to produce more than 70 dBA at 3 feet (unabated - before any acoustic treatments are applied) shall have large sweeping elbows with a minimum radius of as follows:

Pipe Diameter	Minimum Elbow Radius
2” to 6”	72-inch
8” to 12”	144-inch
Over 12”	15-feet

6. All pipes that produce significant noise and/or vibration of more than 55 dBA at 3 feet unabated shall be isolated from their piping supports to minimize structure-borne noise and vibration transmitted to the support structure. The isolator types to be used should be neoprene or spring type isolators as appropriate to the weight of the piping system.

C. *Balance of Plant* Piping System Acoustic Treatments Considerations:

The following guidelines will be necessary in addition to the piping system design considerations in the previous section so that the required noise performance is achieved:

1. All pipes that are expected to produce noise and vibration resulting in more than 70 dBA at 3 feet (unabated) shall be treated with a constrained-layer damping system comprised of an appropriate elastomeric pipe damping compound bonded to both the pipe and a stiff sheet-metal covering wrapped around the damping compound (damping layer without a stiff cover is unacceptable).
2. All pipes that are expected to produce noise and vibration resulting in more than 55 dBA at 3 feet (unabated) shall be treated with pipe lagging that shall be designed to produce a minimum noise reduction of 10-15 dB. Guidelines for the design of such lagging are provided in item C3 below.
3. All pipes that are expected to produce noise and vibration resulting in more than 70 dBA at 3 feet (unabated) shall be treated with pipe lagging that shall be designed to produce a minimum noise reduction of 25-30 dB. Guidelines for the design of such lagging may consist of the following:

    a. Lagging performance is improved when the sheet-metal mass layer and the outer jacketing layer utilize laminated materials as opposed to non-laminated materials;
    b. The provision of a septum layer (an inner layer of barrier material in addition to the constrained layer and outer jacketing layer) provides increased attenuation performance for mid and high frequencies, generally above 1,000 Hz. This would be most useful for the gas media piping systems.
    c. Lagging performance is improved when the insulation material is a 3 to 5 pound density mineral wool without fiber binders (non-rigid type) and provides superior noise isolation compared to rigid insulation types which tend to “couple” the pipe noise to the outer jacketing.
    d. Acoustic insulation thickness greater than 2-inches (or 4 inches if a septum is used for a gas media pipe) provides little or no additional improvement;
    e. Lagging performance is improved when a constant air gap around the pipe of at least 1-inch for the full length of the lagging is incorporated between the pipe and outer jacketing material. This air gap requires the use of resilient stand-offs to hold the insulations and outer jacketing away from the piping.
    f. A vapor/moisture barrier shall be included in the pipe lagging systems to minimize pipe corrosion in those cases where a constraint layer in not being used as part of the lagging system.

4. Where pipe noise is expected to produce more than 70 dBA at 3 feet (unabated), piping enclosures with the following attributes shall be considered in addition to the pipe damping and lagging treatments in order to achieve the required noise control performance:

    a. Pipe enclosure wall construction shall consist of 2-1/2” thick steel acoustical panels with an absorptive, perforated sheet metal interior and a solid sheet-metal exterior, filled with mineral wool insulation and a moisture barrier poly bag encasing around the insulation. The Sound Transmission Class of the wall panels shall have a minimum rating of STC 30.
    b. The enclosure shall be isolated from the piping (no contact or attachment points) to minimize structure-borne noise transmitted to the enclosure. Enclosures should be supported from the ground surface rather than other noise radiating structures.
    c. Piping support structure shall be isolated from piping (see No. 8 above). In addition, piping supports shall be isolated from the enclosure without compromising the integrity of the acoustic enclosure performance (e.g., no holes or gaps that allow acoustic leaks where the pipe supports penetrate the enclosure).

PART 5 BOP CONTRACTOR SUBMITTAL FORMS

SUBMITTAL FORM A

BALANCE OF PLANT NOISE GUARANTEES AT IN-PLANT MEASUREMENT LOCATIONS

(to be completed for each piece of noise producing equipment, and each of the piping system categories)

BOP Contractor's Equipment Noise Performance Guarantee	
Name of Noise Producing Equipment or Pipe System Category: _____	
★**Guaranteed Maximum SPL of _____ at 3 Ft:**	dBA, re: 20 micropascals
Equipment produces *Dominant Tonal Characteristics*?	☐YES or ☐NO
Exceptions:	

Note: attach sketches or diagrams showing predicted SPLs of noise generating equipment.

★ **The noise requirement for the BOP equipment will not be met if the Guaranteed Maximum Sound Pressure Level is projected to be higher than 70 dBA at a standard distance of 3 feet away from the equipment, or higher than 55 dBA for any piping system category at a distance of 3 feet, when measured in accordance with Section 4.2. The final measurement result must be calculated in accordance with Section 4.5 of the Balance of Plant Noise Control Performance Specifications.**

COMBINED CYCLE BALANCE OF PLANT
NOISE CONTROL PERFORMANCE

SUBMITTAL FORM B
BALANCE OF PLANT NOISE GUARANTEES AT <u>COMMUNITY</u> LOCATIONS

Community Location No. (Ground Elev.)	Dist. to SW Corner of Glenarm Bldg. Ref. Point - Ground El. 752.0	① Maximum Allowed Balance of Plant Noise Level, L_{EQ} dBA*	② Guaranteed Balance of Plant Noise Level, L_{EQ} dBA	③ Amount Above (+) or Below (-) the Maximum Allowed Noise Level, dB ② minus ①⁂	④ Will Balance of Plant 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:		40	38	- 2	N	Y
C01 (753.9)	421 Ft.	31				
C02 (753.1)	263 Ft.	39				
C03 (754.0)	618 Ft.	41				
C04 (752.4)	277 Ft.	42				
C05 (752.3)	245 Ft.	41				
C06 (803.1)	588 Ft.	25				
C07 (786.9)	459 Ft.	32				
C08 (761.8)	350 Ft.	37				
C09 (756.5)	298 Ft.	41				
C10 (767.6)	459 Ft.	29				
C11 (764.2)	609 Ft.	37				
C12 (777.9)	740 Ft.	40				
C13 (826.7)	915 Ft.	31				
C14 (819.0)	1025 Ft.	28				

* The maximum allowed noise level is from the *Balance of Plant* equipment alone with no contributions from pre-existing plant noise, GT-5 Power Island 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 Balance of Plant 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.

PART 6 NOISE PERFORMANCE ACCEPTANCE TEST REPORT

A performance acceptance test report shall be submitted to the *BOP Contractor* not more than 14 calendar days after completion of the tests which summarizes the results of the test measurements for the GT-5 Balance of Plant equipment. 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. drawing or sketch showing measurement locations inside the plant;
e. aerial map showing measurement locations in the surrounding community;
f. photos of measurement positions (in-plant and community);
g. background noise measurement results (in-plant and community);
h. GT-5 Balance of Plant noise measurement results (in-plant and community) showing corrections applied for the background noise;
i. record of temperature, wind direction, wind speed, and percent relative humidity at all measurement locations outside the plant in the surrounding community;
j. a statement of compliance or non-compliance for each measurement location; and
k. annual calibration certificates for microphones and meters used for the tests.

PART 7 REFERENCE STANDARDS AND PROCEDURES

The *BOP Contractor's* design shall comply with the current editions, at the date of notice to proceed, of the following relevant standards. Where conflicts exist between the procedures and definition contained in these noise control performance specifications and the standards, the noise control performance 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 Purchaser.

1. American National Standards Institute (ANSI)

    a. ANSI S1.43-1997 (R2007) – Specifications for Integrating-Averaging Sound Level Meters
    b. ANSI S1.11-2004 (R2009) – Octave Band and Fractional-Octave Band Analog and Digital Filters
    c. ANSI S12.9-Part 4-2005 – Quantities and Procedures for Description and Measurement of Environmental Sound - Part 4: Noise Assessment and Prediction of Long-term Community Response

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)

PART 8 ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

ANSI. American National Standards Institute.

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. Measurements of the background noise shall be averaged (*LEQ*) 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 location 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.

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 Equipment* contract. Noise generating equipment in the balance of plant contract includes: auxiliary transformers; various HVAC equipment on the PDC, Controls, Maintenance, and Water Lab buildings, steam drain tank exhaust, demineralized water pumps, waste water pumps, lift station pumps, condensate pumps, chemical injection pumps, a potable water skid, a shell and tube heat exchanger, and all interconnecting piping and valves the *BOP* equipment and *PIE* contracts. The balance of plant noise shall not include *pre-existing plant noise*.

BGN. Background Noise.

BOP. Balance of Plant equipment and materials.

BOP Contractor. The party chosen by the City to provide materials and services for the *Balance of Plant* equipment.

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

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.

Glenarm 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 9 of these specifications.

Guaranteed Noise Performance. The *BOP 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 for the GT-5 Balance of Plant equipment 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 Balance of Plant contract creating a composite or combined noise level. For all noise measurements inside the plant and outside the plant, the *background noise* shall be mathematically subtracted from noise measurements of the GT-5 *Balance of Plant* equipment by the methods described in Section 4.5.

L_{10}. 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.

L_{EQ}. 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 L_{EQ} shall be A-weighted. L_{EQs} shall also be used for one-third octave band levels, but without any weighting applied.

L_{MAX}. 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.

L_{MIN}. 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 *Balance of Plant* equipment. 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 and materials.

Power Island Noise. The combined or composite noise of all noise producing equipment included in the GT-5 Power Island contract only.

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-Intensity Measurement System. A highly sophisticated measurement system that is capable of measuring sound intensity, power levels, and vector quantities of multiple noise sources. This

type of system allows the user to perform accurate measurements of a specific noise source while in the presence of other noise sources.

Sound Intensity Level or SIL. The term "sound intensity level" is a logarithmic measure of the sound intensity (measured in watts per meter squared), with a reference intensity of 10^{-12} watts per meter squared. It is expressed in decibels or (dB or dBA).

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 the slow response 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 *worst-case load condition*. 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 a location on 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 9 EXHIBITS

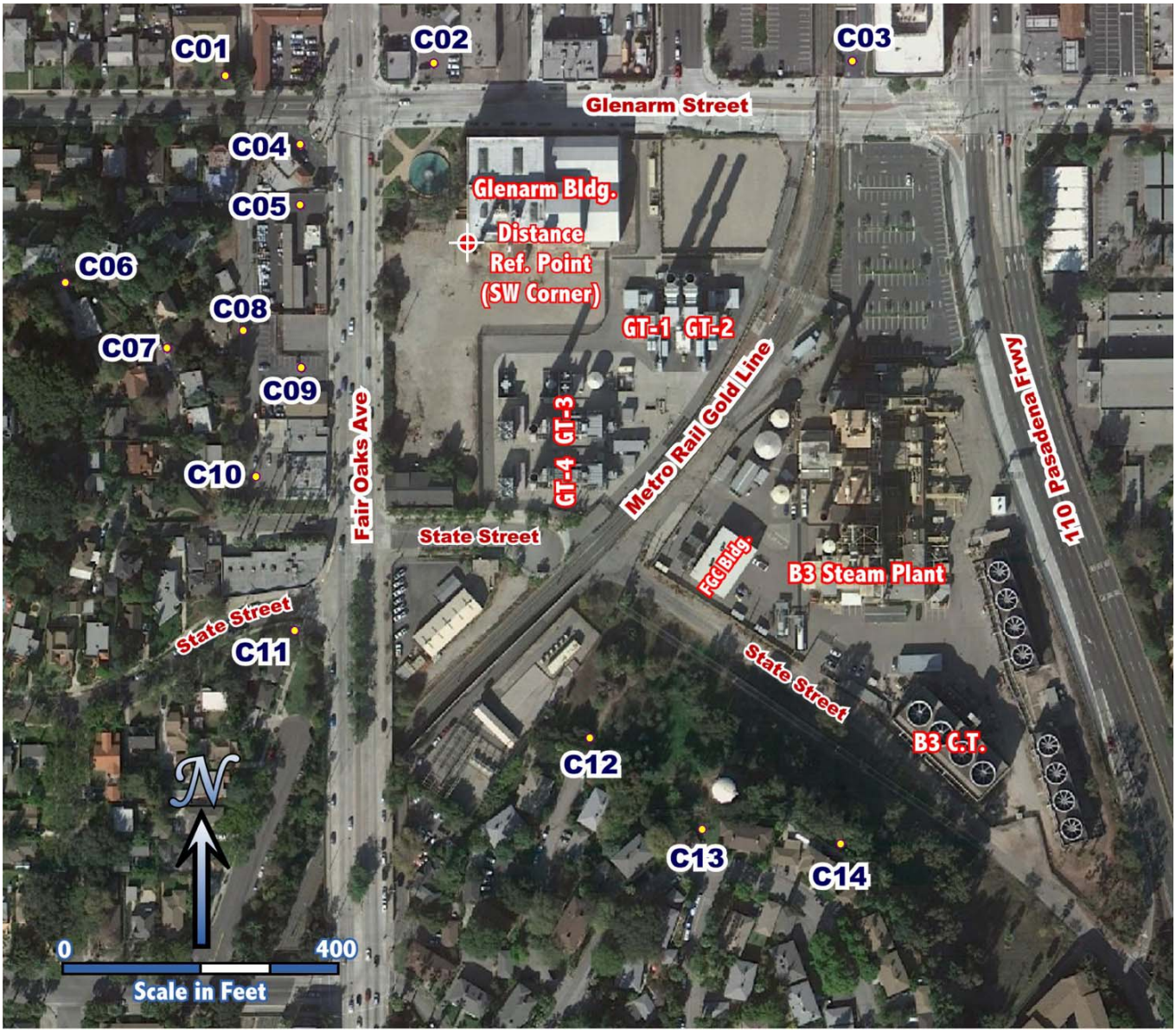


Exhibit A. Locations Outside the Plant for the Noise Performance Guarantees and the Noise Performance Acceptance Tests

August 18, 2011

PASADENA WATER & POWER

Glenarm Repowering Project (GT-5 Combined Cycle Installation)

Pasadena Soil Excavation Volumes

PROJECT NUMBER:
123374

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

POWER ENGINEERS

Pasadena Soil Excavation Volumes

PREPARED FOR: *PASADENA WATER & POWER*
PREPARED BY: *KEITH WALLER*

REVISION HISTORY		
DATE	PREPARED BY	REVISION
8/18/11	K. WALLER	A

EXCAVATION VOLUMES

Given

- Total area of site = 86860 sf
- Total area of asphalt paving = 30410 sf
- Total area of excavations for foundations =

Description	Fdn Depth below grade (ft)	Length (ft)	Width (ft)	Area (ft2)
Cooling Tower	2’-6”	76’-0”	41’-0”	3116
Aux Transformers	2’-6”	56’-0”	21’-0”	1176
GSU	2’-6”	38’-0”	36’-0”	1368
OTSG	4’-6”	30’-0”	80’-0”	2400
STG	4’-6”	36’-0”	30’-0”	1080
OTSG Stack	4’-6”	30’-0”	30’-0”	900
PDC	2’-6”	28’-0”	70’-0”	1960
Fuel Gas Compressor	2’-6”	20’-0”	45’-0” (2 Req’d)	1800
Tanks	2’-6”	34’-0”	36’-0” (2 Req’d)	2448
GTG	4’-6”	120’-0”	40’-0”	4800
Surface Condenser	4’-6”	24’-0”	45’-0”	1080
Total				22128

- Average Depth of Fill Material to Be Removed. Based on average of depths recorded at ten boreholes:
  BH-1 (GSU Transformer) – 5.5'
  BH-2 (PDC) – 5'
  BH-3 (STG/Sfc Condenser) – 5'
  BH-4 (CT north) – 6'
  BH-5 (GTG) – 5'
  BH-6 (OTSG Stack) – 5'
  BH-7 (CT south) – 15'
  BH-8 (Fuel Gas Compressor) – 4.5'
  Bh-9 (Inlet Air Chiller) – 6.5'
  BH-10 (Demin Water Tank) – 5'

  5.5+5+5+6+5+5+15+4.5+6.5+5/10 = 6.25 USE 6.5'

- Per Seyed Mortazavi with Hydrologue, inc., below foundations there is 1.5' of soil containing organic material that should be removed from the site.
- Per Limited Phase II Environmental Investigation for the site by Hydrologue, inc., there is approximately 1.5' at shallow depth of lead contaminated soil that should be removed from the site. Assume aerial extent of soil is 15' x 15'.
- Per geotechnical evaluation by Hydrologue, inc., all fill soil removed can be recompacted back into the excavation (except where under foundations as indicated above).
- Per geotechnical evaluation, below asphalt roadways, the fill soil can be removed to a depth of 2' and recompacted, if some pavement cracking is acceptable. USE 3' depth of fill removal

Determine

1. Amount of clean (organic) soil to be removed from site.

   Volume = Area x Depth
   V = 22128 x 1.5 = 33192 cubic feet = **1230 cubic yards**

2. Amount of contaminated (lead) soil to be removed from site.

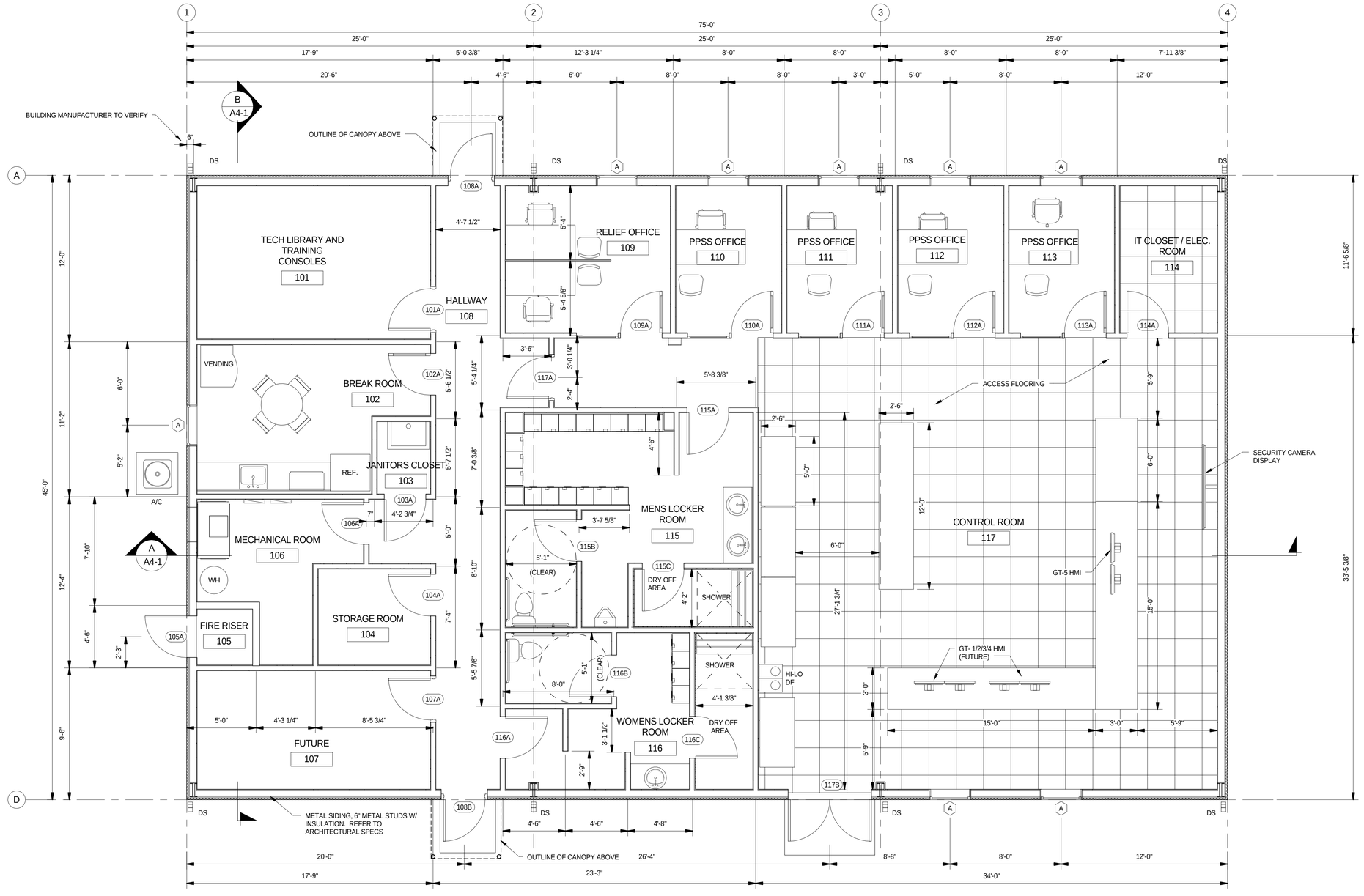
   Volume = Area x Depth
   V = 225 x 2.5 = 562.5 cubic feet = **21 cubic yards**

3. Amount of soil to be removed and recompacted beneath roadways.

   Volume = Area x Depth
   V = 30410 x 3 = 91230 cubic feet = **3380 cubic yards**

4. Amount of soil to be removed and recompacted across the site, not including the roadways and the foundations.

   Volume = Area x Depth
   V = (86860 – 30140 – 22128) x 6.5
   V = 34592 x 6.5 = 224848 cubic feet = **8330 cubic yards**



FLOOR PLAN

SCALE 1/4" = 1'-0"

GENERAL NOTES

STEEL STUDS IN WALLS:
STEEL STUD SIZE AND GUAGE TO BE DETERMINED BY THE STRUCTURAL ENGINEER.

PRELIMINARY BID SET: NOT FOR CONSTRUCTION

0 1 2 3 4 5 10 FEET
1/4" = 1'- 0"

THIS DRAWING WAS PREPARED BY POWER ENINEERS, INC. FOR A SPECIFIC PROJECT. TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIRMENTS 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.

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR BID	10/10/13	SAC	SDS	GH	
C	ISSUED FOR BID	09/27/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	GH	08/03/13
SCALE:		1/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING

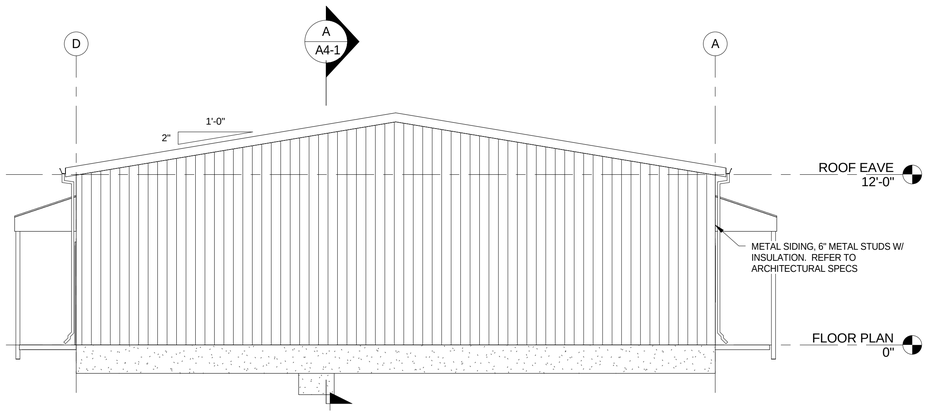
MAIN FLOOR PLAN

JOB NUMBER 123374

REV D

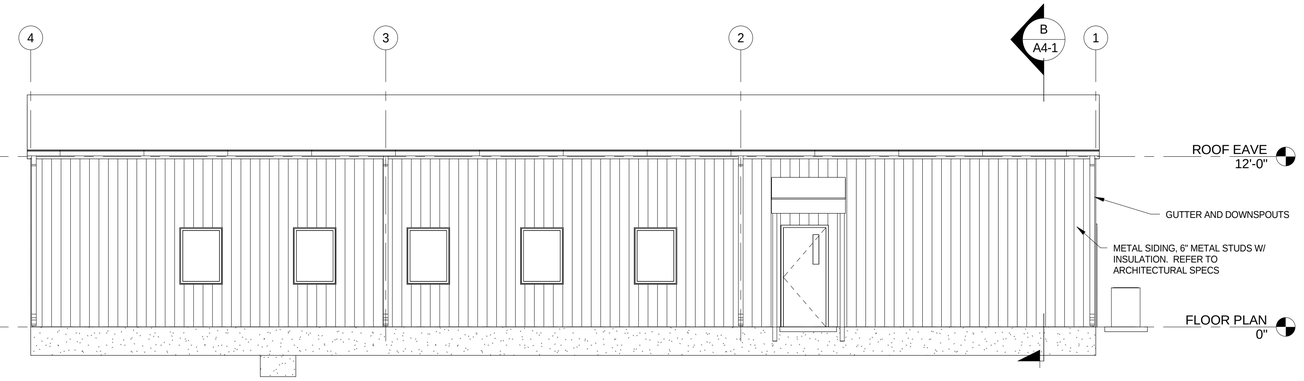
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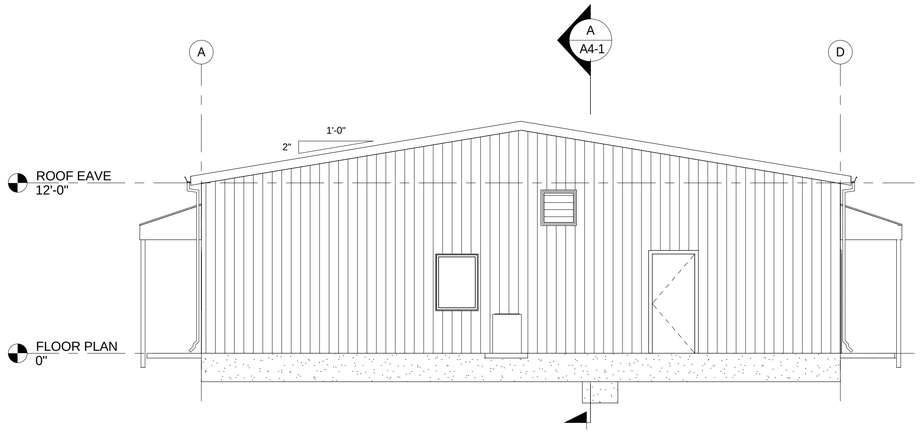
NORTH ELEVATION (LOOKING SOUTH)

SCALE 3/16" = 1'-0"



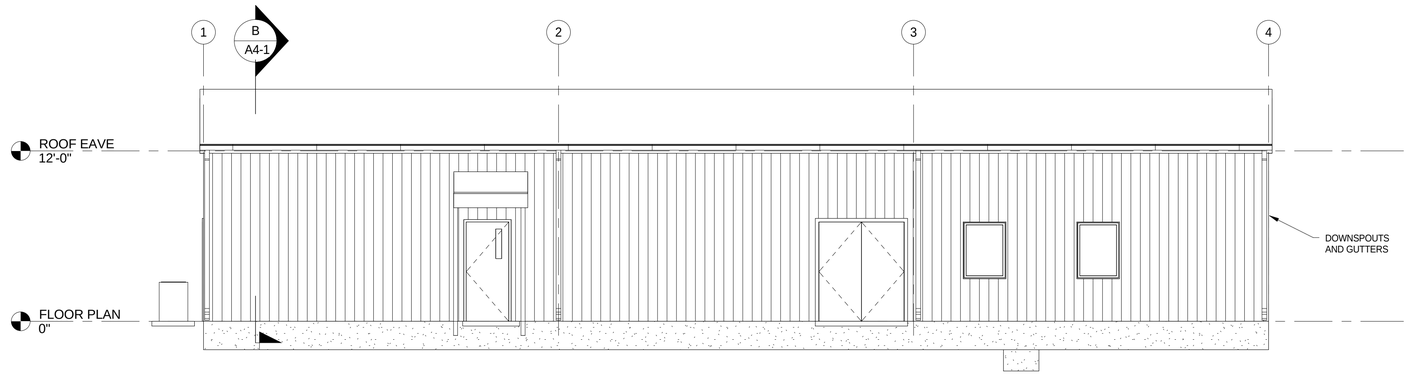
WEST ELEVATION (LOOKING EAST)

SCALE 3/16" = 1'-0"



SOUTH ELEVATION (LOOKING NORTH)

SCALE 3/16" = 1'-0"



EAST ELEVATION (LOOKING WEST)

SCALE 3/16" = 1'-0"

PRELIMINARY BID SET: NOT FOR CONSTRUCTION

0 2 4 8 12 FEET

3/16" = 1'-0"

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C	ISSUED FOR BID	09/27/13	SAC	SDS	GH	
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A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	HSD	

SCALE: 3/16" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING

EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV D

DRAWING NUMBER A1-3-1

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WINDOW SCHEDULE

WC	R.O. Width	R.O. Height	Type	Glazing Thickness	Glazing Type	Head Height	Comments	Count
A	3'-0"	4'-0"	Fixed			7'-0"		9
H	2'-6"	2'-6"	Fixed			11'-6"		1

DOOR SCHEDULE

DOOR NO	ROOM TO	SIZE	DOOR THICKNESS	TYPE NO.	FINISH	Material	HARDWARE SET	FRAME MATERIAL	FRAME TYPE	FRAME FINISH	FIRE RATING	COMMENTS
101A	TECH LIBRARY	36" x 84"	1 3/4"	3	PAINT	INSULATED HM	1	HM	B	PAINT		
102A	BREAK ROOM	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	3	HM	B	PAINT		
103A	JANITORS CLOSET	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	3	HM	B	PAINT		
104A	MECHANICAL ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	4	HM	B	PAINT		
105A	FIRE RISER ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	9	HM	B	PAINT		
106A	STORAGE ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	4	HM	B	PAINT		
107A	FUTURE USE	36" x 84"	1 3/4"	3	PAINT	INSULATED HM	1	HM	B	PAINT		
108A	EGRESS	36" x 84"	1 3/4"	3	PAINT	INSULATED HM	2	HM	B	PAINT		
108B	EGRESS	36" x 84"	1 3/4"	3	PAINT	INSULATED HM	2	HM	B	PAINT		
109A	RELIEF OFFICE	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	1	HM	A	PAINT		
110A	PPSS OFFICE	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	1	HM	A	PAINT		
111A	PPSS OFFICE	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	1	HM	A	PAINT		
112A	PPSS OFFICE	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	1	HM	A	PAINT		
113A	PPSS OFFICE	36" x 84" 1/2 LITE	2"	2	PAINT	INSULATED HM	1	HM	A	PAINT		
114A	IT CLOSET /ELEC. ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	4	HM	B	PAINT		
115A	MENS LOCKER ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	5	HM	B	PAINT		
115B	MENS W/C	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	6	HM	B	PAINT		
115C	MENS SHOWER	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	6	HM	B	PAINT		
116A	WOMENS LOCKER ROOM	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	5	HM	B	PAINT		
116B	WOMENS W/C	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	6	HM	B	PAINT		
116C	WOMENS SHOWER	36" x 84"	1 3/4"	1	PAINT	INSULATED HM	6	HM	B	PAINT		
117A	CONTROL ROOM	36" x 84"	1 3/4"	3	PAINT	INSULATED HM	7	HM	B	PAINT		
117B	CONTROL ROOM EGRESS	72" x 84"	2"	4	PAINT	INSULATED HM	8	HM	B	PAINT		
118A	EGRESS	36" x 84"	2"	3	PAINT	INSULATED HM	3	HM	B	PAINT		
118B	STORAGE CLOSET	36" x 84"	2"	1	PAINT	INSULATED HM	3	HM	B	PAINT		
119A	W/C	36" x 84"	2"	1	PAINT	INSULATED HM	6	HM	B	PAINT		
119B	W/C EXTERIOR	36" x 84"	2"	1	PAINT	INSULATED HM	9	HM	B	PAINT		

ROOM SCHEDULE

ROOM NO	ROOM NAME	FLOOR MATERIAL	FLOOR FINISH	BASE MATERIAL	BASE FINISH	WALLS NORTH	WALLS EAST	WALLS SOUTH	WALLS WEST	CEILING MATERIAL	CEILING HEIGHT	CEILING FINISH	WAINSCOT MATERIAL	WAINSCOT HEIGHT	WAINSCOT FINISH	REMARKS
101	TECH LIBRARY AND TRAINING CONSOLES	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2x2 SUS	9'-0"	FAC FIN				
102	BREAK ROOM	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
103	JANITORS CLOSET	VCT		RUB/VINYL	FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC	GWB	9'-0"	PAINT	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
104	STORAGE ROOM	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2x2 SUS	9'-0"	FAC FIN				
105	FIRE RISER	CONC		---	---	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	OPEN	9'-0"	PAINT				
106	MECHANICAL ROOM	CONC		---	---	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2x2 SUS	9'-0"	FAC FIN				
107	FUTURE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2x2 SUS	9'-0"	FAC FIN				
108	HALLWAY	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
109	RELIEF OFFICE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
110	PPSS OFFICE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
111	PPSS OFFICE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
112	PPSS OFFICE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
113	PPSS OFFICE	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
114	IT CLOSET / ELEC. ROOM	ACCESS		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
115	MENS LOCKER ROOM	CT		CT	FAC FIN	FRP/PAINT	FRP / FAC FIN *	FRP / FAC FIN *	FRP / FAC *	GWB	9'-0"	PAINT	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
116	WOMENS LOCKER ROOM	CT		CT	FAC FIN	FRP/PAINT	FRP / FAC FIN *	FRP / FAC FIN *	FRP / FAC *	GWB	9'-0"	PAINT	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
117	CONTROL ROOM	ACCESS		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	2X2 SUS	9'-0"	FAC FIN				
118	WATER LAB	RESINOUS	SEE SPEC	RESINOUS	SEE SPEC	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC FIN	---			FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
119	W/C	RESINOUS	SEE SPEC	RESINOUS	SEE SPEC	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP / FAC FIN	GWB	8'-0"	PAINT	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT

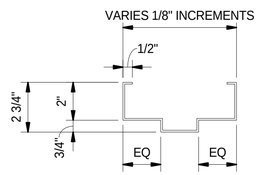
* NOTE: MENS AND WOMENS SHOWERS TO BE CERAMIC TILE WAINSCOT 5'-0" IN HEIGHT.

FINISH ABBREVIATIONS

CARP TILE 1 =	CARPET TILE
CARP TILE 2 =	ABUSIVE RESISTANT
CT =	CERAMIC TILE
CONC =	CONCRETE
PAINT =	HEAVY DUTY PAINT
RUB/VINYL =	RUBBER OR VINYL BASE
EXISTING =	EXISTING BUILDING MATERIALS
FRP =	FIBERGLASS REINFORCED PANEL
GWB =	GYPSUM WALLBOARD
CMU =	CONCRETE MASONRY UNITS
EXIST CMU =	EXISTING CMU
WOOD =	SELECTED WAINSCOT WOOD
2X2 SUS=	2 X 2 SUSPENDED ACOUSTIC TILE

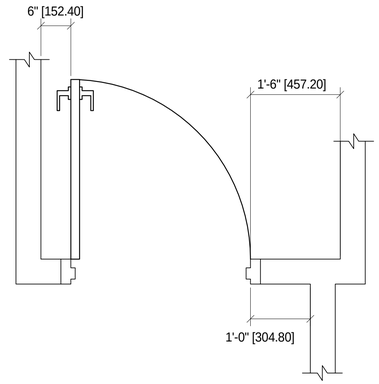
DOOR ABBREVIATIONS

HM =	HOLLOW METAL
FAC FIN =	DOOR MANUFACTURER'S STANDARD BAKED EMANMEL OR POWDER COATED FINISH
MFGR =	BUILDING MANUFACTURER'S STANDARD (SDI) DETAILS AND DETAILS THIS DRAWING

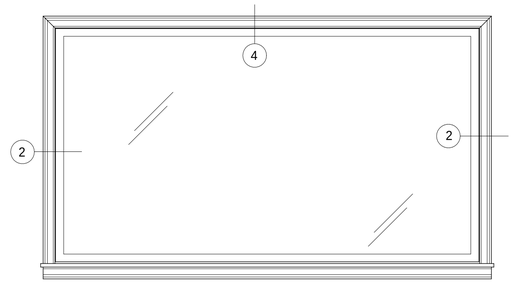


STANDARD HM FRAME
SCALE 3" = 1'-0"

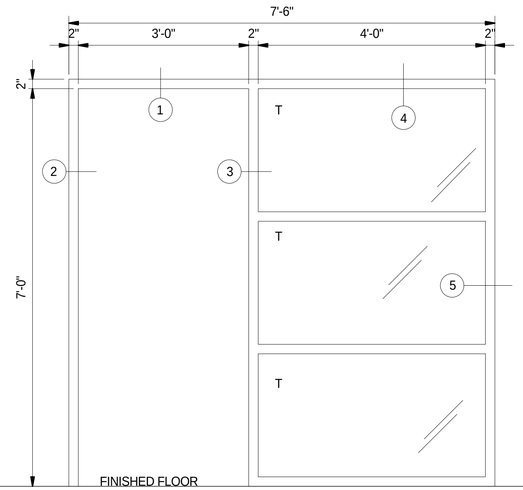
PRELIMINARY BID SET: NOT FOR CONSTRUCTION

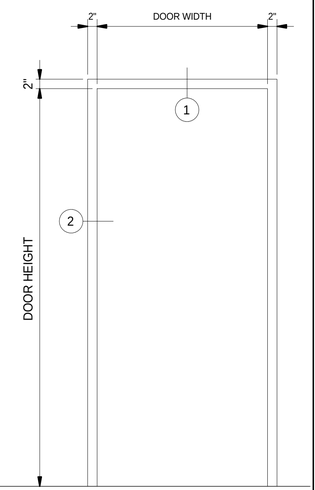


TYPICAL DOOR PULL/PUSH CLEARANCES



NOTE: REFER TO SHEET A9-2 FOR HEAD, SILL, AND JAMB DETAILS



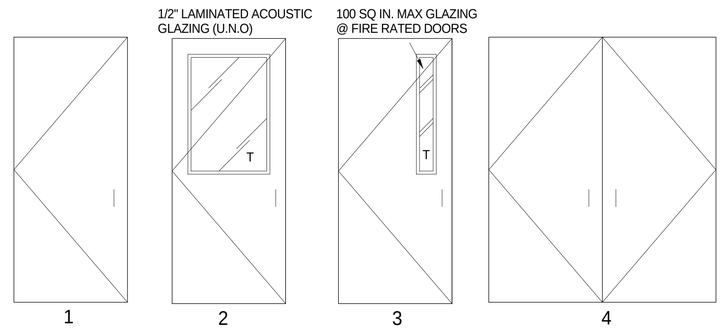


NOTE: REFER TO SHEET A9-2 FOR HEAD, SILL, AND JAMB DETAILS

T= CLEAR TEMPERED GLAZING 1/4" THICK

FRAME TYPE - A

FRAME TYPE - B



T= TEMPERED GLAZING 1/4" THICK

DOOR TYPES

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A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	GH	08/03/13

SCALE: As indicated

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING & WATER LAB

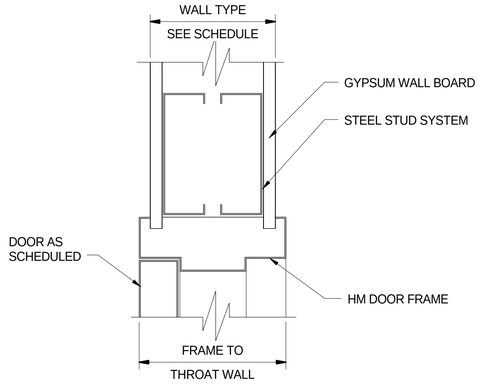
ROOM FINISH, DOOR AND WINDOW SCHEDULES

JOB NUMBER 123374

REV D

DRAWING NUMBER A1-9-1

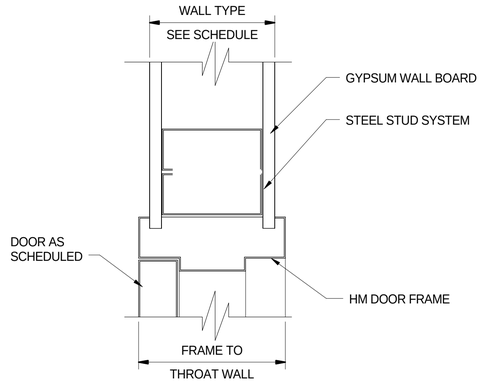
10/10/2013 4:48:51 PM



DOOR HEAD @ FRAMED WALL

DETAIL 1 A9-1

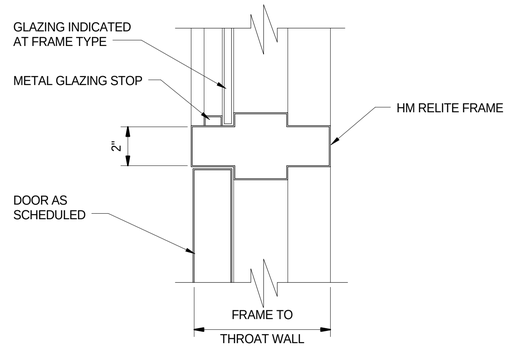
SCALE 3" = 1'-0"



DOOR JAMB @ FRAMED WALL

DETAIL 2 A9-1

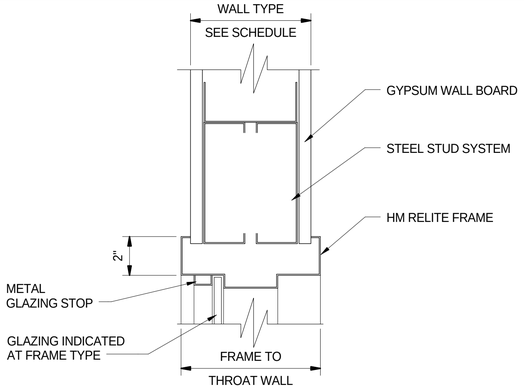
SCALE 3" = 1'-0"



MAN DOOR SILL

DETAIL 3 A9-1

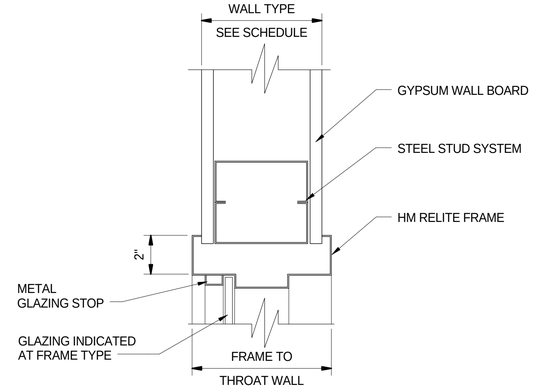
SCALE 3" = 1'-0"



WINDOW HEAD

DETAIL 4 A9-1

SCALE 3" = 1'-0"



WINDOW JAMB

DETAIL 5 A9-1

SCALE 3" = 1'-0"

DETAIL 6 A9-1

SCALE 3" = 1'-0"

PRELIMINARY BID SET: NOT FOR CONSTRUCTION

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR BID	10/10/13	SAC	SDS	GH	
C	ISSUED FOR BID	09/27/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	09/20/13
DRN	SAC	09/20/13
CKD	SDS	09/20/13

SCALE: 3" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING & WATER LAB

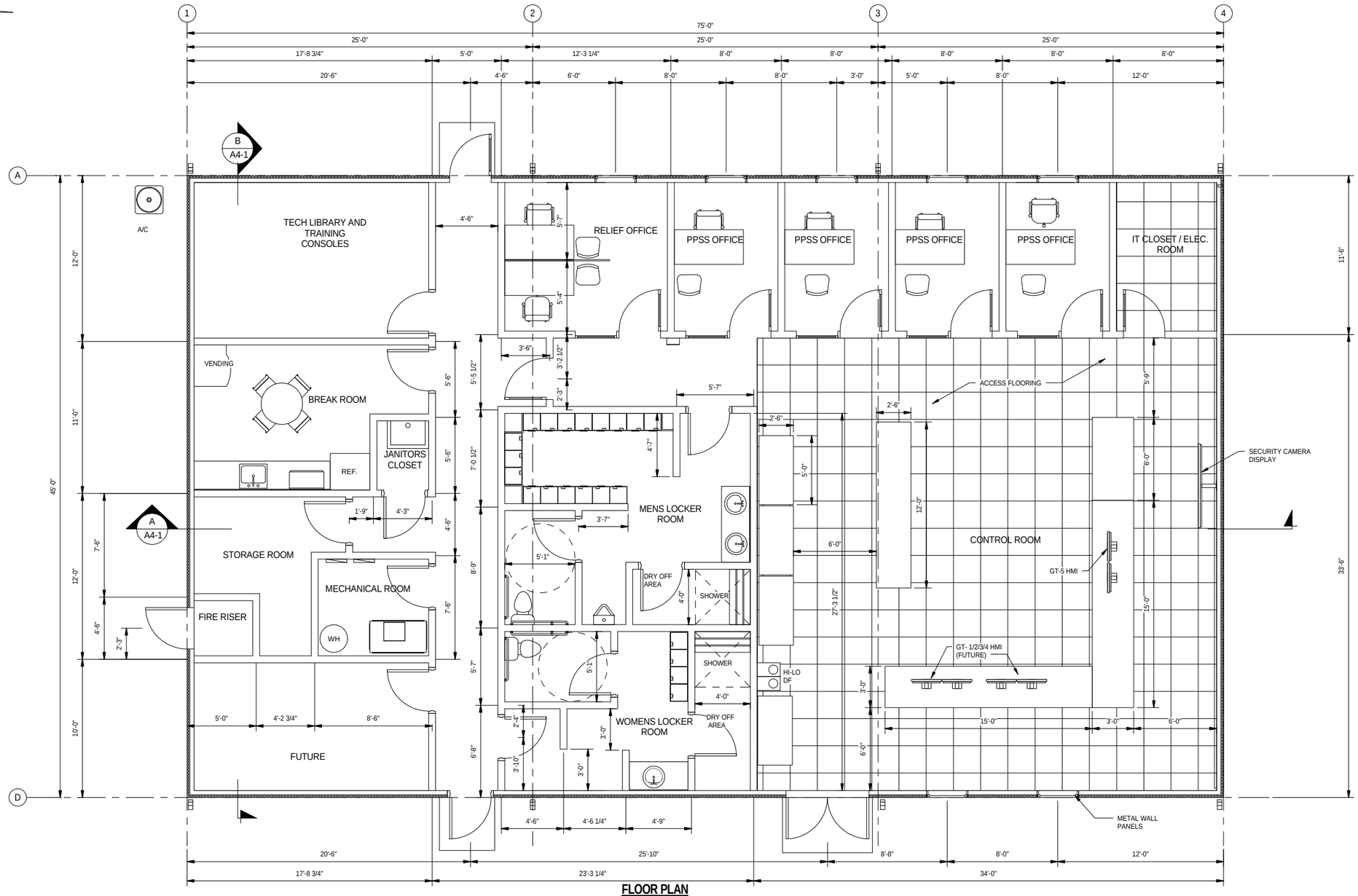
DOOR AND WINDOW DETAILS

JOB NUMBER 123374

REV D

DRAWING NUMBER A1-9-2

10/10/2013 4:49:01 PM



FLOOR PLAN

SCALE 1/4" = 1'-0"

0 0.5 1 1.5 2 FEET

1-1/2" = 1'- 0"

THIS DRAWING WAS PREPARED BY POWER ENINEERS, INC. FOR A SPECIFIC PROJECT. TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIRMENTS 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.

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B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH		
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	HSD	

SCALE: 1/4" = 1'-0"

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING

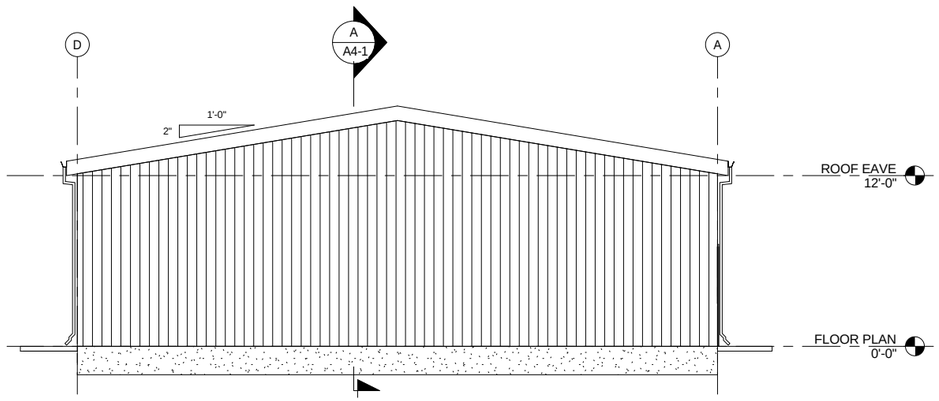
MAIN FLOOR PLAN

JOB NUMBER 123374

REV B

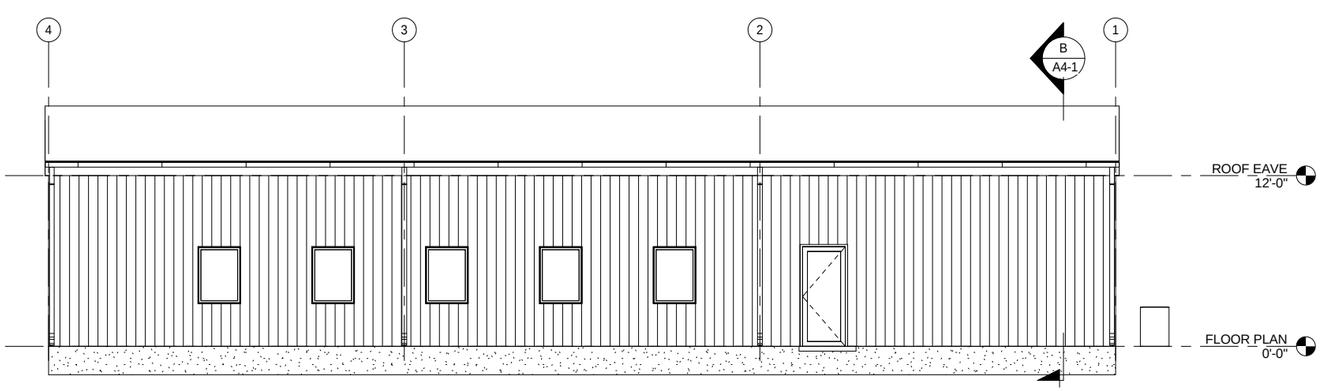
DRAWING NUMBER A2-1

7/11/2013 11:35:11 AM



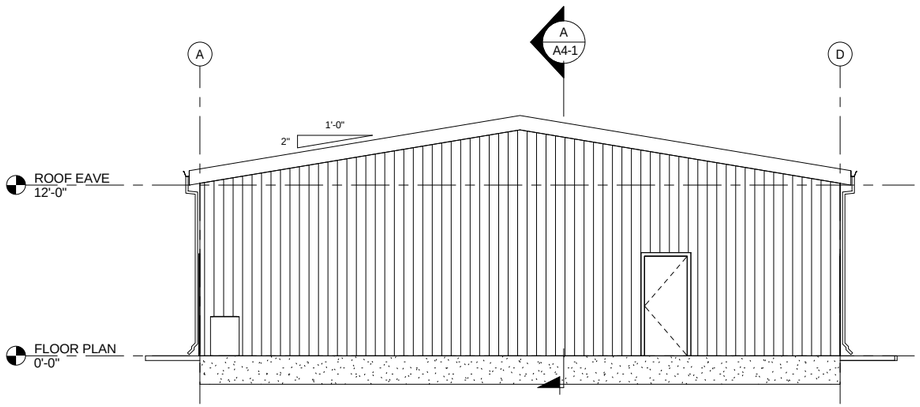
NORTH ELEVATION (LOOKING SOUTH)

SCALE 3/16" = 1'-0"



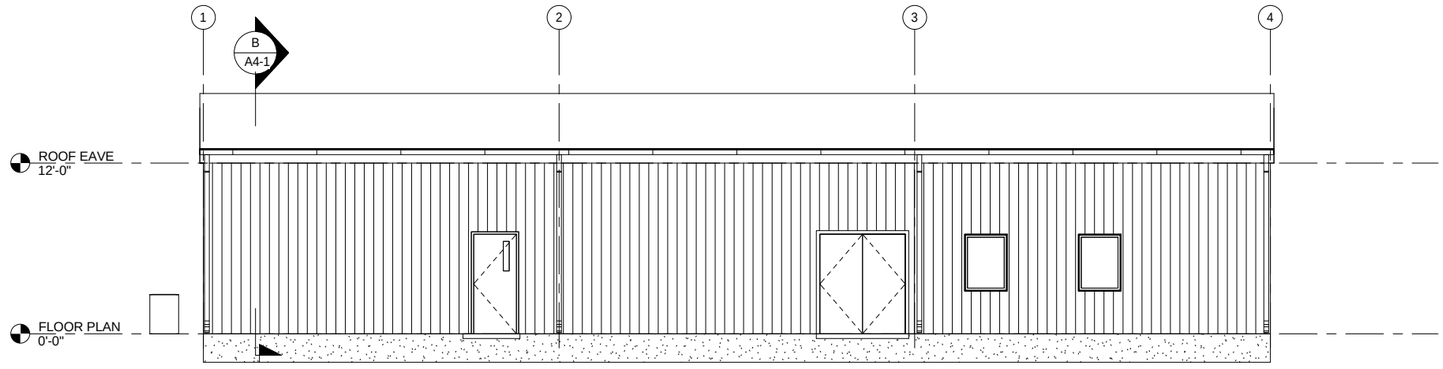
WEST ELEVATION (LOOKING EAST)

SCALE 3/16" = 1'-0"



SOUTH ELEVATION (LOOKING NORTH)

SCALE 3/16" = 1'-0"



EAST ELEVATION (LOOKING WEST)

SCALE 3/16" = 1'-0"

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH		
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	HSD	

SCALE: 3/16" = 1'-0"

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING

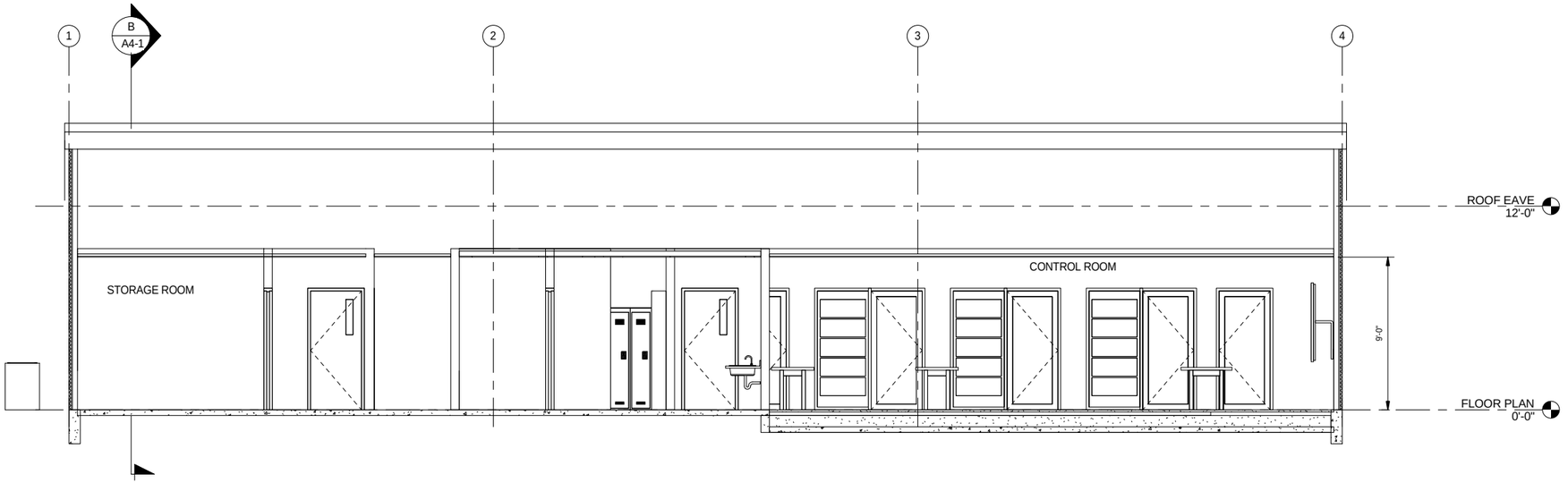
EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV B

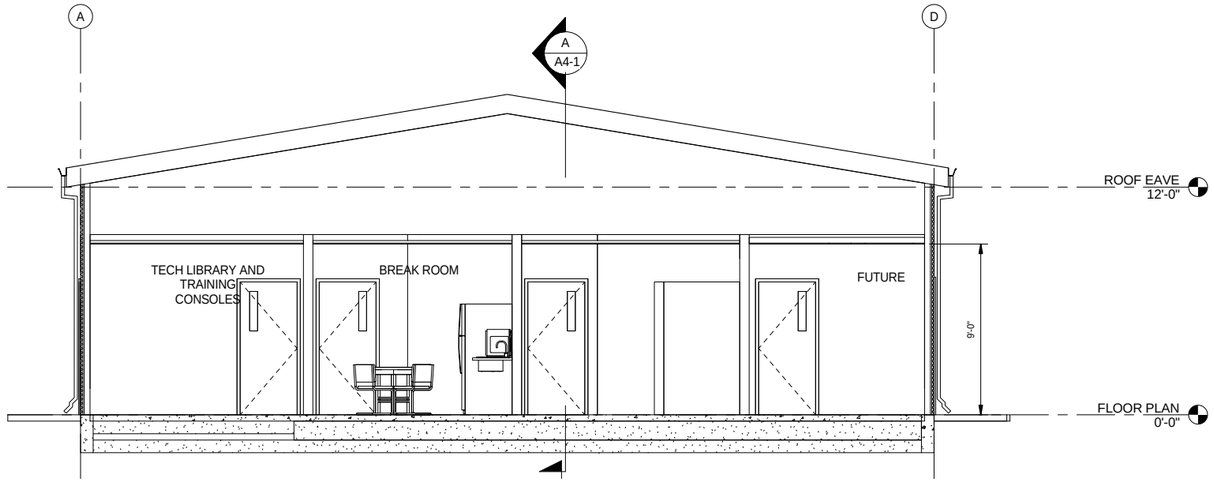
DRAWING NUMBER A3-1

7/11/2013 11:35:11 AM



SECTION B / A2-1

SCALE 1/4" = 1'-0"



SECTION A / A2-1

SCALE 1/4" = 1'-0"

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH		
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	Checker	

SCALE: 1/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING

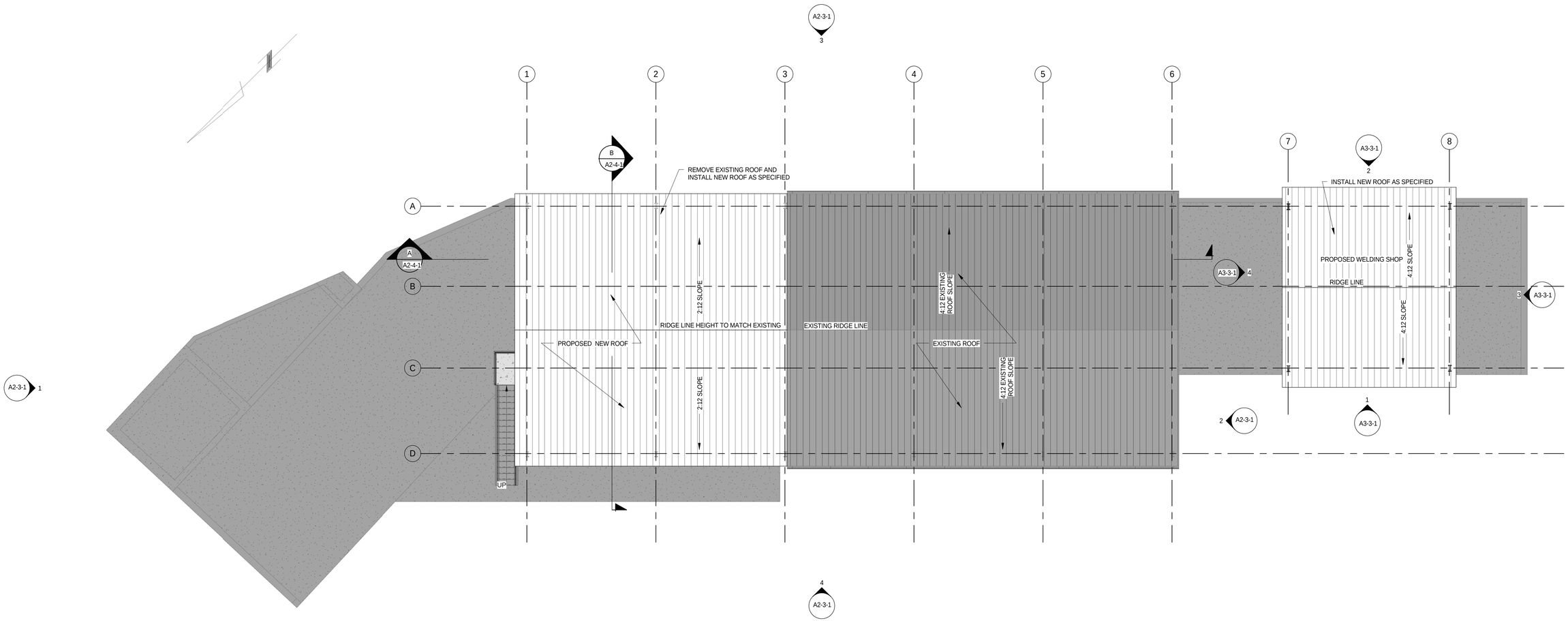
BUILDING SECTIONS

JOB NUMBER 123374

REV B

DRAWING NUMBER A4-1

7/11/2013 11:35:11 AM



ROOF PLAN

SCALE 1/8" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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C	ISSUED FOR BID	09/24/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	08/16/13
DRN	SAC	08/16/13
CKD	GH	08/16/13

SCALE: 1/8" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

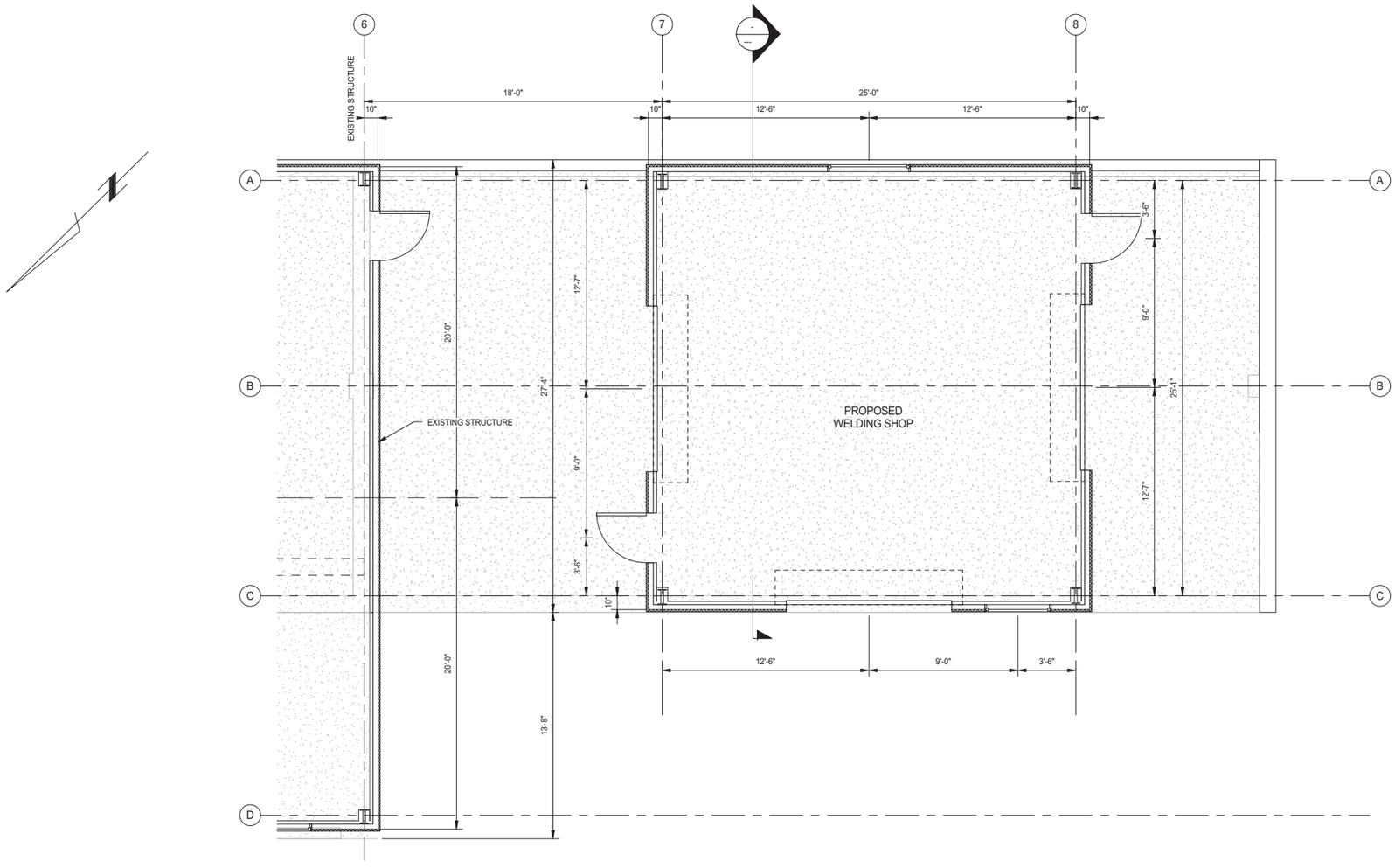
ROOF DEMOLITION PLAN

JOB NUMBER 123374

REV C

DRAWING NUMBER A2-1-1

9/24/2013 2:35:38 PM



WELDING SHOP

SCALE 1/4" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
A	ISSUED FOR REVIEW	07/16/13	SAC	SAC	GH	---	

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	Checker	
SCALE:	1/4" = 1'-0"	

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

PWP MAINTENANCE

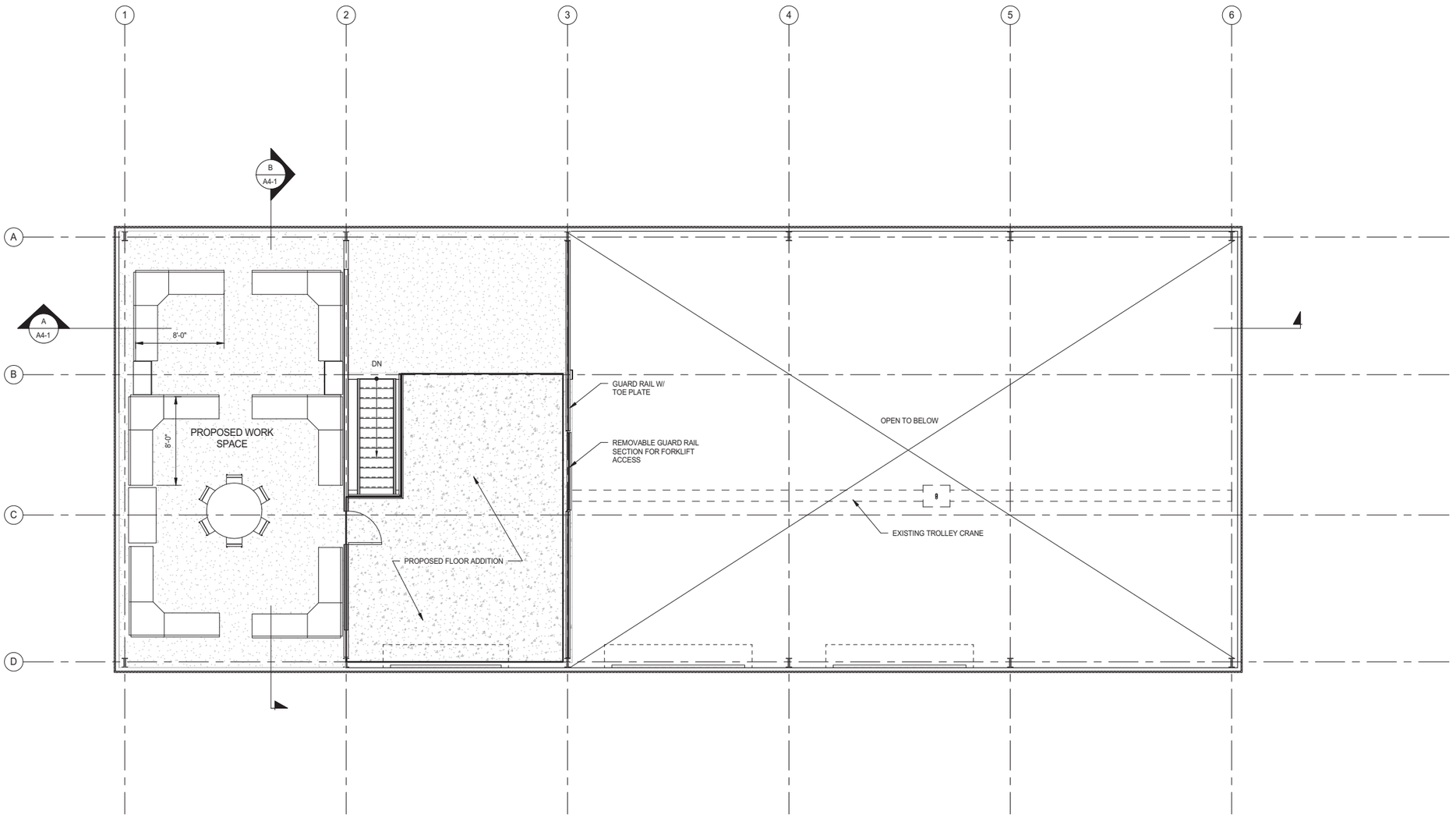
WELDING SHOP FLOOR PLAN

JOB NUMBER 123374

REV A

DRAWING NUMBER A2-1A

7/18/2013 11:33:41 AM



MEZZANINE PLAN

SCALE 3/16" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	07/16/13	SAC	SAC	GH	---

REFERENCE DRAWINGS

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	Checker	

SCALE: 3/16" = 1'-0"

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

PWP MAINTENANCE

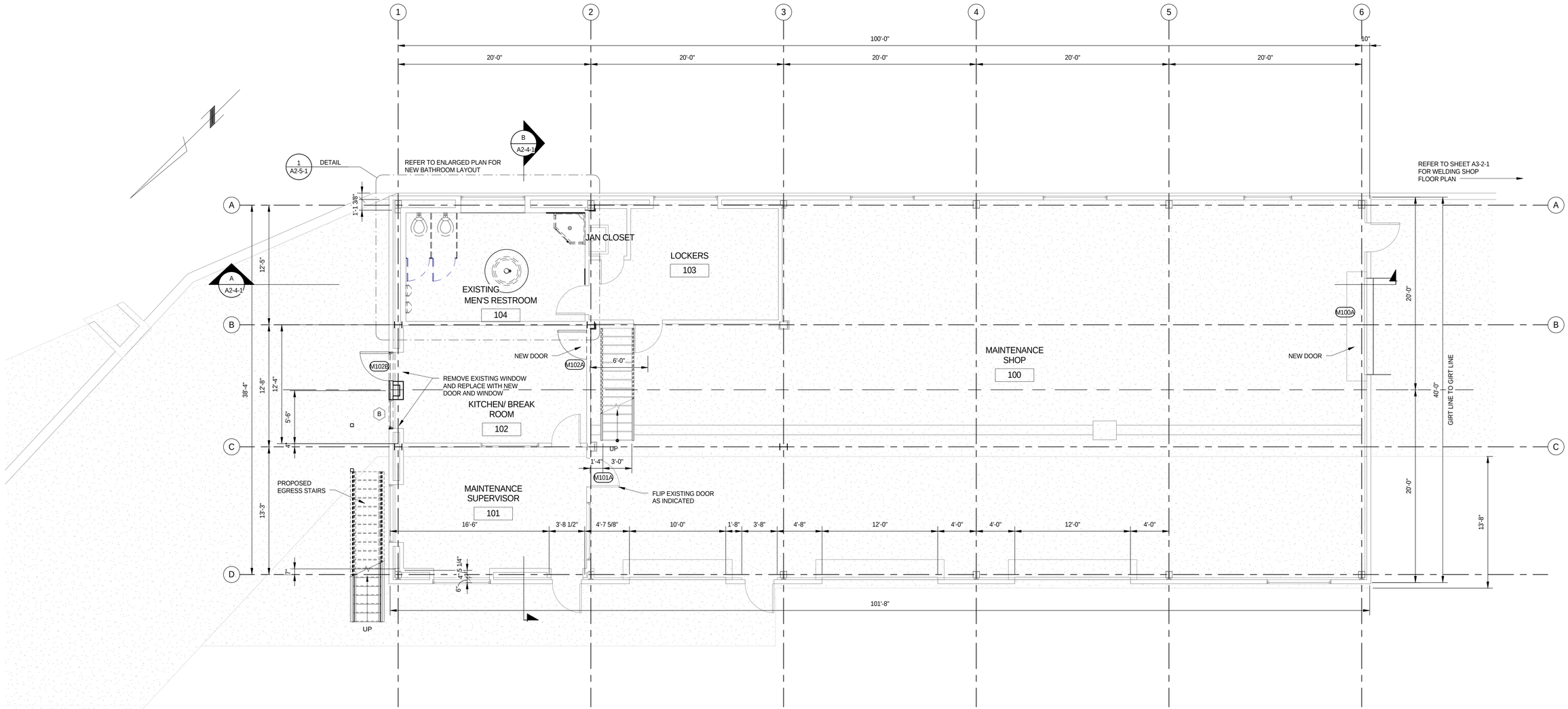
MEZZANINE

JOB NUMBER 123374

REV A

DRAWING NUMBER A2-2

7/18/2013 11:33:41 AM



MAIN FLOOR PLAN

SCALE 3/16" = 1'-0"

GENERAL NOTES

STEEL STUDS IN WALLS:
STEEL STUD SIZE AND GUAGE TO BE DETERMINED BY THE STRUCTURAL ENGINEER.

PRELIMINARY : NOT FOR CONSTRUCTION

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D	ISSUED FOR BID	10/10/13	SAC	SDS	GH		
C	ISSUED FOR BID	09/27/13	SAC	SDS	GH		
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH		
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	GH	09/20/13

SCALE: 3/16" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

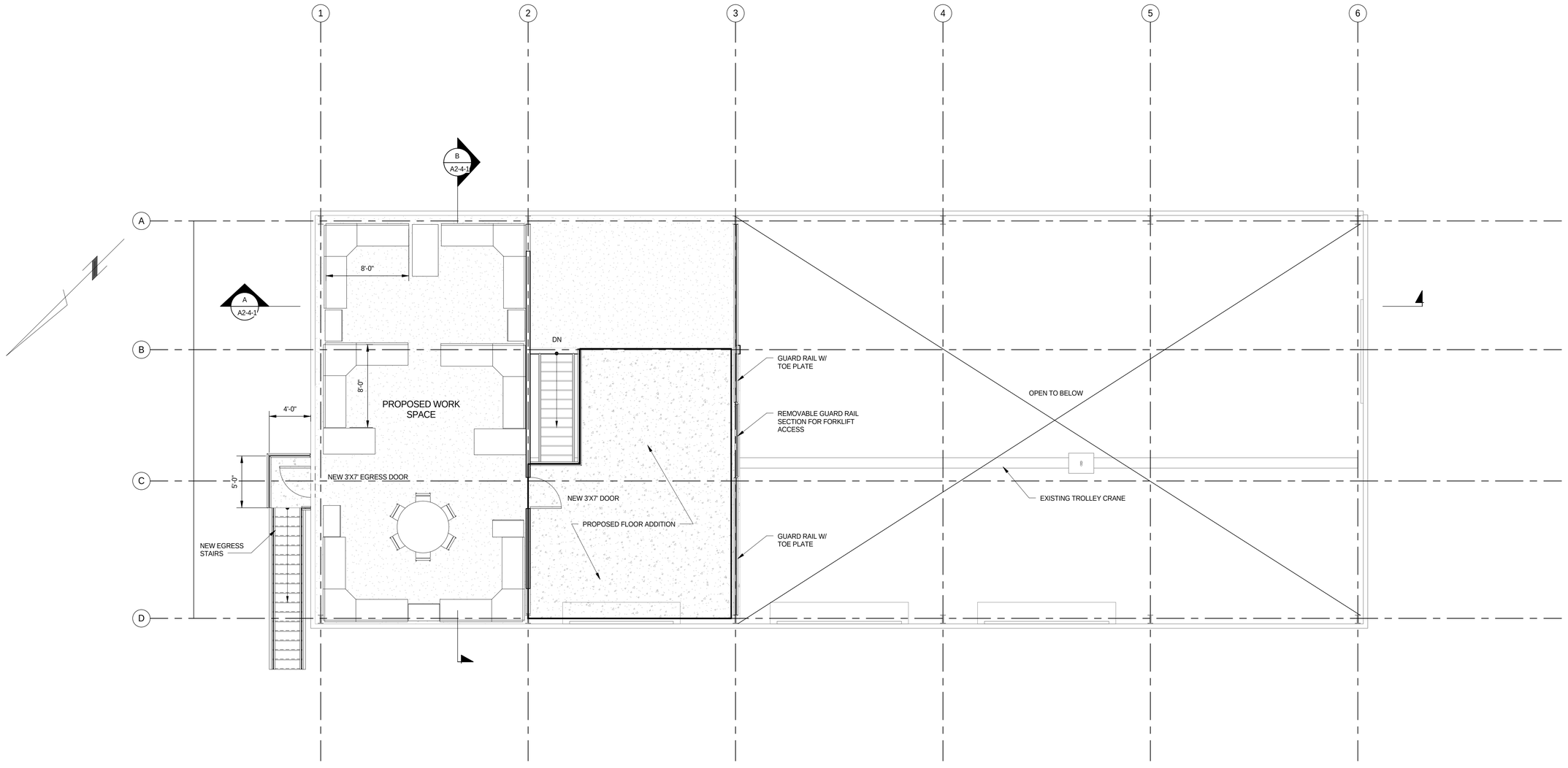
MAIN FLOOR PLAN

JOB NUMBER 123374

REV D

DRAWING NUMBER A2-2-1

10/10/2013 4:50:18 PM



MEZZANINE PLAN

SCALE 3/16" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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C	ISSUED FOR BID	09/24/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	GH	09/20/13

SCALE: 3/16" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

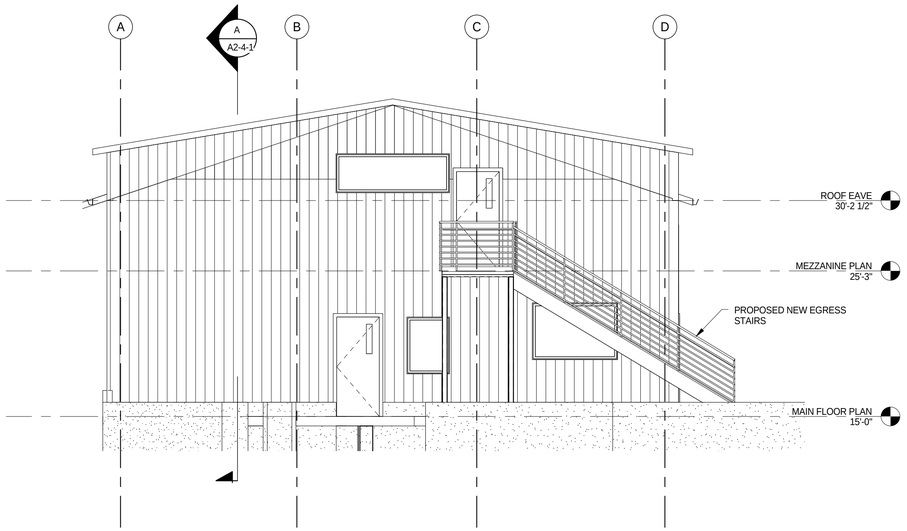
MEZZANINE

JOB NUMBER 123374

REV C

DRAWING NUMBER A2-2-2

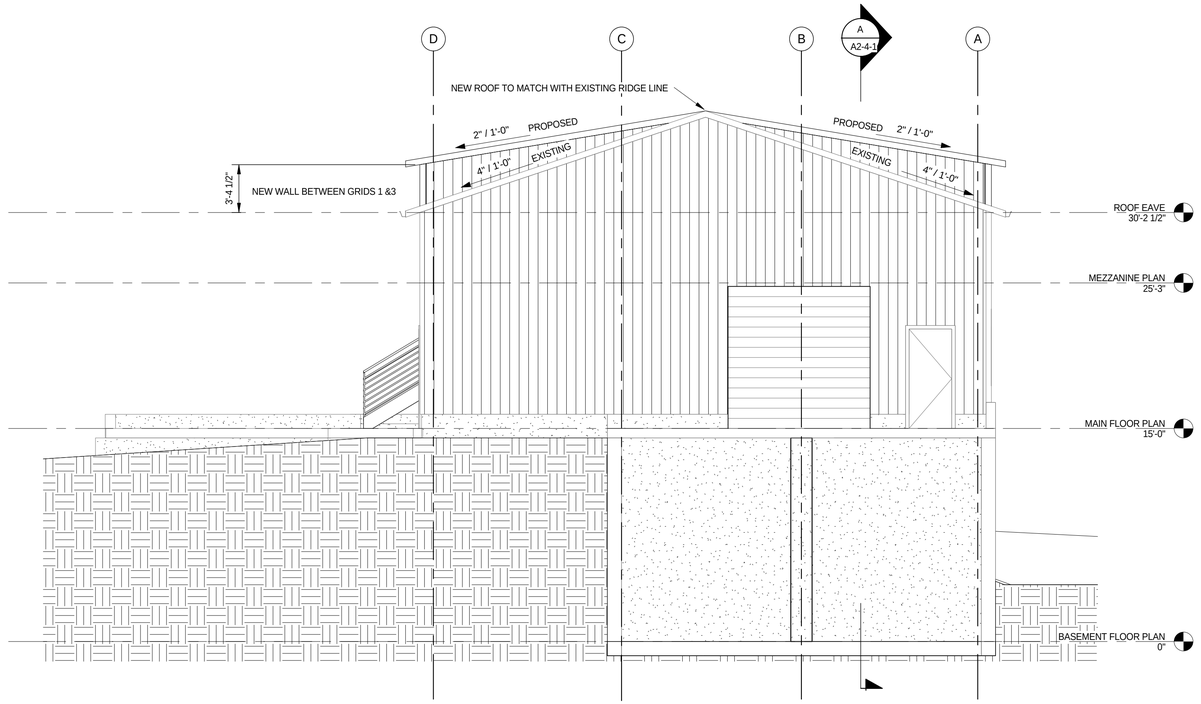
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NORTH ELEVATION
(LOOKING SOUTH)

1
A2-1-1

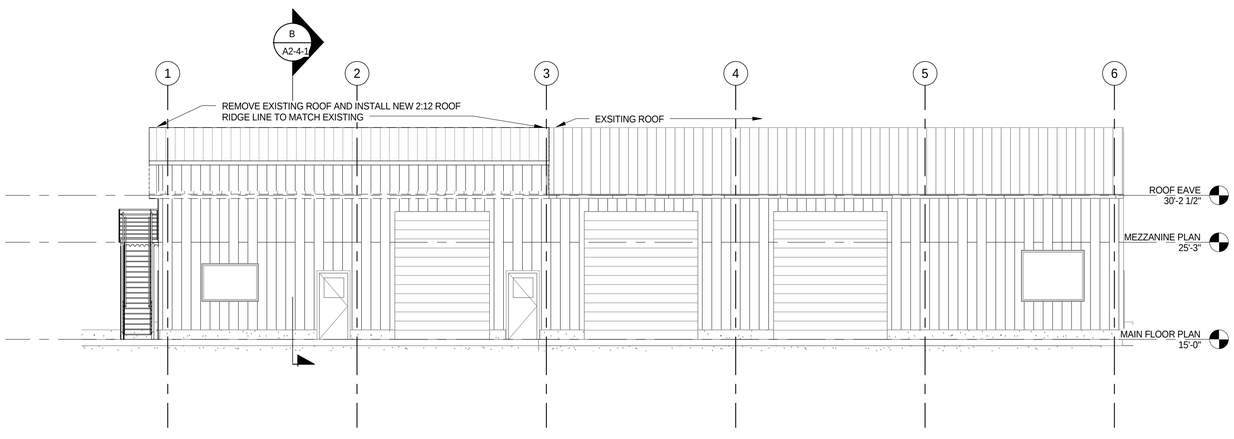
SCALE 3/16" = 1'-0"



SOUTH ELEVATION
(LOOKING NORTH)

2
A2-1-1

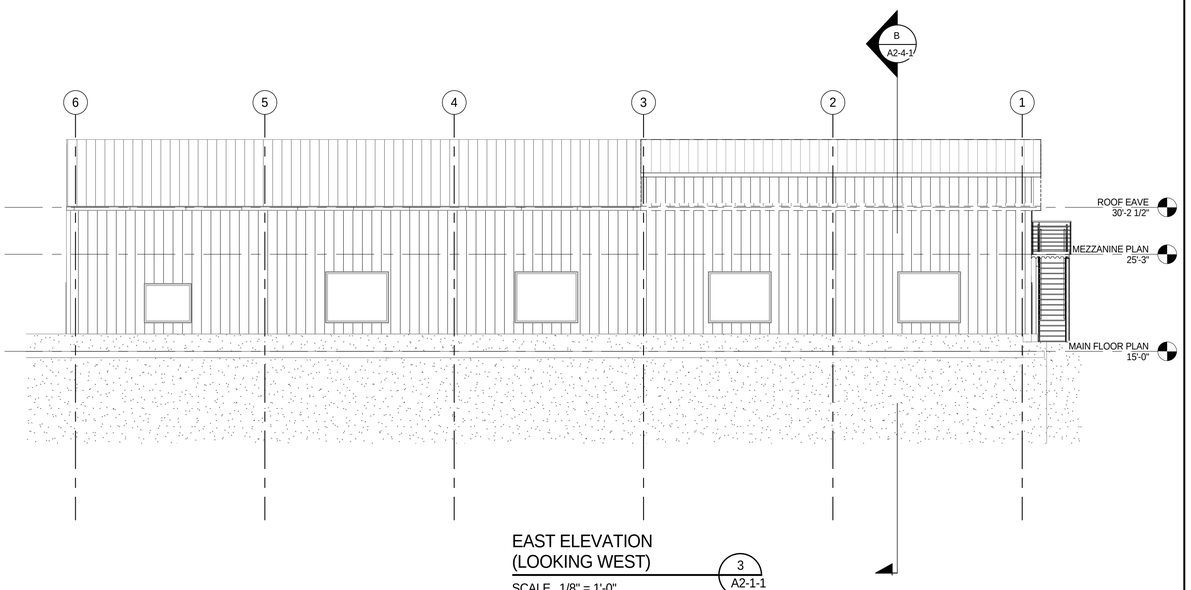
SCALE 3/16" = 1'-0"



WEST ELEVATION
(LOOKING EAST)

4
A2-1-1

SCALE 1/8" = 1'-0"



EAST ELEVATION
(LOOKING WEST)

3
A2-1-1

SCALE 1/8" = 1'-0"

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B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	08/16/13
DRN	SAC	08/16/13
CKD	GH	08/16/13

SCALE: As indicated

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

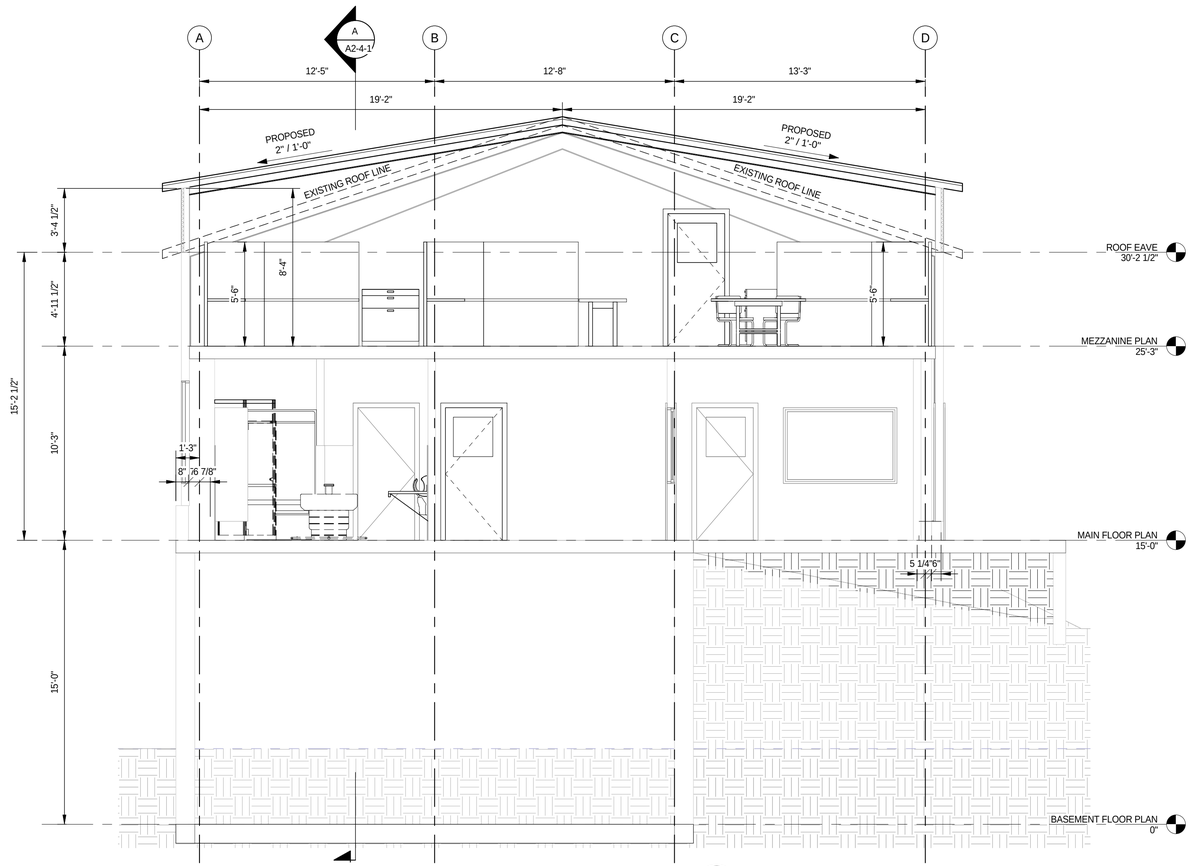
EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV C

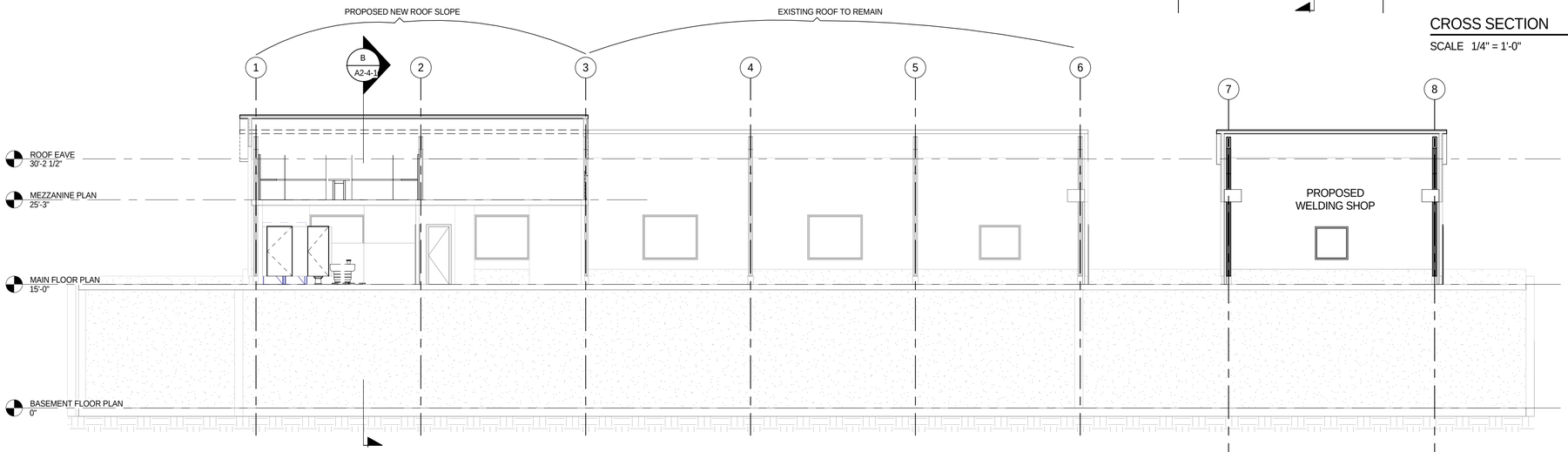
DRAWING NUMBER A2-3-1

9/24/2013 2:35:44 PM



CROSS SECTION B A2-1-1

SCALE 1/4" = 1'-0"



LONGITUDINAL SECTION A A2-1-1

SCALE 1/8" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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C	ISSUED FOR BID	09/27/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	GH	09/24/13

SCALE: As indicated

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

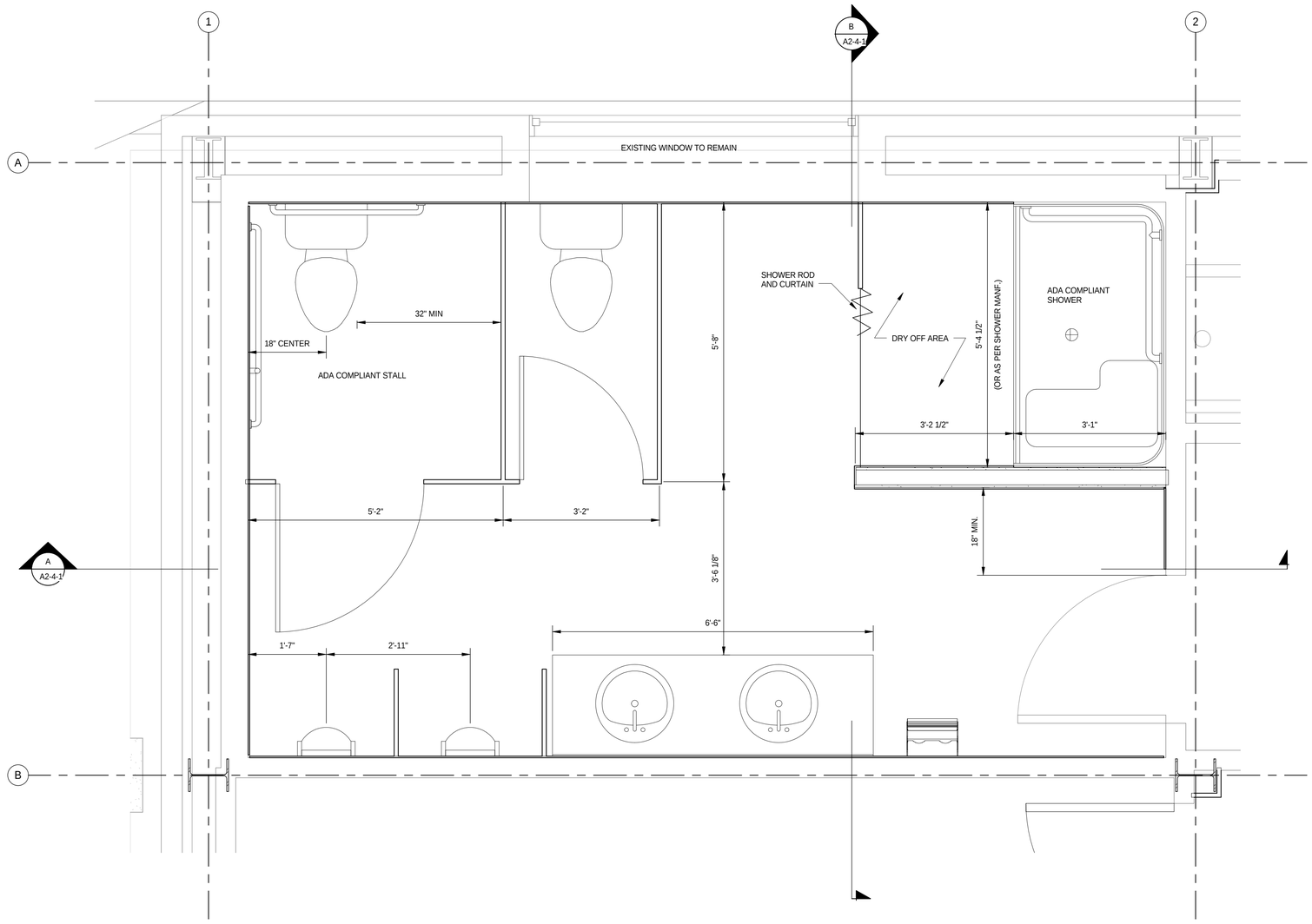
SECTIONS

JOB NUMBER 123374

REV D

DRAWING NUMBER A2-4-1

10/10/2013 4:50:26 PM



PROPOSED ENLARGED
BATHROOM PLAN

1
A2-2-1

SCALE 3/4" = 1'-0"

PRELIMINARY : NOT FOR CONSTRUCTION

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
D	ISSUED FOR BID	10/10/13	SAC	SDS	GH		
C	ISSUED FOR BID	09/27/13	SAC	SDS	GH		
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH		
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SAC	08/16/13
DRN	SAC	08/16/13
CKD	GH	09/20/13

SCALE: 3/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

DETAILED PLANS

JOB NUMBER 123374

REV D

DRAWING NUMBER A2-5-1

10/10/2013 4:50:33 PM

DOOR SCHEDULE

DOOR NUMBER	ROOM TO	SIZE	DOOR THICKNESS	TYPE NO.	FINISH	Material	HARDWARE SET	FRAME MATERIAL	FRAME TYPE	FRAME FINISH	FIRE RATING	COMMENTS
M100A	MAINTENANCE SHOP	10'x10'	2"	5	FAC FIN	STEEL	10	STEEL	A	MFGR		
M101A	MAINTENANCE SUPERVISOR	EXISTING	EXISTING	EXISTING	PAINT	EXISTING	EXISTING	HM	A	PAINT		PROVIDE NEW FRAME AND REVERSE SWING AS INDICATED
M102A	KITCHEN/BREAK ROOM	36" x 84" 1/2 light	2"	2	PAINT	INSULATED HM	3	HM	A	PAINT		
M102B	EGRESS	36" x 84"	2"	4	PAINT	INSULATED HM	9	HM	A	PAINT		
M201A	MEZZANINE WORK SPACE	36" x 84" 1/2 light	2"	2	PAINT	INSULATED HM	4	HM	A	PAINT		
M201B	EGRESS	36" x 84"	2"	4	PAINT	INSULATED HM	9	HM	A	PAINT		
W106A	WELDING SHOP	36" x 84"	2"	4	PAINT	INSULATED HM	9	HM	A	PAINT		
W106B	WELDING SHOP	10'x10'	2"	5	FAC FIN	STEEL	10	STEEL	A	MFGR		
W106C	WELDING SHOP	10'x10'	2"	5	FAC FIN	STEEL	10	STEEL	A	MFGR		
W106D	WELDING SHOP	36" x 84"	2"	1	PAINT	INSULATED HM	9	HM	A	MFGR		
W106E	WELDING SHOP	10'x10'	2"	5	FAC FIN	STEEL	10	STEEL	A	MFGR		

ROOM SCHEDULE

WC	ROOM NAME	FLOOR MATERIAL	FLOOR FINISH	BASE MATERIAL	BASE FINISH	WALLS NORTH	WALLS EAST	WALLS SOUTH	WALLS WEST	CEILING MATERIAL	CEILING HEIGHT	CEILING FINISH	WAINSCOT MATERIAL	WAINSCOT HEIGHT	WAINSCOT FINISH	REMARKS
100	MAINTENANCE SHOP	CONC		---	---	GWB / PAINT	EXIST	EXIST	EXIST	EXIST		---				
101	MAINTENANCE SUPERVISOR	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	EXIST	EXIST		---				
102	KITCHEN/ BREAK ROOM	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	EXIST		---				
103	LOCKERS	VCT		RUB/VINYL	FAC FIN	GWB / PAINT	EXIST	EXIST	EXIST	EXIST		---				
104	MEN'S RESTROOM	VCT		RUB/VINYL	FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP/ FAC FIN	FRP / FAC FIN	GWB	EXISTING	PAINT	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
105	JAN CLOSET	VCT		RUB/VINYL	FAC FIN	FRP / FAC FIN	FRP / FAC FIN	FRP/ FAC FIN	FRP / FAC FIN	EXIST		---	FRP	5'-0"	FAC FIN	PAINT ABOVE WAINSCOT
106	PROPOSED WELDING SHOP	CONC		---	---	METAL LINER PANEL	METAL LINER PANEL	METAL LINER PANEL	METAL LINER PANEL	OPEN	VARIES	---	METAL	10'-0"	FAC FIN	TYPE-X GWB UNFINISHED ABOVE WAINSCOT
201	PROPOSED WORK SPACE	VCT		RUB/VINYL	FAC FIN	GWB/ PAINT	GWB / PAINT	GWB / PAINT	GWB / PAINT	GWB	VARIES	PAINT				

WINDOW SCHEDULE

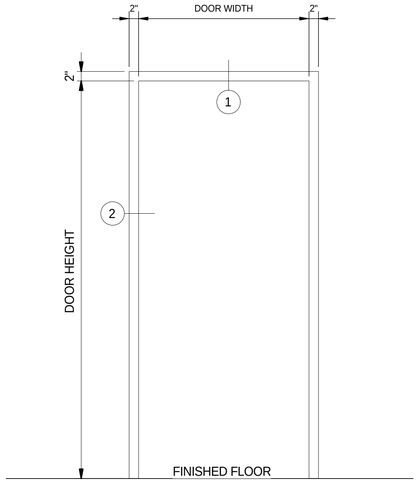
TYPE MARK	R.O. WIDTH	R.O. HEIGHT	TYPE	GLAZING THICKNESS	GLAZING TYPE	HEAD HEIGHT	COMMENTS	COUNT
A	4'-0"	4'-0"	Fixed					2
B	3'-0"	4'-0"	Fixed			7'-0"		1
Grand total: 3								

FINISH ABBREVIATIONS

CARP TILE 1 =	CARPET TILE
CARP TILE 2 =	ABUSIVE RESISTANT
CT =	CERAMIC TILE
CONC =	CONCRETE
PAINT =	HEAVY DUTY PAINT
RUB/VINYL =	RUBBER OR VINYL BASE
EXISTING =	EXISTING BUILDING MATERIALS
FRP =	FIBERGLASS REINFORCED PANEL
GWB =	GYPSUM WALLBOARD
CMU =	CONCRETE MASONRY UNITS
EXIST CMU =	EXISTING CMU
WOOD =	SELECTED WAINSCOT WOOD
2X2 SUS=	2 X 2 SUSPENDED ACOUSTIC TILE

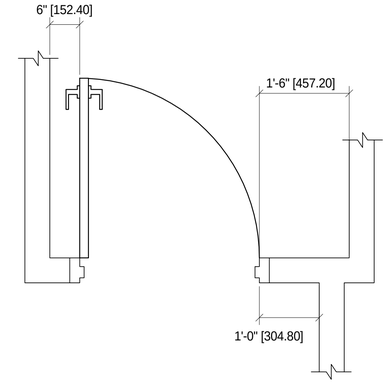
DOOR ABBREVIATIONS

HM =	HOLLOW METAL
FAC FIN =	DOOR MANUFACTURER'S STANDARD BAKED EMANMEL OR POWDER COATED FINISH
MFGR =	BUILDING MANUFACTURER'S STANDARD (SDI) DETAILS AND DETAILS THIS DRAWING

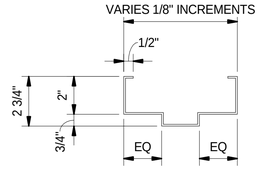


NOTE: REFER TO SHEET A9-2 FOR HEAD, SILL, AND JAMB DETAILS

FRAME TYPE - A

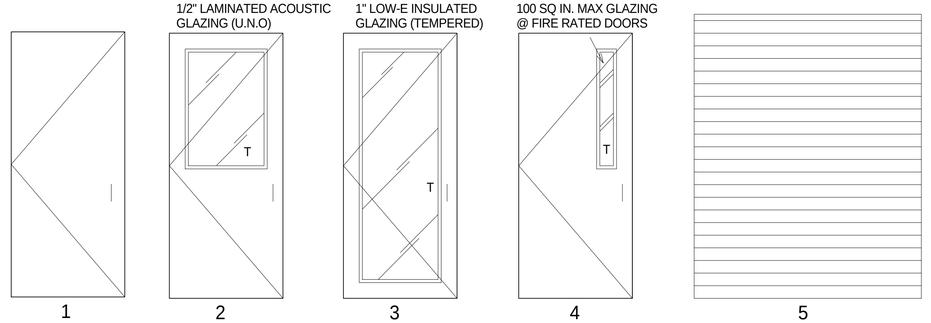


TYPICAL DOOR PULL/PUSH CLEARANCES



STANDARD HM FRAME

SCALE 3" = 1'-0"



T= TEMPERED GLAZING 1/4" THICK

COILING DOOR (U.N.O)

DOOR TYPES

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A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---	

DSGN	SAC	09/30/13
DRN	SAC	09/30/13
CKD	GH	09/30/13

SCALE: As indicated

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

MAINTENANCE SHOP

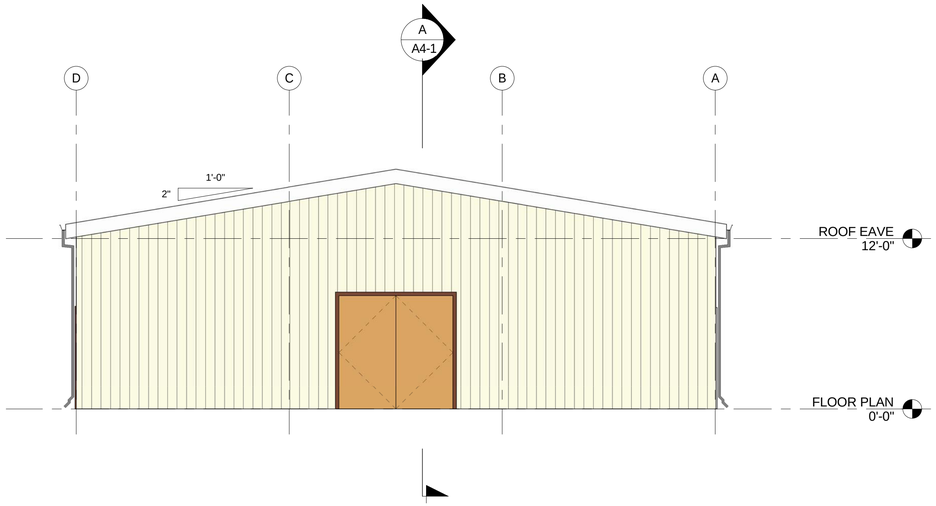
ROOM FINISH, DOOR AND WINDOW SCHEDULES

JOB NUMBER 123374

REV D

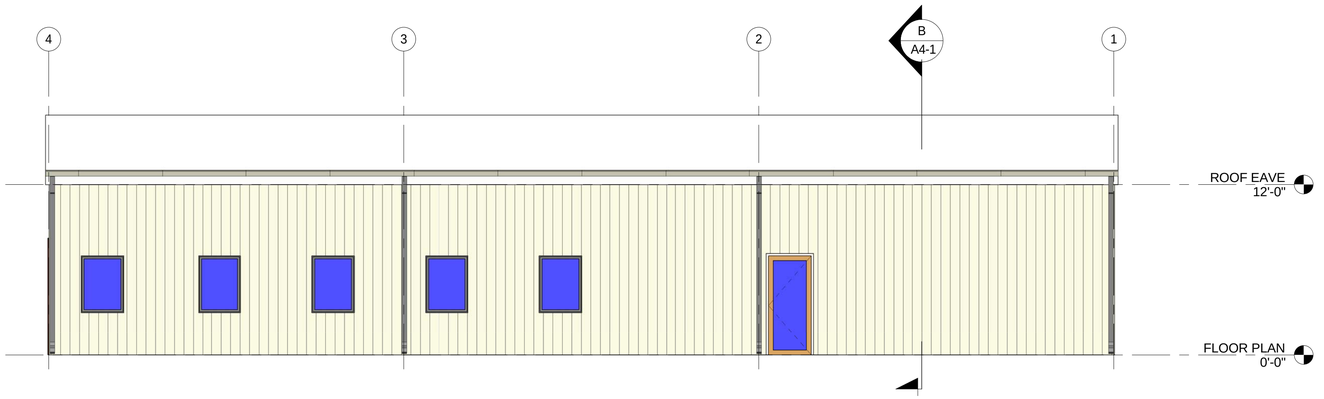
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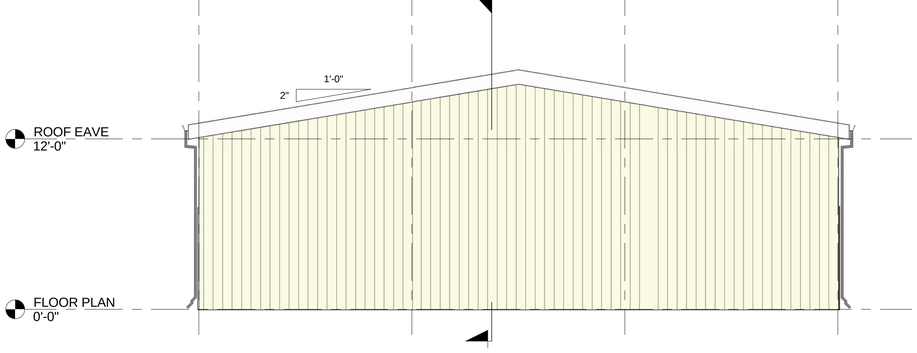
NORTH ELEVATION (LOOKING SOUTH)

SCALE 3/16" = 1'-0"



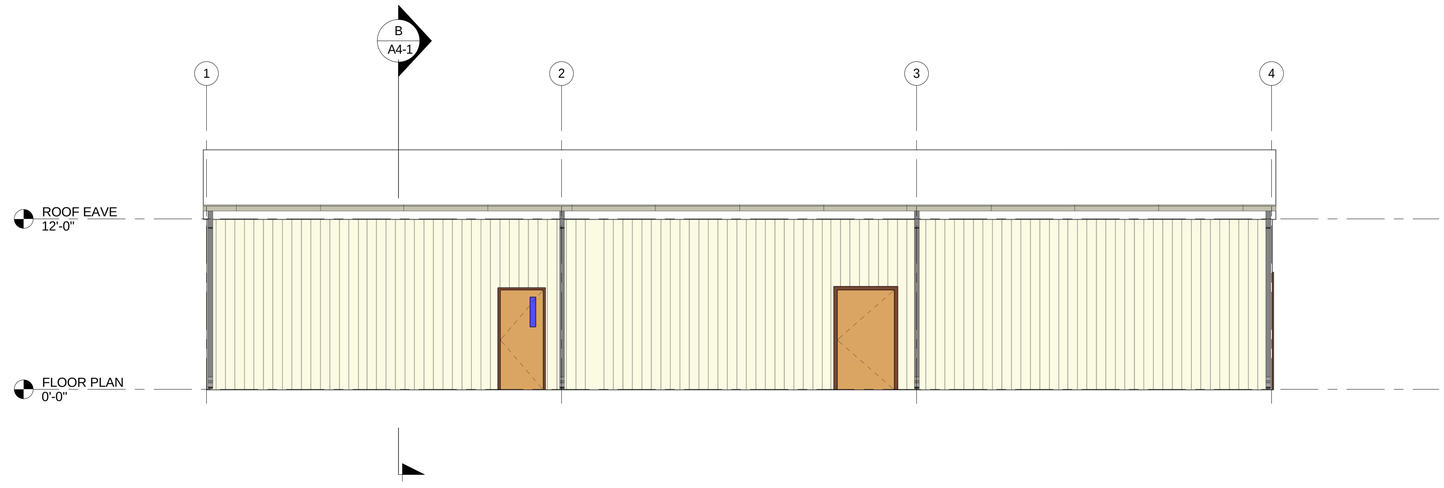
WEST ELEVATION (LOOKING EAST)

SCALE 3/16" = 1'-0"



SOUTH ELEVATION (LOOKING NORTH)

SCALE 3/16" = 1'-0"



EAST ELEVATION (LOOKING WEST)

SCALE 3/16" = 1'-0"

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	HSD	---

REFERENCE DRAWINGS

DSGN	Designer
DRN	Author
CKD	Checker
SCALE:	3/16" = 1'-0"

FOR 22X34 DWG ONLY

POWER ENGINEERS

PASADENA

CONTROL BUILDING

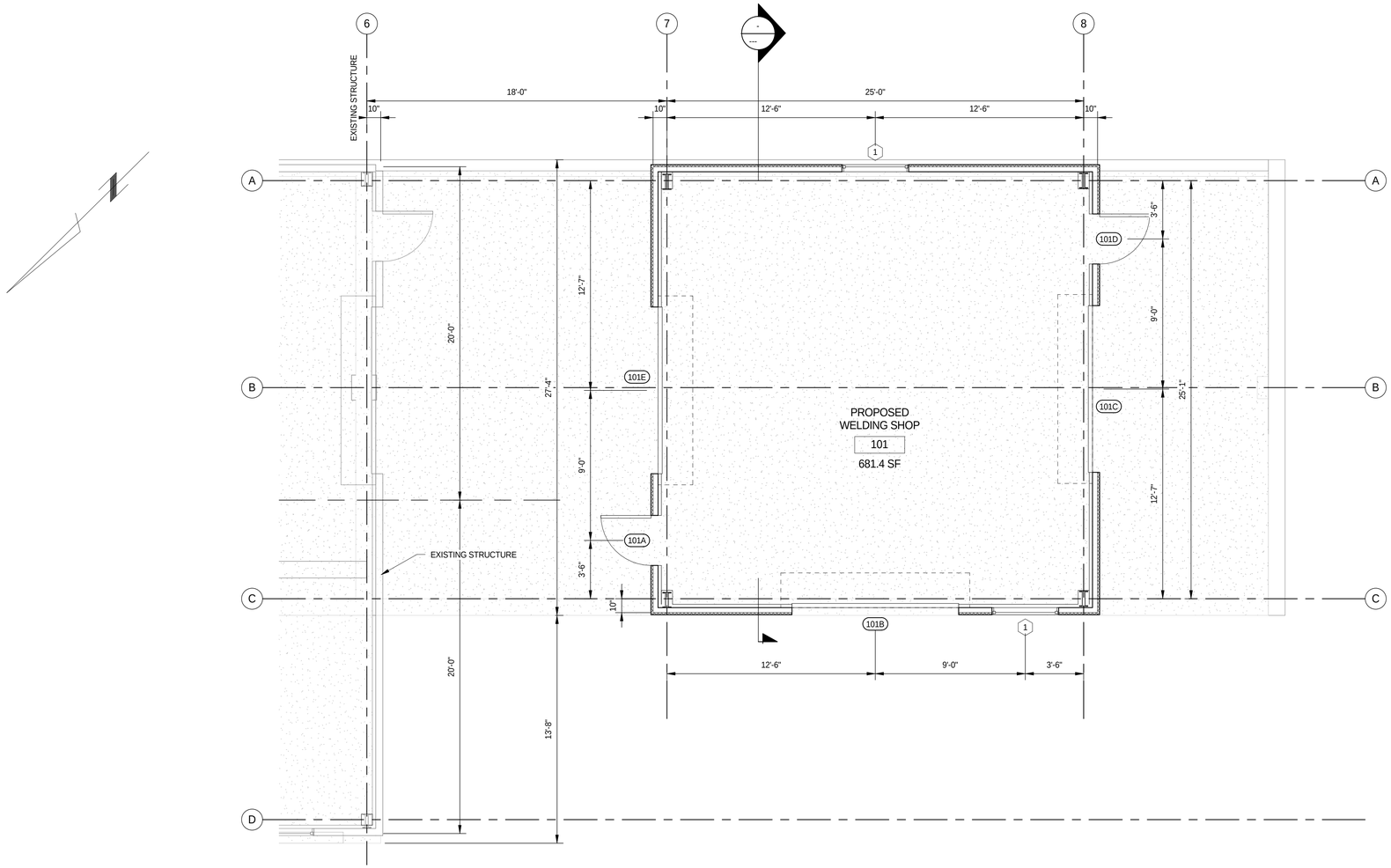
EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV A

DRAWING NUMBER A3-1

3/7/2013 10:37:45 AM



WELDING SHOP

SCALE 1/4" = 1'-0"

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
C	ISSUED FOR BID	09/24/13	SAC	SDS	GH	
B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	Checker	

SCALE: 1/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 19, 1886

POWER ENGINEERS

PASADENA WATER & POWER

. WELDING SHOP .

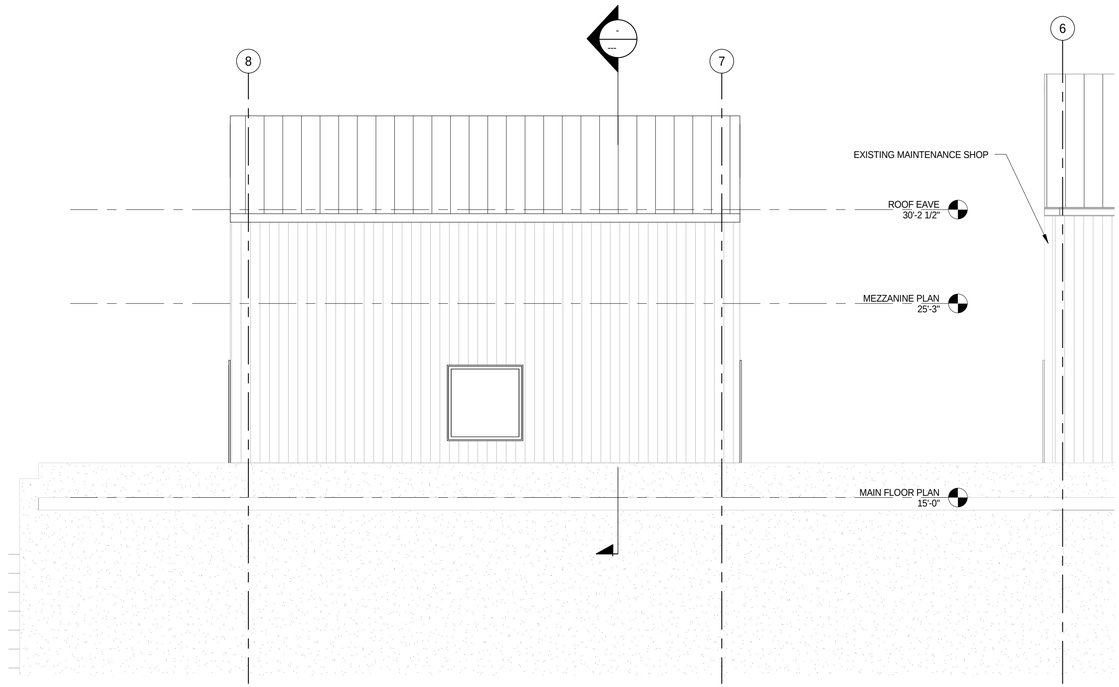
FLOOR PLAN

JOB NUMBER 123374

REV C

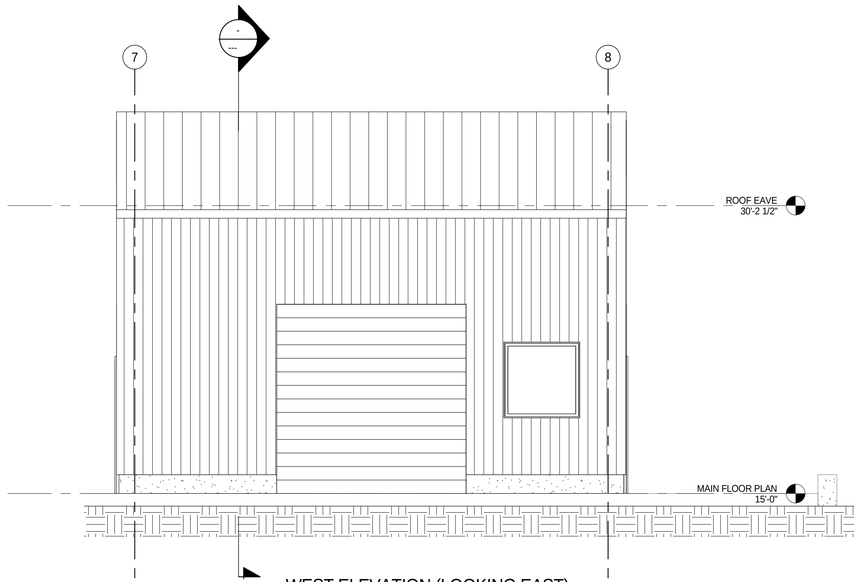
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9/24/2013 2:35:47 PM



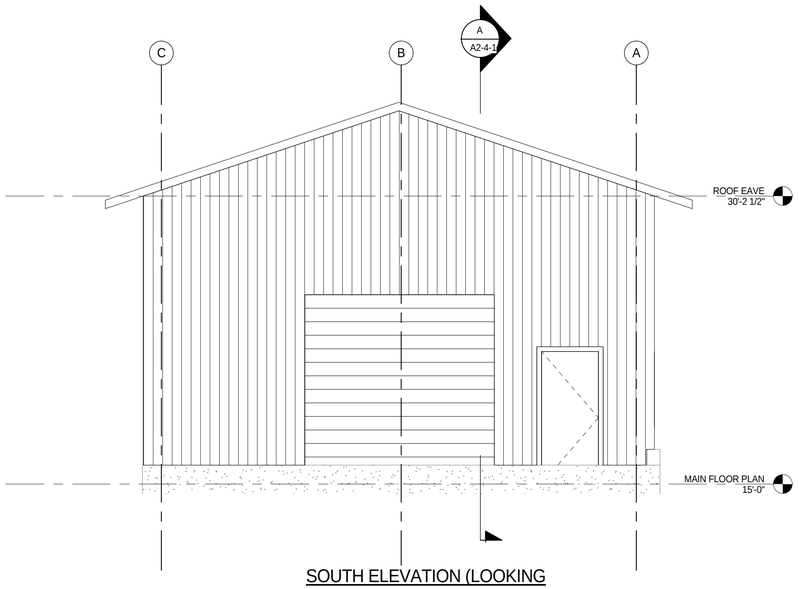
EAST ELEVATION (LOOKING WEST)

SCALE 1/4" = 1'-0"



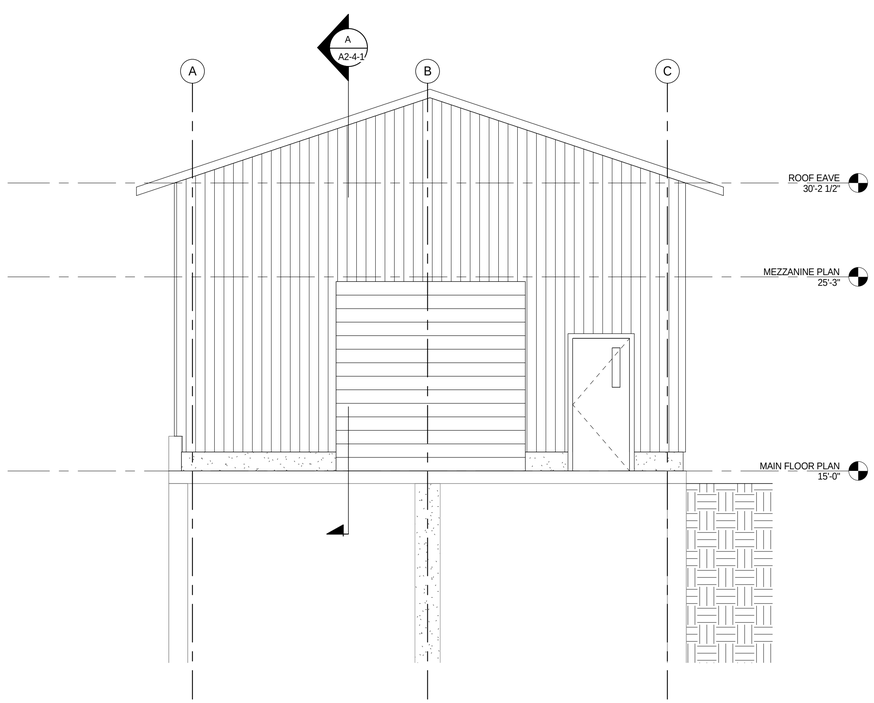
WEST ELEVATION (LOOKING EAST)

SCALE 1/4" = 1'-0"



SOUTH ELEVATION (LOOKING NORTH)

SCALE 1/4" = 1'-0"



NORTH ELEVATION (LOOKING SOUTH)

SCALE 1/4" = 1'-0"

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A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SAC	07/16/13
DRN	SAC	07/16/13
CKD	GH	09/23/13

SCALE: 1/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

. WELDING SHOP .

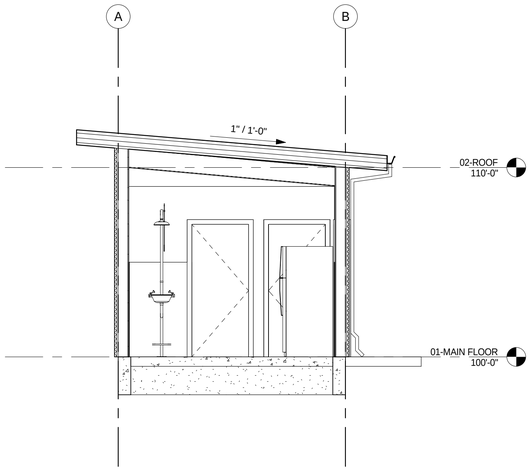
EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV C

DRAWING NUMBER A3-3-1

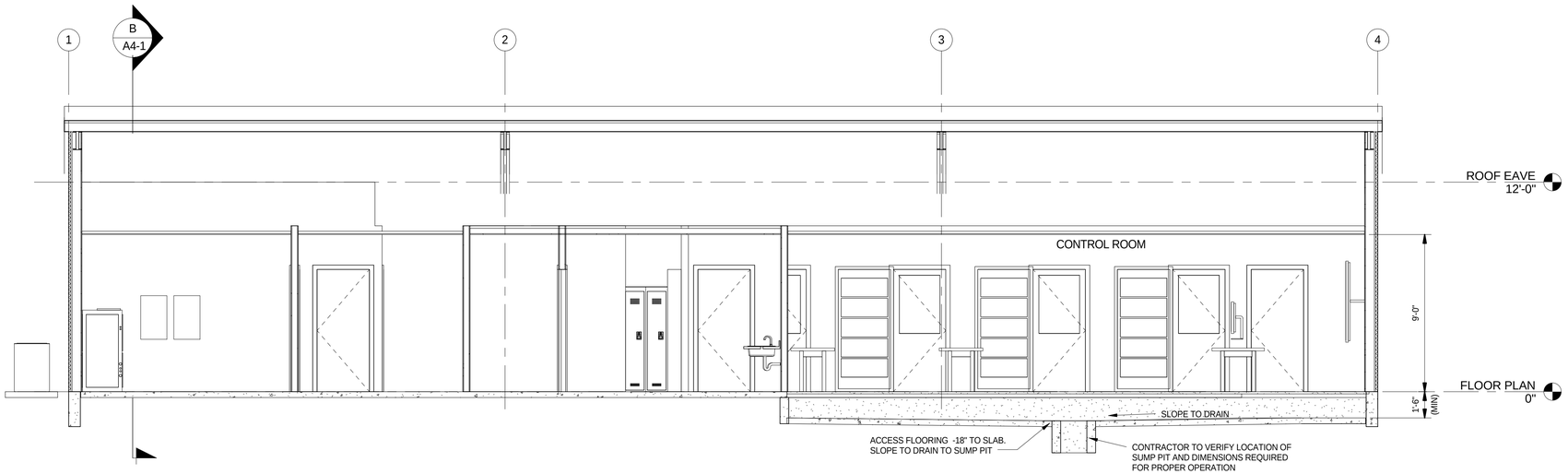
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LABORATORY SECTION C

SCALE 1/4" = 1'-0"

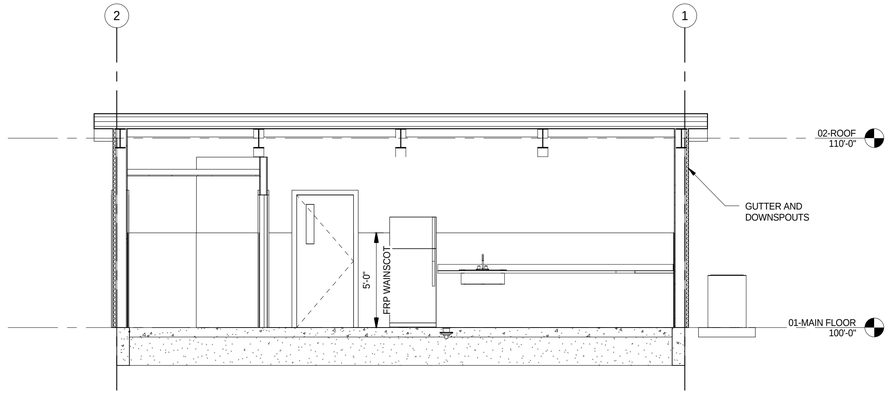
C
A4-2-1



SECTION A

SCALE 1/4" = 1'-0"

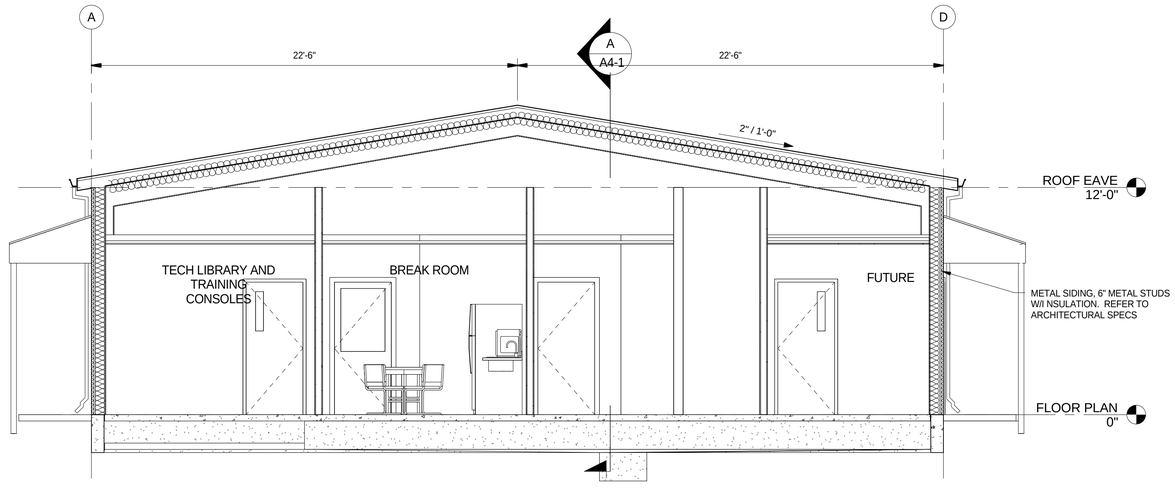
A
A1-2-1



LABORATORY SECTION D

SCALE 1/4" = 1'-0"

D
A4-2-1



SECTION B

SCALE 1/4" = 1'-0"

B
A1-2-1

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B	ISSUED FOR REVIEW	03/27/13	SAC	SDS	GH	
A	ISSUED FOR REVIEW	03/07/13	SAC	SDS	GH	---

REFERENCE DRAWINGS

DSGN	SDS	03/26/13
DRN	SAC	03/26/13
CKD	GH	09/23/13
SCALE:		1/4" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

CONTROL BUILDING & WATER LAB

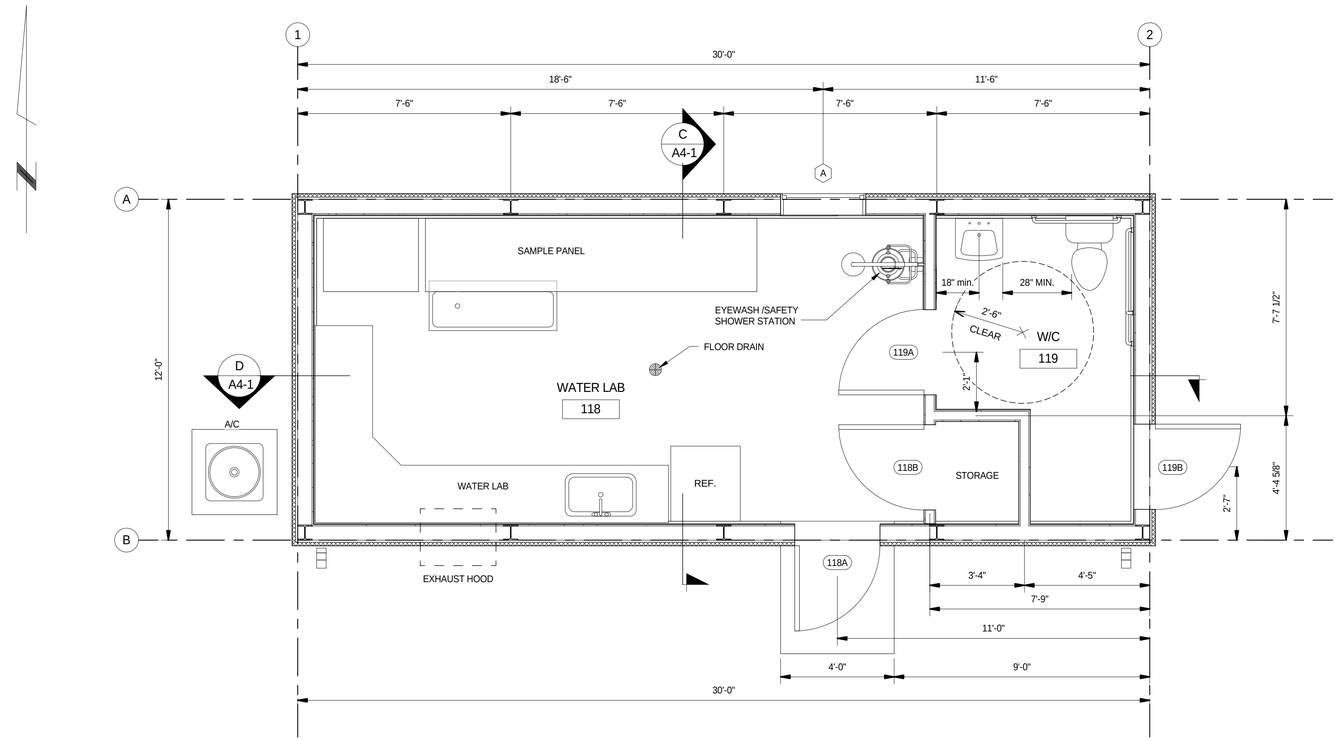
BUILDING SECTIONS

JOB NUMBER 123374

REV D

DRAWING NUMBER A4-1

10/10/2013 4:49:12 PM



FLOOR PLAN

SCALE 3/8" = 1'-0"

GENERAL NOTES

STEEL STUDS IN WALLS:
STEEL STUD SIZE AND GUAGE TO BE DETERMINED
BY THE STRUCTURAL ENGINEER.

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REFERENCE DRAWINGS

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CKD	GH	09/23/13
SCALE:		3/8" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

WATER LABORATORY

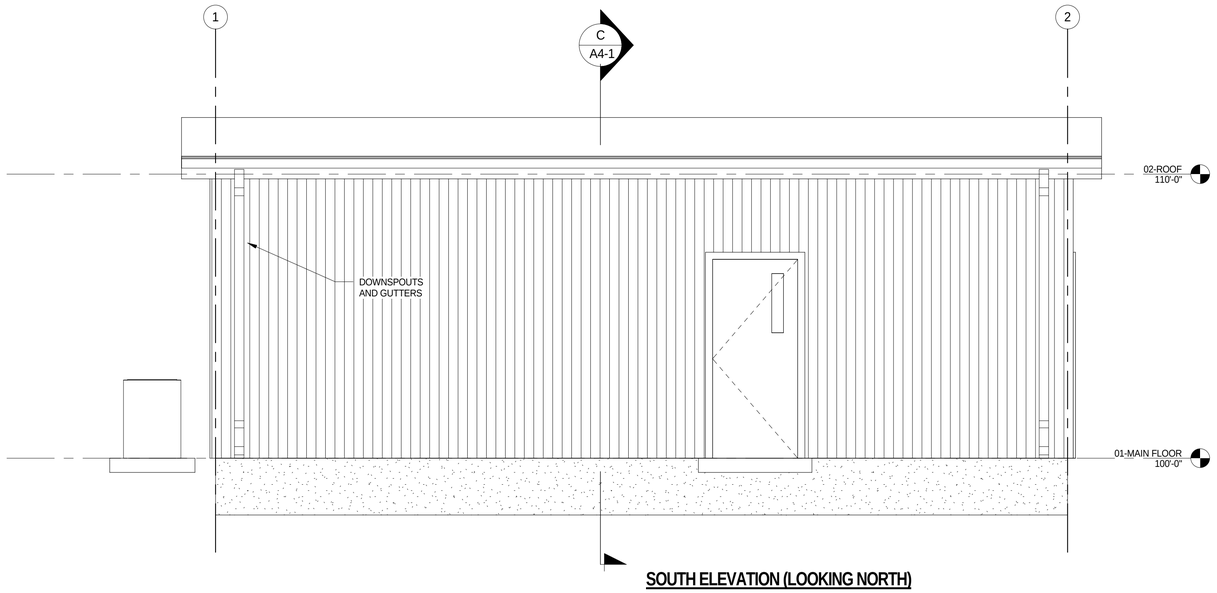
FLOOR PLAN

JOB NUMBER 123374

REV D

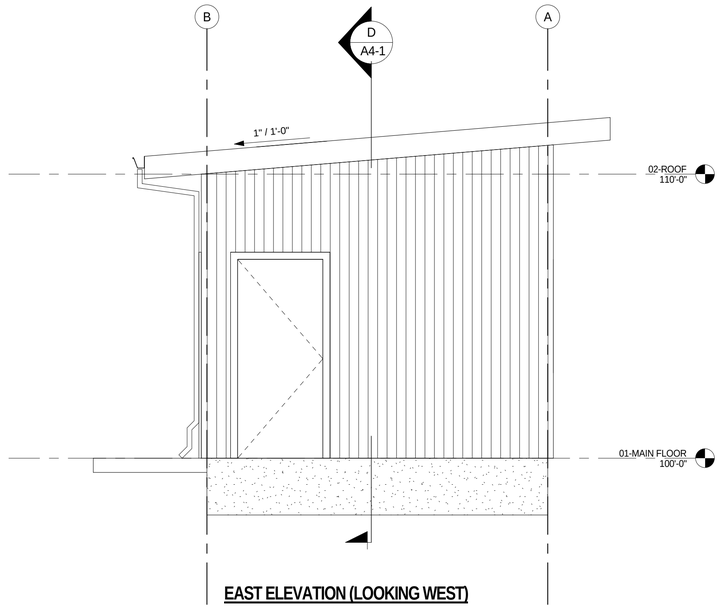
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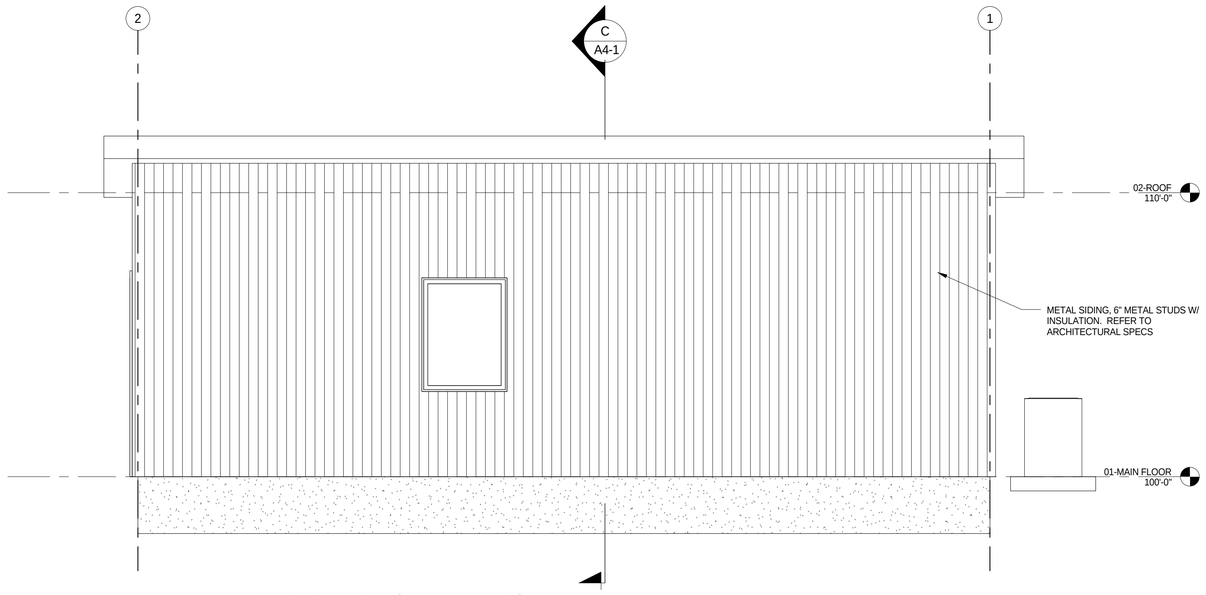
SOUTH ELEVATION (LOOKING NORTH)

SCALE 3/8" = 1'-0"



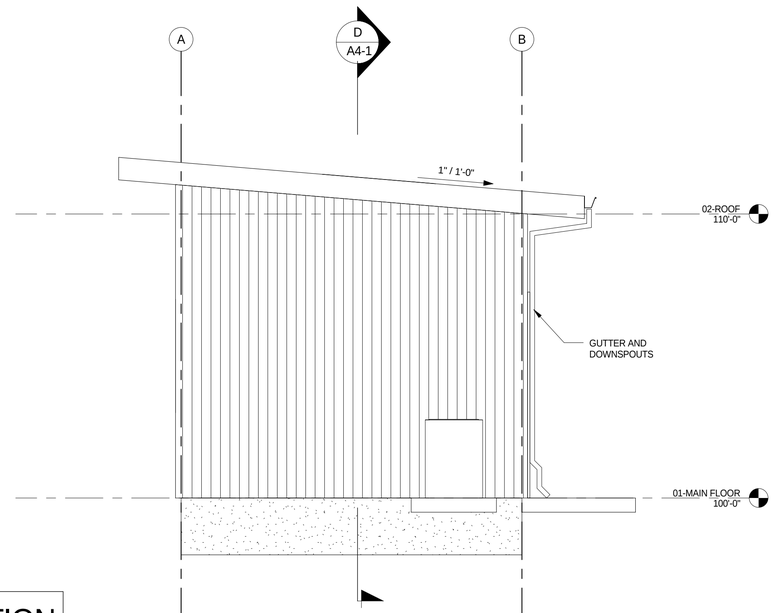
EAST ELEVATION (LOOKING WEST)

SCALE 3/8" = 1'-0"



NORTH ELEVATION (LOOKING SOUTH)

SCALE 3/8" = 1'-0"



WEST ELEVATION (LOOKING EAST)

SCALE 3/8" = 1'-0"

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REFERENCE DRAWINGS

DSGN	Designer
DRN	Author
CKD	Checker
SCALE:	3/8" = 1'-0"

FOR 22X34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

WATER LABORATORY

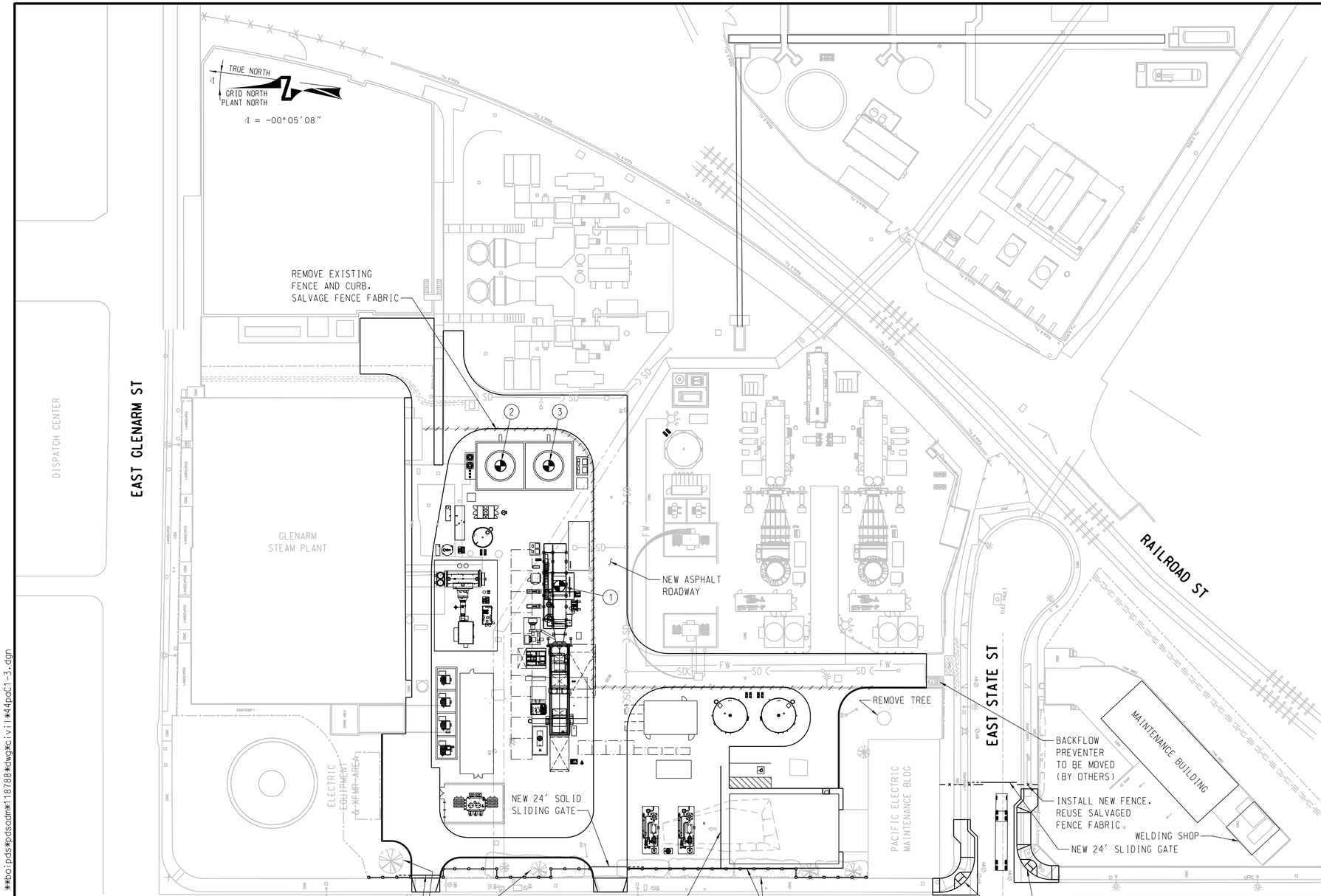
EXTERIOR ELEVATIONS

JOB NUMBER 123374

REV C

DRAWING NUMBER A4-3-1

9/24/2013 2:26:17 PM



LEGEND

APPROXIMATE LIMIT OF PWP PROPERTY	
SD MH	EXISTING STORM DRAIN MANHOLE
WV	EXISTING WATER VALVE
PP	EXISTING FIRE HYDRANT
	EXISTING POWER POLE AND ANCHOR
	EXISTING LIGHT POLE
GV	EXISTING GAS VALVE
	EXISTING TREE
	EXISTING LANDSCAPING
	EXISTING FENCE
SD	EXISTING STORM DRAIN
FW	EXISTING FIREWATER
EL	ELEVATION
FT	FEET
M	METERS
MSL	MEAN SEA LEVEL
	EMISSIONS POINT

NOTES

1. BASIS OF STATE PLANE COORDINATES PROVIDED HEREIN:

   NAD 1983
   CALIFORNIA STATE PLANE ZONE V
   FIPS 0405
   VALUES IN US FEET

   BASIS OF UTM COORDINATES PROVIDED HEREIN:

   NAD 1983
   UTM ZONE 11 NORTH
   VALUES IN METERS

   BASIS OF ELEVATIONS:

   NAVD 1988

2. EXISTING FEATURES ARE DEPICTED BY LIGHTER WEIGHT (SCREENED) LINES. PROPOSED STRUCTURES AND FACILITIES ARE SHOWN IN HEAVIER (BOLD) LINE WEIGHTS.

3. CONTROL POINTS ANS SURVEY INFORMATION FOR THE PROPOSED PROJECT SITE PROVIDED BY COORY ENGINEERING, 2011. OTHER EXISTING INFORMATION DEPICTED SUPPLIED BY PASADENA WATER AND POWER DEPARTMENT.

4. NEW CURB RAMPS SHALL BE CONSTRUCTED PER CITY OF PASADENA DEPARTMENT OF PUBLIC WORKS STANDARD PLAN S-414, SHEETS 1-3. THESE DETAILS ARE SHOWN ON C3-5.

EMISSIONS POINT TABLE

NUMBER	LOCATION	STATE PLANE COORDINATE		UTM COORDINATE		TOC ELEVATION (FT - MSL)	STACK HEIGHT (FT)	TOP OF STACK ELEVATION (FT - MSL)
		NORTHING (FT)	EASTING (FT)	NORTHING (M)	EASTING (M)			
1	OTSG STACK	1868520.63	6516429.92	3776799.789	394003.894	752.00	125.00	877.00
2	COOLING TOWER (NORTH)	1868563.42	6516515.65	3776812.572	394030.146	752.00	26.95	778.95
3	COOLING TOWER (SOUTH)	1868528.92	6516515.87	3776802.060	394030.109	752.00	26.95	778.95

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DISC							
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
K	ISSUED FOR BID	10/07/13	WMT	WKW	WKW	GTH
J	RE-ISSUED FOR PERMIT	04/05/13	WMT	WKW	WKW	GTH
H	RE-ISSUED FOR PERMIT	02/28/13	WMT	WKW	WKW	GTH
G	RE-ISSUED FOR PERMIT	02/25/13	WMT	WKW	WKW	GTH
4	RE-ISSUED FOR PERMIT	01/31/13	WMT	WKW	WKW	GTH

DSGN	WKW	05/27/11
DRN	WMT	05/27/11
CKD	WKW	06/03/11

SCALE: 1"= 40'

FOR 22x34 DWG ONLY

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PASADENA WATER & POWER

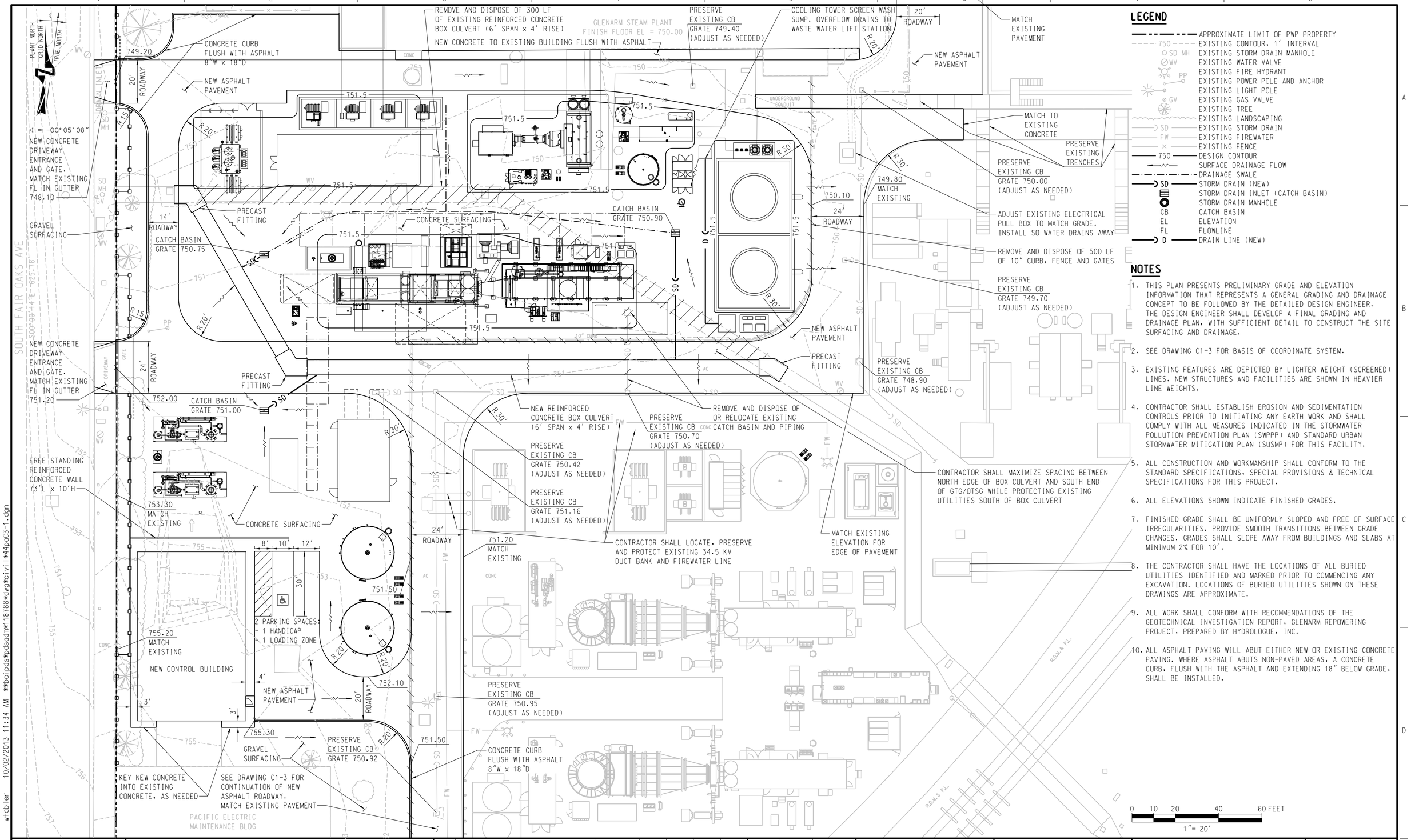
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

PRELIMINARY SITE PLAN
LM6000 CONFIGURATION

JOB NUMBER 123374 | REV K

DRAWING NUMBER C1-3

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LEGEND

- APPROXIMATE LIMIT OF PWP PROPERTY
- 750 EXISTING CONTOUR, 1' INTERVAL
- SD MH EXISTING STORM DRAIN MANHOLE
- WV EXISTING WATER VALVE
- EXISTING FIRE HYDRANT
- PP EXISTING POWER POLE AND ANCHOR
- EXISTING LIGHT POLE
- GV EXISTING GAS VALVE
- EXISTING TREE
- EXISTING LANDSCAPING
- SD EXISTING STORM DRAIN
- FW EXISTING FIREWATER
- EXISTING FENCE
- 750 DESIGN CONTOUR
- SURFACE DRAINAGE FLOW
- DRAINAGE SWALE
- SD STORM DRAIN (NEW)
- STORM DRAIN INLET (CATCH BASIN)
- STORM DRAIN MANHOLE
- CB CATCH BASIN
- EL ELEVATION
- FL FLOWLINE
- D DRAIN LINE (NEW)

NOTES

1. THIS PLAN PRESENTS PRELIMINARY GRADE AND ELEVATION INFORMATION THAT REPRESENTS A GENERAL GRADING AND DRAINAGE CONCEPT TO BE FOLLOWED BY THE DETAILED DESIGN ENGINEER. THE DESIGN ENGINEER SHALL DEVELOP A FINAL GRADING AND DRAINAGE PLAN, WITH SUFFICIENT DETAIL TO CONSTRUCT THE SITE SURFACING AND DRAINAGE.
2. SEE DRAWING C1-3 FOR BASIS OF COORDINATE SYSTEM.
3. EXISTING FEATURES ARE DEPICTED BY LIGHTER WEIGHT (SCREENED) LINES. NEW STRUCTURES AND FACILITIES ARE SHOWN IN HEAVIER LINE WEIGHTS.
4. CONTRACTOR SHALL ESTABLISH EROSION AND SEDIMENTATION CONTROLS PRIOR TO INITIATING ANY EARTH WORK AND SHALL COMPLY WITH ALL MEASURES INDICATED IN THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AND STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP) FOR THIS FACILITY.
5. ALL CONSTRUCTION AND WORKMANSHIP SHALL CONFORM TO THE STANDARD SPECIFICATIONS, SPECIAL PROVISIONS & TECHNICAL SPECIFICATIONS FOR THIS PROJECT.
6. ALL ELEVATIONS SHOWN INDICATE FINISHED GRADES.
7. FINISHED GRADE SHALL BE UNIFORMLY SLOPED AND FREE OF SURFACE IRREGULARITIES. PROVIDE SMOOTH TRANSITIONS BETWEEN GRADE CHANGES. GRADES SHALL SLOPE AWAY FROM BUILDINGS AND SLABS AT MINIMUM 2% FOR 10'.
8. THE CONTRACTOR SHALL HAVE THE LOCATIONS OF ALL BURIED UTILITIES IDENTIFIED AND MARKED PRIOR TO COMMENCING ANY EXCAVATION. LOCATIONS OF BURIED UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE.
9. ALL WORK SHALL CONFORM WITH RECOMMENDATIONS OF THE GEOTECHNICAL INVESTIGATION REPORT, GLENARM REPOWERING PROJECT, PREPARED BY HYDROLOGUE, INC.
10. ALL ASPHALT PAVING WILL ABUT EITHER NEW OR EXISTING CONCRETE PAVING. WHERE ASPHALT ABUTS NON-PAVED AREAS, A CONCRETE CURB, FLUSH WITH THE ASPHALT AND EXTENDING 18" BELOW GRADE, SHALL BE INSTALLED.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	-	07/20/11	07/20/11	-	-	07/20/11	07/20/11
INIT	-	WKW	BT	-	-	TC	DB

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	RE-ISSUED FOR PERMIT	02/25/13	WMT	WKW	WKW	GTH
D	RE-ISSUED FOR PERMIT	01/31/13	WMT	WKW	WKW	GTH
C	RE-ISSUED FOR PERMIT	12/04/12	WMT	WKW	WKW	GTH
B	ISSUED FOR PERMIT	08/18/11	WMT	WKW	WKW	GTH
A	ISSUED FOR BID	10/02/13	WMT	WKW	WKW	GTH

DSGN	WKW	05/27/11
DRN	WMT	05/27/11
CKD	WKW	06/03/11

SCALE: 1"= 20'

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

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PASADENA WATER & POWER

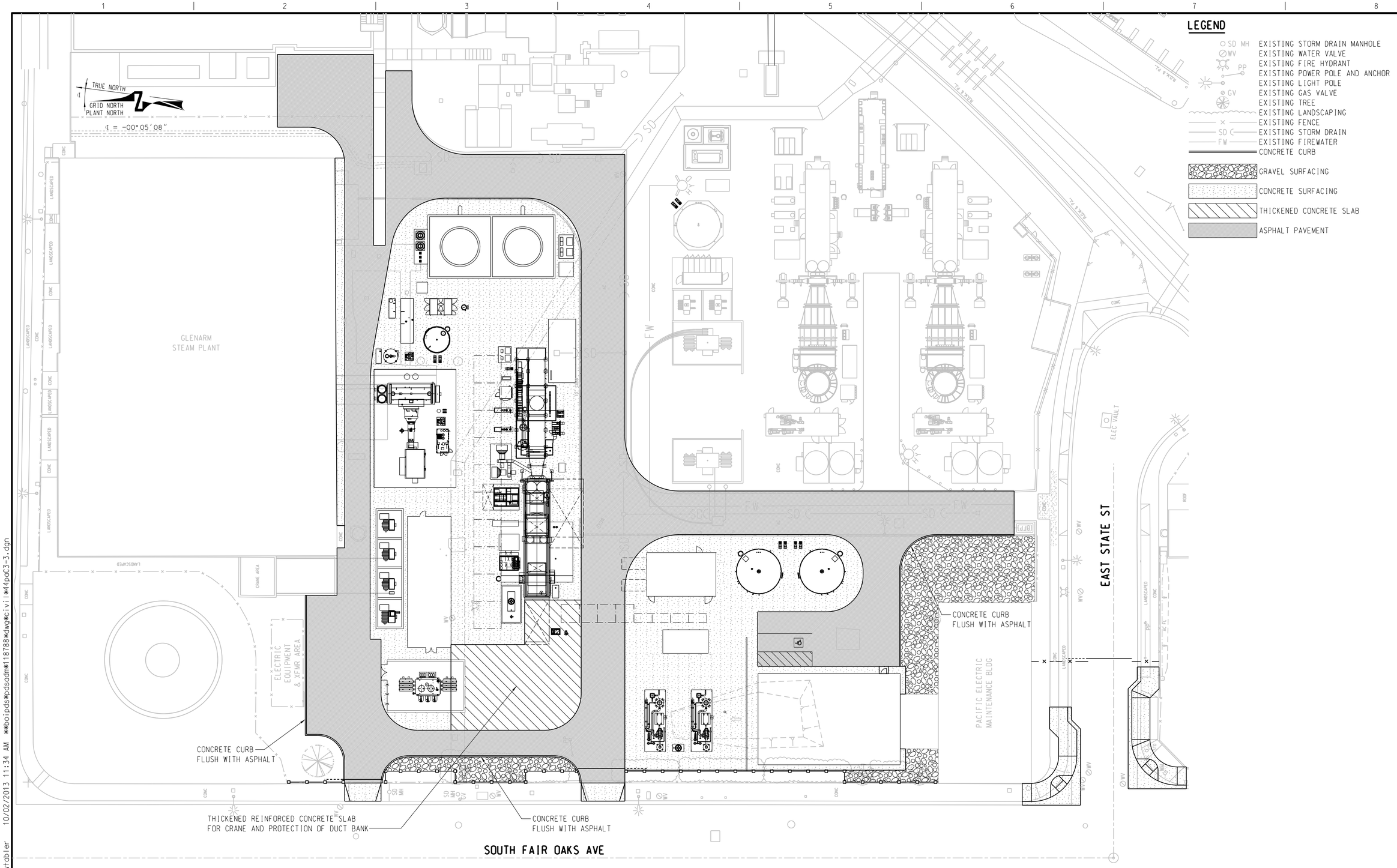
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

PRELIMINARY GRADING & DRAINAGE PLAN GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374 REV F

DRAWING NUMBER C3-1

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DISC							
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR BID	10/02/13	WMT	WKW	WKW	GTH

DSGN	WKW	05/27/11
DRN	WMT	05/27/11
CKD	WKW	06/03/11

SCALE: NTS

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS www.powereng.com

PASADENA WATER & POWER

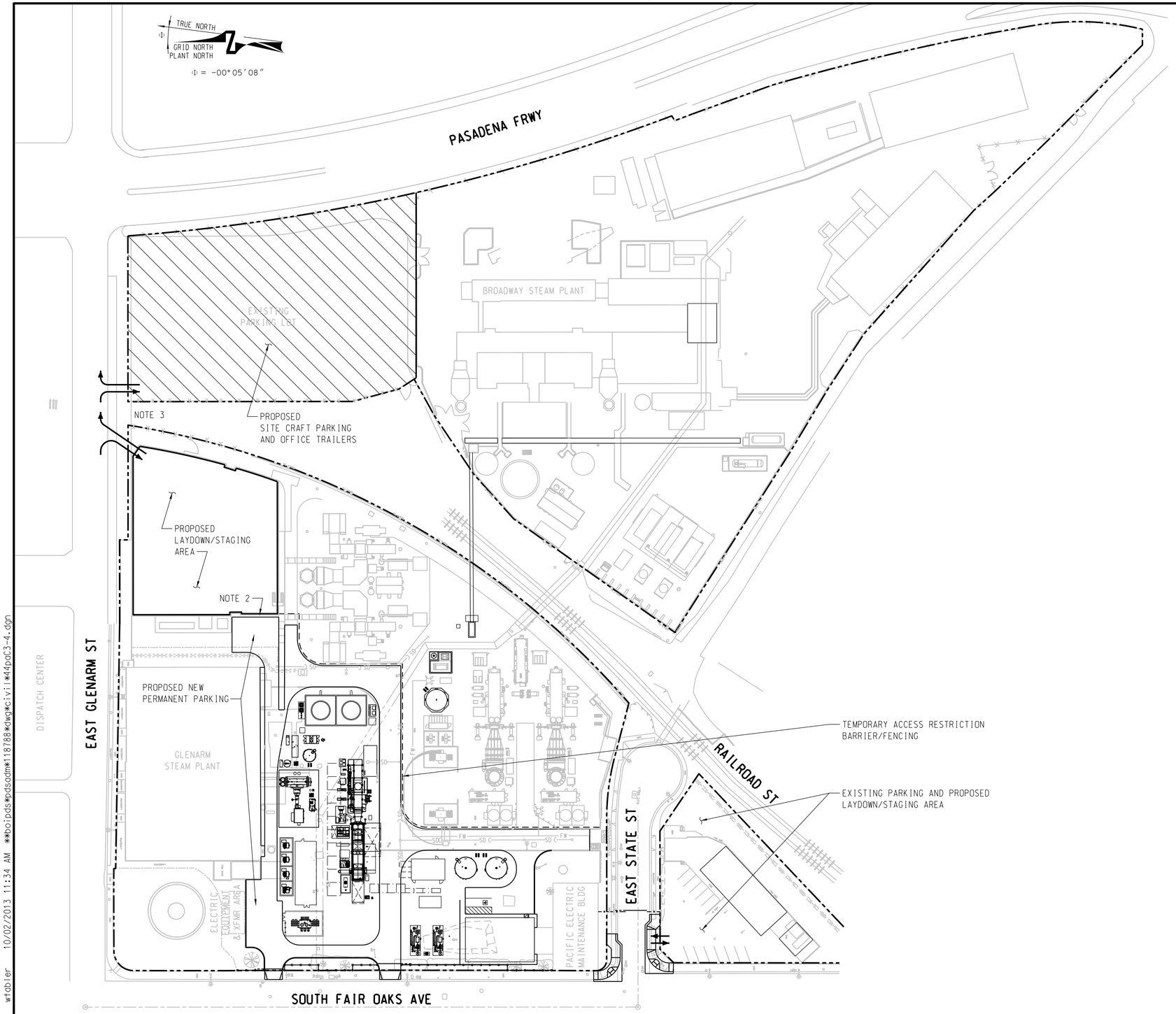
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

PRELIMINARY SITE SURFACING PLAN
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374

REV A

DRAWING NUMBER C3-3



LEGEND

- APPROXIMATE LIMIT OF PWP PROPERTY
- SD MH EXISTING STORM DRAIN MANHOLE
- WV EXISTING WATER VALVE
- EXISTING FIRE HYDRANT
- PP EXISTING POWER POLE AND ANCHOR
- EXISTING LIGHT POLE
- GV EXISTING GAS VALVE
- EXISTING TREE
- EXISTING LANDSCAPING
- EXISTING FENCE
- INGRESS/EGRESS

NOTES

1. PROPOSED NEW EQUIPMENT IS SHOWN IN BOLD FONT. EXISTING FEATURES AND EQUIPMENT ARE SHOWN SCREENED BACK.
2. CONTRACTOR SHALL REMOVE A PORTION OF THIS CONCRETE WALL TO ALLOW ACCESS TO LAYDOWN/STAGING AREA. CONTRACTOR SHALL INSTALL NEW CHAIN LINK GATE UPON DEMOBILIZATION.
3. ARROWS INDICATE PERMISSIBLE TRAFFIC FLOW INTO PARKING LOT AND LAYDOWN AREAS.
4. PARKING AND STAGING AREAS SHALL BE RESTORED TO PRE-MOBILIZATION CONDITIONS AT END OF PROJECT.
5. CONTRACTOR SHALL PROVIDE TEMPORARY SECURITY FENCING AS REQUIRED TO SECURE TRAILER/LAYDOWN/STAGING AREAS AND TO RESTRICT EMPLOYEES FROM ENTERING OPERATING AREAS IN THE PLANT.
6. PROVIDE JERSEY BARRIERS AT GLENARM AND PACIFIC ELECTRIC BUILDING TO PROTECT STRUCTURES.

0 30 60 120 180 FEET
1"= 60'

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DISC							
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR BID	10/02/13	WMT	WKW	WKW	GTH

DSGN	WKW	10/01/13
DRN	WMT	10/01/13
CKD	WKW	10/01/13

SCALE: 1"= 60'
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

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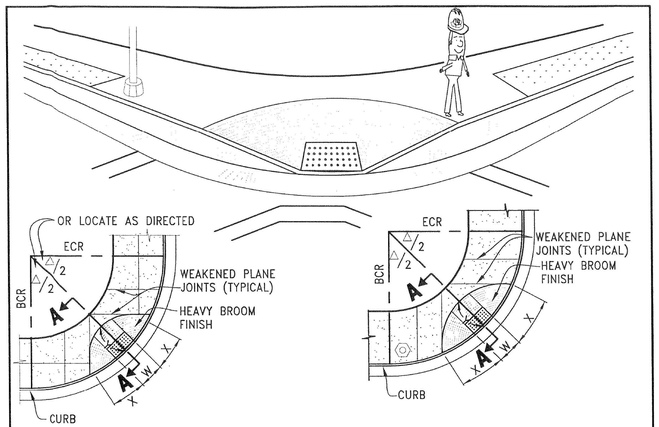
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

CONSTRUCTION PARKING, LAYDOWN, STAGING AND ACCESS PLAN

JOB NUMBER 123374 | REV A

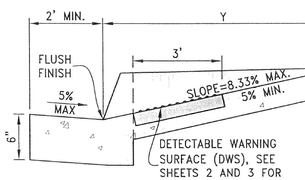
DRAWING NUMBER C3-4

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PLAN - CASE 1

PLAN - CASE 2 & 3



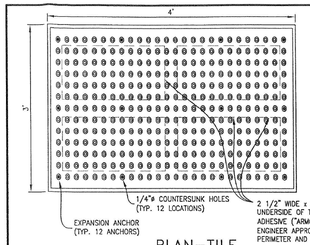
SECTION A-A

NOTE:
IF "X" AND "Y" ARE STEEPER THAN 1:12, LANDING WIDTH AT "A-A" MAY BE DECREASED UNTIL 1:12 "Y" SLOPE IS ATTAINED.

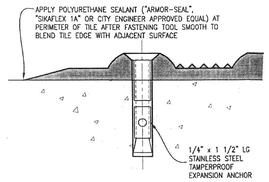
DESIGN PARAMETERS "W" = 4' MIN.		WHEN TO USE ALL CASES
CASE 1:	"Y" AT 1:12 "X"="Y"-"W/2", "X"=2.5' MIN.	RESIDENTIAL AREAS WITH NON-PAVED PARKWAYS
CASE 2:	"Y" AT 1:12 "X" AT 1:12, "X"=8' MAX.	COMMERCIAL AREAS WITH FULL WIDTH SIDEWALK
CASE 3:	"Y" STEEPER THAN 1:12 "X" AT 1:12, "X"=8' MAX.	"Y" STEEPER THAN 1:12

CITY OF PASADENA - DEPARTMENT OF PUBLIC WORKS

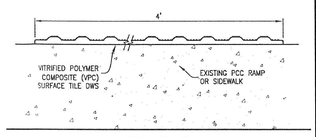
DRAWN BY: MARCOS TIEMANN	INTERSECTION CURB RAMP	REVISION: 4	UNITS: ENG.
DESIGNED BY: JAMES LLOYD		STANDARD PLAN: S-414	
CHECKED BY: GIL WEISS	APPROVED BY: Daniel A. Lt 10/19/2006		
SUBMITTED BY ANDY MUTH	CITY ENGINEER RCE NO. 38689 EXPIRES MARCH 31, 2007 DATE	SHEET 1 OF 3	S414-1-REV3.DWG 12/28/05



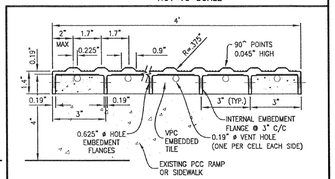
PLAN-TILE
NOT TO SCALE



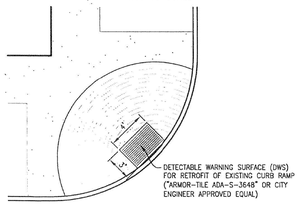
INSTALLATION DETAIL AT TILE PERIMETER
NOT TO SCALE



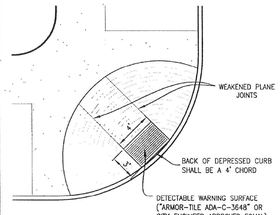
PROFILE
NOT TO SCALE



PROFILE
NOT TO SCALE



SURFACE MOUNTED DETECTABLE WARNING TILE FOR RETROFIT OF EXISTING CURB RAMP
NOT TO SCALE



EMBEDDED DETECTABLE WARNING TILE FOR NEW CURB RAMP
NOT TO SCALE

CITY OF PASADENA - DEPARTMENT OF PUBLIC WORKS

DRAWN BY: MARCOS TIEMANN	INTERSECTION CURB RAMP	REVISION: 4	UNITS: ENG.
DESIGNED BY: JAMES LLOYD		STANDARD PLAN: S-414	
CHECKED BY: GIL WEISS	APPROVED BY: Daniel A. Lt 10/19/2006		
SUBMITTED BY ANDY MUTH	CITY ENGINEER RCE NO. 38689 EXPIRES MARCH 31, 2007 DATE	SHEET 2 OF 3	S414-2-REV3.DWG 12/28/05

CURB RAMP NOTES:

1. TRANSITIONS FROM RAMPS TO WALKS, GUTTERS OR STREETS SHALL BE FLUSH AND FREE OF ABRUPT CHANGES.
2. MAXIMUM SLOPES OF ADJOINING GUTTERS, THE ROAD SURFACE IMMEDIATELY ADJACENT TO THE CURB RAMP AND CONTINUOUS PASSAGE TO THE CURB RAMP SHALL NOT EXCEED 5% WITHIN 4' OF THE BOTTOM OF THE CURB RAMP.
3. IF DISTANCE FROM CURB TO BACK OF SIDEWALK IS NOT SUFFICIENT TO ACCOMMODATE RAMP WITH A MAXIMUM 8.33% SLOPE AND 4' LANDING, THE SIDEWALK MAY BE DEPRESSED LONGITUDINALLY WITH A RETAINING CURB AT THE BACK OF SIDEWALK IF NECESSARY; HOWEVER, RETAINING CURBS SHALL NOT BE CONSTRUCTED WITHOUT THE APPROVAL OF THE CITY ENGINEER.
4. CURB RAMPS SHALL HAVE A DETECTABLE WARNING SURFACE THAT MEASURES 3' IN THE PEDESTRIAN DIRECTION OF TRAVEL AND EXTENDS THE FULL WIDTH OF THE RAMP. DETECTABLE WARNING SURFACES SHALL BE POLYMER COMPOSITE MATERIAL, YELLOW IN COLOR AND SHALL CONFORM TO THE DETAILS AS SHOWN ON SHEET 2 OF THIS STANDARD PLAN.
5. THE EDGE OF THE DETECTABLE WARNING SURFACE NEAREST THE STREET SHALL BE BETWEEN 6" AND 8" FROM THE GUTTER FLOWLINE. SEE SHEET 2 OF THIS STANDARD PLAN FOR ADDITIONAL DETAILS.
6. UTILITY MANHOLES AND VAULTS WITHIN THE BOUNDARIES OF THE CURB RAMP SHALL BE RELOCATED OUTSIDE THE LIMITS OF THE RAMP AREA PRIOR TO, OR IN CONJUNCTION WITH, CURB RAMP CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING THIS WORK WITH THE UTILITY OWNER.
7. PULL BOXES AND CONDUITS WITHIN THE BOUNDARIES OF THE CURB RAMP SHALL BE RELOCATED OUTSIDE THE LIMITS OF THE RAMP AREA. EXISTING WIRING SHALL BE PROTECTED AND REINSTALLED.

CITY OF PASADENA - DEPARTMENT OF PUBLIC WORKS

DRAWN BY: MARCOS TIEMANN	INTERSECTION CURB RAMP	REVISION: 4	UNITS: ENG.
DESIGNED BY: JAMES LLOYD		STANDARD PLAN: S-414	
CHECKED BY: GIL WEISS	APPROVED BY: Daniel A. Lt 10/19/2006		
SUBMITTED BY ANDY MUTH	CITY ENGINEER RCE NO. 38689 EXPIRES MARCH 31, 2007 DATE	SHEET 3 OF 3	S414-3-REV3.DWG 12/28/05

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR BID	10/07/13	WMT	WKW	WKW	GTH

DSGN	WKW	10/02/13
DRN	WMT	10/02/13
CKD	WKW	10/02/13

SCALE: NTS
FOR 22x34 DWG ONLY

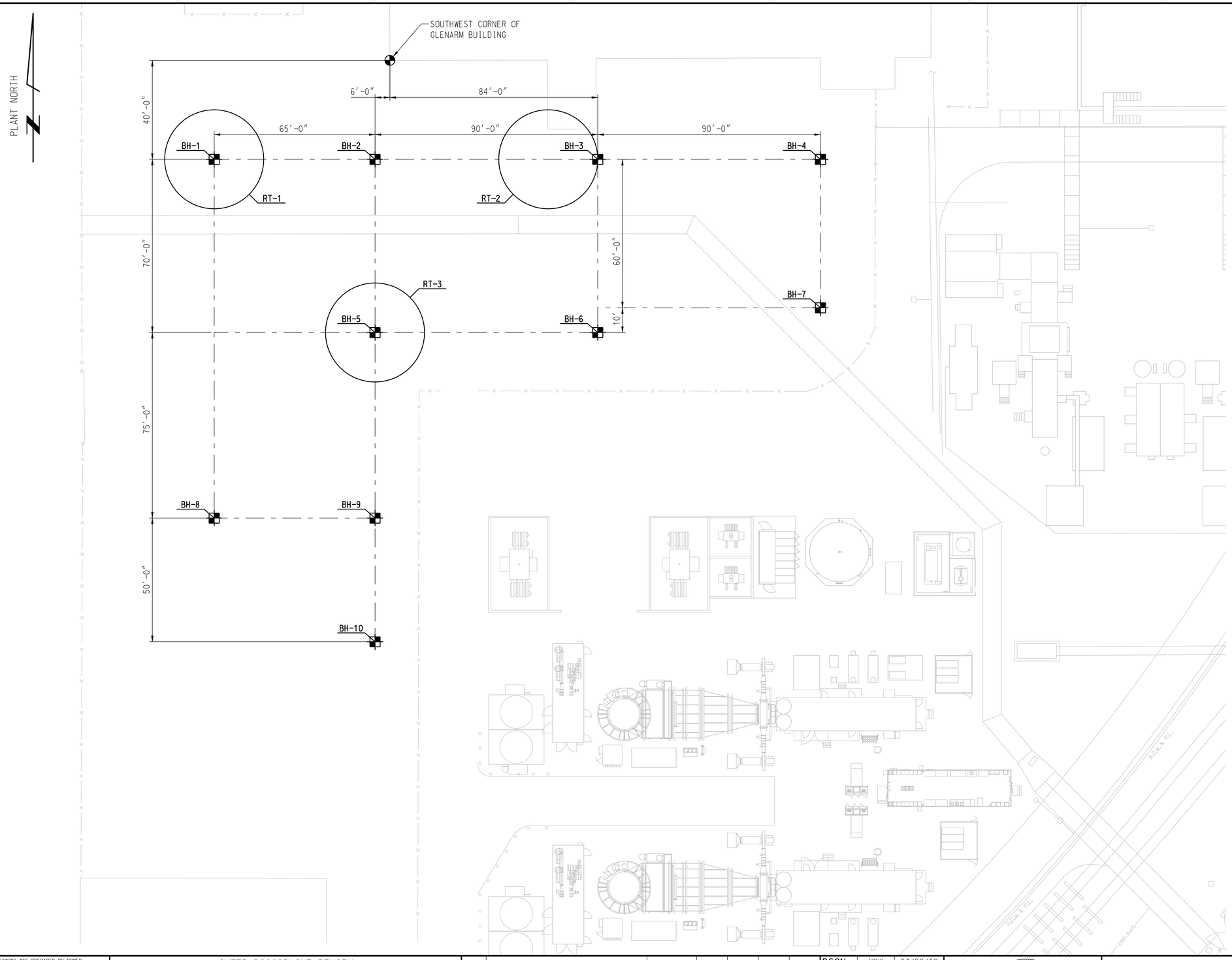
CITY OF PASADENA INCORPORATED JUNE 1886

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PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PRELIMINARY SITE DETAILS
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374 | REV A
DRAWING NUMBER C3-5

wtabler 10/07/2013 03:09 PM **boipds*pdsadm*118788*dwg*civil*44pdc3-5.dgn



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.

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DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ISSUED FOR REVIEW	04/29/11	WMT	WKW	WKW	GTH
A	ISSUED FOR REVIEW	04/28/10	WMT	WKW	WKW	GTH

DSGN	WKW	04/28/10
DRN	WMT	04/28/10
CKD	WKW	04/28/10

SCALE: 1″= 20′

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)

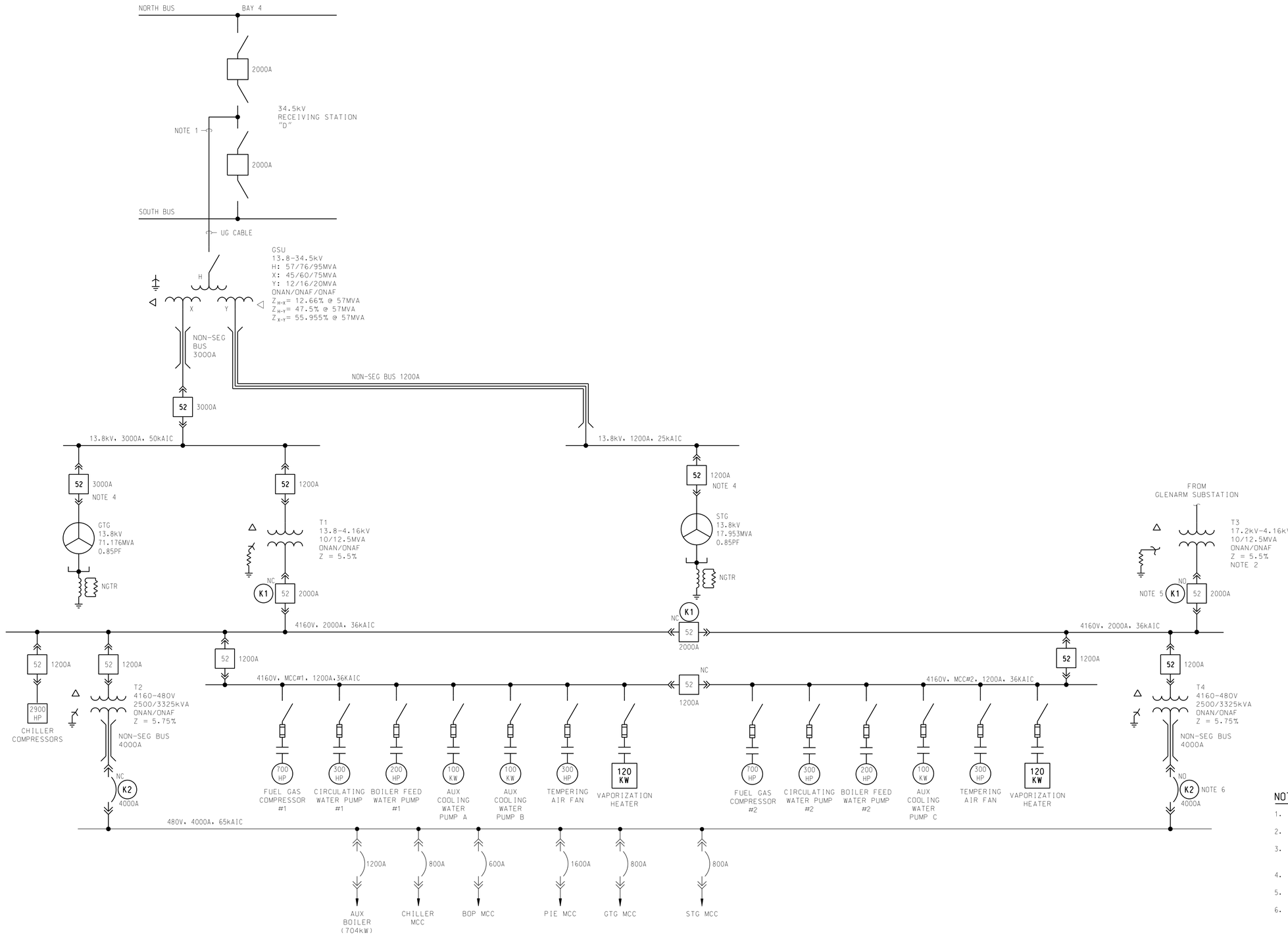
BOREHOLE LOCATION PLAN

JOB NUMBER 119977

REV B

DRAWING NUMBER CSK-1

wtabler 4/29/2011 **bo:pds*pdsadm*119788*dwg*civil*44paCSK-1.dgn



NOTES

1. REPLACES EXISTING FEED TO B3.
2. TRANSFORMER TO PROVIDE A 60° PHASE SHIFT VIA Dzn2 PHASE RELATIONSHIP.
3. ALL EQUIPMENT RATINGS TO BE CONFIRMED BY BOP CONTRACTOR DURING BID AND/OR DETAILED DESIGN.
4. GENERATOR BREAKERS NEED TO BE RATED FOR GENERATOR BREAKER SERVICE.
5. 2-KEY, 3-LOCK INTERLOCK SYSTEM TO BE INSTALLED.
6. 1-KEY, 2-LOCK INTERLOCK SYSTEM TO BE INSTALLED.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
F	RE-ISSUED FOR BID	12/10/13	TLM	FD	RL	GH
E	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
D	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
C	RE-ISSUED FOR REVIEW	10/17/12	RDQ	FD	CH	GH
B	RE-ISSUED FOR REVIEW	08/16/11	RDQ	CH	BT	GH

DSGN	CH	05/13/11
DRN	RDQ	05/16/11
CKD	BT	05/17/11

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

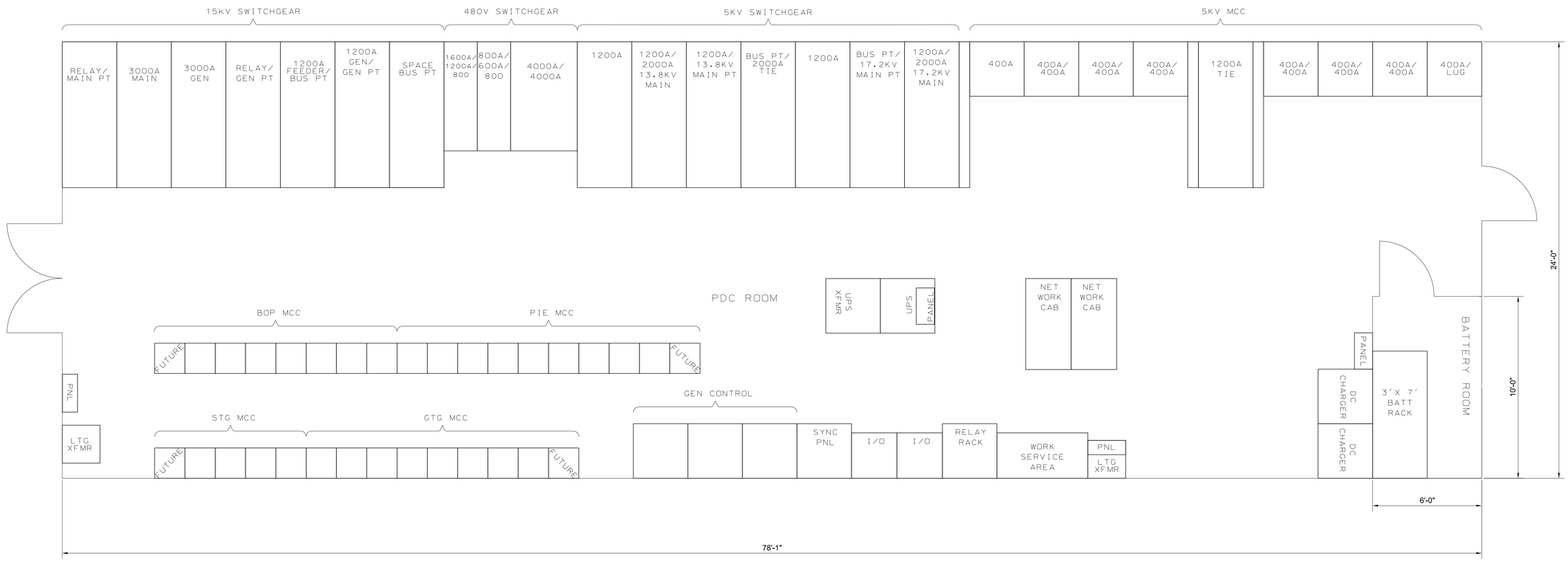
ELECTRICAL OVERALL CONCEPTUAL ONE-LINE DIAGRAM (LM 6000)

JOB NUMBER 123374

REV F

DRAWING NUMBER E1-1A

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INTER-DISCIPLINE REVIEW

	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DISC							
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	RE-ISSUED FOR BID	12/10/13	TLM	FD	RL	GH
D	ISSUED FOR BID	09/06/13	RLA	FD	RL	GH
C	RE-ISSUED FOR REVIEW	07/18/13	TLM	FD	RL	GH
B	RE-ISSUED FOR REVIEW	06/21/13	RLA	RL	RL	GH
A	ISSUED FOR REVIEW	01/18/13	RDQ	FD	CH	GH

DSGN	FD	09/04/12
DRN	MD	09/04/12
CKD	JR	09/07/12

SCALE: * *
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

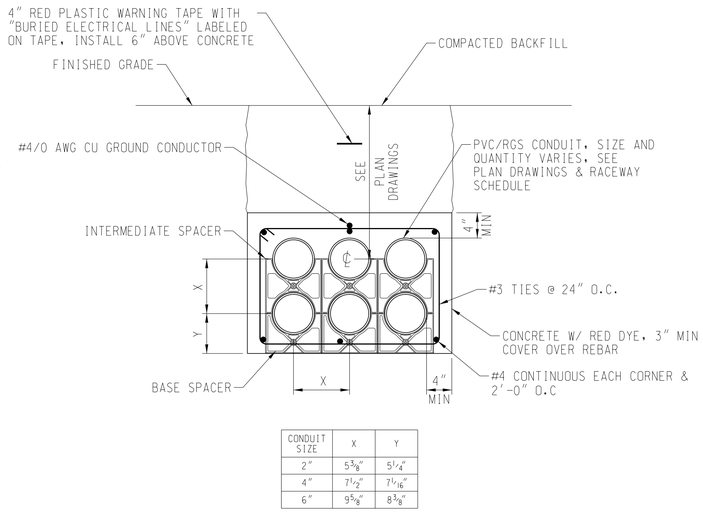
POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
ELECTRICAL OVERALL CONCEPTUAL
PDC BUILDING LAYOUT

JOB NUMBER 123374
REV E
DRAWING NUMBER E1-2

GENERAL NOTES

1. THE UNDERGROUND RACEWAYS SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THESE NOTES AND THE PROJECT DRAWINGS. THESE NOTES APPLY UNLESS OTHERWISE NOTED ON PROJECT DRAWINGS.
2. ALL UNDERGROUND CONCRETE ENCASED DUCTBANK CONDUITS SHALL BE PVC SCHEDULE 40 CONDUIT OR RGS.
3. ALL DIRECT BURIED CONDUITS SHALL BE RATED FOR DIRECT BURIAL AND AS NOTED ON THE PLAN DRAWINGS.
4. ALL CONDUITS EMBEDDED IN FOUNDATIONS AS SHOWN ON THE PLAN DRAWING SHALL BE RIGID GALVANIZED STEEL (RGS) AND SHALL EXTEND OUT PAST THE EDGE OF THE FOUNDATION A MINIMUM OF 24". COORDINATE CONDUIT INSTALLATION WITH REBAR AND ANCHOR BOLT INSTALLATION.
5. CONCRETE SHALL HAVE A MINIMUM 3,000 PSI COMPRESSIVE STRENGTH 28 DAYS. PORTLAND CEMENT SHALL BE ASTM C150 TYPE II. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMED TO ASTM A615, GRADE 60. A RED DYE TYPE COLORING AGENT SHALL BE ADDED TO THE DUCTBANK CONCRETE MIX PRIOR TO ENCASING CONDUITS.
6. UNDERGROUND CONDUIT BURIAL DEPTH SHALL BE AS NOTED ON THE PLAN DRAWINGS.
7. LOCATE CONDUIT STUB-UPS IN CENTER OF EQUIPMENT OPENINGS. VERIFY EQUIPMENT OPENING SIZE AND LOCATION WITH EQUIPMENT MANUFACTURER'S APPROVED DRAWINGS.
8. ALL HORIZONTAL BENDS SHALL BE RIGID GALVANIZED STEEL (RGS) SPECIAL RADIUS SWEEPS WHERE POSSIBLE. WHERE THE MINIMUM RADIUS SWEEP CANNOT BE USED DUE TO FIELD CONDITIONS OR PHYSICAL LAYOUT, A SMALLER SWEEP RADIUS MAYBE USED. STANDARD RGS ELBOWS SHALL NOT BE USED. UNLESS OTHERWISE NOTED ON THE PLAN DRAWINGS THE FOLLOWING SHALL APPLY:
   - 6" CONDUIT SWEEPS SHALL HAVE A MINIMUM RADIUS OF 48"
   - 4" CONDUIT SWEEPS SHALL HAVE A MINIMUM RADIUS OF 36"
   - 2" CONDUIT SWEEPS SHALL HAVE A MINIMUM RADIUS OF 24"
9. A CONDUIT RUN SHALL NOT CONTAIN MORE THAN THE EQUIVALENT OF FOUR QUARTER BENDS (360° TOTAL).
10. ALL VERTICAL BENDS AND RISERS SHALL BE RIGID GALVANIZED STEEL (RGS) CONDUIT. STANDARD RADIUS ELBOWS SHALL BE USED UNLESS OTHERWISE NOTED ON THE PLAN DRAWINGS. WHERE POSSIBLE INSTALL ELBOWS SO THAT THE CURVED SECTION SECTION OF THE ELBOW IS NOT VISIBLE AFTER FINAL INSTALLATION. ADJUST CONDUIT DEPTH AT END OF DUCTBANK RUN IF POSSIBLE. NO SINGLE PHASE SHALL BE RUN IN STEEL CONDUIT.
11. INSTALL A RGS TYPE INSULATED GROUND BUSHING ON THE END OF EACH VERTICAL RISER AS DETAILED ON THE GROUNDING DRAWINGS.
12. WHERE UNDERGROUND VERTICAL RISERS PENETRATE THROUGH CONCRETE EQUIPMENT FOUNDATIONS, PADS OR FLOORS INSTALL A RGS COUPLING. COUPLING SHALL EXTEND AT A MINIMUM HALF OF THE COUPLING'S HEIGHT ABOVE THE CONCRETE. INSTALL A RGS PLUG TO PREVENT DEBRIS FROM ENTERING CONDUIT DURING CONSTRUCTION. RISERS WITHIN CONTAINMENT AREAS SHALL EXTEND TO TOP OF THE CONTAINMENT WITH NO COUPLING.
13. A POLYPROPYLENE ROPE SHALL BE INSTALLED IN EACH CONDUIT FOR THE USE IN CABLE PULLING. ROPE IN SPARE CONDUITS SHALL BE LEFT IN PLACE FOR FUTURE USE. SEAL ALL SPARE CONDUITS OFF AT EACH END WITH FOAM. ALL CONDUITS SHALL BE MOUSE AND MANDRELED PRIOR TO PULLING CABLE.
14. ALL UNDERGROUND CONDUITS TERMINATING AT UNDERGROUND VAULTS, MANHOLES, OR PULL BOX WALLS SHALL BE TERMINATED WITH END BELLS. CONDUITS ENTERING FROM THE BOTTOM OF OPEN BOTTOM BOXES SHALL HAVE A GROUND BUSHING INSTALLED.
15. A #4/0 AWG BARE GROUND CONDUCTOR SHALL RUN THE FULL LENGTH OF THE DUCTBANK. CONNECT EACH END OF THE GROUND CONDUCTOR TO THE MAIN GROUND GRID OR AS DETAILED OTHERWISE. SEE GROUNDING DRAWINGS FOR GROUNDING CONDUCTOR CONNECTION DETAILS.
16. END DUCTBANK CONCRETE ENCASEMENT BELOW THE BOTTOM OF CONCRETE SLABS, PADS, AND FOUNDATIONS. CONDUITS SHALL EXTEND UP AS SHOWN IN THE STUB-UP DETAILS.



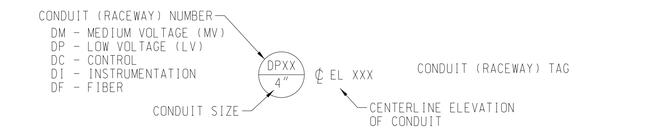
CONDUIT SIZE	X	Y
2"	5 3/8"	5 1/4"
4"	7 1/2"	7 1/16"
6"	9 5/8"	8 3/8"

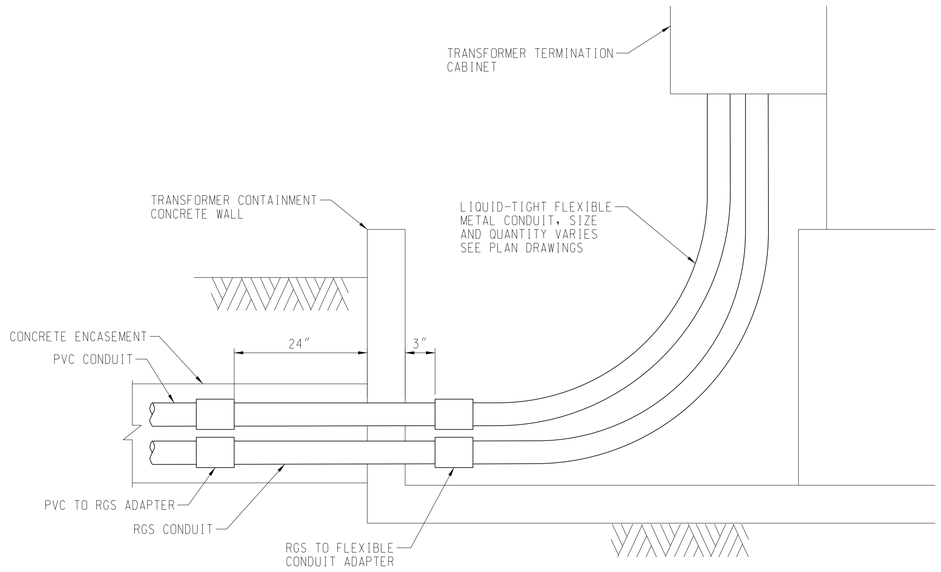
NOTE: CONDUIT SPACING IS BASED ON 3" DUCT TO DUCT SPACING WITH CARLON'S SNAP-N-STAC CONDUIT SPACERS.

TYPICAL UNDERGROUND DUCTBANK DETAIL

NTS

LEGEND

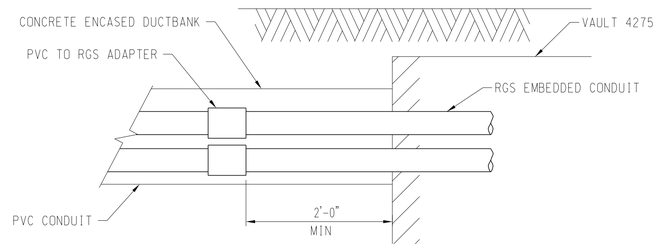




TRANSFORMER CONTAINMENT PENETRATION

NTS

DETAIL 1 / -



VAULT PENETRATION

NTS

DETAIL 2 / -

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	09/30/13	TLM	FTD	RL	GH

DSGN	FTD	07/29/13
DRN	TLM	07/29/13
CKD	RL	07/29/13

SCALE: NTS

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

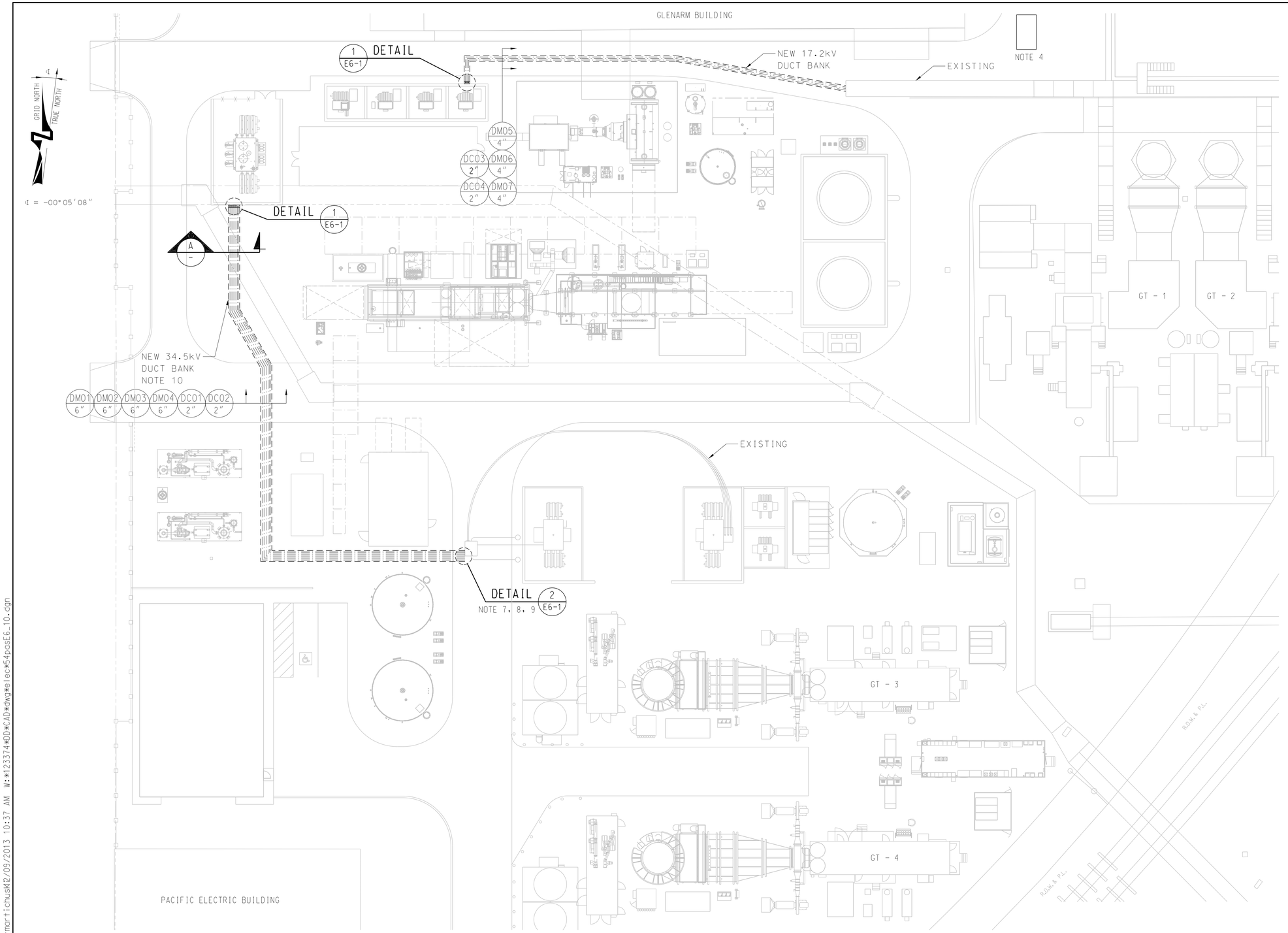
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

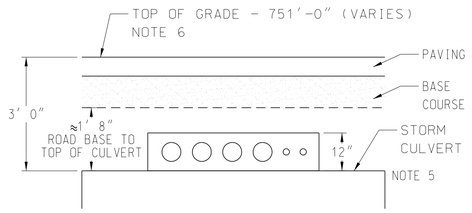
ELECTRICAL UNDERGROUND NOTES AND LEGEND

JOB NUMBER 123374

REV A

DRAWING NUMBER E6-1





SECTION A
SCALE: NTS

NOTES

1. SEE DRAWING E6-1 FOR GENERAL NOTES, LEGEND AND DETAILS.
2. THIS DRAWING REPRESENTS PROPOSED UNDERGROUND ROUTING FOR 17.2kV AND 34.5kV FEEDS. CABLE SIZING AND QUANTITIES TO BE DETERMINED DURING DETAILED DESIGN.
3. PROPOSED ROUTING IS NEW UNLESS OTHERWISE NOTED.
4. 8' X 14' TUNNEL VAULT TO BE INSTALLED. FINAL LOCATION AND DEPTH TO BE DETERMINED BY CONTRACTOR AND COORDINATED WITH PWP.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY FIELD CONDITIONS. ELEVATIONS AND DIMENSIONS ARE PROVIDED FOR REFERENCE ONLY.
6. SEE DRAWING C3-1 FOR APPROXIMATE ELEVATIONS.
7. CORE DRILL THROUGH EXISTING VAULT 4275 TO INSTALL CONDUITS. PENETRATIONS SHALL BE SEALED TO MAKE WATER TIGHT.
8. CABLES TO EXIT VAULT 4275 ON THE SOUTH UTILIZING SPARE DUCT BANK CONDUITS ON THE EAST SIDE OF VAULT.
9. REFER TO EXISTING PWP DRAWINGS 20001-E-004-13, 8-2-547 AND 2-2-1562 FOR DUCTBANK DETAILS AND ROUTING.
10. 4160kV FEED TO ALSO BE ROUTED OVER STORM DRAIN, IN PARALLEL TO THE 34.5kV LINE.

0 10 20 40 60 FEET
1"= 20'

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
B	ISSUED FOR BID	12/10/13	TLM	FTD	RL	GH
1	ISSUED FOR REVIEW	09/30/13	TLM	FTD	RL	GH

DSGN	FTD	07/31/2013
DRN	TLM	07/31/2013
CKD	RL	09/18/2013

SCALE: 1" = 20'-0"
FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

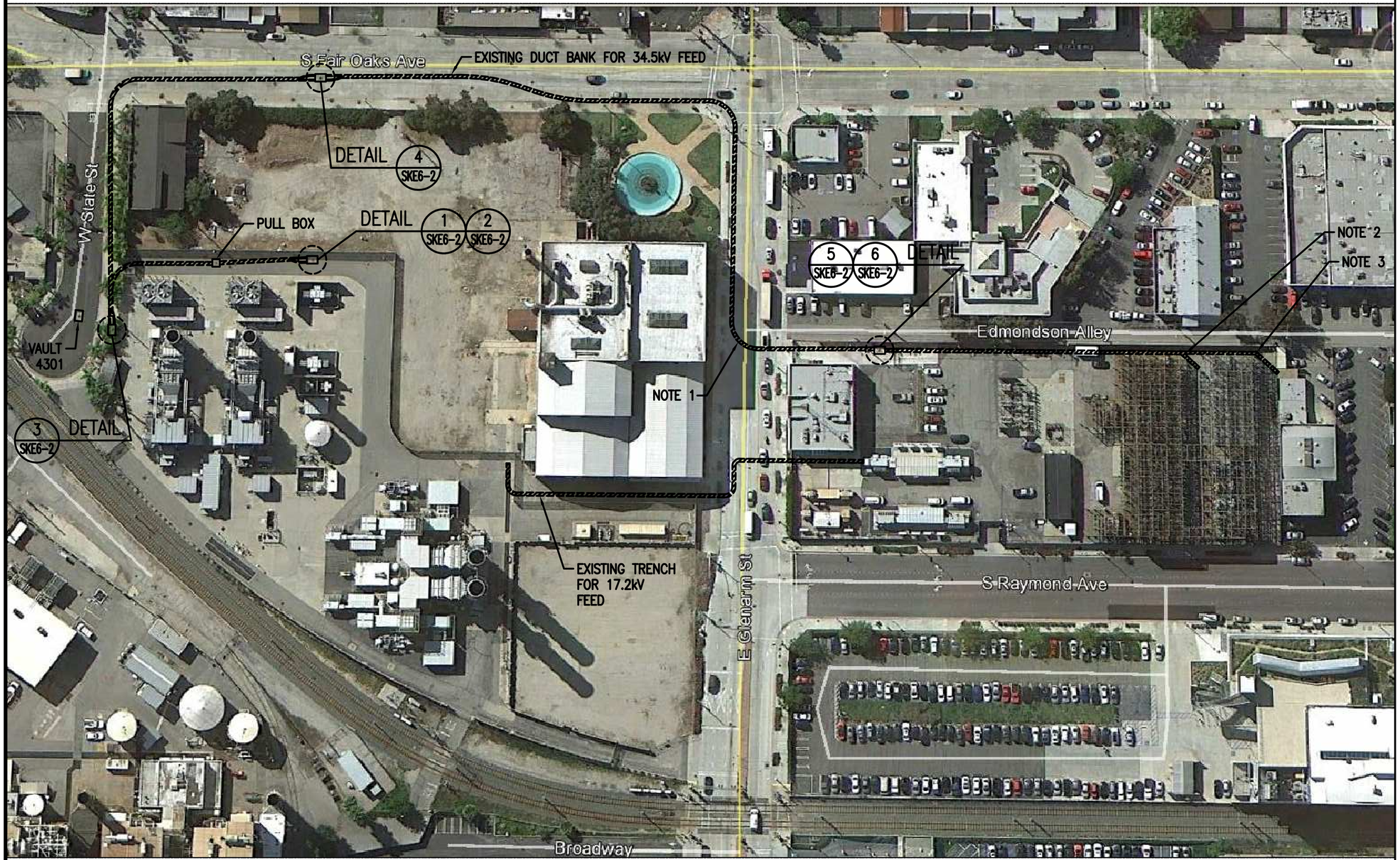
POWER ENGINEERS
www.powereng.com

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PROPOSED ELECTRICAL
UNDERGROUND ROUTING

JOB NUMBER 123374
REV B
DRAWING NUMBER E6-10

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PLANT NORTH



NOTES

1. CABLES ENTER CABLE TUNNEL 02.
2. FINAL TERMINATION LOCATION.
3. TEMPORARY TERMINATION LOCATION.
4. SEE EXISTING PWP DRAWINGS 20001-E-004-13, 8-2-547 AND 2-2-1562 FOR DETAILS.
5. SEE DRAWING E6-1 AND E6-10 FOR PROPOSED UNDERGROUND ROUTING.

0 25 50 100 150 FEET
1" = 50'

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INTER-DISCIPLINE REVIEW							
DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR INFORMATION	*	TLM	FTD	RL	GH

DSGN	FTD	07/31/2013
DRN	TLM	07/31/2013
CKD	RL	09/18/2013

SCALE: 1" = 50'-0"
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POWER ENGINEERS

PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
EXISTING ELECTRICAL
UNDERGROUND ROUTING

JOB NUMBER 123374 | REV A

DRAWING NUMBER SKE6-1

54PASSKE6_1.DWG



VAULT 4275 – WEST WALL, SOUTH CORNER

DETAIL 1 / –
NTS



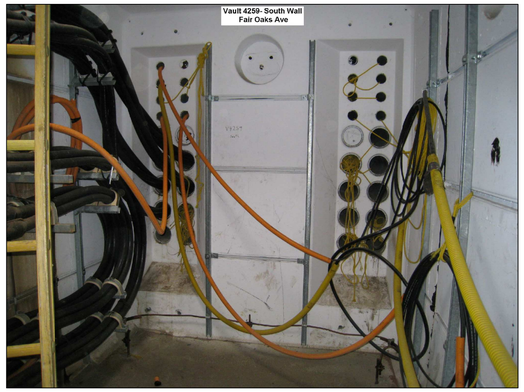
VAULT 4275 – SOUTH WALL

DETAIL 2 / –
NTS



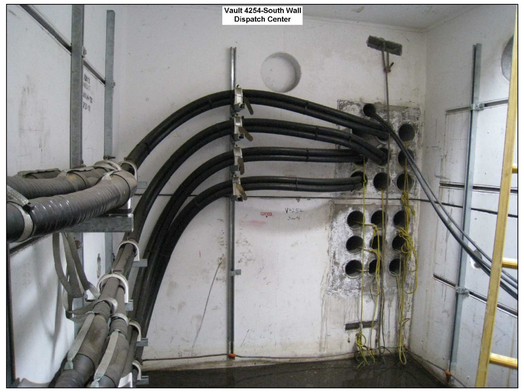
VAULT 4273 – WEST WALL

DETAIL 3 / –
NTS



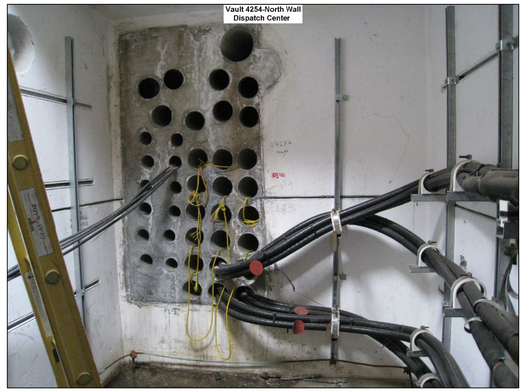
VAULT 4259 – SOUTH WALL

DETAIL 4 / –
NTS



VAULT 4254 – SOUTH WALL

DETAIL 5 / –
NTS



VAULT 4254 – NORTH WALL

DETAIL 6 / –
NTS

NOTES

1. *

54PASSKE6_2.DWG

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DISC							
DATE							
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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR INFORMATION	*	TLM	FTD	RL	GH

DSGN	FTD	07/31/2013
DRN	TLM	07/31/2013
CKD	RL	09/18/2013

SCALE: NTS

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

EXISTING ELECTRICAL
UNDERGROUND ROUTING

JOB NUMBER 123374

REV A

DRAWING NUMBER SKE6-2

NEW CONTROL BLDG CONTROL ROOM

MAIN OPERATOR CONSOLE

GT5 HMI #2
- FIREMANS HMI

GT5 HMI #1

HARDWIRED E-STOPS X7
- MASTER FUEL
- OTSG, GT5, GT4, GT3, GT2, GT1

BOP HMI #2
- FIREMANS HMI
- INCLUDES OTSG
- INCLUDES STEAM TURBINE

BOP HMI #1
- INCLUDES OTSG
- INCLUDES STEAM TURBINE

CONTROL BLDG IT/EWS OFFICE

SCADA SERVER

EWS

NETWORK CABINET

GPS TIME CLOCK

HISTORIAN SERVER
- RAID 5 CONFIGURATION

OPC SERVER

FIBER CONVERTER

NETWORK CABINET

PROCESS CONTROL BUS

ETHERNET 100BASE T

FIBER CONV

ETHERNET IP

ETHERNET IP

(RIG)
CITY OF PASADENA
- REMOTE INTERFACE GATEWAY
- WONDERWARE

MODBUS TCP/IP

ELECTRIC STATION RTU

FUEL METER

CA ISO

PDC

GT5 HMI

GTG CONTROLLER BY GE

GT5 I/O CABINET

STG HMI BY SHIN NIPPON

STG CONTROLLER BY SHIN NIPPON

STG I/O CABINET

BOP CONTROLLER(S)

BOP HW I/O
- COOLING TOWER
- TURBINE BYPASS VALVE
- BF PUMPS
- COND PUMPS

HARDWIRED I/O

HARDWIRED I/O

OTSG I/O CABINET BY IST

B3 CONTROL ROOM

FACP HW OUTPUTS

FIBER CONVERTER

NH3 FLOW CONTROL (AB PLC)

FIBER CONVERTER

SCR (AB PLC)

FIBER CONVERTER

FUEL GAS COMPRESSOR (AB PLC) BY KABELCO

HARDWIRED I/O

I/O PANEL

FIBER CONVERTER

INLET AIR CHILLER/HEATER BY STELLAR

HARDWIRED I/O

I/O PANEL

FIBER CONVERTER

CONDENSATE POLISHER (AB PLC)

FIBER CONVERTER

WATER TREATMENT (AB PLC)

FIBER CONVERTER

WEATHER STATION

FIBER CONVERTER

AIR COMPRESSOR

LEGEND
- ETHERNET 100BASET (CAT5E)
- EHTERNET IP (COPPER)
- ETHERNET IP (FIBER)
- MODBUS TCP/IP

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DATE	-	-	-	-	-	-	-
INIT	-	-	-	-	-	-	-

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUED FOR REVIEW	08/30/13	RDQ	DT	MJA	GH

DSGN	DT	08/26/13
DRN	RDQ	08/27/13
CKD	MJA	08/29/13

SCALE: NONE

FOR 22x34 DWG ONLY

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

PLANT CONTROL SYSTEM ARCHITECTURE

JOB NUMBER 123374

REV A

DRAWING NUMBER I1-1

COP SECURITY NETWORK

COP SECURITY MONITORS
- 4 SCREENS MOUNTED ON WALL
- CONTROL OF FENCE
- CONTROL OF CAMERAS DISPLAYED

COP NETWORK

COP NETWORK

MAIN OPERATORS CONSOLE

E-STOP TREE

COP WORKSTATION 1
- GT5 NET DAHS (CEMS)
- INTERNET ACCESS

COP WORKSTATION 2
- SCHEDULING COMPUTER

BOP OWS 1
- OPERATOR STAITON
- OTSG OWS 1

GT5 OWS 1
- OPERATOR STATION

NET DAHS (CEMS)
- UNIT 1, 2, 3, 4

COP UNITS 3& 4
- REMOTE STATION
- FUTURE INSTALLATION

COP UNITS 1& 2
- REMOTE STATION
- FUTURE INSTALLATION

PROCESS CONTROL BUS

ETHERNET 100BASE T

SEE I1-1

FIREMANS CONSOLE

GT5 OWS 2
- FIREMAN STATION

BOP OWS 2
- FIREMANS STATION
- OTSG OWS 2

PDC

GT5 CONTROLLER

SEE I1-1

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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 REVIEW	08/30/13	RDQ	DT	MJA	GH

DSGN	DT	08/26/13
DRN	RDQ	08/27/13
CKD	MJA	08/29/13

SCALE: NONE

FOR 22x34 DWG ONLY

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

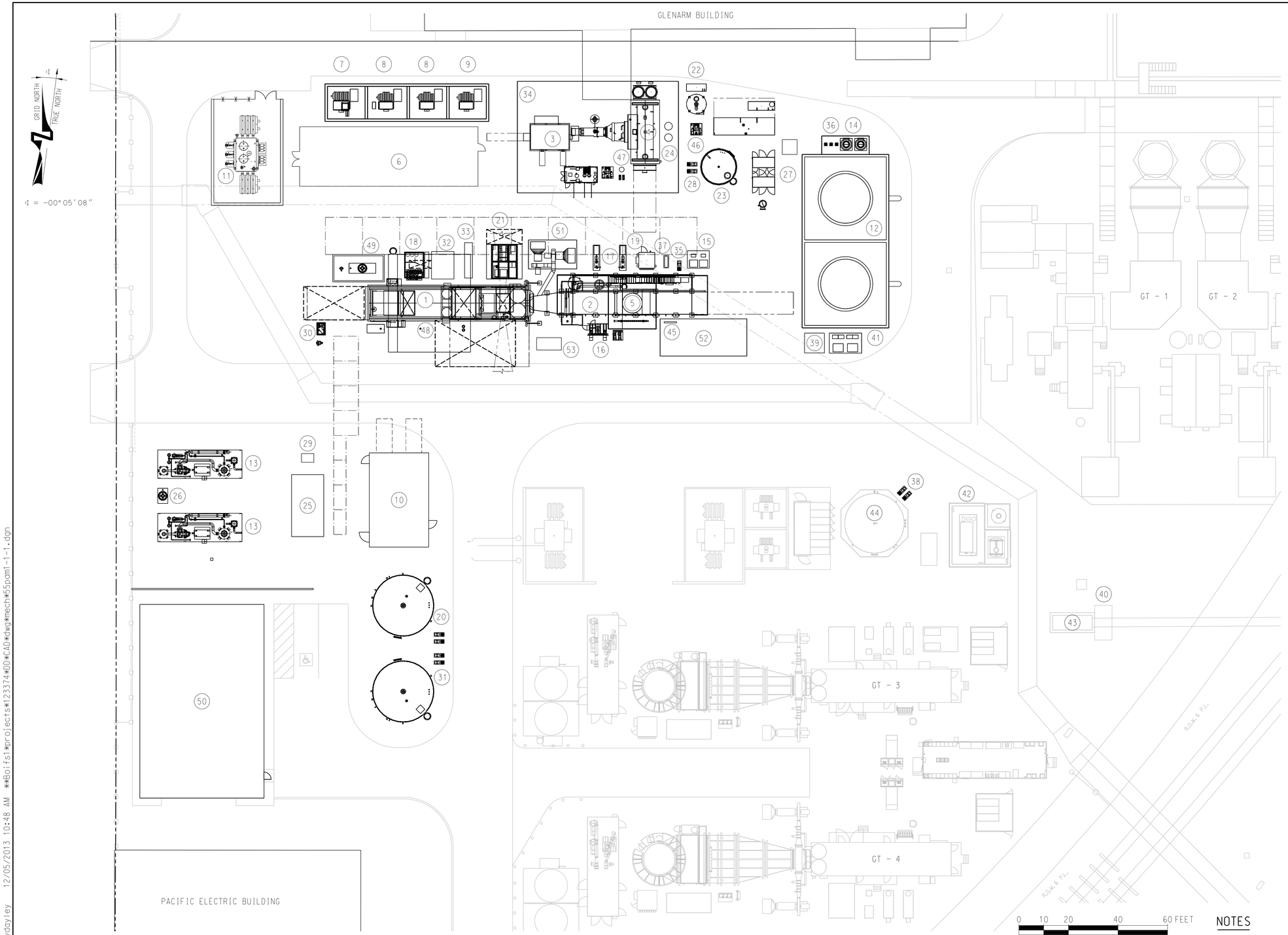
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

CONTROL ROOM WORKSTATIONS

JOB NUMBER 123374

REV A

DRAWING NUMBER I1-2



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) / CONTROL ROOM
7. 13.8KV -4.16KV AUX. TRANSFORMER
8. 4160V -480V AUX. TRANSFORMER
9. 17.2KV -4.16KV 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/PUMPS
21. GTG AUXILIARY SKID
22. CONDENSATE POLISHER
23. CONDENSATE STORAGE TANK
24. CONDENSATE PUMPS
25. INLET AIR HEAT EXCHANGER
26. FUEL GAS COMPRESSOR DRAINS TANK
27. AIR COMPRESSOR AND RECEIVER
28. CONDENSATE MAKE-UP PUMPS
29. INLET AIR PRE-COOLER
30. GTG FUEL GAS FINAL FILTER SKID
31. WASTE WATER TANK/PUMPS
32. GENERATOR/GEARBOX LUBE OIL SKID
33. GTG LUBE OIL COOLER SKID
34. STEAM TURBINE ENCLOSURE
35. BEARING COOLING WATER PUMPS
36. AUXILIARY COOLING WATER PUMPS
37. AUXILIARY COOLING WATER HEAT EXCHANGER
38. DEMINERALIZED WATER FORWARDING PUMPS
39. WASTE WATER LIFT STATION
40. GLENARM WEIR (EXISTING)
41. COOLING TOWER CHEMICAL TREATMENT
42. GT 3 & 4 OILY WATER SEPARATOR (EXISTING)
43. GLENARM BROADWAY TUNNEL (EXISTING)
44. GT 3 & 4 DEMIN TANK (EXISTING)
45. STEAM & WATER SAMPLING PANEL
46. POTABLE WATER RECIRCULATION SKID
47. ATMOSPHERIC FLASH TANK/TRANSFER PUMPS
48. COIL CONDENSATE SUMP
49. GTG WATER WASH DRAINS TANK (IN OPEN VAULT)
50. CONTROL BUILDING
51. PURGE/TEMPERING AIR FANS
52. WATER LAB BUILDING
53. SPRINT SKID

NOTES

1. CONCEPTUAL

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
K	RE-ISSUED FOR BID	12/06/2013	VBD	KAC	TRC	GTH
J	RE-ISSUED FOR BID	10/15/2013	VBD	KAC	TRC	GTH
I	RE-ISSUED FOR BID	09/27/2013	VBD	KAC	ADD	SLH
H	RE-ISSUED FOR REVIEW	07/18/2013	VBD	KAC	ADD	SLH
G	RE-ISSUED FOR REVIEW	01/31/2013	AJG	AJG	ADD	SLH

DSGN	DPB	04/12/2011
DRN	DPB	04/12/2011
CKD	RVK	04/12/2011

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)

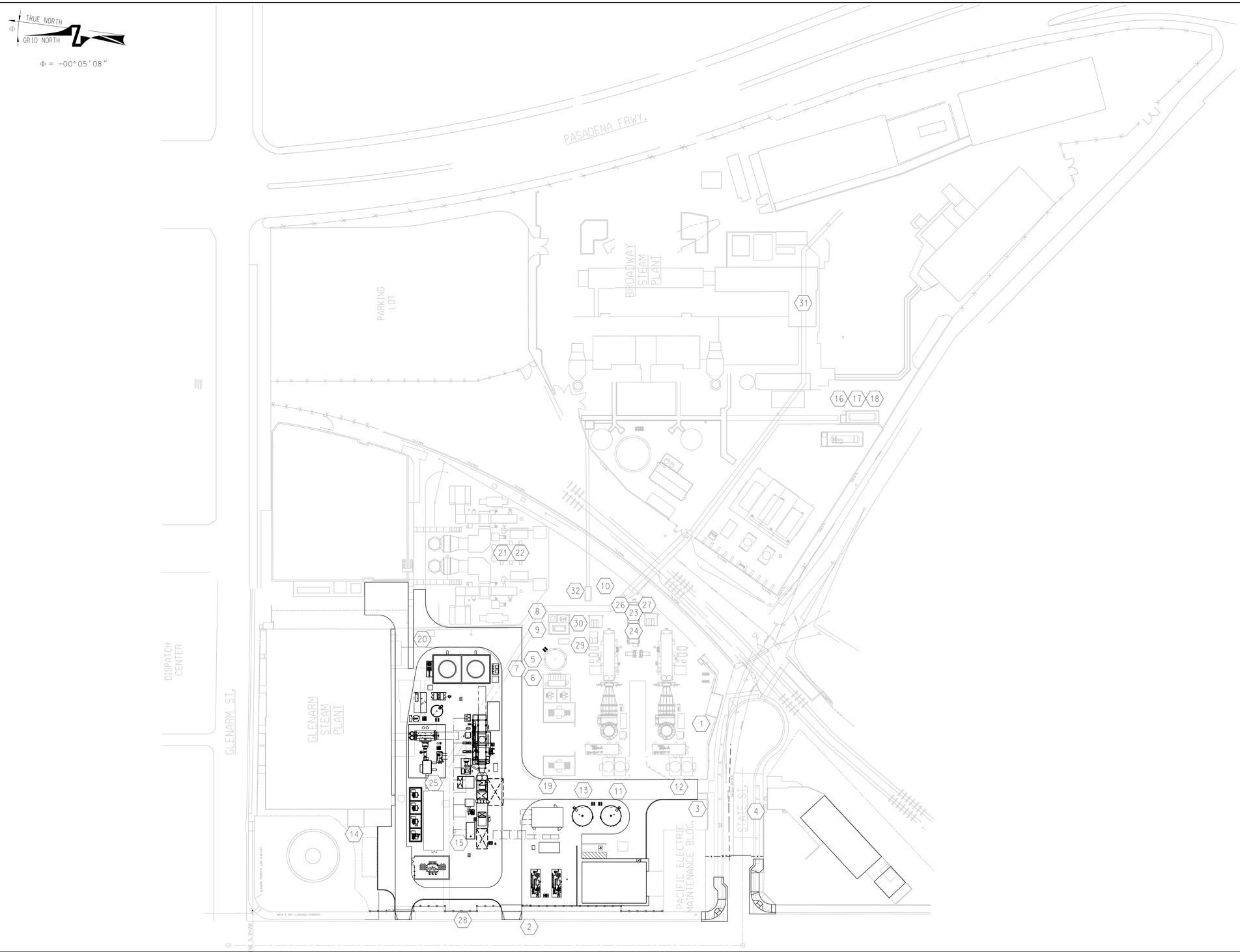
GENERAL ARRANGEMENT GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374

REV K

DRAWING NUMBER M1-1-1

vdayley 12/05/2013 10:48 AM **Boise\projects\123374\0D\CAD\dwg\mech\55pam1-1-1.dgn



LEGEND

1 – FUEL GAS SUPPLY
2 – CITY WATER CONNECTION – POTABLE/SERVICE WATER
3 – CITY WATER CONNECTION – FIRE WATER LOOP
4 – CITY WATER CONNECTION – MAINTENANCE BLDG
5 – DEMINERALIZED WATER FROM TANK 157B
6 – DEMINERALIZED WATER RECIRCULATION TO TANK 157B
7 – DEMINERALIZED WATER FROM TANK 157A
8 – EQUIPMENT DRAIN SUMP TO OWS
9 – OWS EFFLUENT TO WASTEWATER STORAGE TANK
10 – GT-5 WASTEWATER TO EXISTING DISCHARGE PIPE
11 – CT 3 BLOWDOWN
12 – CT 4 BLOWDOWN
13 – WASTEWATER STORAGE TANK TO DISCHARGE PIPE
14 – FOUNTAIN DRAIN
15 – GTG WASH WATER DRAINS TANK PUMP-OUT
16 – AQUEOUS AMMONIA SUPPLY
17 – AQUEOUS AMMONIA PUMP MINIMUM FLOW
18 – AQUEOUS AMMONIA PUMP SKID RECIRCULATION
19 – 34.5 KV
20 – 17 KV
21 – GT1 CONTROL SYSTEM
22 – GT2 CONTROL SYSTEM
23 – GT3 CONTROL SYSTEM
24 – GT4 CONTROL SYSTEM
25 – 34.5 KV RELAY PANEL
26 – PHONE
27 – INTERNET
28 – SANITARY SEWER
29 – INTRUMENT AIR
30 – OWS LEVEL INSTRUMENT
31 – EXISTING B3 CONTROL ROOM
32 – NEW AMMONIA FEED CONNECTION

NOTES:
1. REFER TO DRAWING M9-10 TIE IN POINT INDEX FOR FURTHER DETAILS.
2. TIE POINT LOCATIONS SHOWN ARE APPROXIMATE. BOP CONTRACTOR TO FIELD LOCATE.

0 30 60 120 180 FEET
1" = 60'

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR BID	12/09/2013	VBD	SEG	TRC	TRC
C	ISSUED FOR BID	10/15/2013	VBD	SEG	TRC	TRC
B	ISSUED FOR BID	09/27/2013	VBD	SEG	TRC	TRC
A	ISSUED FOR REVIEW	12/07/2012	DPB	SEG	ADD	TRC

DSGN	DPB	12/05/2012
DRN	DPB	12/05/2012
CKD	SEG	12/05/2012

SCALE: 1" = 60'-0"
FOR 22x34 DWG ONLY

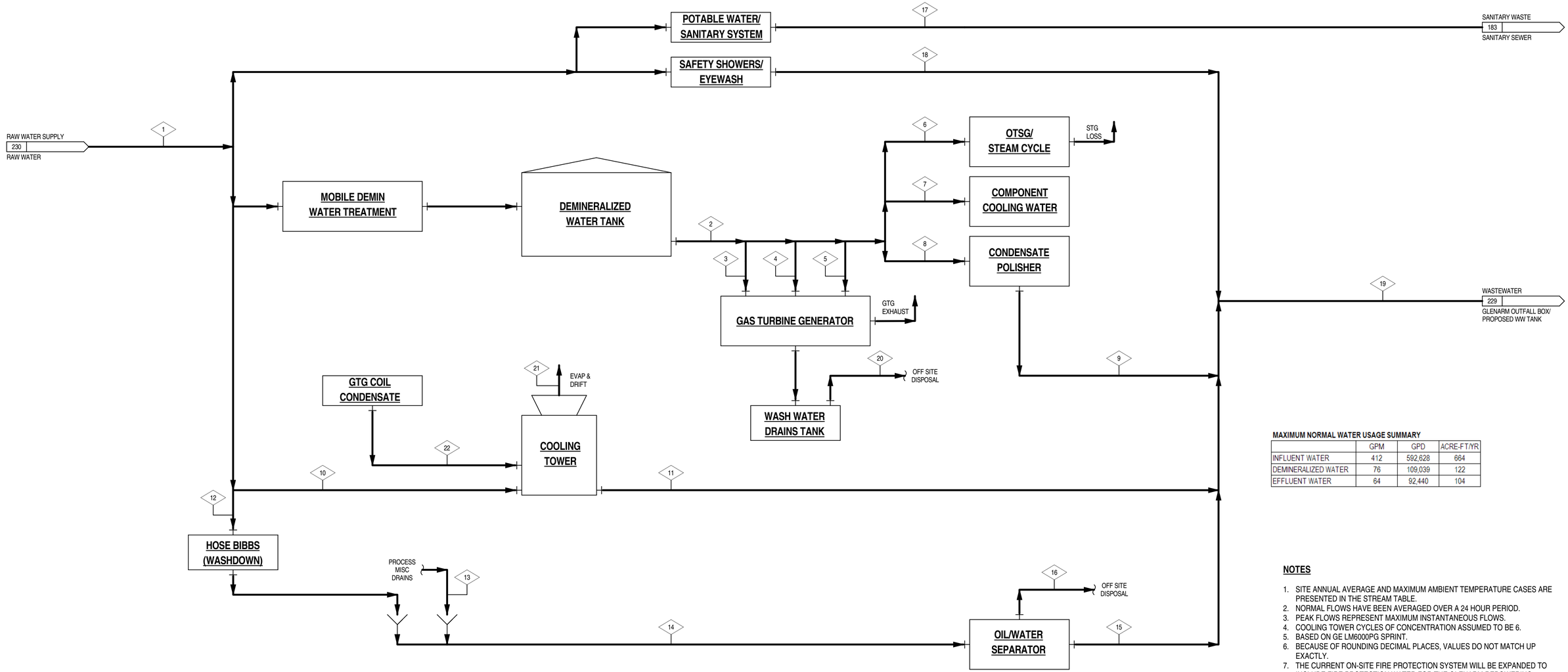
CITY OF PASADENA INCORPORATED JUNE 1886

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PASADENA WATER & POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
TIE POINT DRAWING
GAS TURBINE/AXIAL EXHAUST

JOB NUMBER 123374
REV D
DRAWING NUMBER M1-1-6

agailey 12/09/2013 04:01 PM **BOIFS1*Projects*123374*DD*CAD*dwg*mech*65parm1-1-6.dgn



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	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

PROCESS FLOW DIAGRAM WATER BALANCE (W/ INLET CHILLING)

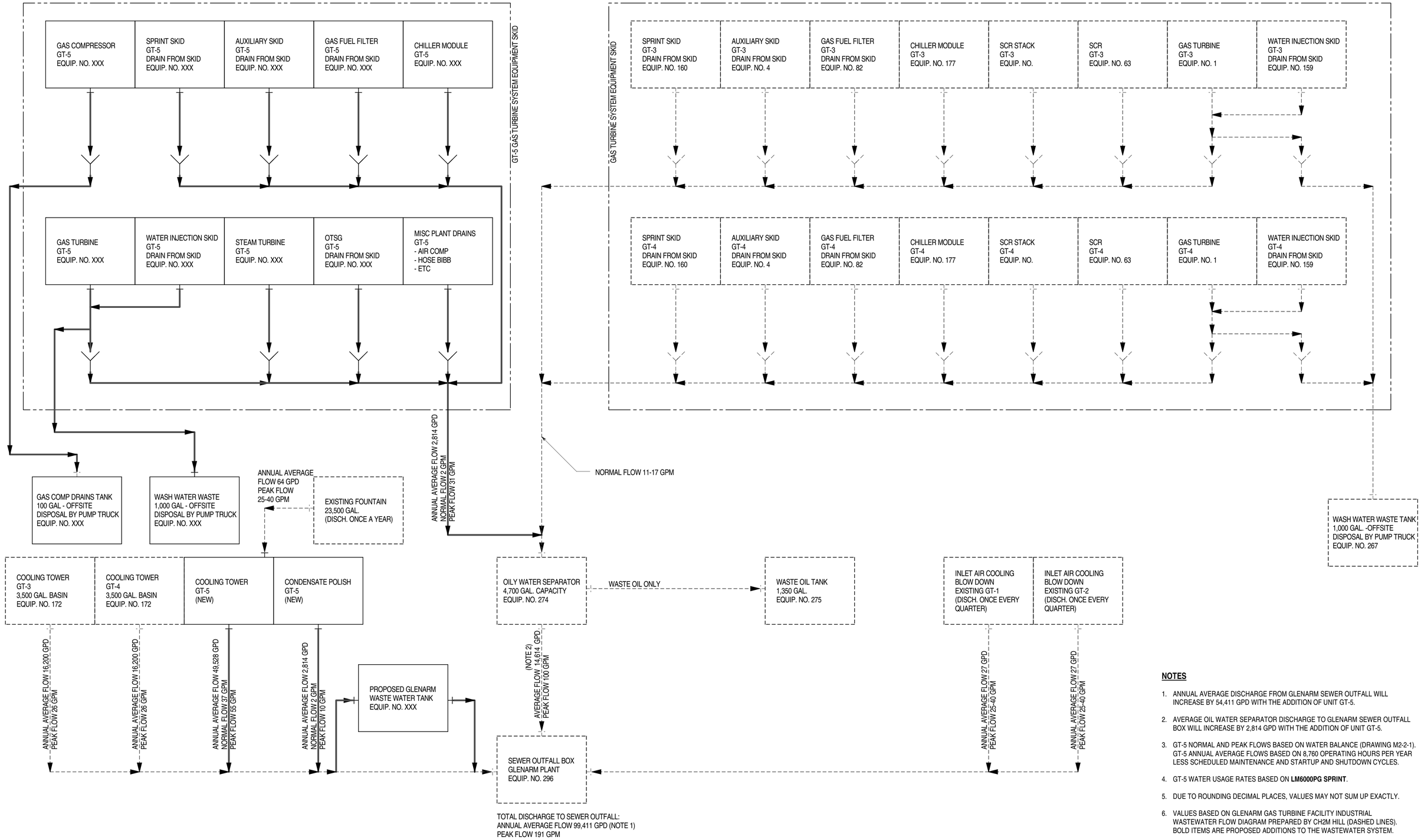
JOB NUMBER 123374

REV D

DRAWING NUMBER M2-2-1

GLENARM REPOWERING PROJECT
GLENARM WASTEWATER PERMIT

REV: B 07/31/12



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
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 B

DRAWING NUMBER M2-2-4

NUMBERS	
M3-1-0	COVER SHEET
M3-1-1	SYMBOLS AND LEGEND
M3-1-2	SYMBOLS AND LEGEND
M3-1-3	SYMBOLS AND LEGEND
M3-2-1	GAS TURBINE INTERCONNECTIONS
M3-3-1	OTSG INTERCONNECTIONS (EXHAUST GAS)
M3-3-2	OTSG INTERCONNECTIONS (STEAM)
M3-4-1	BOILER FEEDWATER SYSTEM
M3-5-1	HIGH PRESSURE STEAM
M3-6-1	STEAM TURBINE INTERCONNECTIONS
M3-7-1	STEAM DRAINS – DRAIN TANK
M3-8-1	STEAM AND WATER SAMPLING
M3-9-1	CYCLE CHEMICAL FEED SYSTEM
M3-10-1	GLAND STEAM SYSTEM
M3-11-1	CONDENSATE SYSTEM
M3-11-2	CONDENSATE SYSTEM
M3-11-3	CONDENSATE SYSTEM
M3-12-1	CONDENSER AIR EXTRACTION
M3-13-1	CIRCULATING WATER SYSTEM
M3-14-1	AUXILIARY COOLING WATER SYSTEM
M3-15-1	COMPONENT COOLING WATER SYSTEM
M3-15-2	COMPONENT COOLING WATER SYSTEM
M3-15-3	COMPONENT COOLING WATER SYSTEM
M3-16-1	COOLING TOWER CHEMICAL FEED SYSTEM
M3-17-1	AQUEOUS AMMONIA SYSTEM
M3-18-1	FUEL GAS SYSTEM
M3-18-2	FUEL GAS SYSTEM
M3-18-3	FUEL GAS SYSTEM
M3-19-1	SERVICE AIR SYSTEM
M3-20-1	INSTRUMENT AIR SYSTEM
M3-21-1	FIREWATER SYSTEM
M3-22-1	SERVICE WATER SYSTEM
M3-23-1	DEMINERALIZED WATER SYSTEM
M3-23-2	DEMINERALIZED WATER SYSTEM
M3-24-1	POTABLE WATER SYSTEM
M3-25-1	CHILLED WATER SYSTEM
M3-25-2	CHILLED WATER SYSTEM
M3-26-1	WASTEWATER COLLECTION SYSTEM
M3-26-2	WASTEWATER COLLECTION SYSTEM
M3-27-1	AUXILIARY STEAM SYSTEM

PASADENA WATER & POWER

GLENARM REPOWER PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING AND INSTRUMENTATION DIAGRAMS

GENERAL NOTES

1. **INSTRUMENT LEGEND ON DRAWING M3-1-2 IS BASED UPON ANSI/ISA 5.1.**
2. **ROOT VALVES ARE SHOWN ON P&IDS.**
3. **ALL VENTS, DRAINS, TEST CONNECTIONS, AND INSTRUMENT ROOT VALVES ARE .75", UNLESS OTHERWISE NOTED.**
4. **CONTRACTOR SHALL INSTALL HIGH POINT VENTS AND LOW POINT DRAINS AS REQUIRED TO MEET DETAIL DESIGN.**
5. **ALL TANK CONNECTIONS SHALL BE PROVIDED WITH ISOLATION VALVES.**
6. **PIPELINE SIZES, WHERE PROVIDED, HAVE BEEN APPROXIMATED FOR ESTIMATING PURPOSES. CONTRACTOR SHALL VERIFY INTERCONNECTING PIPING SIZES SUPPORT REQUIRED PROCESS FLOWS AND TO ASSURE LINE LOSSES WILL NOT AFFECT POWER ISLAND EQUIPMENT PERFORMANCE GUARANTEES. PLEASE REFER TO GE HEAT AND MASS BALANCE DIAGRAMS HB # CCA-17604-NG, REVISION 0 AND HB # CCA-17605-NG, REVISION 0 FOR THE POWER ISLAND CONTRACT GUARANTEED PROCESS CONDITIONS. PIPELINE SIZES SHALL NOT BE SMALLER THAN THOSE INDICATED ON THESE P&IDS WITHOUT APPROVAL FROM THE GENERAL MANAGER.**

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/12/12
DRN	VBD	09/12/12
CKD	SEG	09/12/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER

GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

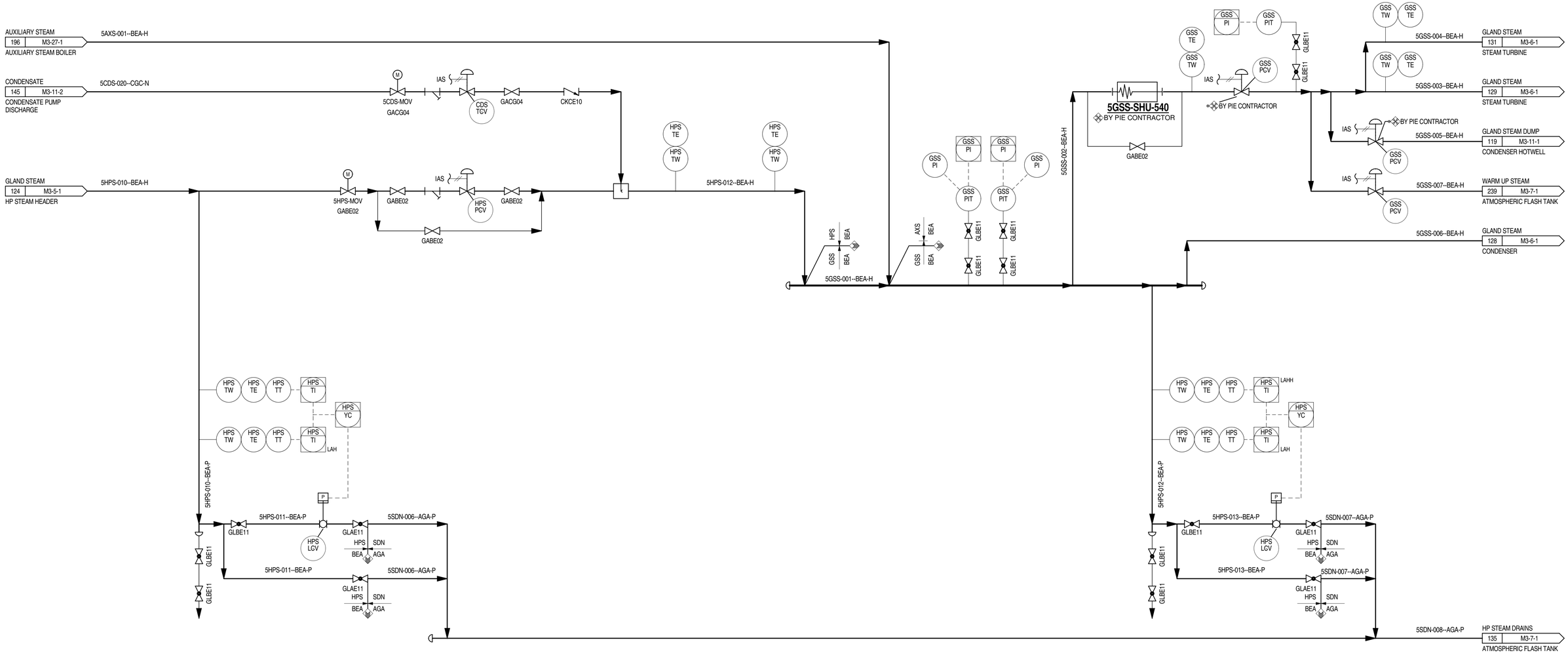
PIPING & INSTRUMENTATION DIAGRAM
COVER SHEET

JOB NUMBER 123374

REV E

DRAWING NUMBER **M3-1-0**

5GSS-SHU-540
SEAL STEAM SUPERHEATER



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. ROUTE VENT PIPING OUTSIDE BUILDING TO SAFE LOCATION.
4. REFER TO PIE VENDOR DRAWING FOR FURTHER INFORMATION.

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DATE						
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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
GLAND STEAM SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER **M3-10-1**

UNIT IDENTIFIERS

UNIT CODE	DESCRIPTION
0	COMMON
1	UNIT 1
2	UNIT 2
3	UNIT 3
4	UNIT 4
5	UNIT 5
6	UNIT 6

PROCESS PIPING

- MAIN PROCESS FLOW PIPING
- SECONDARY PROCESS FLOW PIPING
- TRIM OR UTILITY PIPING
- EXISTING PROCESS FLOW PIPING
- FUTURE PROCESS FLOW PIPING
- FLOW DIRECTION
- LINE SLOPE (TYP) — SLOPE
- LINE SLOPE (ALT) — SLOPE

PIPING VALVES

- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- DIAPHRAGM VALVE
- GATE VALVE
- GLOBE VALVE
- NEEDLE VALVE
- PLUG VALVE
- POST INDICATOR VALVE
- STOP CHECK VALVE
- ANGLE VALVE
- ANGLE BLOWDOWN VALVE
- THREE WAY VALVE
- THREE WAY BALL VALVE

MISCELLANEOUS

- CONCENTRIC REDUCER
- ECCENTRIC REDUCER FOT
- ECCENTRIC REDUCER FOB
- WELD CAP
- THREADED/SCREWED CAP
- CLEAN OUT
- OPEN DRAIN
- GOOSE NECK VENT
- HOSE CONNECTION
- BLIND FLANGE
- INSULATING FLANGE — IF
- DIELECTRIC UNION — DU

PIPING SPECIALTY

- FLAME ARRESTOR
- EXPANSION JOINT
- MECHANICAL COUPLING
- REMOVABLE SPOOL — RS
- FLEXIBLE HOSE
- STEAM TRAP — ST
- DRAIN TRAP — DT
- EXHAUST HEAD
- FILTER
- BACK PRESSURE DIFFUSER — BPD
- DIAPHRAGM SEAL
- AIR RELEASE VALVE — AV
- STATIC MIXER
- VENT SILENCER
- IN-LINE SILENCER
- RESTRICTION ORIFICE
- DUPLEX STRAINER
- T-TYPE STRAINER
- Y-TYPE STRAINER
- CONE STRAINER
- SINGLE BASKET STRAINER
- TEMPORARY STRAINER — TS
- FREE VENT W/SCREEN
- FLEXIBLE BALL JOINT
- BACKFLOW PREVENTER

FIRE PROTECTION & SAFETY

- FIRE HYDRANT
- THREE WAY FIRE HYDRANT
- FIRE HYDRANT W/MONITOR
- STAND PIPE
- FIRE MONITOR
- FOAM MONITOR
- FIRE MONITOR ELEVATED
- FOAM MONITOR ELEVATED
- FIRE MONITOR REMOTE OPERATED
- FOAM MONITOR REMOTE OPERATED
- PRE-ACTION SPRINKLER
- DELUGE SPRAY
- WET SPRINKLER
- HOSE HOUSE — HH
- HOSE REEL
- HOSE RACK STATION
- EYE WASH
- SAFETY SHOWER
- SAFETY SHOWER AND EYE WASH

EQUIPMENT IDENTIFIERS

CODE	DESCRIPTION
ACC	ACCUMULATOR
AGT	AGITATOR
ATM	ATTEMPERATOR
BLO	BLOWER
BLR	BOILER
BTL	BOTTLE, PRESSURIZED GAS
CDA	CONDENSER, AIR COOLED
CLF	CLARIFIER
CLR	COOLER
CMP	COMPRESSOR
CND	CONDENSER
CTW	COOLING TOWER
DEA	DEAERATOR
DGU	GENERATOR, DIESEL
DMP	DAMPER
DRV	ELECTRIC MOTOR
DRY	DRYER
EJR	EJECTOR
EXP	EXPANDER
FAN	FAN
FLT	FILTER
GEN	GENERATOR
HEX	HEAT EXCHANGER
HRU	HEAT RECOVERY SYSTEM
HTR	HEATER
MIX	MIXER
MSP	MOISTURE SEPARATOR
MTR	MOTOR
PMP	PUMP
PND	POND
ROU	REVERSE OSMOSIS UNIT
SCN	SCREEN
SCR	SELECTIVE CATALYTIC REDUCTION UNIT
SIL	SILENCER
SMP	SUMP
STK	STACK
TNK	TANK
TOT	CHEMICAL TOTE
TRB	TURBINE
VPR	VAPORIZER
VSL	VESSEL
WEL	WELL
ZXX	SKID SYSTEM

SPECIALTY IDENTIFIERS

CODE	DESCRIPTION
AT	ATTEMPERATOR
AV	AIR RELEASE VALVE
BL	BLINDS
CN	CONNECTION
CO	CLEANOUTS
DR	DRAIN
EJ	EXPANSION JOINT
FA	FLAME ARRESTOR
FC	FIRE CONNECTION
FM	FIRE MONITOR
FS	FLOW SIGHT GLASS
FU	FILTER UNIT
HH	HOSE HOUSE
HU	HOSE UNIT
HY	HYDRANT
RO	RESTRICTION ORIFICE
RV	RELIEF VALVE
SD	SUCTION DIFFUSER
SE	SEPARATOR
SL	SILENCER
SM	MIXER
SN	SCREEN
SP	PIPING
SS	SAFETY SHOWER
SU	STRAINER UNIT
TP	STEAM TRAP

ABBREVIATIONS

CODE	DESCRIPTION
AG	ABOVE GROUND
ATM	ATMOSPHERE
AUTO	AUTOMATIC
AUX	AUXILIARY
DCS	DISTRIBUTED CONTROL SYSTEM
DR	DRAIN
FD	FLOOR DRAIN
GTG	GAS TURBINE GENERATOR
HW	HARDWIRED
IP	INSPECTION PORT
MAN	MANUAL
RNG	RUNNING
RS	REMOVABLE SPOOL
RUN	RUN COMMAND
STRT/STP	START / STOP COMMAND
TB	THRUST BEARING
TBL	TROUBLE
UG	UNDER GROUND
VT	VENT

INSULATION CODES

N	NOT INSULATED
P	PERSONNEL PROTECTION
E	FREEZE PROTECTION W/ ELECTRIC TRACE
F	FREEZE PROTECTION
W	CONDENSATION CONTROL
H	HIGH TEMP INSULATION
M	MEDIUM TEMP INSULATION
T	THERMAL INS. W/ HEAT TRACE

PIPING VALVE POSITION

- NORMALLY OPEN
- NORMALLY CLOSED — NC
- LOCKED OPEN — LO
- LOCKED CLOSED — LC

RELIEF DEVICES

- CDS PSE 001A — SET@ — PRESS RELIEF RUPTURE DISC
- CDS PSV 001A — SET@ — PRESS RELIEF DEVICE
- CDS PSE 001B — SET@ — VACUUM RELIEF RUPTURE DISC
- CDS PSV 001B — SET@ — VACUUM RELIEF DEVICE

VALVE OPERATORS

- HAND WHEEL OR LEVER
- MOTOR OPERATOR — M
- DIAPHRAGM OPERATOR
- PISTON OPERATOR — P
- ELECTRO-HYDRAULIC — EH

DESIGN BREAKS

- PIPING MATERIAL — AHK / AHA
- SYSTEM IDENTIFIER, UNIT, OR CODE — UNIT 0 / UNIT 0
- SYSTEM CODE BREAK W/ PIPING MATERIAL CHANGE — IBL / IBH / AHK / AGF
- EQUIPMENT CONNECTION — N1
- TIE POINT — TP / XXX
- BY VENDOR

PIPING MATERIAL DESIGNATIONS

	PIPE MATERIAL	PRESSURE CLASS	SEQUENTIAL
A	CARBON STEEL	>2500	A
B	LOW & INTERMEDIATE ALLOY STEEL	2500	B
C	STAINLESS STEEL	1500	C
D	NICKEL & HIGH NICKEL ALLOYS	900	D
E	IRON, DUCTILE, CAST	600	E
F	COPPER & COPPER ALLOYS	400	F
G	ALUMINUM & ALUMINUM ALLOYS	300	G
H	TITANIUM & TITANIUM ALLOYS	150	H
I		350	I
J		250	J
K		125	K
L		35	L
M	MORTAR LINED	ATM	M
N			N
O	HDPE		O
P	THERMOSETTING PLASTICS		P
Q			Q
R	RUBBER LINED		R
S	GLASS LINED		S
T	TEFLON LINED		T
U	CORRUGATED METAL PIPE		U
V			V
W			W
X			X
Y	SPECIAL	SPECIAL	Y
Z			Z

SYSTEM IDENTIFIERS

CODE	SYSTEM NAME	CODE	SYSTEM NAME
	POTABLE WATERS		**STEAM AND CONDENSATE**
PWS	POTABLE WATER (CITY WATER)	ASS	AUXILIARY STEAM SYSTEM
		BDS	BOILER BLOWDOWN
	PROCESS WATERS	BFW	BOILER FEEDWATER
ACW	AUXILIARY COOLING WATER	BSS	BOILER SAMPLING
CCW	COMPONENT COOLING WATER	CDS	CONDENSATE & CONDENSATE RETURN
CWS	CIRCULATING WATER	DWS	DEMINERALIZED WATER
RWS	RAW WATER	EXS	STEAM TURBINE EXTRACTION
		STX	STEAM TURBINE EXHAUST
	MISC. AND HVAC WATERS	GSS	GLAND SEAL – TURBINE
CHW	CHILLED WATER	HPS	HIGH PRESSURE STEAM (MAIN STEAM)
SWS	SERVICE WATER	SDN	STEAM DRAINS
	DRAIN/WASTE/VENT		**PROCESS FLUIDS, OILS AND FUELS**
DRS	DRAIN	FGS	FUEL GAS
EDS	EQUIPMENT DRAINS	HYS	HYDRAULIC SUPPLY
MDS	MISCELLANEOUS DRAINS	LOS	LUBE OIL
OWS	OILY WATER	COS	CONTROL OIL
SSW	SANITARY SEWER		
ROR	WASTE-RO REJECT		**CHEMICALS, REAGENTS & POLYMERS**
WWS	WASTE WATER	CFX	CHEMICAL (REPLACE X WITH NUMBER)
		AST	AMMONIA STORAGE & TRANSFER
	COMPRESSED AIR AND GAS		
AEX	AIR EVACUATION	FPS	**FIRE PROTECTION**
CO2	CARBON DIOXIDE GAS		FIRE PROTECTION
HRS	HEAT RECOVERY		
IAS	INSTRUMENT AIR		
N2G	NITROGEN, GAS		
SAS	SERVICE AIR		
	VENDOR AND MISC. SYSTEMS		
GTS	GAS TURBINE/PACKAGE		
TWS	TURBINE WASH WATER		
STS	STEAM TURBINE/PACKAGE		

PIPING DESIGNATION

- UNIT
- SYSTEM IDENTIFIER
- SEQUENCE NUMBER
- NOMINAL DIAMETER
- PIPE MATERIAL SPECIFICATION
- INSULATION CODE

1BFW-001-12"-ABD-N

EQUIPMENT TAGGING

- UNIT
- SYSTEM IDENTIFIER
- EQUIPMENT IDENTIFIER
- SEQUENCE NUMBER
- SUFFIX

1BFW-PMP-002B

MANUAL VALVE TAGGING

- UNIT
- SYSTEM IDENTIFIER
- SEQUENCE NUMBER

1BFW-V012

PIPING SPECIALTY TAGGING

- UNIT
- SYSTEM IDENTIFIER
- SEQUENCE NUMBER

1BFW-S001

VALVE SPECIFICATION NUMBER

- VALVE TYPE
- BODY MATERIAL
- PRESSURE CLASS
- END TYPE
- TRIM OPTION

GLAD11

BODY MATERIAL AND PRESSURE CLASS ARE SAME AS PIPING MATERIAL DESIGNATION CODES

PIPING SPECIALTY SPECIFICATION NUMBER

- SPECIALTY IDENTIFIER
- IDENTIFIER TYPE

EJ10

OFF SHEET & UNIT CONNECTORS

- CONNECTOR NUMBER
- DESCRIPTION
- DISCIPLINE
- DRAWING TYPE
- SEQUENTIAL NUMBER
- SHEET NUMBER
- DRAWING NUMBER
- TO FROM TEXT

XXX / 172 M3-2-1 / XXX

OFF UNIT CONNECTOR: 172 M3-2-1

- CONNECTOR NUMBER
- VENDOR NAME
- VENDOR DRAWING NUMBER
- TO FROM TEXT

XXX / 172 M3-2-1 / XXX

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
C	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/12/12
DRN	VBD	09/12/12
CKD	SEG	09/12/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM SYMBOLS AND LEGEND

JOB NUMBER 123374 | REV C

DRAWING NUMBER M3-1-1

5CDS-CND-510
CONDENSER
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: 110.00 F Spec: 485432

5CDS-PMP-520A
CONDENSATE PUMP A
Opr Cap: 350.0 gallon/min Proc Cap:
Opr TDH Press: 281.51 psi Drv Rtg:
Opr Temp: 97.00 F Spec: 485311.10

5CDS-PMP-520B
CONDENSATE PUMP B
Opr Cap: 350.0 gallon/min Proc Cap:
Opr TDH Press: 281.51 psi Drv Rtg:
Opr Temp: 97.00 F Spec: 485311.10

CONDENSATE 146 M3-11-2
CONDENSATE MAKE-UP PUMPS
5CDS-037--AHA-N
GAAE11 IAS GAAE11
CDS ZI
CDS LGV
BY PIE CONTRACTOR
GLAE11
CDS PI GLCE10
5CDS-018--CGC-N
GACE10 IAS GACE10
CDS FCV
CONDENSATE M3-11-3 125
GLAND STEAM CONDENSER
GLCE10

GLAND STEAM CONDENSATE 132 M3-12-1
GLAND STEAM CONDENSER
5CDS-027--CGC-P
GACG04
DEMINERALIZED WATER 147 M3-23-1
DEMINERALIZED WATER SUPPLY
5DWS-031-2"-CHB-N
GACE12
BOILER FEEDWATER 115 M3-4-1
BOILER FEEDWATER PUMPS MIN RECIRC
5BFW-006--CGC-N
GACG04
NOTE 3
5CDS-CND-510
BY PIE CONTRACTOR
CDS LIC
CDS LIT
GLAE11
GLAE11
AUXILIARY STEAM 197 M3-27-1
AUXILIARY BOILER
5AXS-003--BEA-H
GABE02
GLAND STEAM DUMP 119 M3-10-1
GLAND STEAM HEADER
BY PIE CONTRACTOR
GACH02 GACH02
5CDS-002-6"-CHE-N
5CDS-001-6"-CHE-N

CWS TI
CWS TE
CWS TW
CWS PI
GLAE10
BFEH40
5CWS-003-28"-AHD-N
CIRCULATING WATER 148 M3-13-1
COOLING TOWER
CWS PDIT
CWS PDI
CWS TI
CWS TE
CWS TW
CWS PI
GLAE10
BFEH40
5CWS-001-28"-AHD-N
CIRCULATING WATER M3-13-1 149
COOLING TOWER

CDS PI GLCE10
SET@
CDS YC
5CDS-006--CGC-N
CDS PCV
GACE10
M
5CDS-008--CHE-N
GACE10
CDS PI
CDS PIT
GLCE10
CKCG00
GACG04
CDS PDI
CDS PDIT
GLCE10 GLCE10
GACE10
DR
5CDS-PMP-520A
BY PIE CONTRACTOR

CDS FIC
CDS FIT
CDS FIT
CDS FE
GLCE10 GLCE10
CDS TI
CDS TE
CDS TW
CDS PI GLCE10
CDS PI CDS PIT GLCE10
CDS PI CDS PIT GLCE10
IAS
CDS LGV
5CDS-012--CGC-N
CONDENSATE 150 M3-11-2
CONDENSATE STORAGE TANK
5CDS-013--CGC-N
CONDENSATE 151 M3-11-2
ATTEMPERATION SPRAY
5CDS-003-6"-CGC-N
CONDENSATE 152 M3-11-2
GLAND STEAM CONDENSER
5CDS-007--CGC-N
CONDENSATE 201 M3-3-2
ATTEMPERATION SPRAY

CDS PI GLCE10
SET@
CDS YC
5CDS-005--CGC-N
CDS PCV
GACE10
M
5CDS-009--CHE-N
GACE10
CDS PI
CDS PIT
GLCE10
CKCG00
GACG04
5CDS-004-6"-CGC-N
CDS PDI
CDS PDIT
GLCE10 GLCE10
GACE10
DR
5CDS-PMP-520B
BY PIE CONTRACTOR

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. REFER TO GE DRAWING M106 SHEET 1 & 2 FOR ADDITIONAL HOTWELL AND WATER BOX LEVEL INDICATING INSTRUMENTATION.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER **M3-11-1**

5CDS-TNK-010
CONDENSATE STORAGE TANK

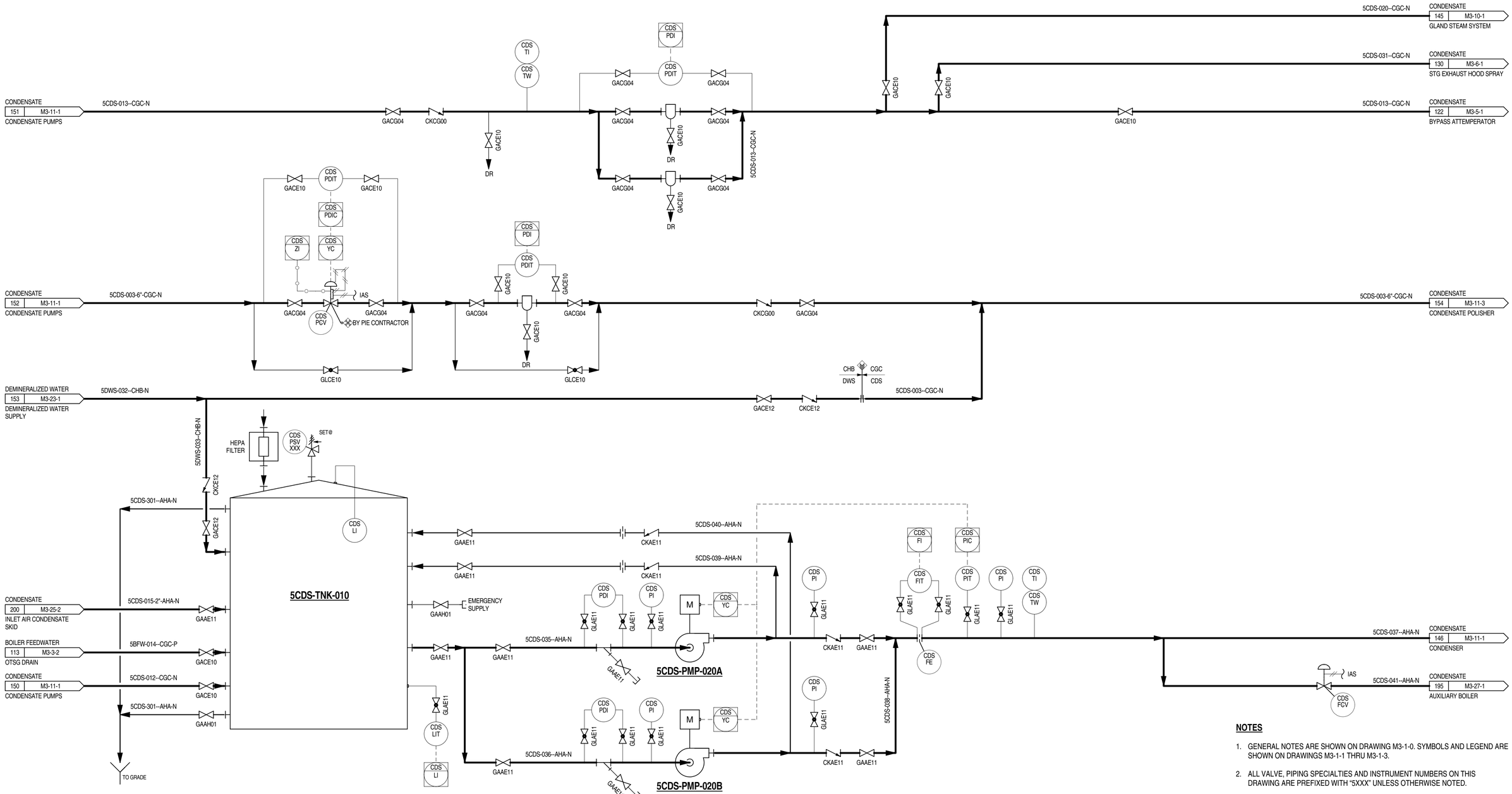
Opr Cap:
Opr Press:
Opr Temp: 117.00 F
Proc Cap:
Vol Cap: 5000.0 gallon
Spec: 485173

5CDS-PMP-020A
CONDENSATE MAKE-UP PUMP A

Opr Cap: 22.0 gallon/min
Opr TDH Press: 40.00 psi
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11

5CDS-PMP-020B
CONDENSATE MAKE-UP PUMP B

Opr Cap: 22.0 gallon/min
Opr TDH Press: 40.00 psi
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. ALL CONDENSATE TANK CONNECTIONS SHALL BE SUPPLIED WITH ISOLATION VALVES.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

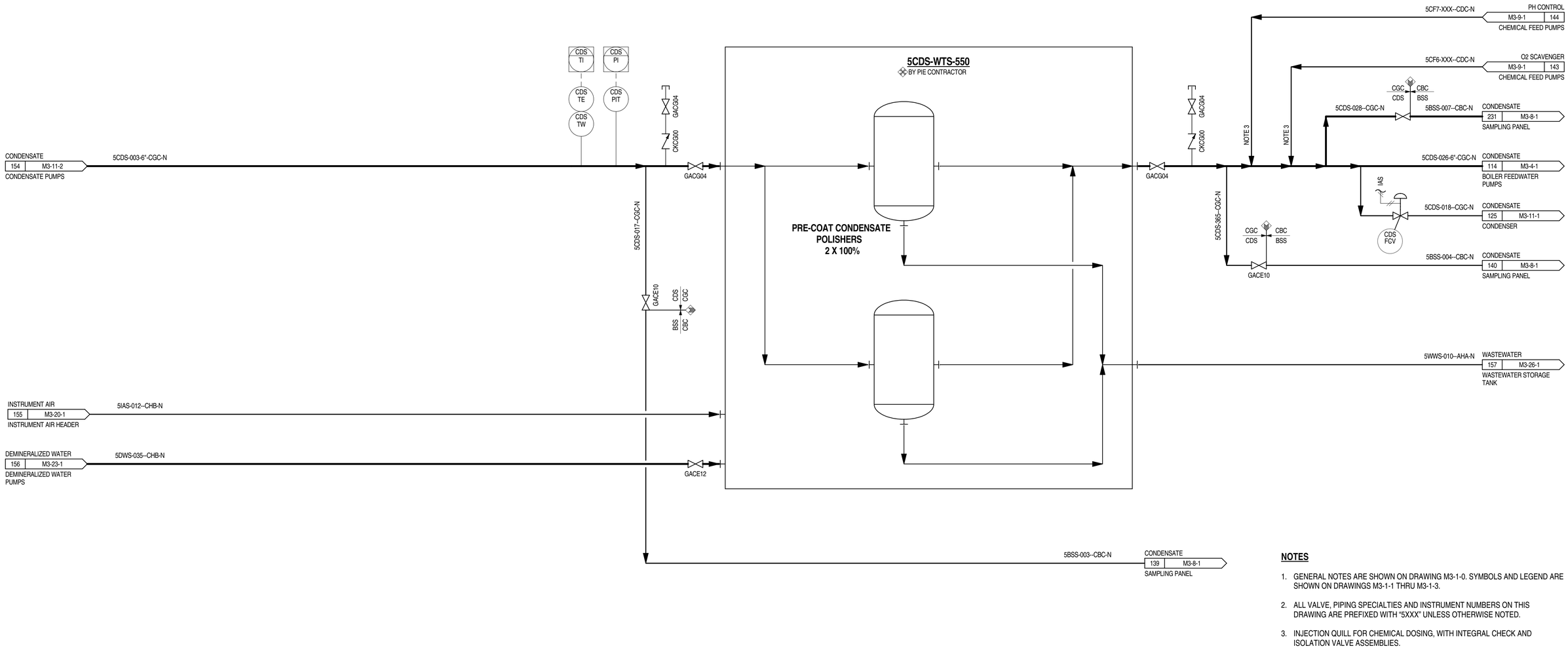
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER M3-11-2

5CDS-WTS-550
CONDENSATE POLISHER SKID

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. INJECTION QUILL FOR CHEMICAL DOSING, WITH INTEGRAL CHECK AND ISOLATION VALVE ASSEMBLIES.

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
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E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CONDENSATE SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER M3-11-3

INSTRUMENTATION LETTERING IDENTIFICATION TABLE

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATED VARIABLE	MODIFIER	READOUT / PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		AUTO
B	BURNER OR COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY (ELEC)			CONTROL	CLOSE
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		ENABLE
F	FLOW RATE	RATIO (FRACTION)			FAULT OR TROUBLE
G	GAGING (DIMENSIONAL)		GLASS		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE	TIME RATE OF CHANGE			
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE OR INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT	INTEGRATE OR TOTALIZE			
R	RADIATION RESTRICTION		RECORD OR PRINT		RUN
S	SPEED OR FREQUENCY	SAFETY		SWITCH	START
T	TEMPERATURE			TRANSMIT	TRIP / STOP
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION	Z AXIS		DRIVE, ACTUATOR OR UNCLASSIFIED FINAL CONTROL ELEMENT	

INSTRUMENT AND RELIEF DEVICE TAGGING

SHOWN ON DRAWING



- SYSTEM IDENTIFIER
- INSTRUMENT TYPE (ISA CODE)
- COMPONENT SUFFIX
- SEQUENCE NUMBER

NOTE:
ALL SYSTEM IDENTIFIERS SHOWN ON P&IDS HAVE A UNIT IDENTIFIER PREFIX. THIS IS NOT SHOWN ON INSTRUMENT BUBBLES FOR CLARITY

UNIT IDENTIFIERS WILL BE THE SAME AS THE ASSOCIATED LINE OR EQUIPMENT UNIT IDENTIFIERS AS SHOWN ON P&IDS.

GENERAL INSTRUMENTS



LOCALLY MOUNTED INSTRUMENT SINGLE VARIABLE ANY NUMBER OF FUNCTIONS



HEAT TRACED INSTRUMENTS ARE INDICATED WITH A DASHED LINE AROUND INSTRUMENT



BOARD MOUNTED (FRONT)
N - BOARD IDENTIFICATION (OPTIONAL)
P - INSTRUMENT REQUIRES 120VAC INSTRUMENT POWER



MOUNTED BEHIND DOOR OR BACK OF PANEL

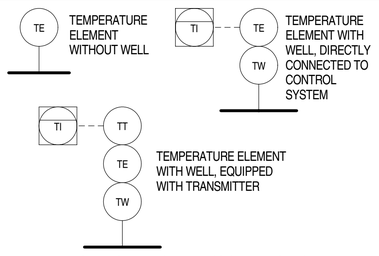


TWO MEASURED VARIABLE OR OPTIONALLY TWO FUNCTIONS (ADDITIONAL TANGENT BALLOONS MAY BE ADDED AS REQUIRED)

SIGNAL LINES

- CONNECT TO PROCESS
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC / SONIC SIGNAL (WITHOUT WIRING OR TUBING)
- MECHANICAL LINK SIGNAL
- DCS SOFTWARE OR DATA LINK

THERMOCOUPLES/THERMOWELLS



ALL THERMOWELLS ARE 1" SW, UNLESS OTHERWISE NOTED.

CONTROL VALVE FAILURE MODES



TWO-WAY THREE-WAY FOUR-WAY

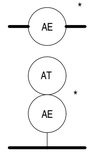
ATC - AIR TO CLOSE
ATO - AIR TO OPEN
FC - FAIL CLOSE
FO - FAIL OPEN
FF - FAIL FIXED
- (POSITION DOES NOT CHANGE)

PRESSURE

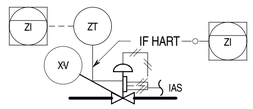


ALL PRESSURE SENSING ELEMENTS ON FRP PIPE WILL BE 1" FLANGED CONNECTIONS. OTHER PIPE MATERIALS WILL INCLUDE 3/4" SW UNLESS OTHERWISE NOTED.

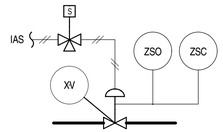
ANALYSIS



POSITION

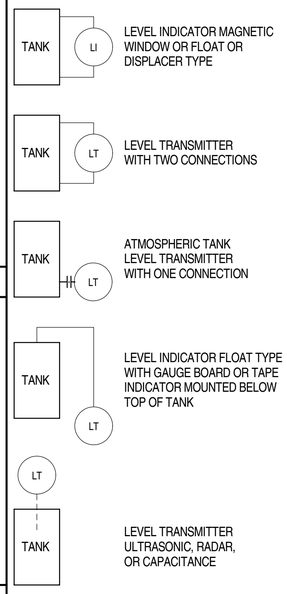


TYPICAL MODULATING CONTROL VALVE WITH POSITION TRANSMITTER

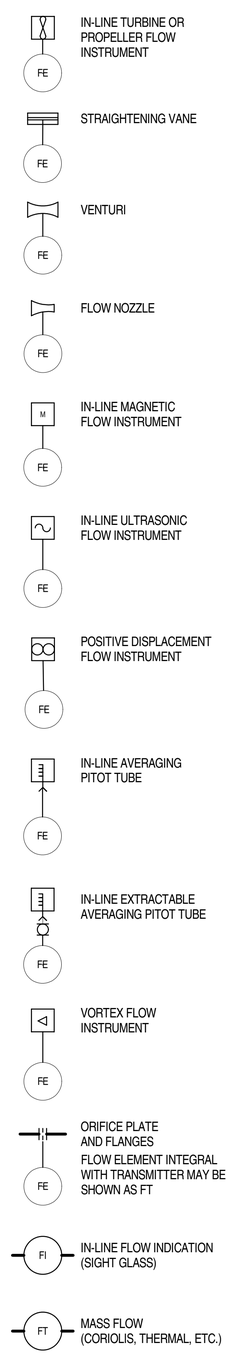


TYPICAL ON/OFF CONTROL VALVE WITH POSITION SWITCHES

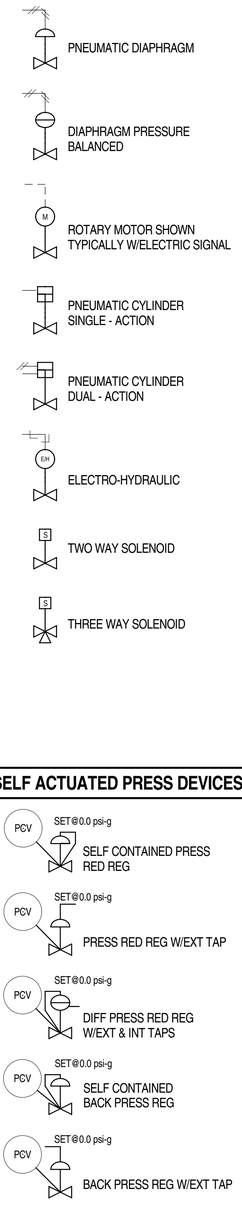
LEVEL



SENSORS - FLOW



CONTROL VALVE ACTUATORS



SELF ACTUATED PRESS DEVICES

SPECIALTY CONTROL VALVES



STEAM CONDITIONING VALVE

CONTROL AND COMPUTER SYSTEM SYMBOLS

CONTROL SHARED DISPLAY SYMBOLS

NORMALLY ACCESSIBLE TO OPERATOR

INDICATOR / CONTROLLER / RECORDER OR ALARM POINTS (TYPICALLY VIDEO DISPLAY)



(1) SHARED DISPLAY
(2) SHARED DISPLAY AND SHARED CONTROL
(3) ACCESS LIMITED TO COMMUNICATION LINK
(4) OPERATOR INTERFACE ON COMMUNICATION LINK

AUXILIARY OPERATOR INTERFACE DEVICE



(1) PANEL MOUNTED NORMALLY HAVING AN ANALOG FACEPLATE - NOT NORMALLY MOUNTED ON MAIN OPERATOR CONSOLE
(2) CAN BE A BACK-UP CONTROLLER OR MANUAL STATION
(3) ACCESS MAY BE LIMITED TO COMMUNICATION LINK
(4) OPERATOR INTERFACE VIA THE COMMUNICATION LINK

NOT NORMALLY ACCESSIBLE TO OPERATOR



(1) SHARED BLIND CONTROLLER
(2) SHARED DISPLAY INSTALLED IN FIELD
(3) COMPUTATION SIGNAL CONDITIONING IN SHARED CONTROLLER
(4) MAY BE ON COMMUNICATION LINK
(5) NORMALLY BLIND OPERATION
(6) MAY BE ALTERED BY CONFIGURATION

LOGIC AND SEQUENTIAL CONTROL SYMBOLS

NOT NORMALLY ACCESSIBLE TO OPERATOR

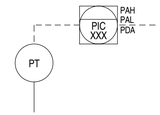
INTERLOCK FUNCTION MAY BE HARD WIRED (HW) OR SOFT WIRED CONTROL SYSTEM BASED, (DCS, PLC, PCS, ETC)



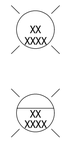
X INDICATES THE TYPE OF INTERLOCK (DCS,HW,ETC)
Y UNIQUE LETTER IDENTIFICATION FOR INTERLOCKS THAT ARE USED TO TRIP MULTIPLE DEVICES
Z SYSTEM IDENTIFIER. INDICATES THE SYSTEM THAT INITIATED THE INTERLOCK

SOFTWARE ALARM

SOFTWARE ALARMS MAY BE IDENTIFIED BY PLACING LETTER DESIGNATORS ON THE INPUT OR THE OUTPUT SIGNAL LINES



OFF LINE INSTRUMENTS



COMPUTER SYMBOLS

NORMALLY ACCESSIBLE TO OPERATOR

INDICATOR / CONTROLLER/ RECORDER OR ALARM POINTS (TYPICALLY VIDEO DISPLAY)



NOT NORMALLY ACCESSIBLE TO OPERATOR



(1) INPUT / OUTPUT INTERFACE
(2) COMPUTATION / SIGNAL CONDITIONING WITHIN A COMPUTER
(3) MAY BE USED AS A BLIND CONTROLLER OR A SOFTWARE CALCULATION MODULE

AUXILIARY OPERATOR INTERFACE



(1) PANEL MOUNTED - NORMALLY HAVING AN ANALOG FACEPLATE - NOT NORMALLY MOUNTED ON MAIN OPERATOR CONSOLE

COMPUTER SYMBOLS

THE FUNCTION DESIGNATIONS ASSOCIATED WITH CONTROLLERS, COMPUTING DEVICES, AND CONVERTERS MAY BE USED ON THEIR OWN OR IN COMBINATION WITH CONTROL AND COMPUTER SYMBOLS.



- ALM ALARM
- Σ/n AVERAGING
- x^n EXPONENTIAL
- d/dt DERIVATIVE
- △ DIFFERENCE
- DIR DIRECT ACTING
- ÷ DIVIDING
- >- HIGH LIMITING
- > HIGH SELECTING
- ∫ INTEGRAL
- -K INVERSE PROPORTIONAL
- LEAD LAG LEAD/LAG
- <- LOW LIMITING
- < LOW SELECTING
- < > MEDIAM SELECT
- − MINUS BIAS
- X MULTIPLYING
- f(x) NONLINEAR OR UNSPECIFIED FUNCTION
- 1-0 ON-OFF
- + PLUS BIAS
- ± PLUS/MINUS BIAS
- K PROPORTIONAL
- REV REVERSE ACTING
- √ ROOT EXTRACTION
- Σ SUMMING
- f(t) TIME FUNCTION
- 2oo3 TWO OUT OF THREE
- ⏚ VELOCITY LIMITER

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
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/12/12
DRN	VBD	09/12/12
CKD	SEG	09/12/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM SYMBOLS AND LEGEND

JOB NUMBER 123374
REV A
DRAWING NUMBER M3-1-2

5GSS-CND-520
GLAND STEAM CONDENSER

Opr Cap:	Proc Cap:
Opr Press:	Drv Rtg:
Opr Temp:	Spec: 485221

5GSS-FAN-530
GLAND EXHAUST FANS

Dsgn Cap:	Proc Cap:
Dsgn Press:	Drv Rtg:
Dsgn Temp:	Spec:

5AEX-ZXX-510
AIR EXTRACTION SKID

Opr Cap: 56.1 gallon/min	Proc Cap:
Opr Press:	Drv Rtg:
Opr Temp:	Spec: 485432

DEMINERALIZED WATER
159 M3-23-1
DEMINERALIZED WATER PUMPS

5DWS-034--CHB-N

AUXILIARY COOLING WATER
160 M3-13-1
AUXILIARY COOLING WATER SUPPLY HEADER

5ACW-012--AHA-N

GAAH00 GAAE10 DR

GAAH00 GAAE10 DR

ACW PI, ACW TE, ACW TI, ACW TW, GLAE10

5ACW-016-6"-AHA-N

NOTE 4
BY PIE CONTRACTOR

5AEX-300--AHA-N

AEX FE

GV

5AEX-ZXX-510
BY PIE CONTRACTOR

P, GV

VACUUM RECEIVER

VACUUM PUMP COOLERS 2 X 100%

LIQUID RING VACUUM PUMPS 2 X 100%

NON-CONDENSABLE GASES
134 M3-6-1
CONDENSER

5AEX-001--AHA-N

TO ATMOSPHERE

5GSS-FAN-530
BY PIE CONTRACTOR

GLAND STEAM
133 M3-6-1
STEAM TURBINE

BY PIE CONTRACTOR

GSS PI, GLCE10, GSS TW, GSS TE, GSS TI

ACW TI, ACW TE, ACW TW, SET@, ACW PSV, GSS PI, GA, VT, GACE10, ACW PI, GLCE10, CDS TI, ACW TE, ACW TW

GACG04, GACE10, GACG04

5GSS-CND-520
BY PIE CONTRACTOR

5ACW-016--AHA-N, 5ACW-017--AHA-N, GACG04

5CDS-025--CGC-P

CDS PI, GLCE10, CDS TW, CDS TE, CDS TI

ST

LOOP SEAL

ACW TI, ACW PI, ACW TE, ACW TW, GLAE10

5ACW-015--AHA-N
AUXILIARY COOLING WATER
158 M3-13-1
AUXILIARY COOLING WATER RETURN

5ACW-017-6"-AHA-N

5MDS-046--AHA-N

5MDS-047--AHA-N
EQUIPMENT DRAIN
232 M3-26-2
EQUIPMENT DRAIN SUMP

5CDS-027--CGC-P
GLAND STEAM CONDENSATE
132 M3-11-1
CONDENSER HOTWELL

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. REFER TO VENDOR DRAWINGS FOR FURTHER INFORMATION.
4. BOP CONTRACTOR SHALL ROUTE VENT PIPING OUTSIDE BUILDING TO A SAFE LOCATION. SILENCER PROVIDED BY PIE CONTRACTOR IF NEEDED.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CONDENSER AIR EXTRACTION

JOB NUMBER 123374
REV F
DRAWING NUMBER M3-12-1

EQUIPMENT SYMBOLS

BOILER
CHEMICAL TOTE
HEATER
SKID SYSTEM

AUXILIARY BOILER

COOLING TOWER

TANK

ACCUMULATOR
HORIZONTAL DRUM
MAIN CONDENSER

VERTICAL DRUM

SUMP

EXPANDER

TURBINE

HP IP LP

MULTIPLE FLOW STEAM TURBINE

DOUBLE FLOW STEAM TURBINE

SINGLE FLOW STEAM TURBINE

AIR COOLED CONDENSER
SURFACE CONDENSER
VAPORIZER

U TUBE HEAT EXCHANGER

M

RADIATOR

AIR COOLED CONDENSER
AIR COOLED EXCHANGER

PLATE HEAT EXCHANGER

SHELL & TUBE EXCHANGER

SHELL & TUBE EXCH (MULTI)

SCREW COMPRESSOR

RECIP COMPRESSOR

PUMP

HORIZ CENTRIFUGAL PUMP

VANE PUMP

HAND PUMP

ROTARY PUMP

PROPORTIONING PUMP

SUMP PUMP

VACUUM PUMP

VERTICAL WET PIT PUMP

VERTICAL CAN PUMP

CENTRIFUGAL FAN

BLOWER

D

DIESEL ENGINE

M

ELECTRIC MOTOR

ELECTRIC GENERATOR

BAYONET HEATER

ELECTRIC BAYONET HEATER

SPRAY DESUPERHEATER

EJECTOR

ATTEMPERATOR

EDUCTOR MIXER

MIXER

FILTER

GAS FILTER

CARTRIDGE FILTER

INTAKE SCREEN

DRYER

DESSICANT DRYER

RAKE THICKENER

IN-LINE SILENCER

VENT SILENCER

PRESSURIZED GAS BOTTLE

VENT STAND PIPE

STACK

FLASH PIPE

OIL COOLER

SUPERHEATER

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DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
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A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/12/12
DRN	VBD	09/12/12
CKD	SEG	09/12/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
SYMBOLS AND LEGEND

JOB NUMBER 123374

REV B

DRAWING NUMBER M3-1-3

5CWS-CTW-510
COOLING TOWER
Opr Cap: 15789.0 gallon/mi Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: 97.00 F Spec: 485491

5CWS-FAN-520A
COOLING TOWER FAN A
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485491

5CWS-FAN-520B
COOLING TOWER FAN B
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485491

5CWS-PMP-530A
CIRCULATING WATER PUMP A
Opr Cap: 10100.0 gallon/mi Proc Cap:
Opr Press: 35.3 psi-g Drv Rtg:
Opr Temp: Spec: 485312

5CWS-PMP-530B
CIRCULATING WATER PUMP B
Opr Cap: 10100.0 gallon/mi Proc Cap:
Opr Press: 35.3 psi-g Drv Rtg:
Opr Temp: Spec: 485312

5ACW-PMP-010A
AUX COOLING WATER PUMP A
Opr Cap: 2700.0 gallon/mi Proc Cap:
Opr Press: 35.3 psi-g Drv Rtg:
Opr Temp: Spec: 485312.10

5ACW-PMP-010B
AUX COOLING WATER PUMP B
Opr Cap: 2700.0 gallon/mi Proc Cap:
Opr Press: 35.3 psi-g Drv Rtg:
Opr Temp: Spec: 485312.10

5ACW-PMP-010C
AUX COOLING WATER PUMP C
Opr Cap: 2700.0 gallon/mi Proc Cap:
Opr Press: 35.3 psi-g Drv Rtg:
Opr Temp: Spec: 485312.10

BIOCIDE 163 M3-16-1 CHEMICAL FEED PUMPS — 5CF1-XXX-1/2"-CDC-N
CORROSION INHIBITOR 164 M3-16-1 CHEMICAL FEED PUMPS — 5CF2-XXX-1/2"-CDC-N
SULFURIC ACID 165 M3-16-1 CHEMICAL FEED PUMPS — 5CF3-XXX-1/2"-CDC-N
BIOCIDE A 166 M3-16-1 CHEMICAL FEED PUMPS — 5CF4-XXX-1/2"-CDC-N
BIOCIDE B 181 M3-16-1 CHEMICAL FEED PUMPS — 5CF5-985-1/2"-CDC-N

SERVICE WATER 167 M3-22-1 SERVICE WATER SUPPLY — 5SWS-001-4"-EJA-N — AHA EJA — 5SWS-008-4"-AHA-N
COIL CONDENSATE 168 M3-25-2 CHILLING COIL CONDENSATE SUMP — TP 14 — 5MDS-044-2"-AHA-N
WASTEWATER 207 FOUNTAIN DRAIN — 5WWS-XXX--AHA-N

NOTE 4

5SWS-002--AHA-N — CKAH00 — SWS WWS — BFEH40 — CKAE10 — MDS WWS — GAAE11 — CKAH00

5CWS-FAN-520A **5CWS-FAN-520B**

CWS LIL — CWS LIT — CWS LT

5SWS-003--AHA-N — CWS YC — M
5SWS-004--AHA-N — CWS YC — M
5SWS-005--AHA-N — ACW YC — M
5ACW-001-18"-AHA-N — ACW YC — M
5SWS-006--AHA-N — ACW YC — M
5ACW-002-18"-AHA-N — ACW YC — M
5SWS-007--AHA-N — ACW YC — M
5ACW-003-18"-AHA-N

5CWS-CTW-510
BY PIE CONTRACTOR

5CWS-005-24"-AHD-N — NOTE 3 — GAAE10 — BFEH40 — CKAH00
5CWS-006-24"-AHD-N — NOTE 3 — GAAE10 — BFEH40 — CKAH00 — NOTE 5 — 5CWS-007-10"-AHD-N

5CWS-PMP-530A BY PIE CONTRACTOR
5CWS-PMP-530B BY PIE CONTRACTOR
5ACW-PMP-010A BY PIE CONTRACTOR
5ACW-PMP-010B BY PIE CONTRACTOR
5ACW-PMP-010C BY PIE CONTRACTOR

CWS PI — GLAE10 — CKAH00 — M — CWS GV — CWS ZIO — CWS ZIC — CWS ZSO — CWS ZSC
CWS PI — GLAE10 — CKAH00 — M — CWS GV — CWS ZIO — CWS ZIC — CWS ZSO — CWS ZSC
ACW PI — GLAE10 — CKAH00 — M — ACW GV — ACW ZIO — ACW ZIC — ACW ZSO — ACW ZSC

5CWS-002-30"-AHD-N — CWS TE — CWS TW — CWS FIQ — CWS FIT — CWS FE — 5CWS-001-30"-AHD-N — CIRCULATING WATER 149 M3-11-1 CONDENSER

ACW TE — ACW TW — 18"x12" — 5ACW-001-12"-AHA-N — AUXILIARY COOLING WATER 161 M3-14-1 ACW HEAT EXCHANGER
5ACW-010-12"-AHA-N — AUXILIARY COOLING WATER 162 M3-25-1 CHILLED WATER SYSTEM
5ACW-012--AHA-N — AUXILIARY COOLING WATER 160 M3-12-1 VACUUM PUMP COOLERS/ GLAND STEAM CONDENSER

PROCESS DRAINS 137 M3-7-1 ATMOSPHERIC FLASH TANK — 5MDS-003--AHA-P — CKAE10
CIRCULATING WATER 148 M3-11-1 CONDENSER — 5CWS-003-28"-AHD-N — CWS TW — CWS TE
AUXILIARY COOLING WATER 169 M3-25-1 CHILLER PACKAGE — 5ACW-011-12"-AHA-N — CKAH00 — ACW TW — ACW TE
AUXILIARY COOLING WATER 170 M3-14-1 ACW HEAT EXCHANGER — 5ACW-004-12"-AHA-N — CKAH00 — ACW TW — ACW TE
AUXILIARY COOLING WATER 158 M3-12-1 VACUUM PUMP COOLERS/ GLAND STEAM CONDENSER — 5ACW-015--AHA-N
BEARING COOLING WATER 171 M3-15-1 CCW SYSTEM DRAIN — 5BCW-015-1"-AHA-N

MDS AHA — CWS AHD — ACW AHA — CWS AHD — ACW AHA — CWS AHD — BSS CBC — CWS AHD — WWS AHA — CWS AHD

5WWS-012--AHA-N — CT BLOWDOWN 172 M3-26-1 WASTEWATER STORAGE TANK
5BSS-005-1/2"-CBC-N — CIRCULATING WATER 141 M3-8-1 SAMPLING PANEL

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. PERFORMANCE TEST FLOW CONNECTIONS.
4. SERVICE WATER FLUSHING CONNECTIONS TO ALL SEALS ON PUMPS IN COOLING TOWER PIT.
5. FLANGE AT GRADE FOR ACCESS.

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DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
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E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

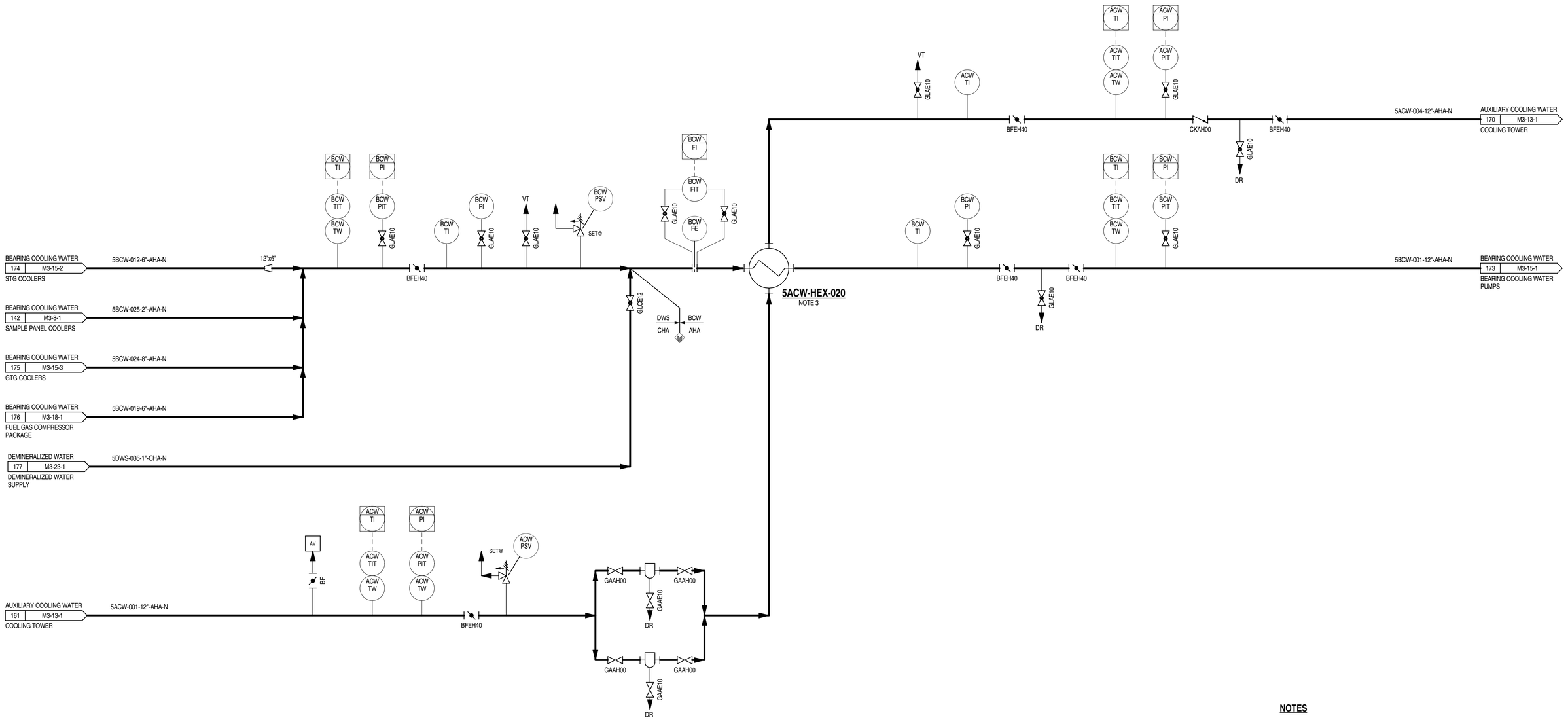
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CIRCULATING WATER SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER M3-13-1

5ACW-HEX-020
AUXILIARY COOLING WATER HEAT EXCHANGER

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485422



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. HEAT EXCHANGER SHALL BE PROVIDED WITH DRAIN TO EQUIPMENT DRAIN SUMP.

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REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
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C	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

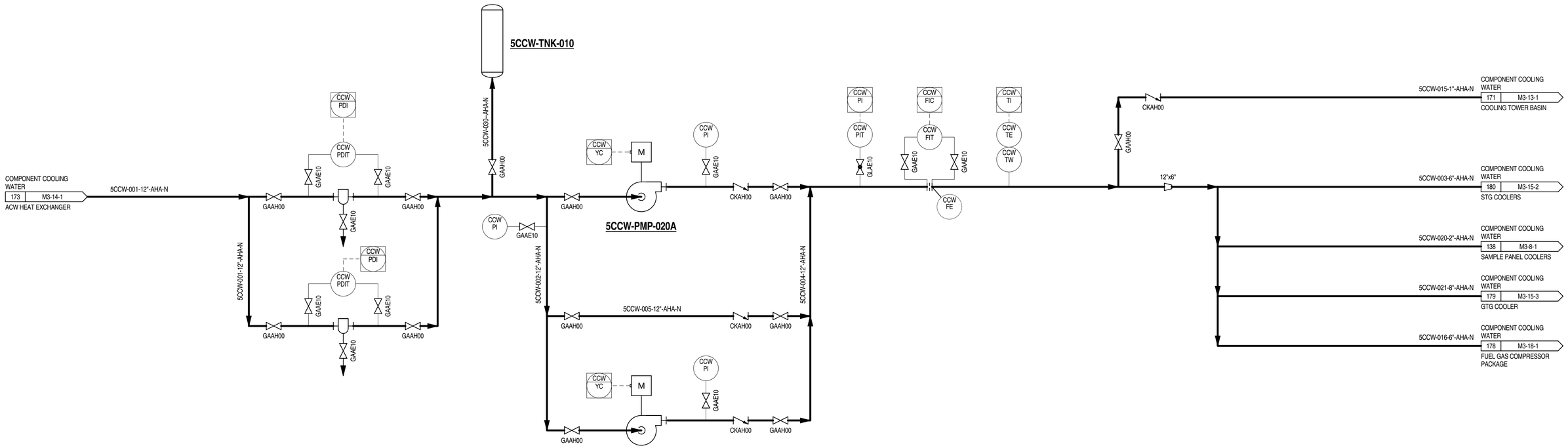
PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
AUXILIARY COOLING WATER SYSTEM

JOB NUMBER 123374
REV F
DRAWING NUMBER M3-14-1

5CCW-TNK-010
COMPONENT COOLING WATER EXPANSION TANK
Opr Cap: Proc Cap:
Opr Press: Vol Cap:
Opr Temp: Spec: 485173

5CCW-PMP-020A
COMPONENT COOLING WATER PUMP A
Opr Cap: 2050.0 gallon/min Proc Cap:
Opr Press: 79.3 psi-g Drv Rtg:
Opr Temp: 120.00 F Spec: 485311.11

5CCW-PMP-020B
COMPONENT COOLING WATER PUMP B
Opr Cap: 2050.0 gallon/min Proc Cap:
Opr Press: 79.3 psi-g Drv Rtg:
Opr Temp: 120.00 F Spec: 485311.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

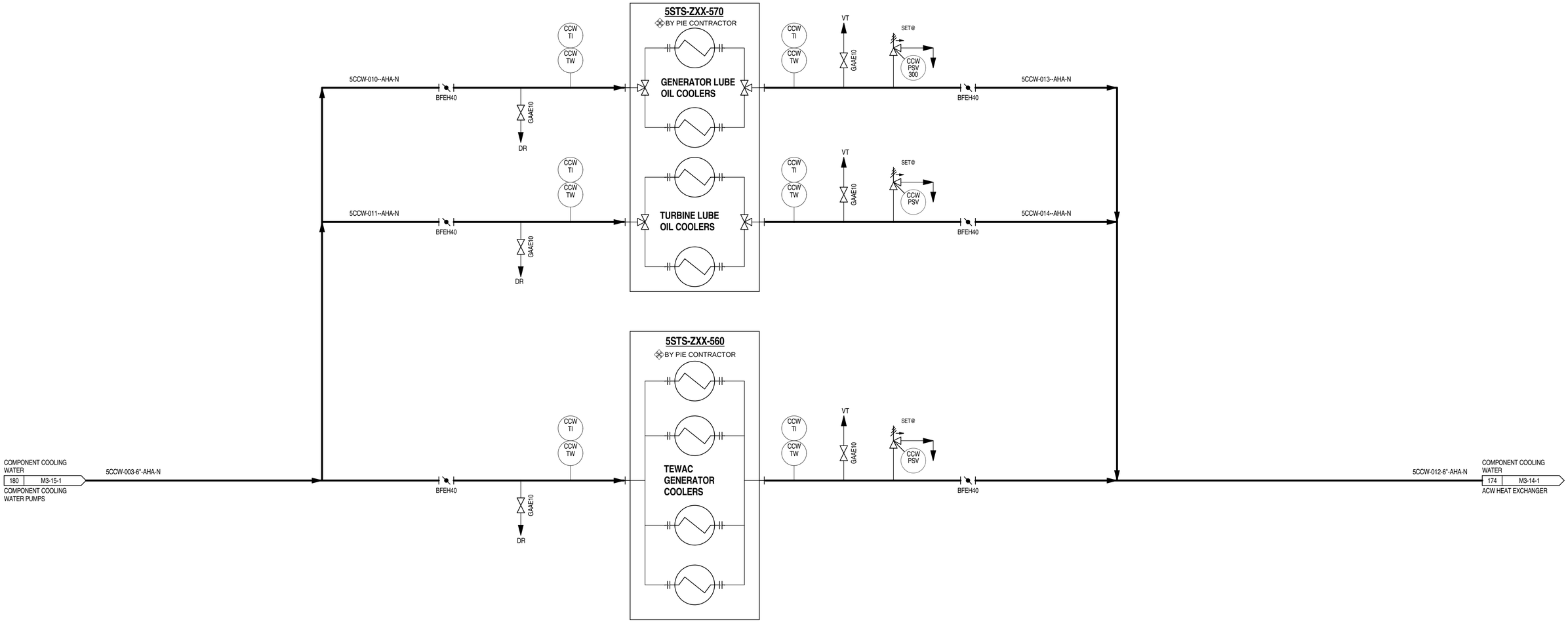
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
COMPONENT COOLING WATER SYSTEM

JOB NUMBER 123374
REV D
DRAWING NUMBER M3-15-1

5STS-ZXX-560
TEWAC GENERATOR COOLERS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221

5STS-ZXX-570
STG LUBE OIL COOLERS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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DATE						
INIT						

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C	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
COMPONENT COOLING WATER SYSTEM

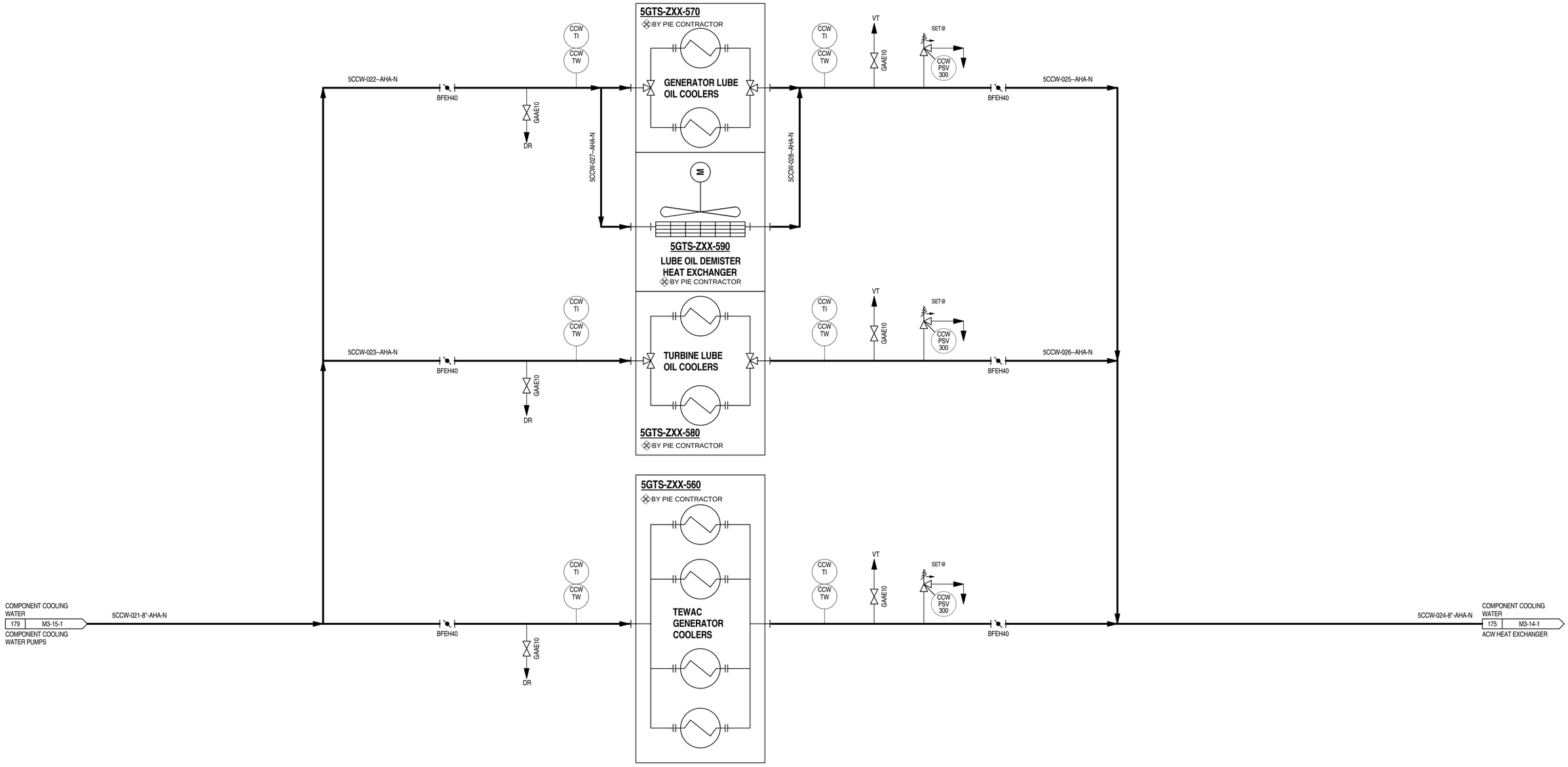
JOB NUMBER 123374
REV D
DRAWING NUMBER M3-15-2

5GTS-ZXX-560
TEWAC GENERATOR COOLERS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-570
GENERATOR LUBE OIL SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-590
LUBE OIL DEMISTER HEAT EXCHANGER
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-580
GTG LUBE OIL COOLERS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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INTER-DISCIPLINE REVIEW

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INIT						

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D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

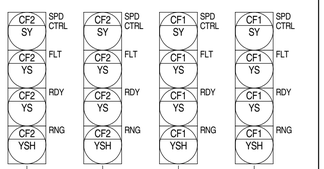
POWER ENGINEERS

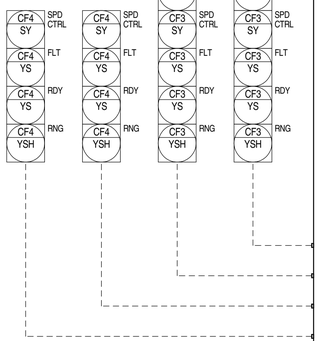
PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
COMPONENT COOLING WATER SYSTEM

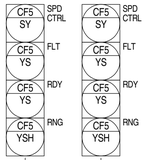
JOB NUMBER 123374
REV E
DRAWING NUMBER M3-15-3

5CFX-ZXX-010
COOLING TOWER CHEMICAL FEED SYSTEM

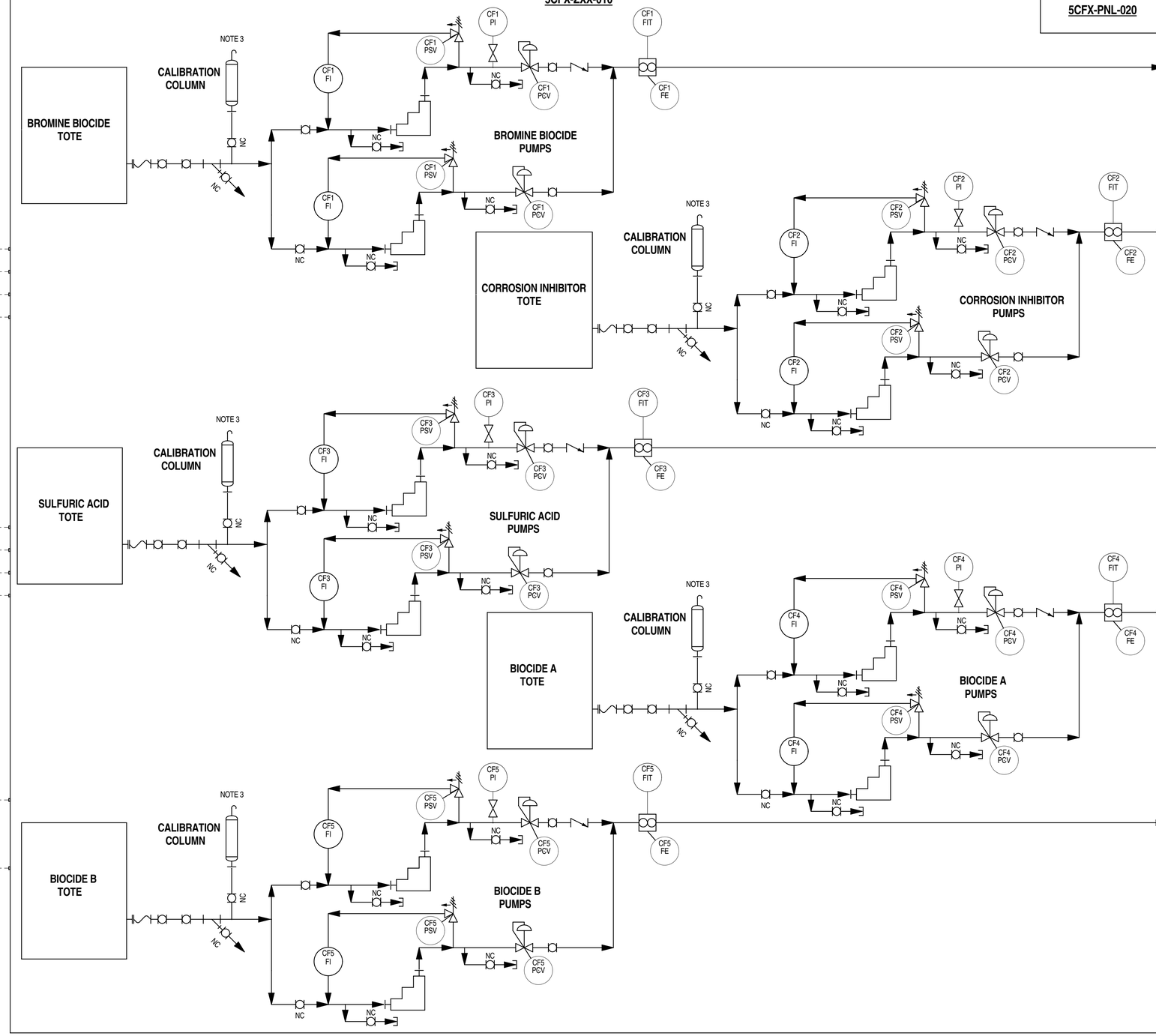
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.05







5CFX-ZXX-010



5CFX-PNL-020

5CFX-PNL-020
COOLING TOWER CHEMICAL CONTROL PANEL

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.05

5CF1-XXX-1/2"-CDC	BROMINE BIOCIDE	163	M3-13-1
5CF2-001-1/2"-CDC-N	CORROSION INHIBITOR	164	M3-13-1
5CF3-001-1/2"-CDC-N	SULFURIC ACID	165	M3-13-1
5CF4-001-1/2"-CDC-N	BIOCIDE A	166	M3-13-1
5CF5-001-1/2"-CDC-N	BIOCIDE B	181	M3-13-1

COOLING TOWER CIRCULATING WATER

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL VERIFY COOLING TOWER WATER TREATMENT CHEMICALS WITH CHEMTREAT, PWP'S WATER TREATMENT CHEMICAL SUPPLIER.

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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	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
COOLING TOWER CHEMICAL FEED SYSTEM

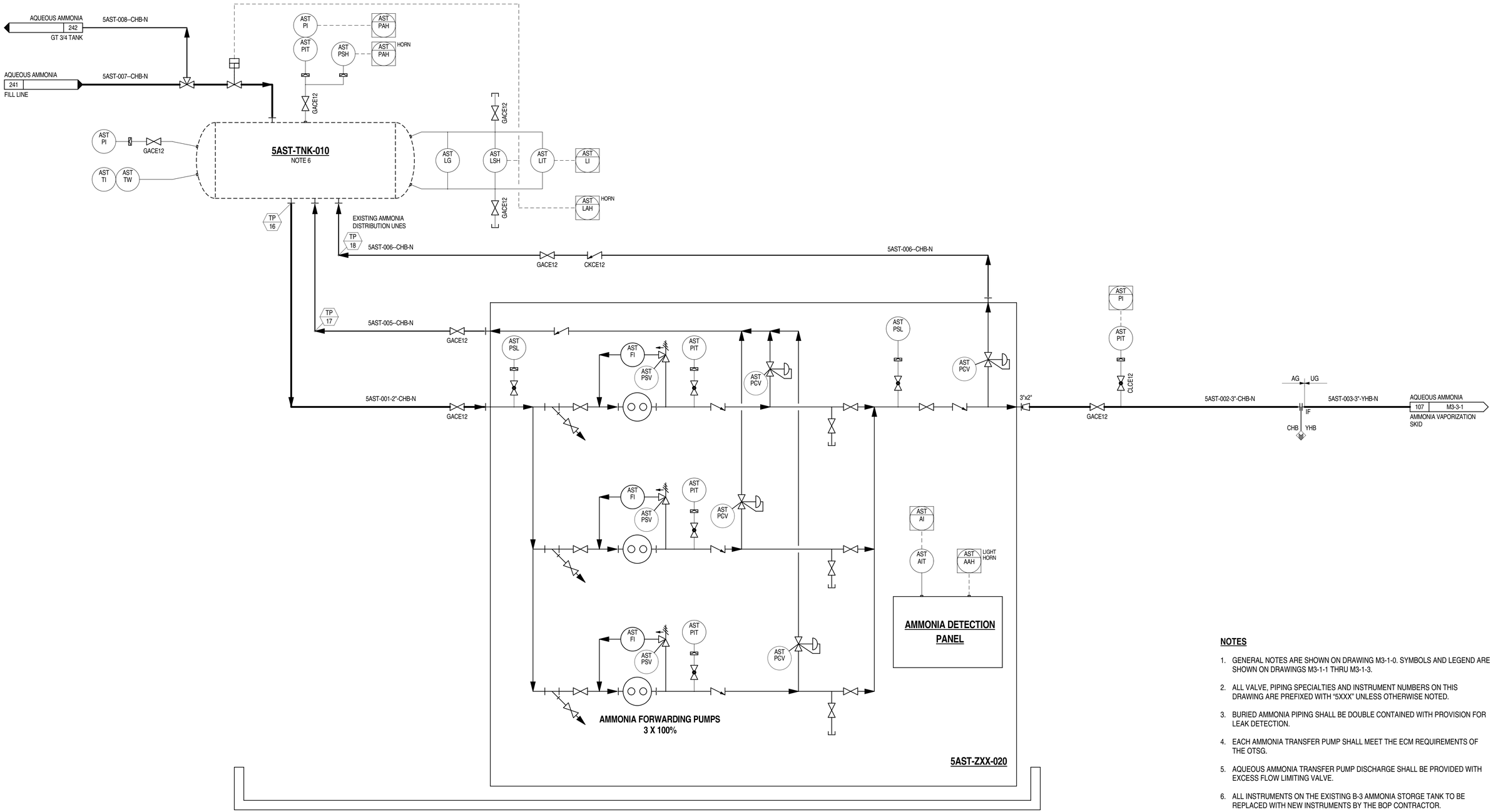
JOB NUMBER 123374
REV D
DRAWING NUMBER M3-16-1

5AST-TNK-010
EXISTING AMMONIA STORAGE TANK

Opr Cap:
Opr Press: 30.0 psi-g
Opr Temp: 97.00 F
Proc Cap:
Vol Cap: 12000.0 gallon
Spec:

5AST-ZXX-020
AMMONIA FORWARDING PUMPS SKID

Opr Cap:
Opr Press:
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485325.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BURIED AMMONIA PIPING SHALL BE DOUBLE CONTAINED WITH PROVISION FOR LEAK DETECTION.
4. EACH AMMONIA TRANSFER PUMP SHALL MEET THE ECM REQUIREMENTS OF THE OTSG.
5. AQUEOUS AMMONIA TRANSFER PUMP DISCHARGE SHALL BE PROVIDED WITH EXCESS FLOW LIMITING VALVE.
6. ALL INSTRUMENTS ON THE EXISTING B-3 AMMONIA STORGE TANK TO BE REPLACED WITH NEW INSTRUMENTS BY THE BOP CONTRACTOR.

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
AQUEOUS AMMONIA SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER M3-17-1

5FGS-ZXX-510A
FUEL GAS COMPRESSOR PACKAGE A
Opr Cap:
Opr Press: 730.0 psi-g
Opr Temp: 270.00 F
Proc Cap:
Dry Rtg:
Spec: 485374.22

5FGS-TNK-520
FUEL GAS DRAINS TANK
Opr Cap:
Opr Press: 5.0 psi-g
Opr Temp: 113.00 F
Proc Cap:
Vol Cap: 100.0 gallon
Spec: 485173

5FGS-ZXX-510A
BY PIE CONTRACTOR

EXISTING FUEL GAS SUPPLY
EXISTING / NEW
TP 1
5FGS-001-6"-AGA-P
FGS YC
FGS HS
FGS YA
FGS I
FGS A
PCS
FGS ZIC
FGS ZIO
FGS ZSC
FGS ZSO
IAS
S
VT
FGS SV
P
FGS FV
NOTE 3
SET@
FGS PSV
BAAG20
GAAE15
FGS PI
FGS PIT
SUCTION SCRUBBER
MOTOR
M
COMPRESSOR
FGS PCV
FGS CV
SEPARATOR AND RESERVOIR
COALESCING OIL SEPARATOR
GAAE05
5FGS-003-4"-AEB-P
FUEL GAS
182 | M3-18-3
GTG FINAL FILTER
5FGS-005-4"-AEB-P
FUEL GAS
M3-18-2 | 225
FUEL GAS COMPRESSOR PACKAGE B
FUEL GAS DISCHARGE HEAT EXCHANGER
5BCW-018-6"-AHA-N
BEARING COOLING WATER
M3-18-2 | 224
FUEL GAS COMPRESSOR PACKAGE B
5BCW-019-6"-AHA-N
BEARING COOLING WATER
176 | M3-14-1
ACW HEAT EXCHANGER
BAAE10
DUAL OIL FILTERS
OIL-COOLER
CONTROL PANEL
FUEL GAS
M3-18-2 | 219
FUEL GAS COMPRESSOR PACKAGE B
5FGS-002-6"-AGA-P
INSTRUMENT AIR
116 | M3-20-1
INSTRUMENT AIR HEADER
5IAS-009--CHB-N
INSTRUMENT AIR
M3-18-2 | 220
FUEL GAS COMPRESSOR PACKAGE B
5IAS-010--CHB-N
BEARING COOLING WATER
178 | M3-15-1
COMPONENT COOLING WATER PUMPS
5BCW-016-6"-AHA-N
BEARING COOLING WATER
M3-18-2 | 221
FUEL GAS COMPRESSOR PACKAGE B
5BCW-017-6"-AHA-N
FUEL GAS DRAINS
222 | M3-18-2
FUEL GAS COMPRESSOR PACKAGE B
5FGS-XX2--AHA-N
EQUIPMENT DRAINS
223 | M3-18-2
FUEL GAS COMPRESSOR PACKAGE B
5MDS-036--AHA-N
5FGS-XX1--AHA-N
FGS LAH
FGS LSH
GLAE15
FGS LG
5FGS-TNK-520
5FGS-1014--AHA-N
BAAH21
5MDS-036--AHA-N
EQUIPMENT DRAINS
213 | M3-26-2
EQUIPMENT DRAIN SUMP

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE ALL FUEL GAS VENTS TO SAFE LOCATION.

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DATE						
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D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

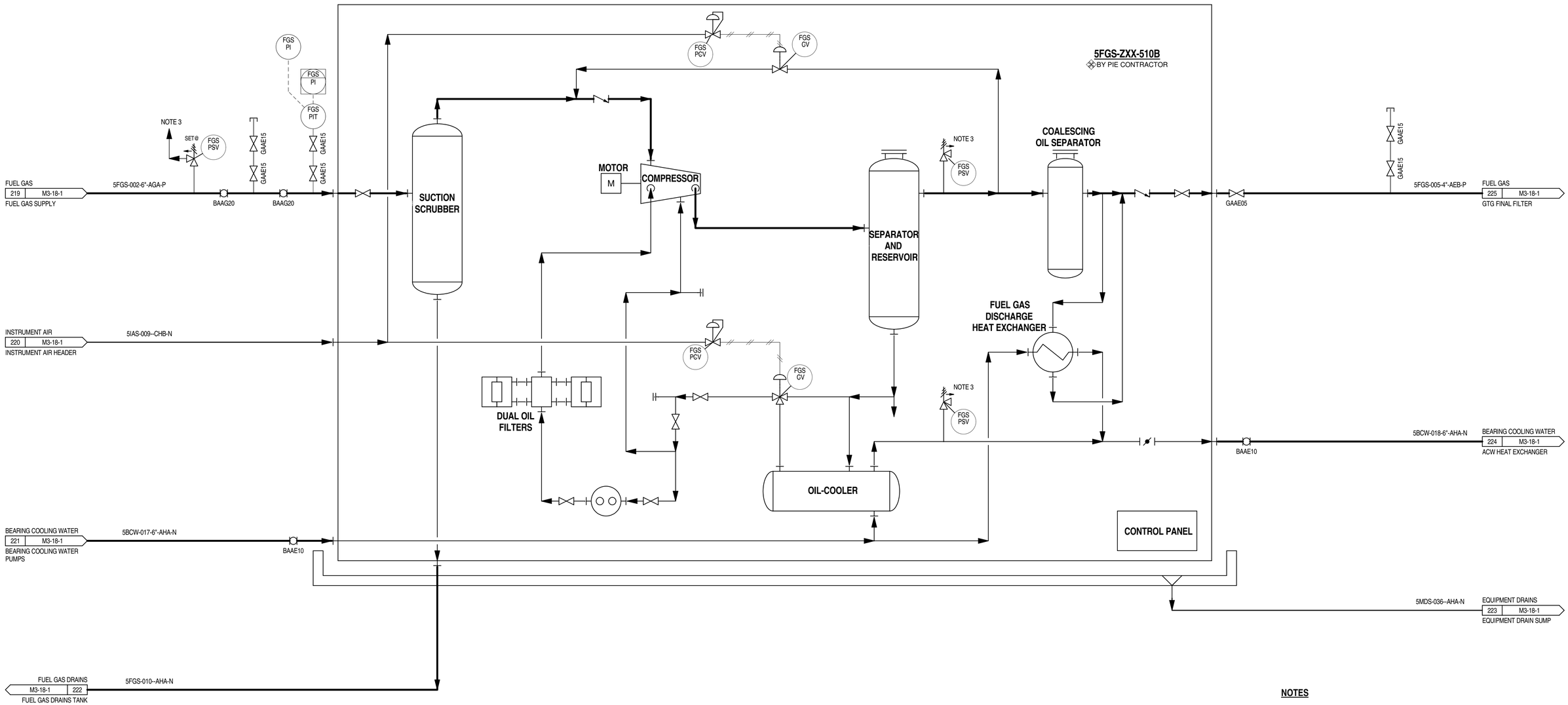
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
FUEL GAS SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER **M3-18-1**

5FGS-ZXX-510B
FUEL GAS COMPRESSOR PACKAGE B

Opr Cap: Proc Cap:
Opr Press: 730.0 psi-g Drv Rtg:
Opr Temp: 270.00 F Spec: 485374.22



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE ALL FUEL GAS VENTS TO SAFE LOCATION.

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DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
FUEL GAS SYSTEM

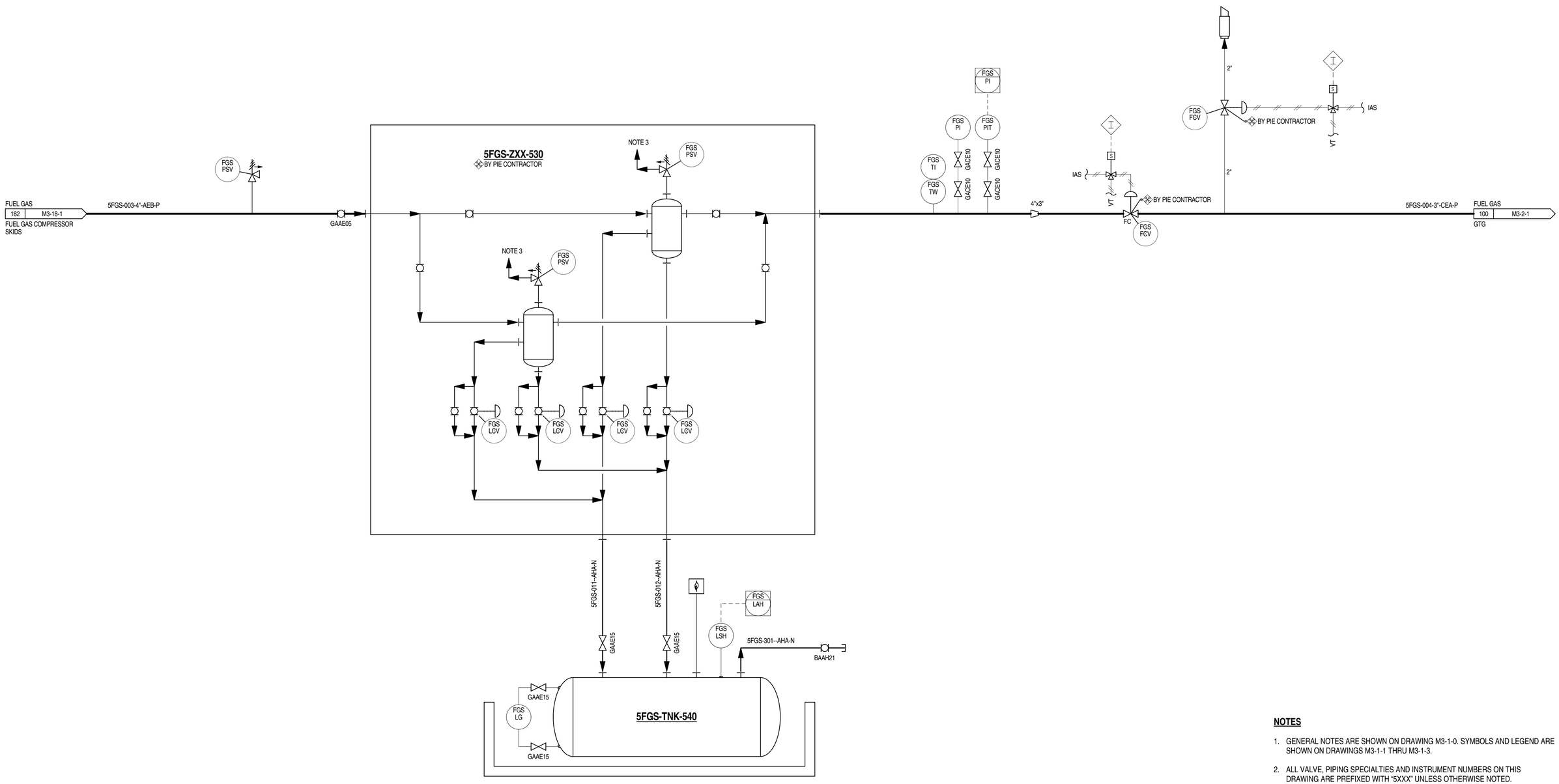
JOB NUMBER 123374
REV G
DRAWING NUMBER M3-18-2

5FGS-ZXX-530
FUEL GAS FINAL FILTER SKID

Opr Cap:	Proc Cap:
Opr Press: 730.0 psi-g	Drv Rtg:
Opr Temp: 270.00 F	Spec:

5FGS-TNK-540
FGS FINAL FILTER DRAINS TANK

Opr Cap:	Proc Cap:
Opr Press: 5.0 psi-g	Vol Cap: 100.0 gallon
Opr Temp: 113.00 F	Spec: 485173



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. CONNECT TO AND INSTALL FURNISHED GAS VENT SILENCER.
4. BOP CONTRACTOR SHALL ROUTE ALL FUEL GAS VENTS TO A SAFE LOCATION. TOP OF VENT SHALL DE DESIGNED TO PREVENT RAIN WATER AND BIRD INTRUSION.

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A	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC

DSGN	ADD	08/16/13
DRN	AJG	08/16/13
CKD	SEG	08/16/13
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

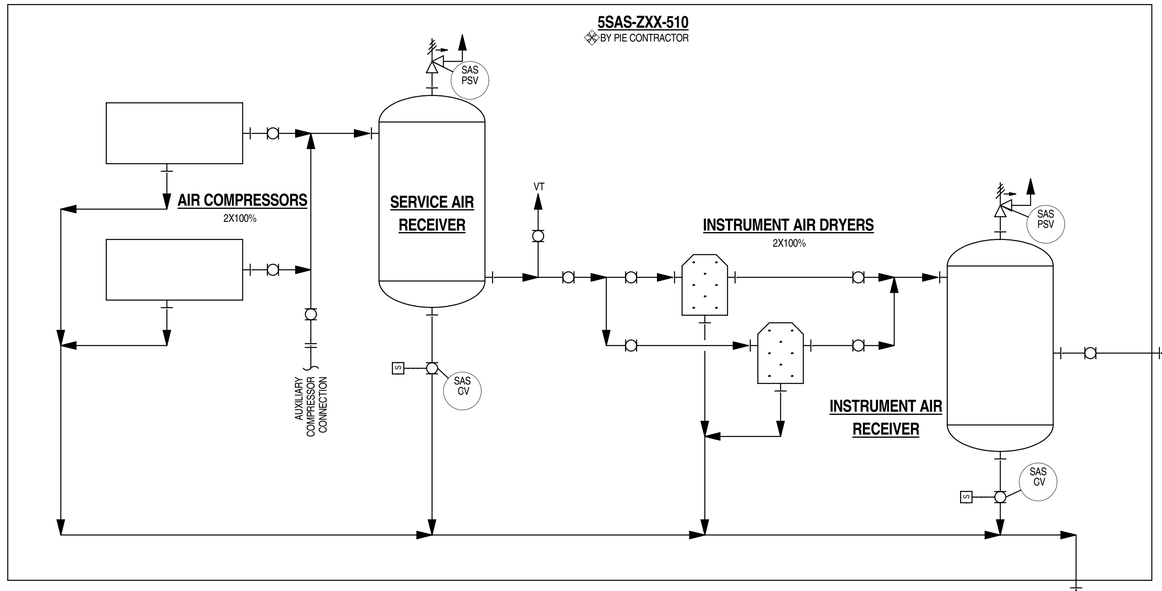
PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
FUEL GAS SYSTEM

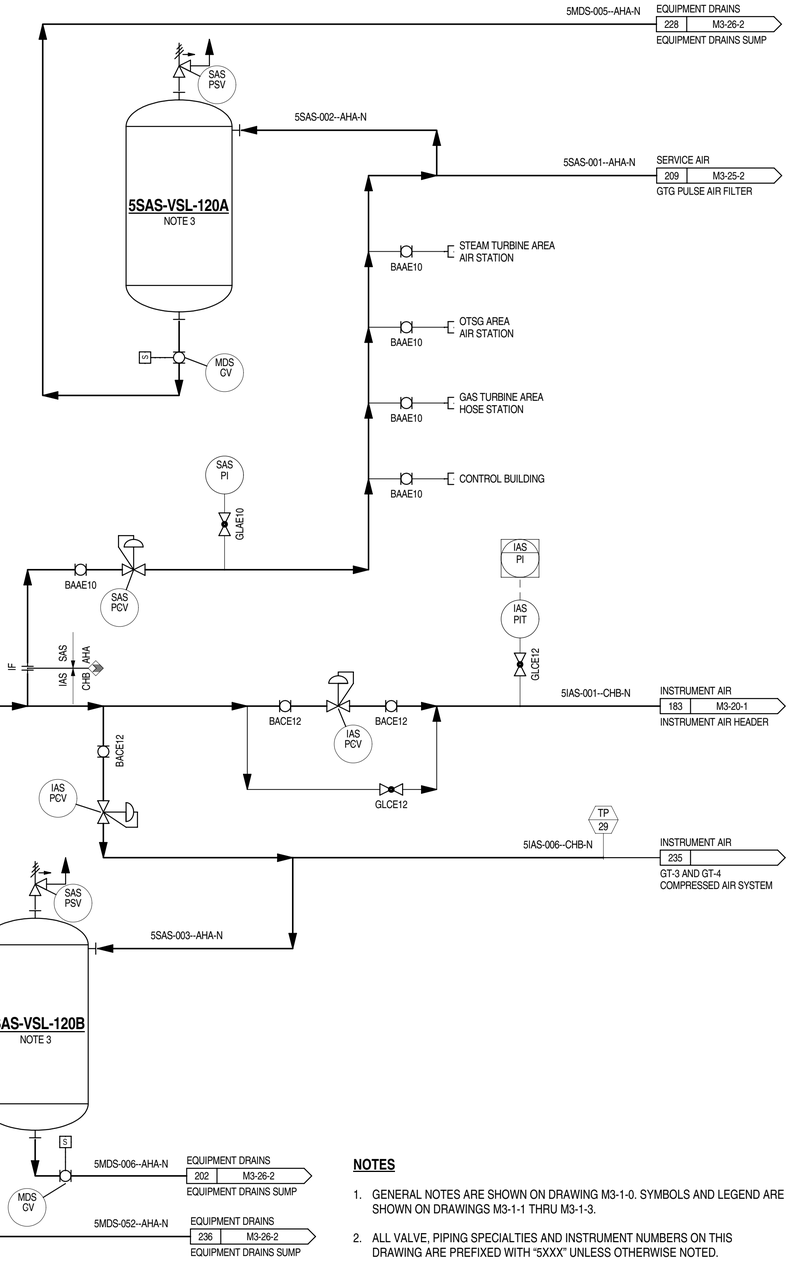
JOB NUMBER 123374
REV B
DRAWING NUMBER **M3-18-3**

5SAS-ZXX-510
AIR COMPRESSOR DRYER PACKAGE
Opr Cap: 1870.1 gallon/min Proc Cap:
Opr Press: 130.0 psi-g Drv Rtg:
Opr Temp: 97.00 F Spec: 485374.21

5SAS-VSL-120A
SERVICE AIR RECEIVER A
Opr Cap: Proc Cap:
Opr Press: Vol Cap:
Opr Temp: Spec:

5SAS-VSL-120B
SERVICE AIR RECEIVER B
Opr Cap: Proc Cap:
Opr Press: Vol Cap:
Opr Temp: Spec:





NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. LOCATION OF SERVICE AIR RECEIVERS TO BE DETERMINED.

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
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

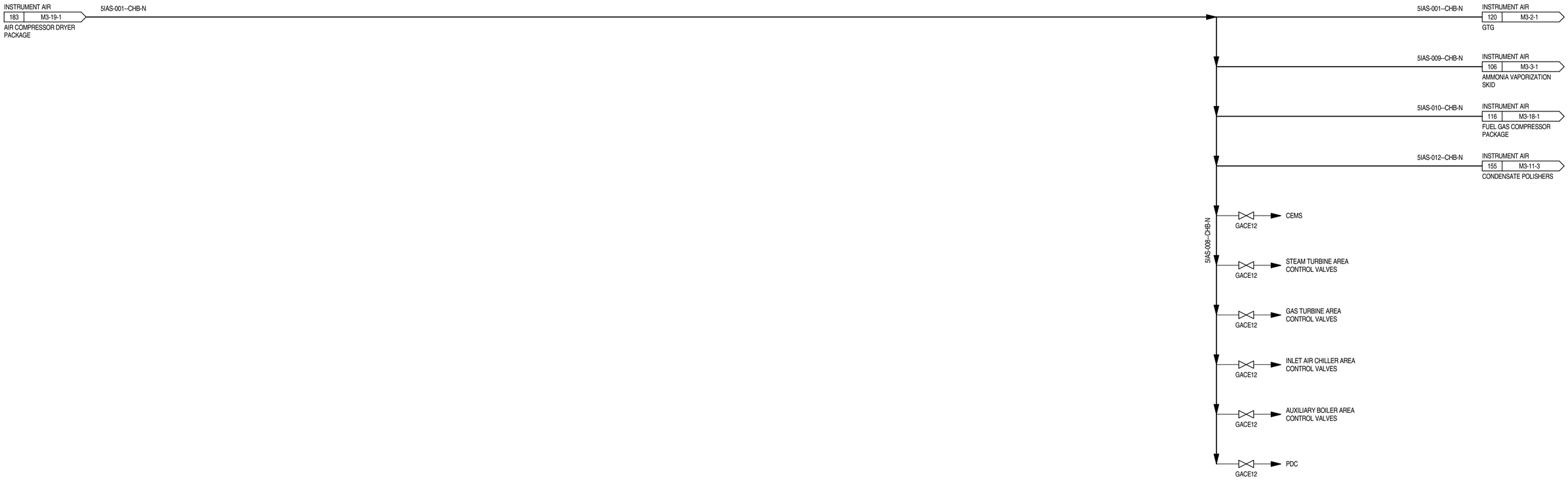
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DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
SERVICE AIR SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-19-1



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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
D	ISSUED FOR REVIEW	10/15/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
INSTRUMENT AIR SYSTEM

JOB NUMBER 123374
REV D
DRAWING NUMBER M3-20-1

5GTS-ZXX-510
GAS TURBINE GENERATOR
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-520
AUXILIARY SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-530A
NOX WATER INJECTION PUMP SKID
Opr Cap: 96.0 gallon/min Proc Cap:
Opr Press: 635.3 psi-g Drv Rtg:
Opr Temp: 97.00 F Spec: 485222

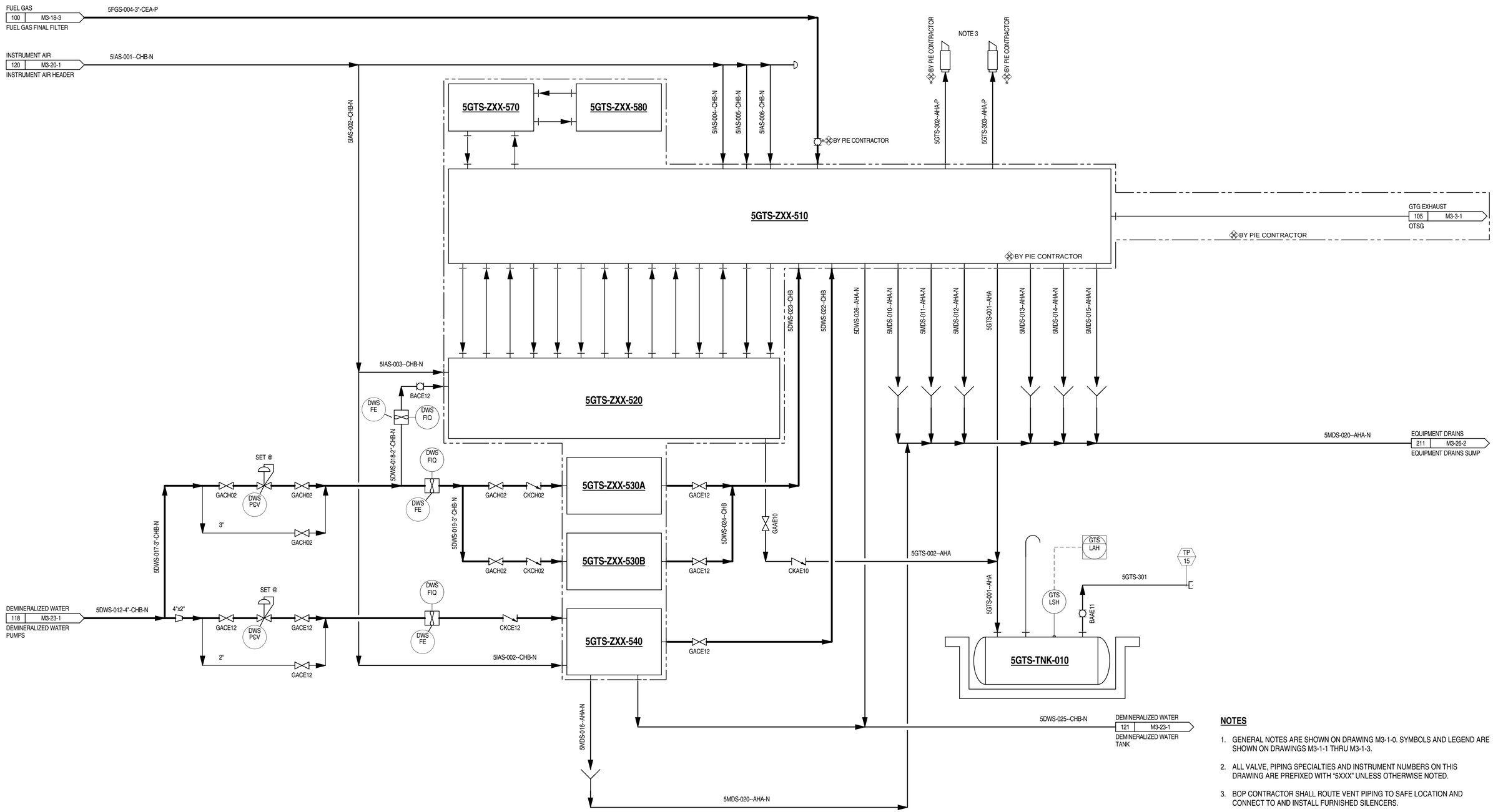
5GTS-ZXX-530B
NOX WATER INJECTION PUMP SKID
Opr Cap: 96.0 gallon/min Proc Cap:
Opr Press: 635.3 psi-g Drv Rtg:
Opr Temp: 97.00 F Spec: 485222

5GTS-ZXX-540
SPRINT SKID
Opr Cap: 29.0 gallon/min Proc Cap:
Opr Press: 135.3 psi-g Drv Rtg:
Opr Temp: 97.00 F Spec: 485222

5GTS-TNK-010
TURBINE WATER WASH DRAINS TANK
Opr Cap: Proc Cap:
Opr Press: 0.0 psi-g Vol Cap: 1000.0 gallon
Opr Temp: 250.00 F Spec: 485173

5GTS-ZXX-570
GENERATOR LUBE OIL SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222

5GTS-ZXX-580
GTG LUBE OIL COOLERS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485222



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE VENT PIPING TO SAFE LOCATION AND CONNECT TO AND INSTALL FURNISHED SILENCERS.

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

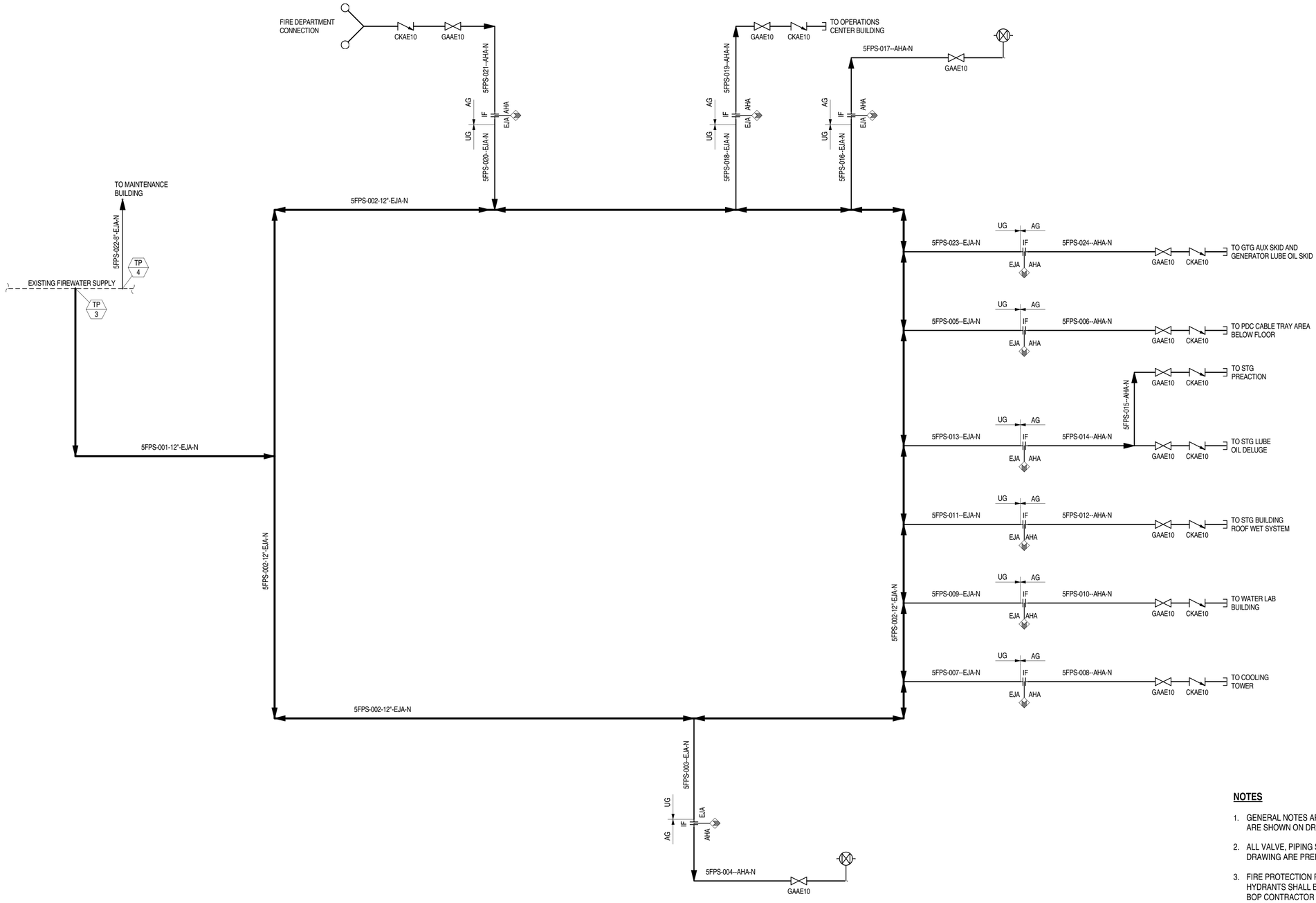
DSGN	ADD	09/13/12
DRN	VBD	09/13/12
CKD	SEG	09/13/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
GAS TURBINE INTERCONNECTIONS

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-2-1



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYSMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALITIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. FIRE PROTECTION PIPING DESIGN INCLUDING LOCATION AND NUMBER OF HYDRANTS SHALL BE SUBMITTED TO PASADENA FIRE DEPT FOR APPROVAL. BOP CONTRACTOR SHALL BEAR ALL COSTS TO INSTALL PFD-APPROVED DESIGN.

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
B	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER

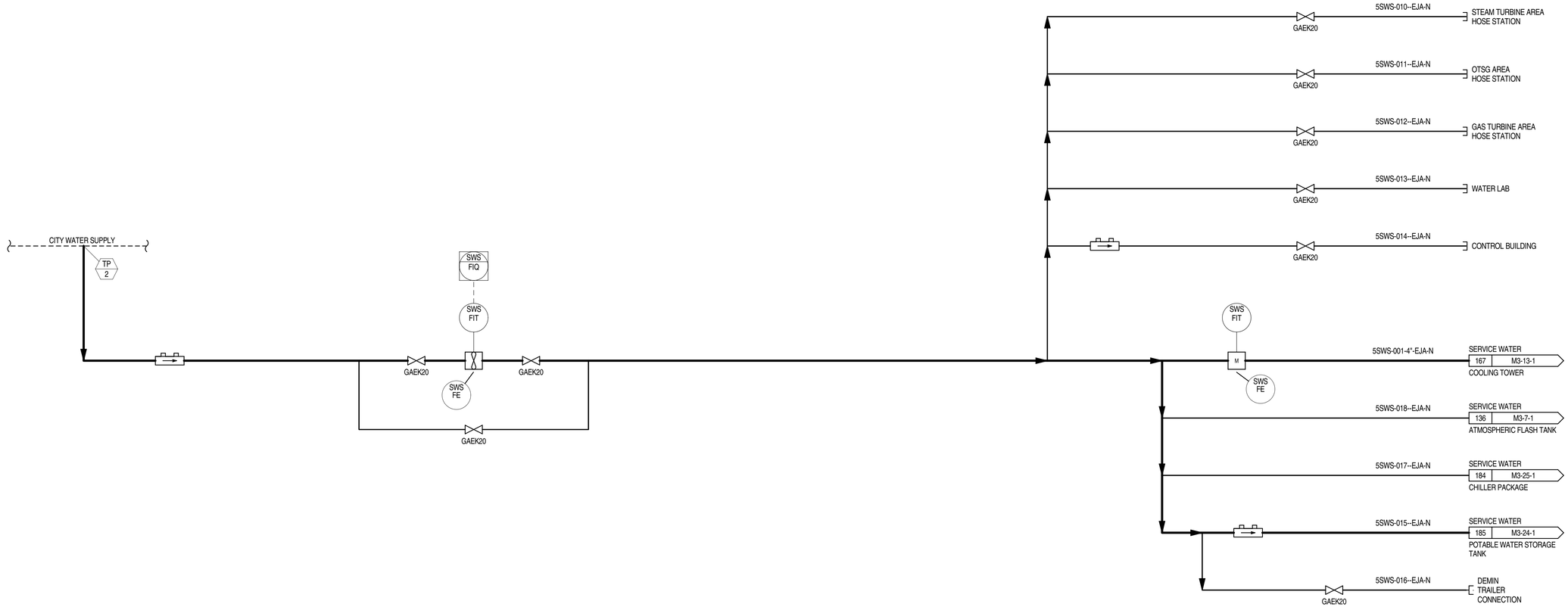
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

PIPING & INSTRUMENTATION DIAGRAM FIREWATER SYSTEM

JOB NUMBER 123374

REV D

DRAWING NUMBER M3-21-1



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

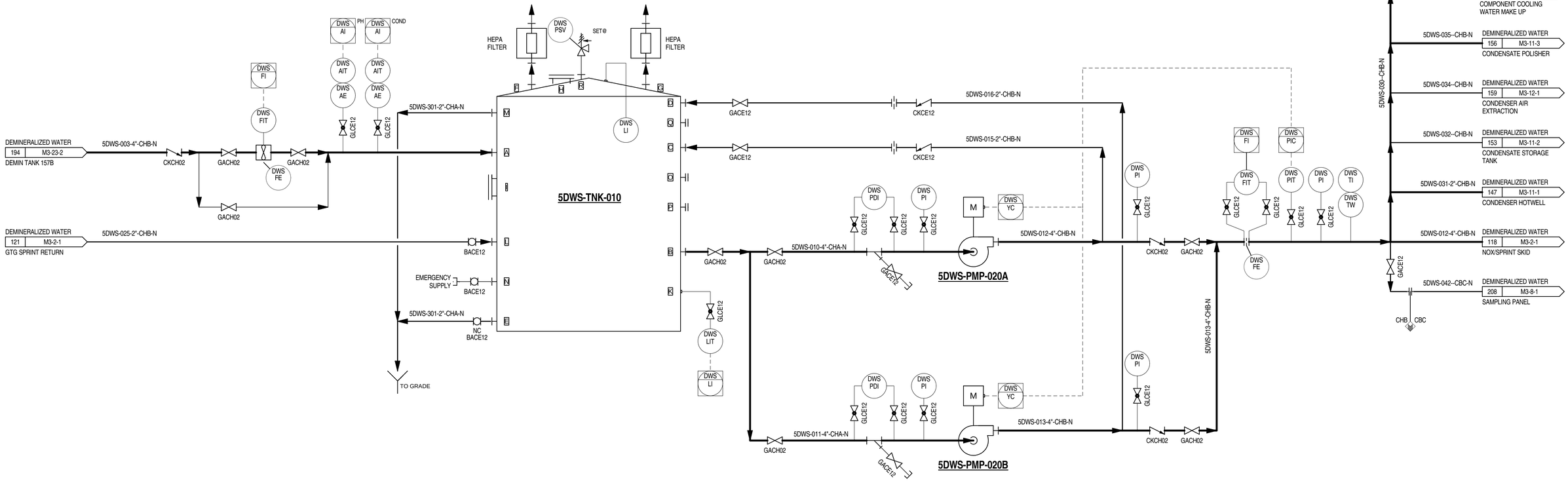
PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
SERVICE WATER SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-22-1

5DWS-TNK-010
DEMINERALIZED WATER TANK
Opr Cap:
Opr Press:
Opr Temp: 97.00 F
Proc Cap:
Vol Cap: 109000.0 gallon
Spec: 485172

5DWS-PMP-020A
DEMINERALIZED WATER PUMP
Opr Cap: 125.0 gallon/min
Opr Press: 135.3 psi-g
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11

5DWS-PMP-020B
DEMINERALIZED WATER PUMP
Opr Cap: 125.0 gallon/min
Opr Press: 135.3 psi-g
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. ALL DEMINERALIZED WATER TANK CONNECTIONS SHALL BE SUPPLIED WITH ISOLATION VALVES.

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
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D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

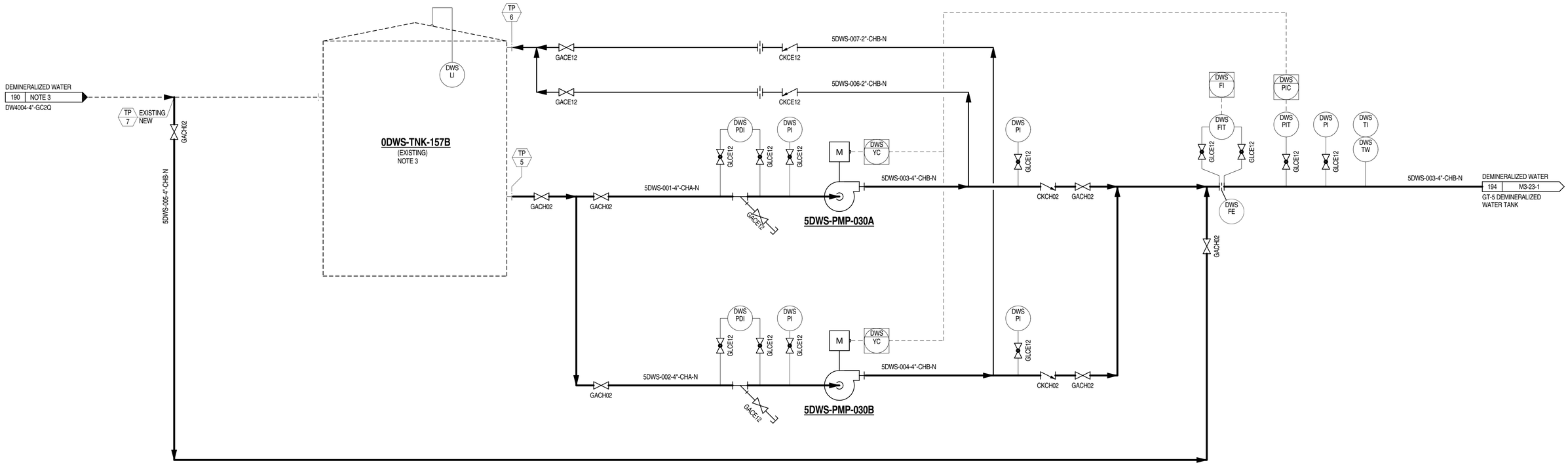
PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
DEMINERALIZED WATER SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-23-1

0DWS-TNK-157B
DEMINERALIZED WATER TANK
Opr Cap:
Opr Press:
Opr Temp: 97.00 F
Proc Cap:
Vol Cap: 70000.0 gallon
Spec:

5DWS-PMP-030A
DEMINERALIZED WATER FORWARDING PUMP
Opr Cap: 125.0 gallon/min
Opr Press: 135.3 psi-g
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11

5DWS-PMP-030B
DEMINERALIZED WATER FORWARDING PUMP
Opr Cap: 125.0 gallon/min
Opr Press: 135.3 psi-g
Opr Temp: 97.00 F
Proc Cap:
Drv Rtg:
Spec: 485311.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. REFER TO CHEMIC ENGINEERS P&ID 20001-040, REV 2, 2/17/03.

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
C	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	10/12/12
DRN	VBD	10/12/12
CKD	SEG	10/12/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 19, 1886

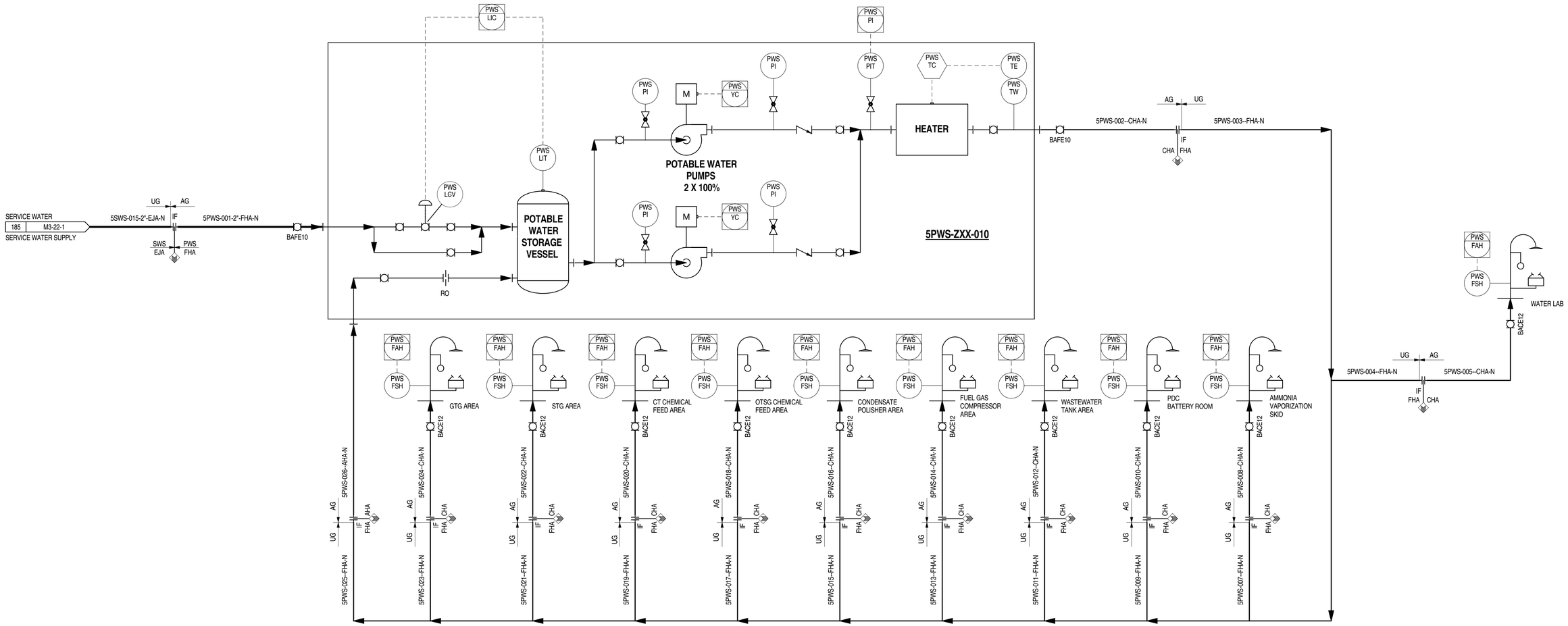
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
DEMINERALIZED WATER SYSTEM

JOB NUMBER 123374
REV C
DRAWING NUMBER M3-23-2

5PWS-ZXX-010
POTABLE WATER RECIRCULATION SKID

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485951.96



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE EYEWASH STATION DRAINS TO THE EQUIPMENT DRAINS SUMP (5MDS-SMP-010).

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
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12

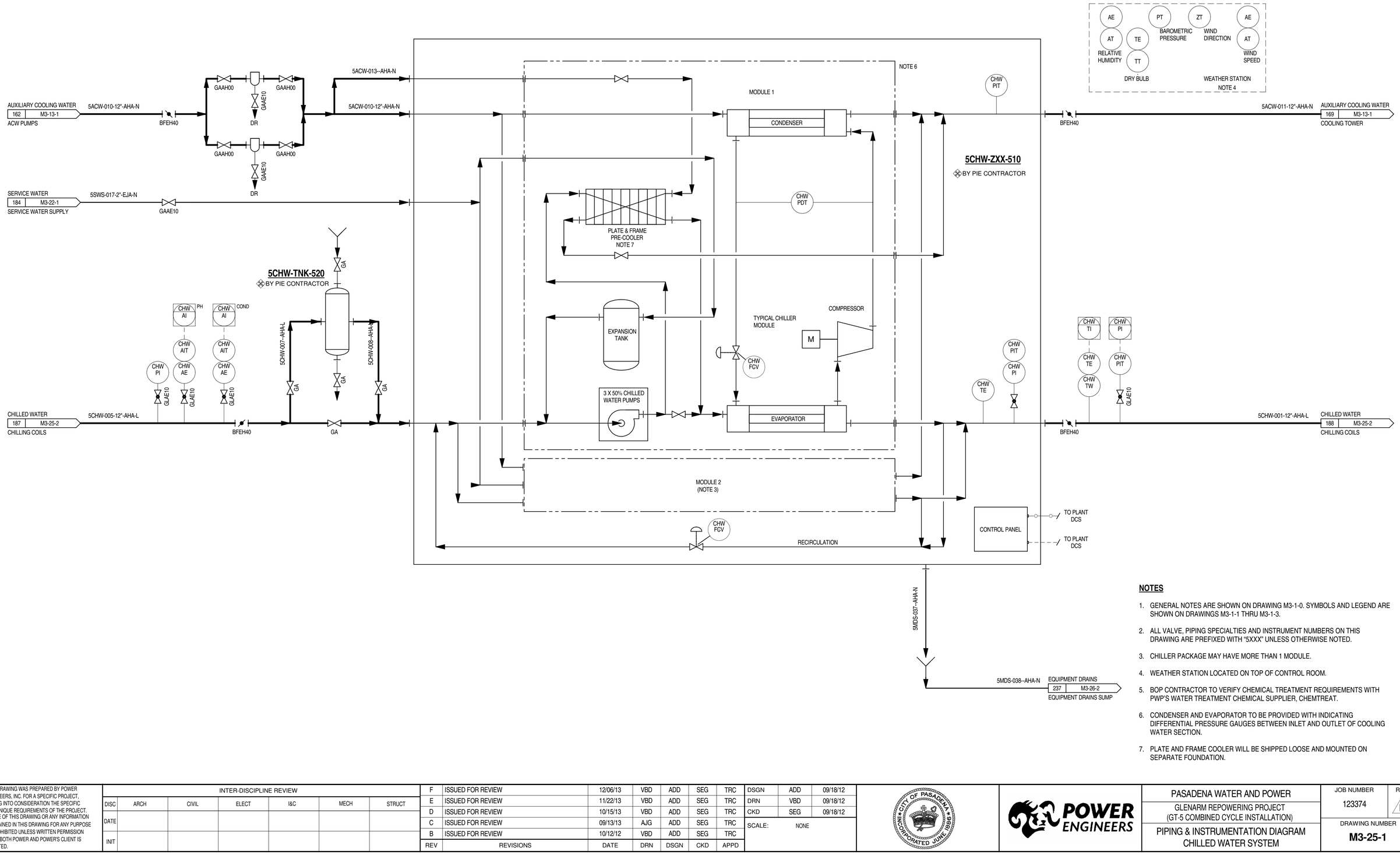
SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM POTABLE WATER SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-24-1



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. CHILLER PACKAGE MAY HAVE MORE THAN 1 MODULE.
4. WEATHER STATION LOCATED ON TOP OF CONTROL ROOM.
5. BOP CONTRACTOR TO VERIFY CHEMICAL TREATMENT REQUIREMENTS WITH PWP'S WATER TREATMENT CHEMICAL SUPPLIER, CHEMTREAT.
6. CONDENSER AND EVAPORATOR TO BE PROVIDED WITH INDICATING DIFFERENTIAL PRESSURE GAUGES BETWEEN INLET AND OUTLET OF COOLING WATER SECTION.
7. PLATE AND FRAME COOLER WILL BE SHIPPED LOOSE AND MOUNTED ON SEPARATE FOUNDATION.

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
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E	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER

GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)

PIPING & INSTRUMENTATION DIAGRAM
CHILLED WATER SYSTEM

JOB NUMBER 123374

REV F

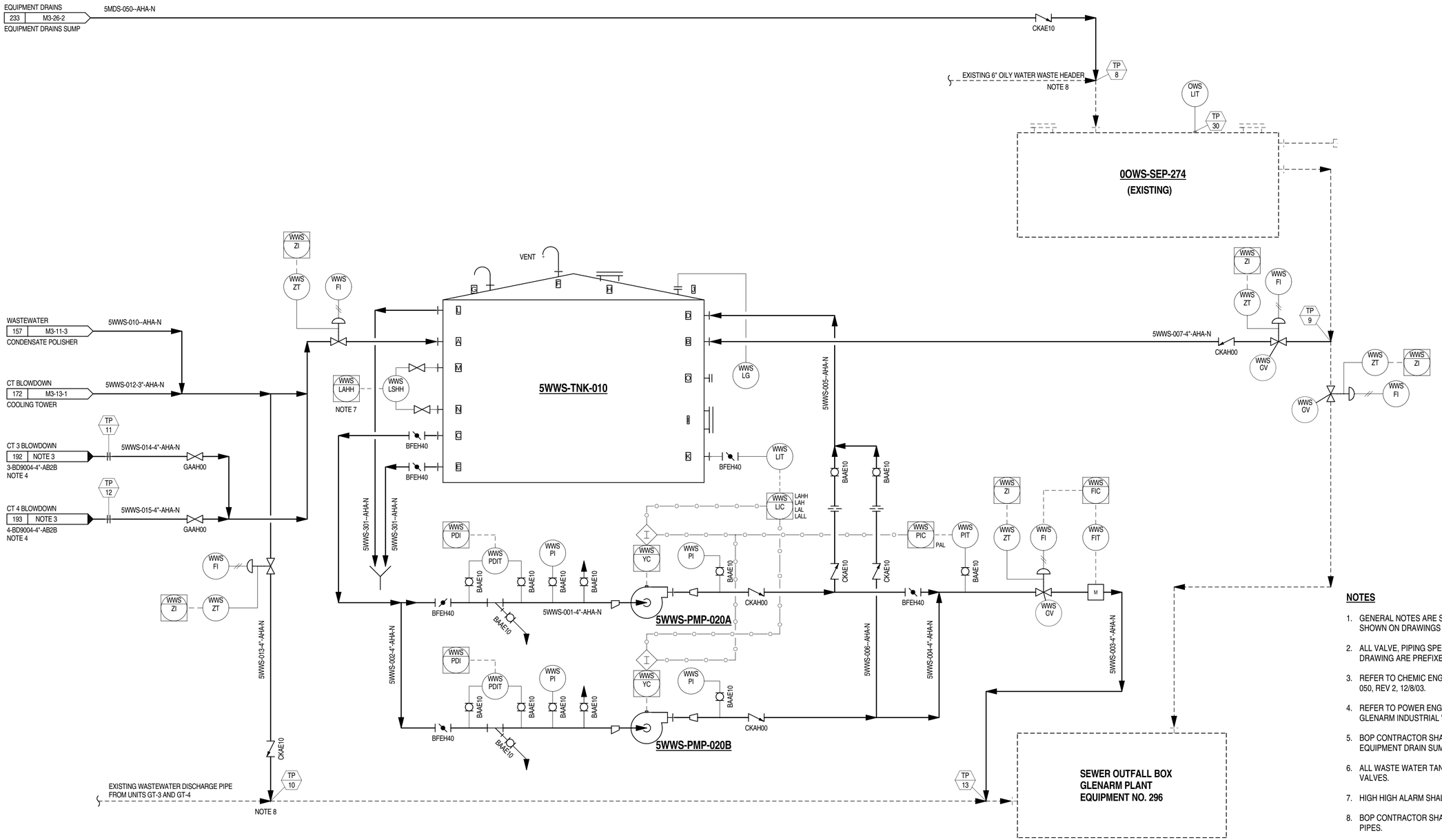
DRAWING NUMBER M3-25-1

5WWS-TNK-010
WASTEWATER STORAGE TANK
Opr Cap: Proc Cap:
Opr Press: Vol Cap: 88000.0 gallon
Opr Temp: Spec: 485172

5WWS-PMP-020A
WASTEWATER TRANSFER PUMP A
Opr Cap: 195.0 gallon/min Proc Cap:
Opr TDH Press: 40.00 psi Drv Rtg:
Opr Temp: 100.00 F Spec: 485311.11

5WWS-PMP-020B
WASTEWATER TRANSFER PUMP B
Opr Cap: 195.0 gallon/min Proc Cap:
Opr TDH Press: 40.00 psi Drv Rtg:
Opr Temp: 100.00 F Spec: 485311.11

0OWS-SEP-274
OILY WATER SEPARATOR (EXISTING)
Opr Cap: 100.0 gallon/min Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec:



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. REFER TO CHEMIC ENGINEERS P&IDS: 20001-3-050, REV 2, 12/8/03 AND 20001-4-050, REV 2, 12/8/03.
4. REFER TO POWER ENGINEERS DRAWING M2-2-4, PROCESS FLOW DIAGRAM, GLENARM INDUSTRIAL WASTEWATER.
5. BOP CONTRACTOR SHALL ROUTE ALL A/C DRIP PANS AND EYEWASH DRAINS TO EQUIPMENT DRAIN SUMP (5MDS-SMP-010).
6. ALL WASTE WATER TANK CONNECTIONS SHALL BE SUPPLIED WITH ISOLATION VALVES.
7. HIGH HIGH ALARM SHALL INCLUDE A VISIBLE BEACON.
8. BOP CONTRACTOR SHALL INSTALL CHECK VALVES ON EXISTING WASTE WATER PIPES.

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/18/12
DRN	VBD	09/18/12
CKD	SEG	09/18/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
WASTEWATER COLLECTION SYSTEM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-26-1

5MDS-SMP-010
EQUIPMENT DRAIN SUMP
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485951.62

5MDS-PMP-030A
EQUIPMENT DRAIN PUMP
Opr Cap: Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485951.62

5MDS-PMP-030B
EQUIPMENT DRAIN PUMP
Opr Cap: Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485951.62

EQUIPMENT DRAINS 211 M3-2-1
GTG
5MDS-020--AHA-N
AG UG
AHA EMA
5MDS-057--EMA-N

EQUIPMENT DRAINS 212 M3-3-2
OTSG
5MDS-022--AHA-N
AG UG
AHA EMA
5MDS-058--EMA-N

EQUIPMENT DRAINS 227 M3-6-1
STG
5MDS-028--AHA-N
AG UG
AHA EMA
5MDS-059--EMA-N

EQUIPMENT DRAINS 229 M3-8-1
STEAM AND WATER SAMPLING PANEL
5MDS-031--AHA-N
AG UG
AHA EMA
5MDS-060--EMA-N

EQUIPMENT DRAINS 232 M3-12-1
AIR EXTRACTION SKID
5MDS-047--AHA-N
AG UG
AHA EMA
5MDS-061--EMA-N

EQUIPMENT DRAINS 213 M3-18-1
FUEL GAS COMPRESSOR PACKAGES
5MDS-036--AHA-N
AG UG
AHA EMA
5MDS-062--EMA-N

EQUIPMENT DRAINS 226 M3-4-1
BOILER FEED WATER PUMPS
5MDS-024--AHA-N
AG UG
AHA EMA
5MDS-063--EMA-N

EQUIPMENT DRAINS 237 M3-25-1
CHILLER PACKAGE
5MDS-038--AHA-N
AG UG
AHA EMA
5MDS-064--EMA-N

EQUIPMENT DRAINS 228 M3-19-1
SERVICE AIR SYSTEM
5MDS-005--AHA-N
AG UG
AHA EMA
5MDS-007--EMA-N

EQUIPMENT DRAINS 202 M3-19-1
SERVICE AIR SYSTEM
5MDS-006--AHA-N
AG UG
AHA EMA
5MDS-008--EMA-N

EQUIPMENT DRAINS 236 M3-19-1
AIR COMPRESSOR DRYER
5MDS-052--AHA-N
AG UG
AHA EMA
5MDS-053--EMA-N

5MDS-055--EMA-N (vertical, left)
5MDS-055--EMA-N
5MDS-055--EMA-N (vertical, right)

5MDS-SMP-010

MDS LIC
MDS LIT
MDS YC
MDS YC
M
M
5MDS-051--AHA-N

5MDS-PMP-030A **5MDS-PMP-030B**

CO
5MDS-050--AHA-N
5MDS-050--AHA-N
EQUIPMENT DRAINS 233 M3-26-1
OILY WATER SEPARATOR

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR SHALL ROUTE ALL A/C DRIP PANS TO EQUIPMENT DRAIN SUMP (5MDS-SMP-010).

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

	ARCH	CIVIL	ELECT	I&C	MECH	STRUCT
DISC						
DATE						
INIT						

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
D	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
B	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	10/12/12
DRN	VBD	10/12/12
CKD	SEG	10/12/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
WASTEWATER COLLECTION SYSTEM

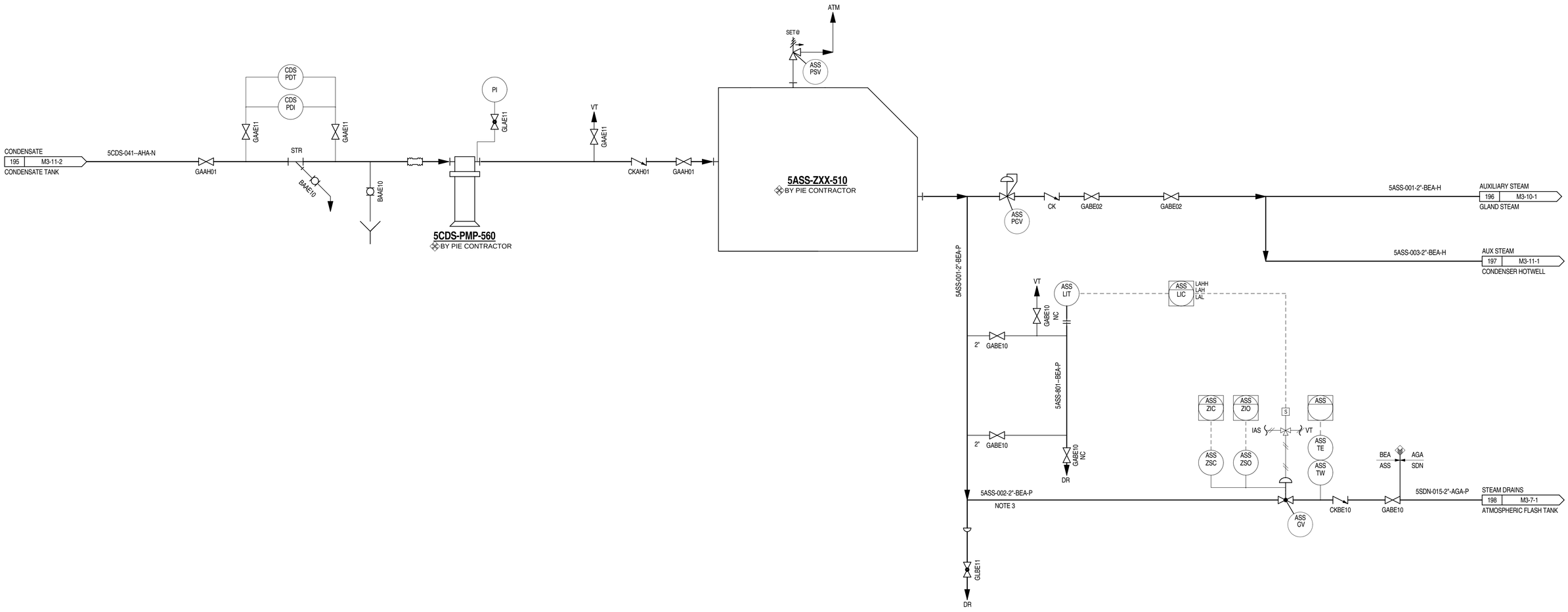
JOB NUMBER 123374
REV D
DRAWING NUMBER M3-26-2

5CDS-PMP-560
AUXILIARY BOILER FEED PUMP

Opr Cap:	Proc Cap:
Opr TDH Press:	Drv Rtg:
Opr Temp:	Spec:

5ASS-ZXX-510
AUXILIARY STEAM SKID

Opr Cap:	Proc Cap:
Opr Press: 150.0 psi-g	Drv Rtg:
Opr Temp:	Spec:



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR TO VERIFY NUMBER AND LOCATION OF DRIP LEGS.

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
C	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
A	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	06/10/13
DRN	VBD	06/11/13
CKD	SEG	06/11/13
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
AUXILIARY STEAM SYSTEM

JOB NUMBER 123374
REV C
DRAWING NUMBER M3-27-1

5HRS-FAN-520A
TEMPERING AIR FAN
Opr Cap: Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485413

5HRS-FAN-520B
TEMPERING AIR FAN
Opr Cap: Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485413

5HRS-MTR-580
MOTORIZED STACK DAMPER
Dsgn Cap: Proc Cap:
Dsgn Press: Drv Rtg:
Dsgn Temp: Spec: 485413

5HRS-BLR-510
OTSG
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413

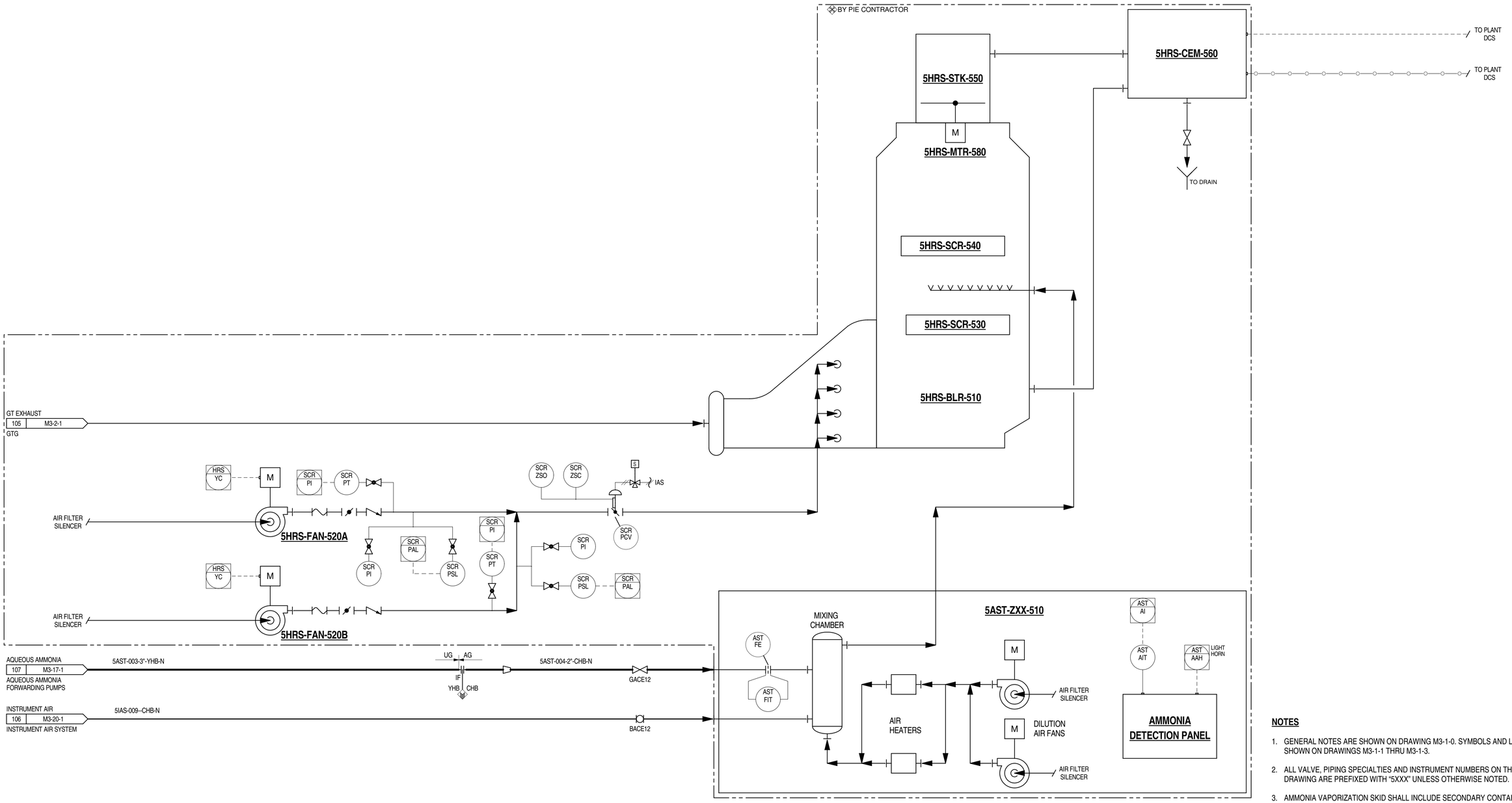
5HRS-SCR-530
SCR-CO CATALYST
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413

5HRS-SCR-540
SCR-NOX CATALYST
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413

5HRS-STK-550
STACK
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413

5HRS-CEM-560
CEMS
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413

5AST-ZXX-510
AMMONIA VAPORIZATION SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485413



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. AMMONIA VAPORIZATION SKID SHALL INCLUDE SECONDARY CONTAINMENT.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/13/12
DRN	VBD	09/13/12
CKD	SEG	09/13/12

SCALE: NONE

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
OTSG INTERCONNECTIONS (EXHAUST GAS)

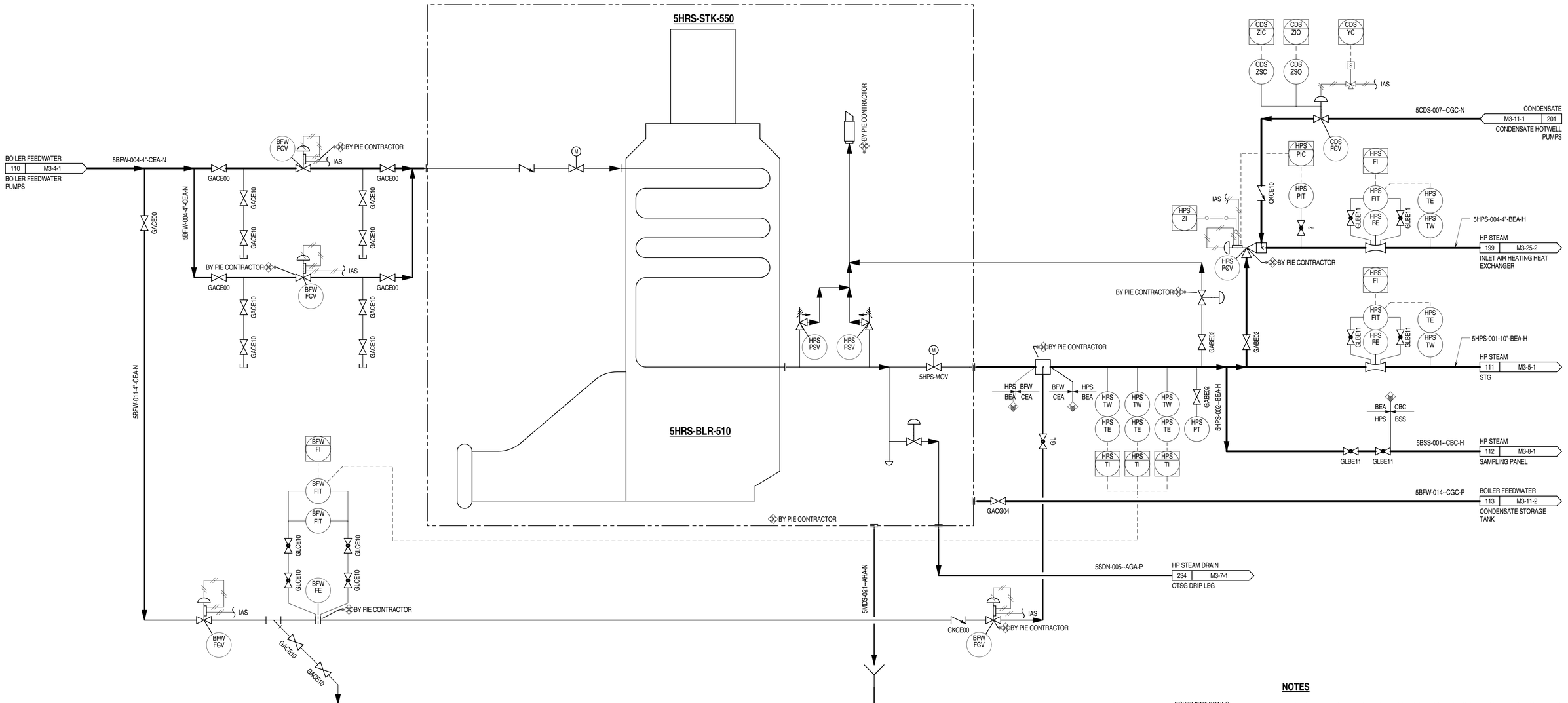
JOB NUMBER 123374
REV G
DRAWING NUMBER M3-3-1

5HRS-BLR-510
OTSG

Opr Cap:
Opr Press:
Opr Temp:
Proc Cap:
Drv Rtg:
Spec: 485413

5HRS-STK-550
STACK

Opr Cap:
Opr Press:
Opr Temp:
Proc Cap:
Drv Rtg:
Spec: 485413



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/13/12
DRN	VBD	09/13/12
CKD	SEG	09/13/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
OTSG INTERCONNECTIONS (STEAM)

JOB NUMBER 123374
REV G
DRAWING NUMBER **M3-3-2**

5BFW-PMP-510A
BOILER FEEDWATER PUMP A
Opr Cap: 280.0 gallon/min Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485311.20

5BFW-PMP-510B
BOILER FEEDWATER PUMP B
Opr Cap: 280.0 gallon/min Proc Cap:
Opr TDH Press: Drv Rtg:
Opr Temp: Spec: 485311.20

CONDENSATE
114 M3-11-3
CONDENSATE POLISHER

5CDS-026-6"-CGC-N

5BFW-PMP-510A
BY PIE CONTRACTOR
NOTE 4

5BFW-PMP-510B
BY PIE CONTRACTOR
NOTE 4

5BFW-003-4"-CEA-N

5BFW-001-6"-CGC-N

5BFW-002-6"-CGC-N

5BFW-005--CEA-N

5BFW-006--CGC-N

BOILER FEEDWATER
115 M3-11-1
CONDENSATE HOTWELL

5BFW-010--CEA-N

5BSS-002--CBC-N

BOILER FEEDWATER
117 M3-8-1
SAMPLING PANEL

5BFW-1455-4"-CEA-N

BOILER FEEDWATER
110 M3-3-2
OTSG

5MDS-024--AHA-N

EQUIPMENT DRAINS
226 M3-26-2
EQUIPMENT DRAINS SUMP

BFW FI, BFW FIT, BFW FE, BFW PI, BFW PIT, BFW PDI, BFW PSV, BFW YC, BFW FCV, BFW PCV, BFW TI, BFW TIT, BFW TE, BFW TW
GLCE10, GACE10, GACE00, CKCE00, GACG04
CDS, BFW, CEA, CGC, CBC, BSS, IAS, VT, M, SET@, NOTE 3
BY PIE CONTRACTOR, DR

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. ALL LIQUID SERVICE RELIEF VALVES SHALL BE ROUTED TO GRADE.
4. PUMPS SHALL BE LOCATED IN A SPILL CONTAINMENT TRAY. TRAY SHALL DRAIN TO THE PROCESS DRAINS SUMP FOR PROCESSING IN OILY WATER SEPARATOR.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

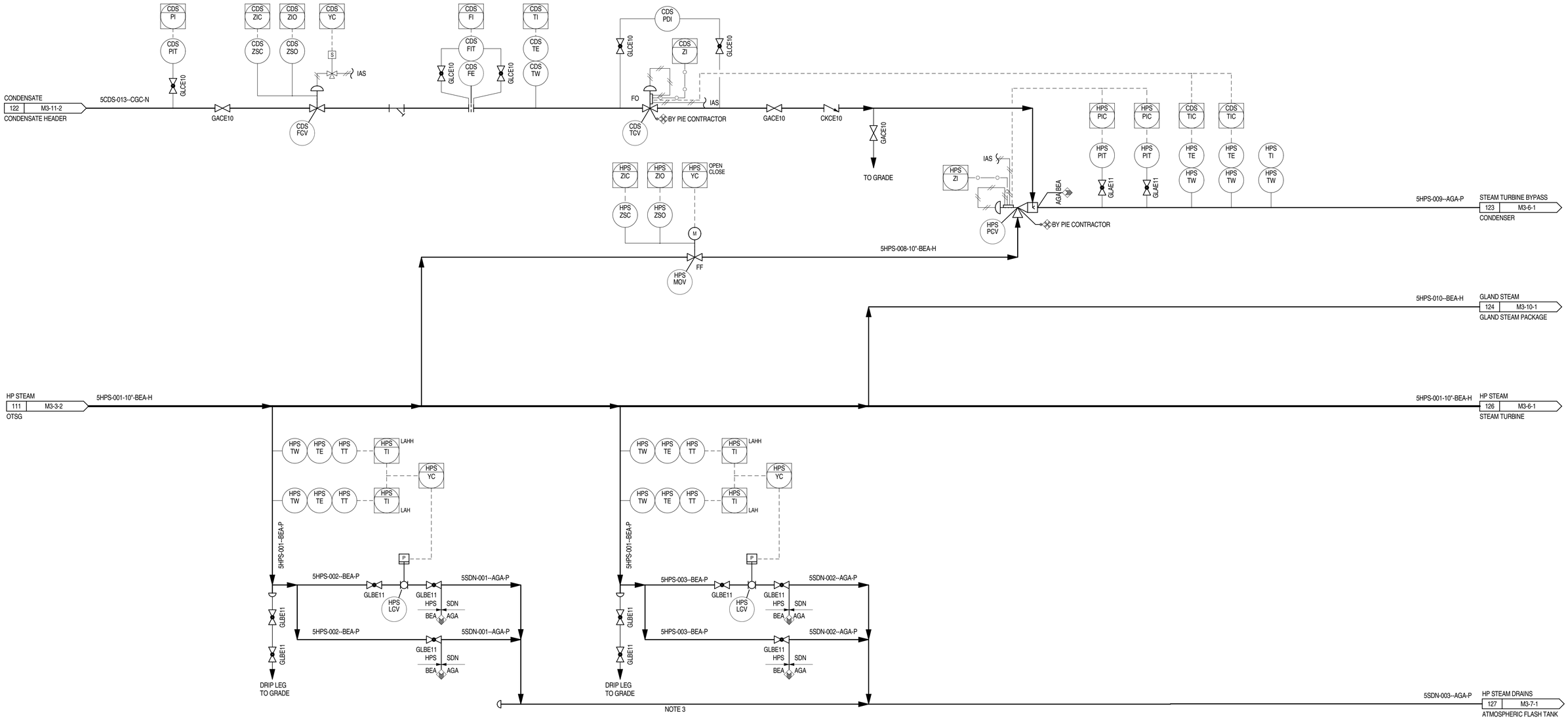
DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
BOILER FEEDWATER SYSTEM

JOB NUMBER 123374
REV G
DRAWING NUMBER M3-4-1



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. BOP CONTRACTOR TO VERIFY NUMBER AND LCOATION OF DRIP LEGS. ADDITIONAL ASSEMBLIES MAY BE REQUIRED.

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
E	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
C	ISSUED FOR REVIEW	09/13/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
HIGH PRESSURE STEAM

JOB NUMBER 123374
REV E
DRAWING NUMBER M3-5-1

5STS-ZXX-510
STEAM TURBINE GENERATOR
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221

5STS-GEN-530
GENERATOR
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221

5STS-TRB-520
STEAM TURBINE
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221

5STS-ZXX-550
STG LUBE OIL SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485221

5CDS-CND-510
CONDENSER
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: 110.00 F Spec: 485432

5STS-ZXX-540
LUBE OIL CONDITIONER
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec:

BY PIE CONTRACTOR

GLAND STEAM 128 M3-10-1 GLAND STEAM SYSTEM — 5GSS-006--BEA-H

GLAND STEAM 129 M3-10-1 GLAND STEAM SYSTEM — 5GSS-003--BEA-H

CONDENSATE 130 M3-11-2 CONDENSATE PUMP DISCHARGE — 5CDS-031--CGC-N

HP STEAM 126 M3-5-1 OTSG — 5HPS-001-10"-BEA-H

GLAND STEAM 131 M3-10-1 GLAND STEAM SYSTEM — 5GSS-004--BEA-H

HPS PI, HPS PIT, HPS TI, HPS TE, HPS TW, GLBE11, GLBE11

P — CDS GV

P — HPS GV

P — HPS GV

5STS-ZXX-510

5STS-GEN-530

5STS-TRB-520

5STS-ZXX-550

5STS-ZXX-540

FILTER

LUBE OIL CONDITIONING PUMP

5MDS-025--AHA-N

5MDS-026--AHA-N

5MDS-027--AHA-N

5MDS-028--AHA-N

5MDS-028--AHA-N — EQUIPMENT DRAINS 227 M3-26-2 EQUIPMENT DRAINS SUMP

GLAND STEAM 133 M3-12-1 GLAND STEAM CONDENSER

VT — CDS PSE

5AEX-001--AHA-N — NON-CONDENSABLE GASSES 134 M3-12-1 CONDENSER AIR EXTRACTION

STEAM TURBINE BYPASS 123 M3-5-1 OTSG — 5HPS-009--AGA-P

5CDS-CND-510

NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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
F	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
STEAM TURBINE INTERCONNECTIONS

JOB NUMBER 123374 REV F

DRAWING NUMBER M3-6-1

5SDN-TNK-010
ATMOSPHERIC FLASH TANK

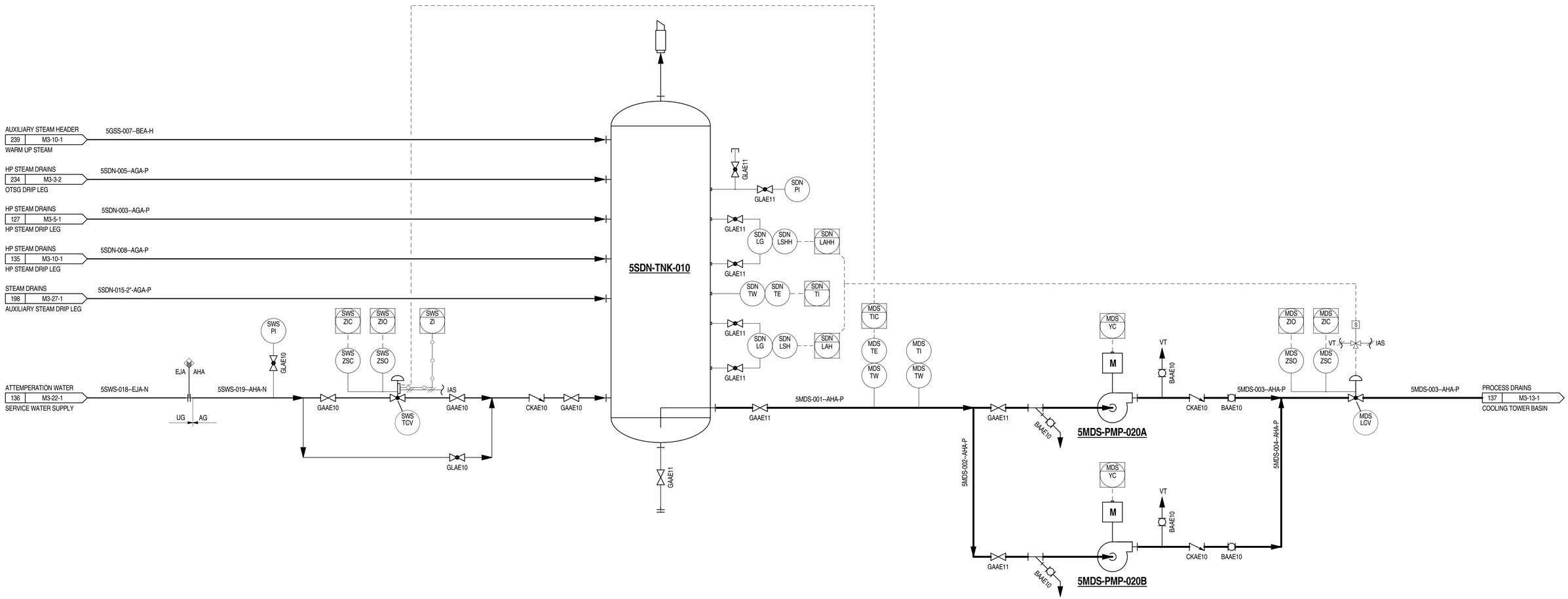
Opr Cap:	Proc Cap:
Opr Press: 50.0 psi-g	Vol Cap: 260.0 gallon
Opr Temp: 750.00 F	Spec: 485173

5MDS-PMP-020A
PROCESS DRAINS FORWARDING PUMP A

Opr Cap: 20.0 gallon/min	Proc Cap:
Opr TDH Press: 75.00 psi	Drv Rtg:
Opr Temp:	Spec: 485311.11

5MDS-PMP-020B
PROCESS DRAINS FORWARDING PUMP B

Opr Cap: 20.0 gallon/min	Proc Cap:
Opr TDH Press: 75.00 psi	Drv Rtg:
Opr Temp:	Spec: 485311.11



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.

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
G	ISSUED FOR REVIEW	12/06/13	VBD	ADD	SEG	TRC
F	ISSUED FOR REVIEW	11/22/13	VBD	ADD	SEG	TRC
E	ISSUED FOR REVIEW	10/15/13	VBD	ADD	SEG	TRC
D	ISSUED FOR REVIEW	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

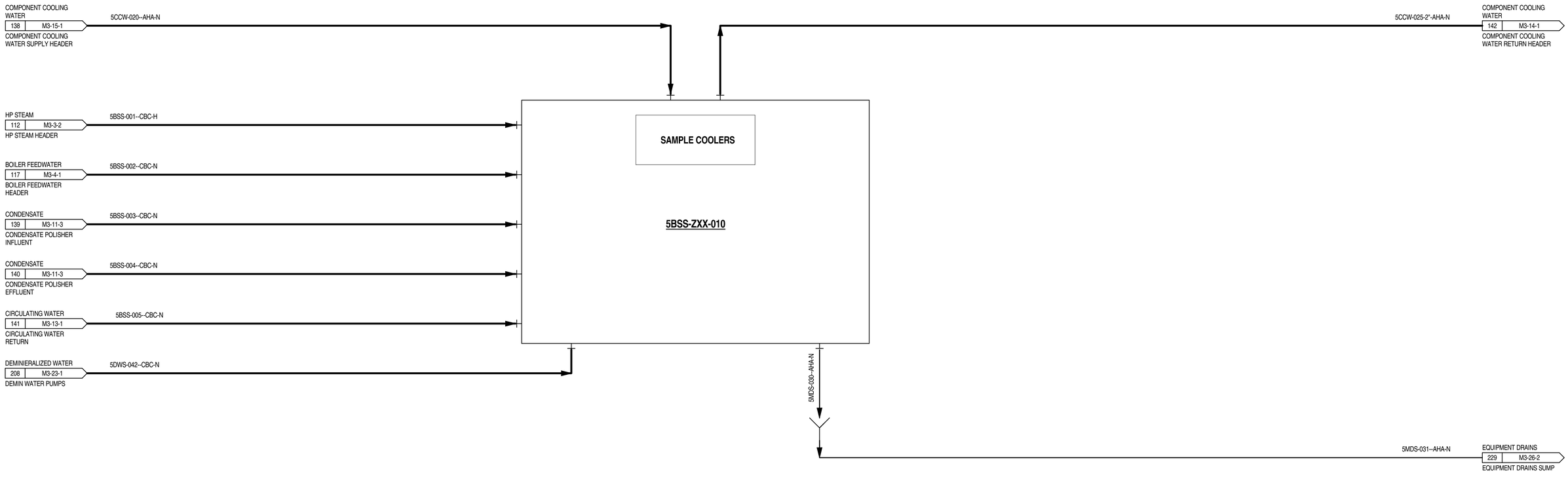
POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
STEAM DRAINS – DRAIN TANK

JOB NUMBER 123374
REV G
DRAWING NUMBER **M3-7-1**

5BSS-ZXX-010
STEAM AND WATER SAMPLING PANEL

Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485951.80



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
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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	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE, 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
STEAM AND WATER SAMPLING

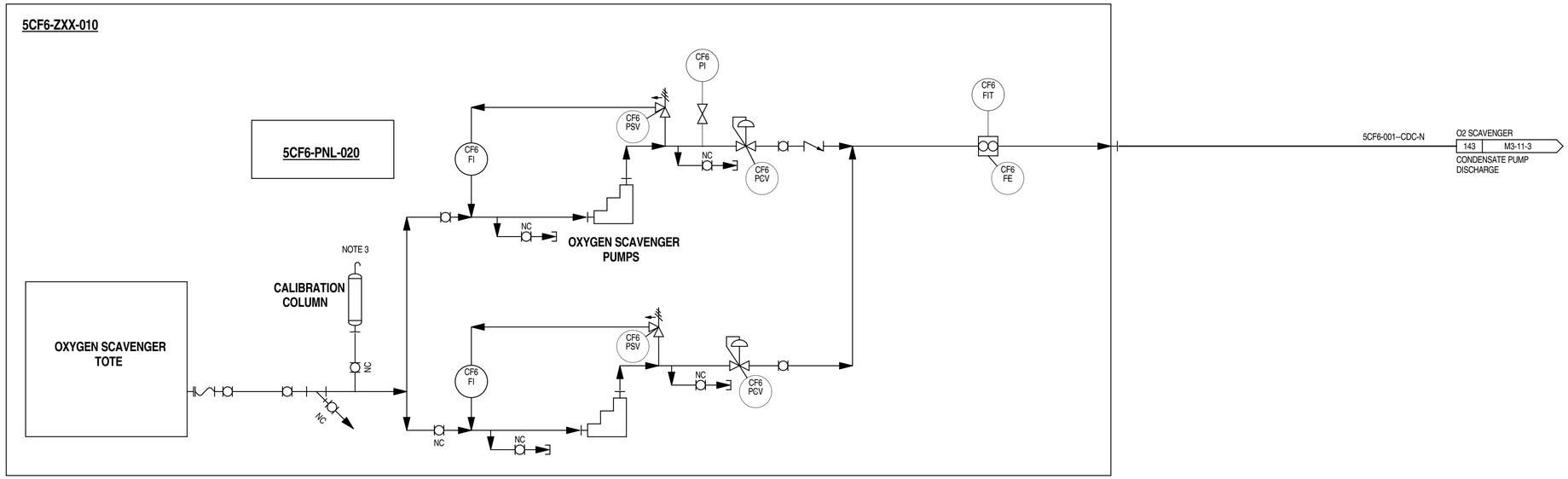
JOB NUMBER 123374
REV D
DRAWING NUMBER M3-8-1

5CF6-ZXX-010
OXYGEN SCAVENGER SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.06

5CF6-PNL-020
OXYGEN SCAVENGER CONTROL PANEL
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.06

5CF7-ZXX-010
PH CONTROL SKID
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.06

5CF7-PNL-020
PH CONTROL PANEL
Opr Cap: Proc Cap:
Opr Press: Drv Rtg:
Opr Temp: Spec: 485952.06



NOTES

1. GENERAL NOTES ARE SHOWN ON DRAWING M3-1-0. SYMBOLS AND LEGEND ARE SHOWN ON DRAWINGS M3-1-1 THRU M3-1-3.
2. ALL VALVE, PIPING SPECIALTIES AND INSTRUMENT NUMBERS ON THIS DRAWING ARE PREFIXED WITH "5XXX" UNLESS OTHERWISE NOTED.
3. VENT GOOSENECK INVERT SHALL BE INSTALLED AT AN ELEVATION 6" HIGHER THAN TOP OF CHEMICAL TANK. VENT SHALL THEREAFTER BE PIPED TO 6" ABOVE ADJACENT GRADE.
4. BOP CONTRACTOR SHALL VERIFY CHEMICAL TREATMENT CHEMICALS WITH CHEMTREAT, PWP'S WATER TREATMENT CHEMICAL SUPPLIER.

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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	09/13/13	AJG	ADD	SEG	TRC
C	ISSUED FOR REVIEW	07/16/13	VBD	ADD	SEG	TRC
B	ISSUED FOR REVIEW	10/12/12	VBD	ADD	SEG	TRC
A	ISSUED FOR REVIEW	10/08/12	VBD	ADD	SEG	TRC

DSGN	ADD	09/17/12
DRN	VBD	09/17/12
CKD	SEG	09/17/12
SCALE:	NONE	

CITY OF PASADENA INCORPORATED JUNE 1886

POWER ENGINEERS

PASADENA WATER AND POWER
GLENARM REPOWERING PROJECT
(GT-5 COMBINED CYCLE INSTALLATION)
PIPING & INSTRUMENTATION DIAGRAM
CYCLE CHEMICAL FEED SYSTEM

JOB NUMBER 123374
REV D
DRAWING NUMBER M3-9-1

TIE-IN INDEX

Unit 5		Size (in)	Material	Connection Type	Pressure	Temperature	Estimated Flow Rate	Fluid	Description	PWP		Notes
Tie Pt	P&ID									P&ID	Line #	
1	M3-18-1	6	CS	600# RF	180-200 psig	60°F	24,250 lb/hr	Fuel Gas	Fuel Gas Supply	-	-	To tie into existing Glenarm city gas line.
2	M3-22-1	4	DI	250# MJ	60-65 psig	TBD	425 gpm	Potable/Service Water	City Potable Water Connection	-	-	Control Building, Cooling Tower Make-Up, Quench Spray, Potable Water System, Demineralized Water Treatment Trailer
3	M3-21-1	8	DI	250# MJ	60-65 psig	TBD	TBD	Firewater	City Fire Water Connection			Location TBD by BOP Contractor; supply for Fire Water Loop
4	M3-21-1	8	DI	250# MJ	60-65 psig	TBD	TBD	Firewater	City Fire Water Connection	-	-	Location TBD by BOP Contractor; supply for Maintenance Building
5	M3-23-2	4	SS	150# RF	25 psia	97°F	98 gpm	Demineralized Water	Demineralized Water Supply from Tank 157B to new Demin Water Tank	20001-040, Rev 2	Tank 157B Spare Nozzle	Existing Tank 157B (Glenarm); new forwarding pumps. BOP Contractor to coordinate with PWP to determine location of available nozzle
6	M3-23-2	2	SS	150# RF	25 psia	97°F	98 gpm	Demineralized Water	Demineralized Water Forwarding Pump Recirculation to Tank 157B	20001-040, Rev 2	Tank 157B Spare Nozzle	Existing Tank 157B (Glenarm); new forwarding pumps. BOP Contractor to coordinate with PWP to determine location of available nozzle
7	M3-23-2	4	SS	150# RF	25 psia	97°F	250 gpm	Demineralized Water	Demineralized Water Supply from Tank 157A to new Demin Water Tank	20001-040, Rev 2	DW4004-4"-GC2Q	Existing forwarding pumps (158A) and Tank 157A (Broadway)
8	M3-26-1	4 (TBD)	CS	150# RF	TBD	80°F	2-31 gpm	Potentially Oily Drains	Discharge from Equipment Drains Sump to OWS	20001-071, Rev 0	OW7004-6"-AB2B	Existing drain header is 6"
9	M3-26-1	4	CS	150# RF	32 psia	97°F	100 gpm	Wastewater	OWS effluent to Glenarm Wastewater Storage Tank	20001-071, Rev 0	WT7001-4"-AB2B	
10	M3-26-1	4 (TBD)	CS	150# RF	50 psia	97°F	65 gpm	Wastewater	GT-5 Wastewater connection to existing wastewater discharge pipe	-	-	75,190 gpd limit on Glenarm weir discharge
11	M3-26-1	4 (TBD)	CS	150# FF	50 psia	140°F	26 gpm	Wastewater	CT 3 Blowdown	20001-3-050, Rev 2	3-BD9004-4"-AB2B	Diameter of Tie-in connection to be verified by BOP Contractor.
12	M3-26-1	4 (TBD)	CS	150# FF	50 psia	140°F	26 gpm	Wastewater	CT 4 Blowdown	20001-4-050, Rev 2	4-BD9004-4"-AB2B	Diameter of Tie-in connection to be verified by BOP Contractor.

REV	REVISIONS	DATE	DSG	CHK	APP
D	ISSUE FOR BID	11.20.13	SEG	TRC	GTH
C	ISSUE FOR BID	10.15.13	SEG	TRC	GTH
B	ISSUE FOR BID	9.27.13	SEG	TRC	GTH

REFERENCE DRAWINGS	
M1-1-6	TIE POINT DRAWING

DSGN	SEG	12.06.12
DRN	SEG	12.06.12
CHK	ADD	12.06.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER AND POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TIE POINT INDEX

JOB NUMBER 123374

DRAWING # M9-10

SHEET 1 OF 2

REV D

THIS DOCUMENT WAS PREPARED BY POWER ENGINEERS, INC. FOR SPECIFIC PROJECTS, AND UNIQUE REQUIREMENTS OF THE PROJECTS. REUSE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED IN THIS DOCUMENT FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

Unit 5		Size (in)	Material	Connection Type	Pressure	Temperature	Estimated Flow Rate	Fluid	Description	PWP		Notes
Tie Pt	P&ID									P&ID	Line #	
13	M3-26-1	4 (TBD)	CS	TBD	50 psia	97°F	191 gpm	Wastewater	Glenarm Wastewater Storage Tank connection to existing wastewater disharge pipe	-	-	Diameter of Tie-in connection to be verified by BOP Contractor.
14	M3-13-1	TBD	CS	TBD	TBD	97°F	TBD	Process Water	Fountain Drain	-	-	To be emptied quarterly. Connection and means of pumping to the cooling tower TBD by BOP Contractor.
15	M3-2-1	TBD	CS	Hose Connect	5 psig	97°F	TBD	Wash Water Drains	GTG Wash Water Drains Tank Pump-out	-	-	To be pumped out along with GT-3/4 wash water
16	M3-17-1	2	SS Double Wall	150# RF	50 psig	80°F	23 lb/hr	19% Aqueous Ammonia	Aqueous Ammonia Supply	20001-090, Rev 1	TBD	Existing 29% Ammonia Tank to be retrofitted for 19% Aqueous Ammonia
17	M3-17-1	1 (TBD)	SS	150# RF	50 psig	80°F	TBD	19% Aqueous Ammonia	Aqueous Ammonia Pump Minimum Flow	20001-090, Rev 1	TBD	Minimum Flow for Aqueous Ammonia Forwarding Pumps
18	M3-17-1	1 (TBD)	SS	150# RF	50 psig	80°F	TBD	19% Aqueous Ammonia	Aqueous Ammonia Pump Skid Recirculation	20001-090, Rev 1	TBD	Recirculation for 19% Ammonia forwarding skid
19	NA	NA	NA	NA	NA	NA	NA		34.5 kV	-	-	
20	NA	NA	NA	NA	NA	NA	NA		17 kV	-	-	
21	NA	NA	NA	NA	NA	NA	NA		GT1 Control System	-	-	
22	NA	NA	NA	NA	NA	NA	NA		GT2 Control System	-	-	
23	NA	NA	NA	NA	NA	NA	NA		GT3 Control System	-	-	
24	NA	NA	NA	NA	NA	NA	NA		GT4 Control System	-	-	
25	NA	NA	NA	NA	NA	NA	NA		34.5 kV Relay Panel	-	-	LOCATION ON HOLD
26	NA	NA	NA	NA	NA	NA	NA		Phone	-	-	LOCATION ON HOLD
27	NA	NA	NA	NA	NA	NA	NA		Internet	-	-	LOCATION ON HOLD
28	NA	TBD	CS	TBD	TBD	TBD	TBD	Sanitary Waste	Sanitary Sewer	-	-	LOCATION ON HOLD
29	M3-20-1	TBD	SS	150# RF	TBD	97°F	TBD	Compressed Dry Air	Service/Instrument Air			Cross-tie to GT-3 and GT-4 Air System
30	M3-26-1	TBD	CS	TBD	TBD	97°F	NA	Potentially Oily Drains	OWS Level Instrument	-	-	
31	NA	NA	NA	NA	NA	NA	NA		Existing B3 Control Room	-	-	
32	M3-3-1	3	SS Double Wall	WE	50 psig	80°F	23 lb/hr	19% Aqueous Ammonia	New Ammonia Feed Connection	20001-090-SK2	-	Existing double containment pipe currently used for B-3.

REV	REVISIONS	DATE	DSG	CHK	APP
D	ISSUE FOR BID	11.20.13	SEG	TRC	GTH
C	ISSUE FOR BID	10.15.13	SEG	TRC	GTH
B	ISSUE FOR BID	9.27.13	SEG	TRC	GTH

REFERENCE DRAWINGS	
M1-1-6	TIE POINT DRAWING

DSGN	SEG	12.06.12
DRN	SEG	12.06.12
CHK	ADD	12.06.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER AND POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

TIE POINT INDEX

JOB NUMBER 123374

DRAWING # M9-10

SHEET 2 OF 2

REV D

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VENT/VAP RECOVERY
TANK FILL
SCR SUPPLY
LINE EVACUATION
FILL & VAP RECOVERY LOW POINT DRAIN COLLECTION
AIR SUPPLY

AIR SUPPLY
FI
SS TUBING EC2Y
1/2"
1/2"
NH3
AE
SCS
AI
DETAIL "1"
TYP. DOUBLE WALL PIPING LEAK DETECTION MONITOR

SHELTER (NOTE 4)
GLENARM PLANT
BROADWAY PLANT
FUTURE AMMONIA FORWARDING PUMP SKID
(FOR GTG 1 & 2)
NH3 AE 956
SCS AI 956
LOCATE NEAR AMMONIA FWD PUMP SKID

SOV 952
XV 952
FC
AS
LOCATE @ TANK 65
XI 951
XAH 951
LOCATE NEAR PLATFORM
NH3 AE 958
SCS AI 958
PSV 965
VRV 966
CSO
2"FP
3"
BD9008-1 1/2"-EC2Q
AM9021-2"-EC2Q

TO SCR AMMONIA INJ. SKID 3-64
3-001
AE-3-984
3-AM9005-1"-EC2Y
AG EC2Q
UG EC2Y
TO SCR AMMONIA INJ. SKID 4-64
4-001
AE-4-984
4-AM9005-1"-EC2Y
AG EC2Q
UG EC2Y
PT 986
1/2"
FI-984/985
EC2Y EC2Q
AM9005-1"-EC2Y
UG AG
NOTE 2
3/4"
LOW POINT
AM9015-3/4"-EC2Q
HS 970 XS 971 XS 972 PSL 973
HS 980 XS 981 XS 982 PSL 983
HS 990 XS 991 XS 992 PSL 993
SCS
EC2Q EC2Y
FI-970
PIPE CULVERT
NOTE 2
EC2Y EC2Q
AE-970
1"
B
BY VENDOR
66
AMMONIA FORWARDING PUMP SKID
NOTE 1
JB
1"
D
C
A
1 1/2"x1"
3/4"
E
FUTURE CONNECTION
FUTURE CONNECTION
CURBED AREA AMMONIA FORWARDING PUMPS
AM9004-1"-EC2Q
AM9003-1"-EC2Q
AM9001-3"-EC2Q
AM9002-1 1/2"-EC2Q
3/4"
1"x3/4"
1"
3"
2"x1 1/2"
2"
7 1" 1 3"
3 2" 6 2"
8 2"
9 2" 10 2"
2"
65
19% AMMONIA STORAGE TANK
12,000 GAL. CAPACITY
NOTE 1
(REF. TEXAS SYSTEMS DWG. XXXXX)
PI 953
TI 954
12 1"
13 1 1/2"
1 1/2" 2 1 1/2"
5 1 1/2"
2" 4 2"
2" 11 2"
1 1/2"x1" 1 1/2"
1 1/2"x1" 1 1/2"
LG 967
LSHH 951
LSH 951
LIT 950
SCS
LI 950
DIKED AREA AMMONIA TANK

S9001
VAPOR RETURN 19% AMMONIA LOADING STATION
2"
2"x1 1/2"
AM9002-1 1/2"-EC2Q
AG UG
UG AG
3/4"
LOW POINT
S9001
S9002
19% AMMONIA LOADING STATION
2"
2"
2"
3"x2"
AM9001-3"-EC2Q
AE-975
FI-975
AG EC2Q
UG EC2Y
AG EC2Q
LOW POINT
AM9016-3/4"-EC2Q
3/4"
EC2Q EC2Y
FI-973
FI-972
NOTE 2
PIPE CULVERT
EC2Y EC2Q
AE-973
AE-972
AM9018-3/4"-EC2Q
PIPE CULVERT
NOTE 2
NH3 AE
SCS AI
(981)
(982)
(983)
XAH 951/960
LI 950-1
HORN & FLASHING LIGHT @ LOADING STATION
XI 951/960
LI 962-1
FI-971
NOTE 2
PIPE CULVERT
AE-971
AM9012-3/4"-EC2Q
EC2Q EC2Y
EC2Y EC2Q
XI 960
XAH 960
LOCATE @ EXISTING TANK
SOV 961
AS
T 11 EXIST. NEW
AM9020-2"-EC2Q
SHUT DOWN
LSHH 960
ALARM
LSH 960
LIT 962
LG 968
T 6
T 7
2"x1 1/2"
2"
3"x2"
NEW EXIST
EXISTING 29% AMMONIA TANK
XV 961
FC
TO B-3 SCR
B-3 PUMP SKID
T 12 EXIST. NEW
SCS
LI 962

VAPOR RETURN 29% AMMONIA LOADING STATION (NOTE 3)
2"
2"x1 1/2"
AM9008-1 1/2"-EC2Q
AG UG
UG AG
AE-976
FI-976
3/4"
LOW POINT
S9002
29% AMMONIA LOADING STATION (NOTE 3)
2"
2"
2" 3"x2"
AM9007-3"-EC2Q
AG EC2Q
UG EC2Y
AG EC2Q
CURBED AREA AMMONIA LOADING
FG 963A
FG 963B
FI-974
PIPE CULVERT
NOTE 2
EC2Q EC2Y
EC2Y EC2Q
AE-974
3/4"
3/4"
LP
AM9010-3/4"-EC2Q
AM9013-3/4"-EC2Q
AM9009-3/4"-EC2Q
AM9014-3/4"-EC2Q
AM9019-3/4"-EC2Q
3/4"
3/4"
ATM
68A AMMONIA RETURN PUMP
68B AMMONIA RETURN PUMP
12"DIAx3'L
12"DIAx3'L
3/4"
AM9011-3/4"-EC2Q
AM9017-3/4"-EC2Q
NOTE 5
NOTE 5
IA6016-1 1/2"-EC2Q
IA6016A-3/4"-EC2Q
IA6016B-3/4"-EC2Q
AIR SUPPLY TO LEAK DETECTION FI'S PER DETAIL "1"
BY INSTR.
BY PIPING
1/2" TYP.
060
2"x1 1/2"
PIT ON WEST END OF PIPE CULVERT

EXISTING

USERNAME $$$$$$$SYTIME$$$$$

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUE FOR INFORMATION ONLY	12/4/13	NJN	*	*	*

DSGN	*	*
DRN	*	*
CKD	*	*

SCALE: *
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

JOB NUMBER 123374
REV A
DRAWING NUMBER SKM1-7

VENT/VAP RECOVERY
TANK FILL
SCR SUPPLY
LINE EVACUATION
FILL & VAP RECOVERY LOW POINT DRAIN COLLECTION
AIR SUPPLY

AIR SUPPLY | FI | SS TUBING EC2Y | 1/2" | 1/2" | NH3 AE | SCS AI

DETAIL "1"
TYP. DOUBLE WALL PIPING
LEAK DETECTION MONITOR

TO SCR AMMONIA INJ. SKID 3-64 | 3-001 | AE-3-984 | 3-AM9005-1"-EC2Y | AG EC2Q | UG EC2Y
TO SCR AMMONIA INJ. SKID 4-64 | 4-001 | AE-4-984 | 4-AM9005-1"-EC2Y | AG EC2Q | UG EC2Y

FI-984/985 | EC2Y EC2Q | AM9005-1"-EC2Y | UG AG | NOTE 2
PT 986 | 1/2" | 3/4" | LOW POINT
AM9015-3/4"-EC2Q

EC2Q EC2Y | FI-970 | PIPE CULVERT | NOTE 2 | EC2Y EC2Q | AE-970

GLENARM PLANT
BROADWAY PLANT

SHELTER (NOTE 4)

FUTURE AMMONIA FORWARDING PUMP SKID (FOR GTG 1 & 2)

BY VENDOR
66
AMMONIA FORWARDING PUMP SKID
NOTE 1
1" B | 1" D | 1" C | 1" A | 3/4" E | JB
FUTURE CONNECTION
1 1/2"x1"
FUTURE CONNECTION
CURBED AREA AMMONIA FORWARDING PUMPS

NH3 AE 956 | SCS AI 956
LOCATE NEAR AMMONIA FWD PUMP SKID

HS 970 | XS 971 | XS 972 | PSL 973
HS 980 | XS 981 | XS 982 | PSL 983
HS 990 | XS 991 | XS 992 | PSL 993
SCS

SCS AI 957 | NH3 AE 957
PIPE CULVERT

S9001 | VAPOR RETURN 19% AMMONIA LOADING STATION | 2" | 2"x1 1/2" | AM9002-1 1/2"-EC2Q | AG UG | UG AG | 3/4" | LOW POINT

S9001 | S9002 | 19% AMMONIA LOADING STATION | 2" | 2" | 2" | 3"x2" | AM9001-3"-EC2Q
AE-975 | FI-975 | AG EC2Q | UG EC2Y | AG EC2Q
LOW POINT | AM9016-3/4"-EC2Q | 3/4"

EC2Q EC2Y | FI-973 | FI-972 | NOTE 2 PIPE CULVERT | EC2Y EC2Q | AE-973 | AE-972
NH3 AE | SCS AI (981) (982) (983)
AM9018-3/4"-EC2Q
PIPE CULVERT NOTE 2

TEMPORARY GT-5 PUMP LOCATION

XAH 951/960 | LI 950-1
HORN & FLASHING LIGHT @ LOADING STATION
XI 951/960 | LI 962-1

FI-971 | NOTE 2 PIPE CULVERT | AE-971
AM9012-3/4"-EC2Q
EC2Q EC2Y | EC2Y EC2Q

VAPOR RETURN 29% AMMONIA LOADING STATION (NOTE 3) | 2" | 2"x1 1/2" | AM9008-1 1/2"-EC2Q | AG UG | UG AG | 3/4" | LOW POINT

FG 963A | FG 963B

(NOTE 3)
CURBED AREA AMMONIA LOADING

AM9010-3/4"-EC2Q — AM9013-3/4"-EC2Q | AM9009-3/4"-EC2Q | AM9014-3/4"-EC2Q | AM9019-3/4"-EC2Q
68A AMMONIA RETURN PUMP | 68B AMMONIA RETURN PUMP
12"DIAx3'L | 12"DIAx3'L | ATM | NOTE 5
AM9011-3/4"-EC2Q | AM9017-3/4"-EC2Q
IA6016-1 1/2"-EC2Q | IA6016A-3/4"-EC2Q | IA6016B-3/4"-EC2Q
PIT ON WEST END OF PIPE CULVERT

AIR SUPPLY TO LEAK DETECTION FI'S PER DETAIL "1"
BY INSTR. | BY PIPING | 1/2" TYP. | 2"x1 1/2" | 060

FI-974 | TO GT-5 | EC2Q EC2Y | PIPE CULVERT | EC2Y EC2Q | AE-974 | PIPE CULVERT NOTE 2

XV 961 | FC

TO B-3 SCR | B-3 PUMP SKID

EXISTING 29% AMMONIA TANK

T 6 | 2"x1 1/2" | 2" | T 7 | 3"x2" | NEW EXIST

XV 952 | FC | SOV 952 | AS
BD9008-1 1/2"-EC2Q | 3/4"
LOCATE NEAR PLATFORM | NH3 AE 958 | SCS AI 958
1 1/2" 2"x1 1/2" | CSO
PSV 965 | 3" | CSO 2"FP
VRV 966 | 2"
AM9021-2"-EC2Q

1"x3/4" | 3" | 2" 2"x1 1/2"
7 1" | 1 3" | 3 2" | 6 2" | 8 2" | 9 2" | 10 2"

65
19% AMMONIA STORAGE TANK
12,000 GAL. CAPACITY
NOTE 1
(REF. TEXAS SYSTEMS DWG. XXXXX)

PI 953 | 12 1"
TI 954 | 13 1 1/2"

1 1/2" 2 | 1 1/2" 5 | 2" 4 | 2" 11
1 1/2"x1" 1 1/2"
1 1/2"x1" 1 1/2"
2"

LOCATE @ TANK 65
XI 951 | XAH 951 | LSHH 951 | LSH 951 | LIT 950 | LG 967
SCS LI 950
2" DIKED AREA AMMONIA TANK

XI 960 | XAH 960 | LOCATE @ EXISTING TANK
SOV 961 | AS
T 11 EXIST. NEW | AM9020-2"-EC2Q
SHUT DOWN
LSHH 960 | LSH 960 | ALARM | LIT 962 | LG 968
T 12 EXIST. NEW
SCS LI 962

INTERIM/TEMPORARY CONDITION

USERNAME $$$$$$$$SYSTIME$$$$$$$$

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	ISSUE FOR INFORMATION ONLY	12/4/13	NJN	*	*	*

DSGN	*	*
DRN	*	*
CKD	*	*
SCALE:	*	
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)
INTERIM / TEMPORARY CONFIGURATION

JOB NUMBER 123374 | REV A
DRAWING NUMBER SKM1-8

VENT/VAP RECOVERY
TANK FILL
SCR SUPPLY
LINE EVACUATION
FILL & VAP RECOVERY LOW POINT DRAIN COLLECTION
AIR SUPPLY

AIR SUPPLY
FI
SS TUBING EC2Y
1/2"
1/2"
NH3 AE
SCS AI
DETAIL "1" TYP. DOUBLE WALL PIPING LEAK DETECTION MONITOR

SHELTER (NOTE 4)
GLENARM PLANT
BROADWAY PLANT
FUTURE AMMONIA FORWARDING PUMP SKID (FOR GTG 1 & 2)
NH3 AE 956
SCS AI 956
LOCATE NEAR AMMONIA FWD PUMP SKID

TO SCR AMMONIA INJ. SKID 3-64
3-001
AE-3-984
3-AM9005-1"-EC2Y
AG EC2Q
UG EC2Y
TO SCR AMMONIA INJ. SKID 4-64
4-001
AE-4-984
4-AM9005-1"-EC2Y
AG EC2Q
UG EC2Y
FI-984/985
EC2Y EC2Q
AM9005-1"-EC2Y
UG AG
NOTE 2
PT 986
1/2"
3/4"
LOW POINT
AM9015-3/4"-EC2Q
HS 970 XS 971 XS 972 PSL 973
HS 980 XS 981 XS 982 PSL 983
HS 990 XS 991 XS 992 PSL 993
SCS
EC2Q EC2Y
FI-970
PIPE CULVERT
EC2Y EC2Q
AE-970
NOTE 2
1" B
JB
BY VENDOR
66
AMMONIA FORWARDING PUMP SKID
NOTE 1
1" D
1" C
1" A
3/4" E
CURBED AREA AMMONIA FORWARDING PUMPS
FUTURE CONNECTION
1 1/2"x1"
FUTURE CONNECTION
SCS AI 957
NH3 AE 957
PIPE CULVERT

S9001
VAPOR RETURN 19% AMMONIA LOADING STATION
2"
2"x1 1/2"
AM9002-1 1/2"-EC2Q
AG UG
UG AG
3/4"
LOW POINT
PIPE CULVERT
AM9003-1"-EC2Q
AM9004-1"-EC2Q
AM9001-3"-EC2Q
AM9002-1 1/2"-EC2Q
3/4"
1"x3/4"
1"
3"
2"x1 1/2"
2"
CSO
PSV 965
3"
CSO 2"FP
VRV 966
2"
AM9021-2"-EC2Q
7 1" 1 3" 3 2" 6 2" 8 2" 9 2" 10 2"
PI 953
TI 954
12 1"
13 1 1/2"
65
19% AMMONIA STORAGE TANK
12,000 GAL. CAPACITY
NOTE 1
(REF. TEXAS SYSTEMS DWG. XXXXX)
LSHH 951
LSH 951
LIT 950
LG 967
1 1/2" 2 1 1/2" 5 2" 4 2" 11
1 1/2"x1" 1 1/2"
1 1/2"x1" 1 1/2"
2"

S9001
S9002
19% AMMONIA LOADING STATION
2"
2"
2"
3"x2"
1"
AE-975
FI-975
AM9001-3"-EC2Q
AG EC2Q UG EC2Y AG EC2Q
LOW POINT
AM9016-3/4"-EC2Q
3/4"
EC2Q EC2Y
FI-973
FI-972
NOTE 2 PIPE CULVERT
EC2Y EC2Q
AE-973
AE-972
AM9018-3/4"-EC2Q
PIPE CULVERT NOTE 2
NH3 AE
SCS AI (981) (982) (983)
DIKED AREA AMMONIA TANK
2"
XAH 951/960
LI 950-1
HORN & FLASHING LIGHT @ LOADING STATION
XI 951/960
LI 962-1
FI-971
NOTE 2 PIPE CULVERT
AE-971
AM9012-3/4"-EC2Q
EC2Q EC2Y
EC2Y EC2Q
XI 960
XAH 960
LOCATE @ EXISTING TANK
SOV 961
AS
T 11
EXIST. NEW
2"
AM9020-2"-EC2Q
SHUT DOWN
LSHH 960
ALARM
LSH 960
LG 968
LIT 962
T 6
2"x1 1/2"
2"
T 7
3"x2"
2"
NEW EXIST
EXISTING 29% AMMONIA TANK
2"
EXIST. NEW
T 12
LI 950
SCS
LI 962

VAPOR RETURN 29% AMMONIA LOADING STATION (NOTE 3)
2"
2"x1 1/2"
AM9008-1 1/2"-EC2Q
AG UG
UG AG
3/4"
LOW POINT
FG 963A
FG 963B
(NOTE 3)
CURBED AREA AMMONIA LOADING
AM9010-3/4"-EC2Q
AM9013-3/4"-EC2Q
3/4"
AM9009-3/4"-EC2Q
AM9014-3/4"-EC2Q
AM9019-3/4"-EC2Q
3/4"
68A AMMONIA RETURN PUMP
68B AMMONIA RETURN PUMP
ATM
12"DIAx3'L
12"DIAx3'L
AIR SUPPLY TO LEAK DETECTION FI'S PER DETAIL "1"
BY INSTR.
BY PIPING
1/2" TYP.
060
2"x1 1/2"
3/4"
AM9011-3/4"-EC2Q
IA6016-1 1/2"-EC2Q
NOTE 5
IA6016A-3/4"-EC2Q
AM9017-3/4"-EC2Q
IA6016B-3/4"-EC2Q
NOTE 5
PIT ON WEST END OF PIPE CULVERT
FI-974
TO GT-5
EC2Q EC2Y
PIPE CULVERT NOTE 2
PIPE CULVERT
EC2Y EC2Q
AE-974
3/4"
XV 961
FC
GT-5 PUMP SKID

PROPOSED FINAL

USERNAME $$$$$$$$SYTIME$$$$$

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INTER-DISCIPLINE REVIEW

DISC	ARCH	CIVIL	ELECT	HVAC	I&C	MECH	STRUCT
DATE							
INIT							

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD
A	ISSUE FOR INFORMATION ONLY	12/4/13	NJN	*	*	*

DSGN	*	*
DRN	*	*
CKD	*	*
SCALE:	*	
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)
FINAL CONFIGURATION

JOB NUMBER 123374
REV A
DRAWING NUMBER SKM1-9

EQUIPMENT LIST

GENERAL NOTES:

A. This list shall be used in combination with procurement documents, P&IDs, vendor documents, and project drawings.

B. Component equipment located within a skid or package may not be included individually.

C. Unless Supplier is listed as “Existing” or “By PIE Contractor”, equipment is implied to be provided by the BOP Contractor under Section 481200 Combined Cycle Balance of Plant.

D. The noted revision to the below listed equipment items may not match the M9-1 drawing sheet revision.

E. If conflicts exist between documents, the Engineer shall determine requirements.

F. Operating Conditions and preliminary equipment sizing shown are based on 100% load at maximum operating cases. This is not representative of maximum continuous rating, startup/shutdown sequence, guaranty performance, permit limitations, and other operating or off-normal cases.

G. Design Conditions are based on system calculations, code requirements, design margins and other engineering criteria as shown on the manufacturers’ equipment datasheets and are not representative of operating cases shown on the heat and mass balance drawings. Information presented in the Design Press. and Design Temp. is for convenience. The manufacturers’ equipment datasheets are the formal control data and take precedence over this document.

INTER-DISCIPLINE REVIEW						
DISC	ARCH	CIVIL	ELECT	I&C	APPD	STRUCT
DATE						
INT						

REV	REVISIONS	DATE	DSGN	CHK	APPD
C	RE-ISSUED FOR BID	12.06.13	SEG	TRC	GTH
B	ISSUE FOR BID	10.11.13	SEG	TRC	GTH
A	ISSUE FOR REVIEW	10.16.12	TRC	SEG	GTH

REFERENCE DRAWINGS	
M3-X	P&IDs

DSGN	TRC	10.16.12
DRN	TRC	10.16.12
CHK	SEG	10.16.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

DRAWING # M9-1

SHEET 1 OF 6

REV C

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Item Tag	Service Description	P&ID Number	Maximum Capacity	Design Pressure	Design Temp	Process Capacity	Normal Capacity	Operating Pressure	Operating Temp	Insul. Code	Insul. Thickness	Device Rating	Spec.	Supplier	Notes	Rev
0DWS-TNK-157B	DEMINERALIZED WATER TANK (EXISTING)	M3-23-2					70000.0 gallon		97F	N	0			EXISTING		B
0OWS-SEP-274	OILY WATER SEPARATOR (EXISTING)	M3-26-1					100gallon/min			N	0			EXISTING		B
5ACW-HEX-020	AUXILIARY COOLING WATER HEAT EXCHANGER	M3-14-1								N	0		485422			B
5ACW-PMP-010A	AUX COOLING WATER PUMP A	M3-13-1					**2700gallon/min (minimum)**	50psi	100F	N	0		485312.10	BY PIE CONTRACTOR		C
5ACW-PMP-010B	AUX COOLING WATER PUMP B	M3-13-1					**2700gallon/min (minimum)**	50psi	100F	N	0		485312.10	BY PIE CONTRACTOR		C
5ACW-PMP-010C	AUX COOLING WATER PUMP C	M3-13-1					**2700gallon/min (minimum)**	50psi	100F	N	0		485312.10	BY PIE CONTRACTOR		C
5AEX-ZXX-510	AIR EXTRACTION SKID	M3-12-1					7.5 SCF/min	1.0 inHgA		P	0		485432	BY PIE CONTRACTOR		B
5AXS-ZXX-510	AUXILIARY STEAM SKID	M3-27-1					1500lb/hr	150 psi-g	366F	H				BY PIE CONTRACTOR		C
5AST-TNK-010	EXISTING AMMONIA STORAGE TANK	M3-17-1		50psi-g			12000 gallon	30 psi-g	97F	N	0			EXISTING		B
5AST-ZXX-020	AMMONIA FORWARDING PUMPS SKID	M3-17-1					23lb/hr	94.7 psi-a	97F	N	0		485325.11			B
5AST-ZXX-510	AMMONIA VAPORIZATION SKID	M3-3-1								P			485413	BY PIE CONTRACTOR		B
5BFW-PMP-510A	BOILER FEEDWATER PUMP A	M3-4-1					280gallon/min			N	0		485311.20	BY PIE CONTRACTOR		B
5BFW-PMP-510B	BOILER FEEDWATER PUMP B	M3-4-1					280gallon/min			N	0		485311.20	BY PIE CONTRACTOR		B
5BSS-ZXX-010	STEAM AND WATER SAMPLING PANEL	M3-8-1								N	0		485951.80			B
5BCW-PMP-020A	**BEARING COOLING WATER PUMP A**	M3-15-1					2050gallon/min	94 psi-a	120F	N	0		485311.11			C
5BCW-PMP-020B	**BEARING COOLING WATER PUMP B**	M3-15-1					2050gallon/min	94 psi-a	120F	N	0		485311.11			C
5BCW-TNK-010	**BEARING COOLING WATER EXPANSION TANK**	M3-15-1								N	0		485173			C
5CDS-CND-510	CONDENSER	M3-6-1						2.11inHgA	110F	N	0		485432	BY PIE CONTRACTOR		B
5CDS-PMP-020A	CONDENSATE MAKE-UP PUMP A	M3-11-2					22gallon/min	40psi-a	97F	N	0		485311.11			B
5CDS-PMP-020B	CONDENSATE MAKE-UP PUMP B	M3-11-2					22gallon/min	40psi-a	97F	N	0		485311.11			B

INTER-DISCIPLINE REVIEW						
DISC	ARCH	CIVIL	ELECT	I&C	APPD	STRUCT
DATE						
INT						

REV	REVISIONS	DATE	DSGN	CHK	APPD
C	RE-ISSUED FOR BID	12.06.13	SEG	TRC	GTH
B	ISSUE FOR BID	10.11.13	SEG	TRC	GTH
A	ISSUE FOR REVIEW	10.16.12	TRC	SEG	GTH

REFERENCE DRAWINGS	
M3-X	P&IDs

DSGN	TRC	10.16.12
DRN	TRC	10.16.12
CHK	SEG	10.16.12
SCALE	NONE	

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

DRAWING # M9-1

SHEET 2 OF 6

REV C

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Item Tag	Service Description	P&ID Number	Maximum Capacity	Design Pressure	Design Temp	Process Capacity	Normal Capacity	Operating Pressure	Operating Temp	Insul. Code	Insul. Thickness	Device Rating	Spec.	Supplier	Notes	Rev
5CDS-PMP-520A	CONDENSATE PUMP A	M3-11-1					350gallon/min	650 ft_of_H2O	110F	N	0		485311.10	BY PIE CONTRACTOR		B
5CDS-PMP-520B	CONDENSATE PUMP B	M3-11-1					350gallon/min	650 ft_of_H2O	110F	N	0		485311.10	BY PIE CONTRACTOR		B
5CDS-PMP-540A	INLET AIR CONDENSATE PUMP A	M3-25-2								P			485471	BY PIE CONTRACTOR		B
5CDS-PMP-540B	INLET AIR CONDENSATE PUMP B	M3-25-2								P			485471	BY PIE CONTRACTOR		B
5CDS-PMP-560	AUXILIARY BOILER FEED PUMP	M3-27-1								N	0			BY PIE CONTRACTOR		B
5CDS-TNK-010	CONDENSATE STORAGE TANK	M3-11-2	5000 gallon				5000 gallon		117F	N	0		485173			B
5CDS-WTS-550	CONDENSATE POLISHER SKID	M3-11-3								N	0		485952	BY PIE CONTRACTOR		B
5CF6-PNL-020	OXYGEN SCAVENGER CONTROL PANEL	M3-9-1								N	0		485952.06			B
5CF6-ZXX-010	OXYGEN SCAVENGER SKID	M3-9-1								N	0		485952.06			B
5CF7-PNL-020	PH CONTROL PANEL	M3-9-1								N	0		485952.06			B
5CF7-ZXX-010	PH CONTROL SKID	M3-9-1								N	0		485952.06			B
5CFX-PNL-020	COOLING TOWER CHEMICAL CONTROL PANEL	M3-16-1								N	0		485952.05			B
5CFX-ZXX-010	COOLING TOWER CHEMICAL FEED SYSTEM	M3-16-1								N	0		485952.05			B
5CHW-PMP-010	COIL CONDENSATE SUMP PUMP	M3-25-2					20gallon/min		97F	N	0		485951.63			B
5CHW-SMP-030	COIL CONDENSATE SUMP	M3-25-2							97F	N	0		485951.63			B
5CHW-TNK-520	POT FEEDER	M3-25-1								N	0		485471	BY PIE CONTRACTOR		B
5CHW-ZXX-040	WEATHER STATION	M3-25-1								N	0					B
5CHW-ZXX-510	CHILLER PACKAGE	M3-25-1								N	0		485471	BY PIE CONTRACTOR		B
5CWS-CTW-510	COOLING TOWER	M3-13-1					15789gallon/min		97F	N	0		485491	BY PIE CONTRACTOR		B
5CWS-FAN-520A	COOLING TOWER FAN A	M3-13-1								N	0		485491	BY PIE CONTRACTOR		B
5CWS-FAN-520B	COOLING TOWER FAN B	M3-13-1								N	0		485491	BY PIE CONTRACTOR		B

INTER-DISCIPLINE REVIEW						
DISC	ARCH	CIVIL	ELECT	I&C	APPD	STRUCT
DATE						
INT						

REV	REVISIONS	DATE	DSGN	CHK	APPD
C	RE-ISSUED FOR BID	12.06.13	SEG	TRC	GTH
B	ISSUE FOR BID	10.11.13	SEG	TRC	GTH
A	ISSUE FOR REVIEW	10.16.12	TRC	SEG	GTH

REFERENCE DRAWINGS	
M3-X	P&IDs

DSGN	TRC	10.16.12
DRN	TRC	10.16.12
CHK	SEG	10.16.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

DRAWING # M9-1

SHEET 3 OF 6

REV C

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Item Tag	Service Description	P&ID Number	Maximum Capacity	Design Pressure	Design Temp	Process Capacity	Normal Capacity	Operating Pressure	Operating Temp	Insul. Code	Insul. Thickness	Device Rating	Spec.	Supplier	Notes	Rev
5CWS-PMP-530A	CIRCULATING WATER PUMP A	M3-13-1					10100gallon/min	50 psi-a		N	0		485312	BY PIE CONTRACTOR		B
5CWS-PMP-530B	CIRCULATING WATER PUMP B	M3-13-1					10100gallon/min	50 psi-a		N	0		485312	BY PIE CONTRACTOR		B
5DWS-PMP-020A	DEMINERALIZED WATER PUMP	M3-23-1					125gallon/min	150psi-a	97F	N	0		485311.11			B
5DWS-PMP-020B	DEMINERALIZED WATER PUMP	M3-23-1					125gallon/min	150psi-a	97F	N	0		485311.11			B
5DWS-PMP-030A	DEMINERALIZED WATER FORWARDING PUMP	M3-23-2					125gallon/min	150psi-a	97F	N	0		485311.11			B
5DWS-PMP-030B	DEMINERALIZED WATER FORWARDING PUMP	M3-23-2					125gallon/min	150psi-a	97F	N	0		485311.11			B
5DWS-TNK-010	DEMINERALIZED WATER TANK	M3-23-1	109000 gallon				109000 gallon		97F	N	0		485172			B
5FGS-TNK-520	FUEL GAS DRAINS TANK	M3-18-1	100 gallon				100 gallon	5psi-g	113F	N	0		485173			B
5FGS-TNK-540	FGS FINAL FILTER DRAINS TANK	M3-18-3	100 gallon	15psi-g			100 gallon	5 psi-g	113F	N	0		485173			B
5FGS-ZXX-510A	FUEL GAS COMPRESSOR PACKAGE A	M3-18-1					13MMSCFD	730 psi-g	270F	P			485374.22	BY PIE CONTRACTOR		B
5FGS-ZXX-510B	FUEL GAS COMPRESSOR PACKAGE B	M3-18-2					13MMSCFD	730 psi-g	270F	P			485374.22	BY PIE CONTRACTOR		B
5FGS-ZXX-530	FUEL GAS FINAL FILTER SKID	M3-18-3					13MMSCFD	730 psi-g	270F	P			485222	BY PIE CONTRACTOR		B
5GSS-CND-520	GLAND STEAM CONDENSER	M3-11-3								P			485221	BY PIE CONTRACTOR		B
5GSS-FAN-530	GLAND EXHAUST FANS	M3-11-3								N	0		485221	BY PIE CONTRACTOR		B
5GSS-SHU-540	SEAL STEAM SUPERHEATER	M3-10-1					1500lb/hr	150 psi-a		H			485221	BY PIE CONTRACTOR		B
5GTS-HEX-550	INLET AIR HEAT EXCHANGER	M3-25-2								H			485471	BY PIE CONTRACTOR		B
5GTS-TNK-010	TURBINE WATER WASH DRAINS TANK	M3-2-1	1000 gallon	5psi-g			1000 gallon	0psi-g	250F	P			485173			B
5GTS-ZXX-510	GAS TURBINE GENERATOR	M3-2-1								H			485222	BY PIE CONTRACTOR		B
5GTS-ZXX-520	AUXILIARY SKID	M3-2-1								N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-530A	NOX WATER INJECTION PUMP SKID	M3-2-1					96gallon/min	650.0 psi-a	97F	N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-530B	NOX WATER INJECTION PUMP SKID	M3-2-1					96gallon/min	650.0 psi-a	97F	N	0		485222	BY PIE CONTRACTOR		B

INTER-DISCIPLINE REVIEW						
DISC	ARCH	CIVIL	ELECT	I&C	APPD	STRUCT
DATE						
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REV	REVISIONS	DATE	DSGN	CHK	APPD
C	RE-ISSUED FOR BID	12.06.13	SEG	TRC	GTH
B	ISSUE FOR BID	10.11.13	SEG	TRC	GTH
A	ISSUE FOR REVIEW	10.16.12	TRC	SEG	GTH

REFERENCE DRAWINGS	
M3-X	P&IDs

DSGN	TRC	10.16.12
DRN	TRC	10.16.12
CHK	SEG	10.16.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

DRAWING # M9-1

SHEET 4 OF 6

REV C

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Item Tag	Service Description	P&ID Number	Maximum Capacity	Design Pressure	Design Temp	Process Capacity	Normal Capacity	Operating Pressure	Operating Temp	Insul. Code	Insul. Thickness	Device Rating	Spec.	Supplier	Notes	Rev
5GTS-ZXX-540	SPRINT SKID	M3-2-1					29gallon/min	150.0 psi-a	97F	N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-560	TEWAC GENERATOR COOLERS	M3-15-3								N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-570	GENERATOR LUBE OIL SKID	M3-2-1								N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-580	GTG LUBE OIL COOLERS	M3-15-3								N	0		485222	BY PIE CONTRACTOR		B
5GTS-ZXX-590	LUBE OIL DEMISTER HEAT EXCHANGER	M3-15-3								N	0		485222	BY PIE CONTRACTOR		B
5HRS-BLR-510	OTSG	M3-3-1								H			485413	BY PIE CONTRACTOR		B
5HRS-CEM-560	CEMS	M3-3-1								N	0		485413	BY PIE CONTRACTOR		B
5HRS-FAN-520A	TEMPERING AIR FAN	M3-3-1								N	0	300 HP	485413	BY PIE CONTRACTOR		B
5HRS-FAN-520B	TEMPERING AIR FAN	M3-3-1								N	0	300 HP	485413	BY PIE CONTRACTOR		B
5HRS-MTR-580	MOTORIZED STACK DAMPER	M3-3-1								N	0		485413	BY PIE CONTRACTOR		B
5HRS-SCR-530	SCR-CO CATALYST	M3-3-1								N	0		485413	BY PIE CONTRACTOR		B
5HRS-SCR-540	SCR-NOX CATALYST	M3-3-1								N	0		485413	BY PIE CONTRACTOR		B
5HRS-STK-550	STACK	M3-3-1								H			485413	BY PIE CONTRACTOR		B
5MDS-PMP-020A	PROCESS DRAINS FORWARDING PUMP A	M3-7-1					20gallon/min	75 psi-a	250F	N	0		485311.11			B
5MDS-PMP-020B	PROCESS DRAINS FORWARDING PUMP B	M3-7-1					20gallon/min	75 psi-a	250F	N	0		485311.11			B
5MDS-PMP-030A	EQUIPMENT DRAIN PUMP	M3-26-2								N	0		485951.62			B
5MDS-PMP-030B	EQUIPMENT DRAIN PUMP	M3-26-2								N	0		485951.62			B
5MDS-SMP-010	EQUIPMENT DRAIN SUMP	M3-26-2								N	0		485951.62			B
5PWS-ZXX-010	POTABLE WATER RECIRCULATION SKID	M3-24-1					40gallon/min	85 psi-a	80F	N	0		485951.96			B
5SAS-VSL-120A	SERVICE AIR RECEIVER A	M3-19-1								N	0		485173			B
5SAS-VSL-120B	SERVICE AIR RECEIVER B	M3-19-1								N	0		485173			B

INTER-DISCIPLINE REVIEW						
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DATE						
INT						

REV	REVISIONS	DATE	DSGN	CHK	APPD	REFERENCE DRAWINGS
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A	ISSUE FOR REVIEW	10.16.12	TRC	SEG	GTH	M3-X P&IDs

DSGN	TRC	10.16.12
DRN	TRC	10.16.12
CHK	SEG	10.16.12
SCALE	NONE	

POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

DRAWING # M9-1

SHEET 5 OF 6

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5SAS-ZXX-510	AIR COMPRESSOR DRYER PACKAGE	M3-19-1					250 SCF/min	130psi-g	97F	N	0		485374.21	BY PIE CONTRACTOR		B
5SDN-TNK-010	ATMOSPHERIC FLASH TANK	M3-7-1	260gallon				260gallon	50psi-g	750F	P			485173			B
5STS-ZXX-510	STEAM TURBINE GENERATOR	M3-6-1								H			485221	BY PIE CONTRACTOR		B
5STS-ZXX-540	LUBE OIL CONDITIONER	M3-6-1								N	0		485221	BY PIE CONTRACTOR		B
5STS-ZXX-550	STG LUBE OIL SKID	M3-6-1								N	0		485221	BY PIE CONTRACTOR		B
5STS-ZXX-560	TEWAC GENERATOR COOLERS	M3-15-2								N	0		485221	BY PIE CONTRACTOR		B
5STS-ZXX-570	STG LUBE OIL COOLERS	M3-15-2								N	0		485221	BY PIE CONTRACTOR		B
5WWS-PMP-020A	WASTEWATER TRANSFER PUMP A	M3-26-1					195gallon/min	40 psi-a	100F	N	0		485311.11			B
5WWS-PMP-020B	WASTEWATER TRANSFER PUMP B	M3-26-1					195gallon/min	40 psi-a	100F	N	0		485311.11			B
5WWS-TNK-010	WASTEWATER STORAGE TANK	M3-26-1	88000 gallon				88000 gallon		97F	N	0		485172			B

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M3-X	P&IDs

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DRN	TRC	10.16.12	
CHK	SEG	10.16.12	
SCALE	NONE		

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

EQUIPMENT LIST

JOB NUMBER 122374

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SHEET 6 OF 6

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October 21, 2013

PASADENA WATER & POWER

Glenarm Repowering Project
(GT-5 Combined Cycle Installation)

Section 480032.10

Balance of Plant Contractor Performance Testing

PROJECT NUMBER:
123374

PROJECT CONTACT:
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Section 480032.10
Balance of Plant Contractor Performance Testing

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

REVISION HISTORY		
DATE	REVISED BY	REVISION
10/21/13	S. Harris	A

SECTION 480032.10
BALANCE OF PLANT CONTRACTOR TESTING

TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 SUMMARY 1
1.2 FURNISHED BY POWER ISLAND EQUIPMENT CONTRACTOR 1
1.3 FURNISHED BY BOP CONTRACTOR 1
1.4 RELATED SECTIONS (PIE CONTRACT DOCUMENTS) 2
1.5 CODES AND STANDARDS 2
1.6 DEFINITIONS 2
1.7 SUBMITTALS 3
1.8 QUALITY ASSURANCE 4
1.9 SITE CONDITIONS 4
1.10 WARRANTY 4

PART 2 - PRODUCTS 4

PART 3 - EXECUTION 4

3.1 COMMISSIONING 4
3.2 PERFORMANCE TESTING 5

PART 4 - ATTACHMENTS 8

4.1 TECHNICAL DATASHEET 8

SECTION 480032.10
BALANCE OF PLANT CONTRACTOR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes the requirements for verification of the BOP Contractor to meet contract guarantees for net heat rate, total plant net output, air emissions, water consumption and discharge, and noise emissions.

B. The BOP Contractor shall have single source responsibility for all test 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 PIE Contractor's ability to meet the performance requirements contained herein, the BOP Contractor shall refer the conflict in writing to the General Manager for resolution.

1.2 FURNISHED BY POWER ISLAND EQUIPMENT CONTRACTOR

A. The Contractor shall provide the following equipment and services for performance testing, including but not limited to the following:

1. Performance testing and controls engineers to run performance tests
2. Performance correction curves from ambient to **75°F, 50% humidity.**
3. Training of the General Manager's personnel appointed to operate the equipment and involved in commissioning and performance testing

1.3 FURNISHED BY BOP CONTRACTOR

A. The supply by BOP Contractor shall include:

1. Electricians, mechanics, laborers, and other crafts and labor supervision necessary to assist with performance testing.
2. Rigging/hoisting equipment, man lifts and scaffold
3. Unloading and storage of equipment at jobsite
4. Calibrated station instruments as part of normal operating control system
5. Temporary lighting
6. Field wiring, cable and conduit connecting PIE Contractor supplied components
7. Compressed air supply to PIE Contractor's connections
8. Fill of all lubrication and control oils, gases, and water
9. Local gauges, instruments, data loggers, etc. required for the performance test
10. Special tools required for the performance test
11. Summary performance testing report

1.4 RELATED SECTIONS (PIE Contract Documents)

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
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
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 coordinates the PIE Contractor's and Subcontractor's work on the site.

B. City: The City of Pasadena, CA

C. PIE Contractor: The PIE 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

A. Installation and Commissioning Plan

1. The PIE 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. BOP Contractor's Commissioning plan shall include as a minimum:

    a. All tests to be performed by BOP 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. The BOP Contractor shall provide 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.
2. Certified copies of test results shall be submitted to the General Manager by the BOP Contractor 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 Section 481100 Combined Cycle Power Island for general warranty requirements.

PART 2 - PRODUCTS

A. Not used

PART 3 - EXECUTION

3.1 COMMISSIONING

A. General

1. The BOP Contractor shall provide onsite commissioning and testing of the Power Island Equipment.
2. The PIE Contractor shall allow for training of the General Manager's personnel appointed to operate the equipment and involved in commissioning and testing.
3. The BOP 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 BOP Contractor shall support final cleaning and steam blow of boiler and steam piping prior to startup completed per the Contractor's standard procedure.

C. BOP Contractor 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 BOP 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 BOP Contractor to provide a replacement Installation and Commissioning Manager.

D. BOP Contractor's 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. BOP Contractor shall generator an ICS manual for each major piece of equipment to be tested.
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: shop/fabrication drawings, electrical drawings, wiring schematics, logic diagrams 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 and factory testing documents showing switch and control action and set points

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 BOP 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 PIE Contractor shall supply to the Owner, 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 by the BOP Contractor 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 PIE 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. BOP Contractor Performance Test Program

1. The performance test program shall consist of several separate tests. The BOP 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 BOP 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 equipment supplier's role in testing of individual equipment.

    b. Control System Tests

        1) Demonstrate full capability of the control system.

    c. Balance of Plant 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 BOP 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

1. In the event that the plant does not meet performance guarantees, the BOP Contractor shall test individual plant components as required to locate the deficient equipment and the PIE Contractor shall replace the deficient equipment until performance guarantees are achieved.
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 PIE 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.

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 Balance of Plant final design

SERVICE INDEX

GENERAL NOTES:

1. This list shall be used as a reference for minimum requirements for piping material supplied under Section 481200 Combined Cycle Balance of Plant. It is the responsibility of the BOP Contractor to provide materials suitable for the intended services and to meet applicable codes and regulations.

2. Preferred valve types are identified in **BOLD** where multiple choices are shown.

3. If conflicts exist between documents, the General Manager shall determine requirements.

4. Refer to the following documents for
   a. Drawing M3-X (P&IDs) for Pipe Line Designation and Pipe, Valve and Specialty Material Specifications
   b. Section 485072: Coating for Piping and Tanks
   c. Section 485080: Piping and Equipment Insulation
   d. Section 485100.01: Pipe Material Specifications
   e. Section 485100.03: Valve Material Specifications
   f. Section 485101: General Piping Requirements
   g. Section 485102: Pipe Identification
   h. Section 485140: Pipe Hangers and Supports
   i. Section 485956.25: Firewater Underground Piping, Valves and Hydrants
   j. Section 485956.30: Fire Water Sprinklers
   k. Section 485972: Mechanical Installation Requirement
   l. Section 485975: General Welding Requirement

5. Design temperatures and pressures shown are based on material limiting component. Limiting component may be either piping or valve material.

6. Design conditions shown on this list are to be used for establishing required piping inspection & test requirements (NDE & pressure) in accordance with Section 485101, General Piping Requirements.

7. FGS valves shall be supplied with low emission valve stem packing.

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POWER ENGINEERS

PASADENA WATER & POWER

GLENARM REPOWERING PROJECT (GT-5 COMBINED CYCLE INSTALLATION)

SERVICE INDEX

JOB NUMBER 123374

DRAWING # M9-2

SHEET 1 OF 5

REV C

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SYSTEM DESIGNATION		DESIGN		PIPING MATERIALS					VALVES NPS 1/2 (DN 15) - NPS 2 (DN 50)					VALVES ≥NPS 2 1/2 (DN 65)				
CODE	**SYSTEM NAME**	**PRESS PSIG**	**TEMP F**	**PIPE MAT'L**	**PIPE SPEC**	**JOINT**		**CLASS**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**
	POTABLE WATERS																	
PWS	POTABLE WATER SYSTEM: CL 150, CU, SPEC. FHA	125	150	CU	FHA	Solder	CL	150	Bronze	SJ	BAFE10		CKFK10 (CL 125)	CI DI	LUG LUG	BFEH42 BFEH43		
PWS	POTABLE WATER SYSTEM: CL 250, CAST/DUCTILE IRON, CEMENT-MORTOR LINED, SPEC. EJA	Full Vacuum to 200	75	DI	EJA	MJ	CL	250						CI	FLG MJ	GAEK20 GAEK70		CKEK20
PWS	POTABLE WATER SYSTEM (SAFETY SHOWERS): CL 150, SS 304L, SPEC. CHA	Full Vacuum to 75	140	SS 304L	CHA	Welded	CL	150	SS 304L	SW	GACE12 BACE12	GLCE12	CKCE12	SS 304L	WE FLG	GACH02, GACH22	GLCH02 GLCH22	CKCH02 CKCH22
	PROCESS WATERS																	
ACW	AUXILIARY COOLING WATER: , CL 150, CS, SPEC. AHA	Full Vacuum to 150	200	CS	AHA	Welded	CL	150	CS	SW	**BAAE10** GAAE10	GLAE10	CKAE10	CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
BCW	BEARING (CLOSED CYCLE) COOLING WATER: , CL 150, CS, SPEC. AHA	Full Vacuum to 150	200	CS	AHA	Welded	CL	150	CS	SW	**BAAE10** GAAE10	GLAE10	CKAE10	CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
CHW	CHILLED WATER SYSTEM: CL 150, CS, SPEC. AHA	Full Vacuum to 150	200	CS	AHA	Welded	CL	150	CS	SW	BAAE10 BAAE11 GAAE10	GLAE10	CKAE10	CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	GLAH00 GLAH20	CKAH00 CKAH20
CWS	CIRCULATING WATER: , CL 150, CS, EPOXY LINED, SPEC. AHD	Full Vacuum to 150	180	CS	AHD	Welded	CL	150						CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
DWS	DEMINERALIZED WATER/GAS TURBINE INJECTION: CL 150, SS 304L, SPEC. CHB	230 195	100 200	SS 304L	CHB	Welded	CL	150	SS 304L	SW	BACE12 GACE12	GLCE12	CKCE12	SS 304L	**WE** FLG	**GACH02** GACH22	**GLCH02** GLCH22	**CKCH02** CKCH22
	MISC. & HVAC WATERS																	
SWS	SERVICE WATER (CITY WATER): , CL 250, CAST/DUCTILE IRON, CEMENT-MORTOR LINED, SPEC. EJA	Full Vacuum to 175	75	DI	EJA	MJ	CL	250						CI	FLG MJ	GAEK20 GAEK70		CKEK20 (CL 125)
SWS	SERVICE WATER : , CL 150, CS, SPEC. AHA	Full Vacuum to 150	200	CS	AHA	Welded	CL	150	CS	SW	**BAAE10** GAAE10	GLAE10	CKAE10	CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20

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PASADENA WATER & POWER

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SERVICE INDEX

JOB NUMBER 123374

DRAWING # M9-2

SHEET 2 OF 5

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SYSTEM DESIGNATION		DESIGN		PIPING MATERIALS					VALVES NPS 1/2 (DN 15) - NPS 2 (DN 50)					VALVES ≥NPS 2 1/2 (DN 65)				
CODE	**SYSTEM NAME**	**PRESS PSIG**	**TEMP F**	**PIPE MAT'L**	**PIPE SPEC**	**JOINT**		**CLASS**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**
	DRAIN/WASTE/VENT																	
MDS	MISCELLANEOUS DRAINS: , CL ATM, CISP, SPEC. EMA	5	140	CISP	EMA	H&S	CL	ATM										
MDS	MISCELLANEOUS DRAINS: , CL 150, CS, SPEC. AHA	285 260 215	100 200 350	CS	AHA	Welded	CL	150	CS	SW	BAAE10 GAAE11		CKAE10	CS	WE	GAAH01		
WWS	WASTE WATER: , CL 150, CS, SPEC. AHA	Full Vacuum to 150	200	CS	AHA	Welded	CL	150	CS	SW	**BAAE10** **BAAE11** GAAE10	GLAE10	CKAE10	CI DI CS CS	**LUG** **LUG** WE FLG	**BFEH40** **BFEH41** GAAH00 GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
	COMPRESSED AIR AND GASES																	
IAS	INSTRUMENT AIR: , CL 150, SS 304L, SPEC. CHB	230 195	100 200	SS 304L	CHB	Welded	CL	150	SS 304L	SW	GACE12 BACE12	GLCE12	CKCE16 CKCE12	SS 304L	**WE** FLG	**GACH02** GACH22	**GLCH02** GLCH22	**CKCH02** CKCH22
SAS	SERVICE AIR : , CL 150, CS, SPEC. AHA	150	200	CS	AHA	Welded	CL	150	CS	SW	GAAE10 BAAE10	GLAE10	CKAE10	CS	**WE** FLG	**GAAH00** GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
	STEAM & CONDENSATE																	
AXS	AUXILIARY STEAM: , CL600, ASTM A335 P22, SPEC. BEA	760 623	800 900	P22	BEA	Welded	CL	600	F22	SW	GABE10	GLBE11	CKBE10 CKBE12	F22	WE	GABE02		
BFW	BOILER FEEDWATER: , CL 600, SS 304, SPEC. CEA	1178 974 868	200 400 600	SS 304	CEA	Welded	CL	600	SS 304	SW	GACE10	GLCE10	CKCE10 CKCE14	SS 304	WE	GACE00		CKCE00
BFW	BOILER FEEDWATER: , CL 300, SS 304, SPEC. CGC	553 462 382	100 200 400	SS 304	CGC	Welded	CL	300	SS 304	SW	GACE10	GLCE10	CKCE10 CKCE14	SS 304	WE	GACG04		CKCG00
BSS	SAMPLING SYSTEM: , CL 2500, SS 316, SPEC. CBC	2234	655	SS 316	CBC	Welded	CL	2500										
CDS	CONDENSATE AND CONDENSATE RETURN: , CL 150, CS, SPEC. AHA	285 200 95	100 400 750	CS	AHA	Welded	CL	150	CS	SW	BAAE10 GAAE11	GLAE11	CKAE11	CS	**WE** FLG	**GAAH01** GAAH21	**GLAH01** GLAH21	**CKAH01** CKAH21
CDS	CONDENSATE AND CONDENSATE RETURN: , CL 150, SS 304, SPEC. CHE	275 230 190	100 200 400	SS 304	CHE	Welded	CL	150	SS 304	SW	GACE10	GLCE10	CKCE10 CKCE14	SS 304	WE	GACH02		
CDS	CONDENSATE AND CONDENSATE RETURN: , CL 300, SS 304, SPEC. CGC	553 462 382	100 200 400	SS 304	CGC	Welded	CL	300	SS 304	SW	GACE10	GLCE10	CKCE10 CKCE14	SS 304	WE	GACG04		CKCG00
DWS	DEMINERALIZED WATER/HOTWELL MAKE-UP/D.A. MAKE-UP: , CL 150, SS 304L, SPEC. CHA	Full Vacuum to 75	140	SS 304L	CHA	Welded	CL	150	SS 304L	SW	BACE12 GACE12	GLCE12	CKCE12	SS 304L	**WE** FLG	**GACH02** GACH22	**GLCH02** GLCH22	**CKCH02** CKCH22

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SERVICE INDEX

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SHEET 3 OF 5

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CODE	**SYSTEM NAME**	**PRESS PSIG**	**TEMP F**	**PIPE MAT'L**	**PIPE SPEC**	**JOINT**		**CLASS**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**	**MAT'L**	**JOINT**	**SHUTOFF**	**THROTTLE**	**CHECK**
DWS	DEMINERALIZED WATER/HOTWELL MAKE-UP/D.A. MAKE-UP: , CL 150, SS 304L, SPEC. CHB	230 195	100 200	SS 304L	CHB	Welded	CL	150	SS 304L	SW	BACE12 GACE12	GLCE12	CKCE12	SS 304L	**WE** FLG	**GACH02** GACH22	**GLCH02** GLCH22	**CKCH02** CKCH22
HPS	HIGH PRESSURE STEAM (MAIN STEAM): , CL 600, P22, SPEC. BEA	783 760 623	200 800 900	P22	BEA	Welded	CL	600	F22	SW	GABE10	GLBE11	CKBE10 CKBE12	F22	WE	GABE02		
HPS	HIGH PRESSURE STEAM (MAIN STEAM): , CL 300, CS, SPEC. AGA	740 635 505	100 400 750	CS	AGA	Welded	CL	300	CS	SW	GAAE11	GLAE11	CKAE11	CS	WE	GAAG00	GLAG00	**CKAG00** CKAG01
SDN	STEAM DRAINS: , CL 300, CS, SPEC. AGA	740 635 505	100 400 750	CS	AGA	Welded	CL	300	CS	SW	GAAE11	GLAE11	CKAE11	CS	WE	GAAG00	GLAG00	**CKAG00** CKAG01
	PROCESS FLUIDS, OILS AND FUELS																	
FGS	FUEL-NATURAL GAS SYSTEM: CL 600, CS, SPEC. AEB (NOTE 7)	1265	400	CS	AEB	Welded	CL	600	CS	SW	GAAE15			CS	WE	GAAE05		
FGS	FUEL-NATURAL GAS SYSTEM: CL 300, CS, SPEC. AGA (NOTE 7)	740 635	100 400	CS	AGA	Welded	CL	300	CS	SW	GAAE15			CS	WE	GAAG05		
FGS	FUEL-NATURAL GAS SYSTEM: CL 150, CS, SPEC. AHA (NOTE 7)	285	100	CS	AHA	Welded	CL	150	CS	SW	GAAE15			CS	FLG WE	BAAH21 GAAH05		
FGS	FUEL-NATURAL GAS SYSTEM: CL 600, SS, SPEC. CEA (NOTE 7)	974	400	SS 304	CEA	Welded	CL	600	SS 304	SW	GACE10			SS 304	WE	GACE00		
	CHEMICALS, REAGENTS & POLYMERS																	
AST	AQUEOUS AMMONIA STORAGE AND TRANSFER SYSTEM: ABOVEGROUND: CL 150, SS 304L, SPEC. CHB	230 195	100 200	SS 304L	CHB	Welded	CL	150	SS 304L	SW	GACE12	GLCE12	CKCE12	SS 304L	WE FLG	GACH02 GACH22	GLCH02 GLCH22	CKCH02 CKCH22
AST	AQUEOUS AMMONIA STORAGE AND TRANSFER SYSTEM: UNDERGROUND DOUBLE CONTAINMENT: CL 150, SS 304L, SPEC. YHB	-14.7 to 230	33 to 195	SS 304L	YHB	Welded	CL	150										
CF1	BROMINE BIOCIDE: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF2	INHIBITOR/DISPERSANT: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF3	SULFURIC ACID: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF4	BIOCIDE A: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF5	BROMINE B: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF6	CHEMICAL FEED - OXYGEN SCAVENGER: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										
CF7	CHEMICAL FEED - PH CONTROL: CL 900, SS 316L, SPEC. CDC	200	100	SS 316	CDC	Welded	CL	900										

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	SAFETY & CRITICAL SYSTEMS																	
	FIRE PROTECTION																	
FWS	FIRE WATER: , CL 150, CS, SPEC. AHA	125	100	CS	AHA	Welded	CL	150	CS	SW	GAAE10	GLAE10	CKAE10	CI	FLG	GAEK22 (CL 125)		CKEK20 (CL 125)
FWS	FIRE WATER (CITY WATER): UNDERGROUND, CL 250, CAST/DUCTILE IRON, CEMENT-MORTOR LINED, SPEC. EJA	Full Vacuum to 125	75	DI	EJA	MJ	CL	250						CI	FLG FLG MJ MJ	GAEK21 GAEK20 GAEK70 GAEK71 (CL 125)		CKEK20 (CL 125)
	VENDOR & MISCELLANEOUS SYSTEMS																	
AEX	VACUUM SYSTEM: CONDENSER AIR EXTRACTION : , CL 150, CS, SPEC. AHA	Full Vacuum to 100	150	CS	AHA	Welded	CL	150						CI DI	LUG	BFEH40 BFEH41		
GTS	GAS TURBINE/PACKAGE: VENTS, CL 150, CS, SPEC. AHA	285 260 215	100 200 350	CS	AHA	Welded	CL	150	CS	SW	GAAE10	GLAE10	CKAE10	CS	**WE** FLG	**GAAH00** GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20
GTS	GAS TURBINE/PACKAGE: WW DRAINS, CL 150, CS, SPEC. AHA	285 260 215	100 200 350	CS	AHA	Welded	CL	150	CS	SW	GAAE10	GLAE10	CKAE10	CS	**WE** FLG	**GAAH00** GAAH20	**GLAH00** GLAH20	**CKAH00** CKAH20

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